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March 27, 2020

Bonnie Bergsma
Sahtu Land and Water Board
Regulatory Specialist
P.O. Box 1
Fort Good Hope, NT
X0E 0H0

Re: 2019 Annual Water Use Report
Type A Water Licence S13L1-007, Part B, Item 13
Imperial Oil Resources N.W.T. Limited (Imperial)

Dear Ms. Bergsma,

Imperial is submitting the 2019 Annual Water Use Report as per Part B, Item 13 of the Sahtu Land and Water Board Water Licence, S13L1-007.

If you require further information please contact Christine Wickens at 587-476-5007 or christine.a.wickens@exxonmobil.com.

Sincerely,

CWickens

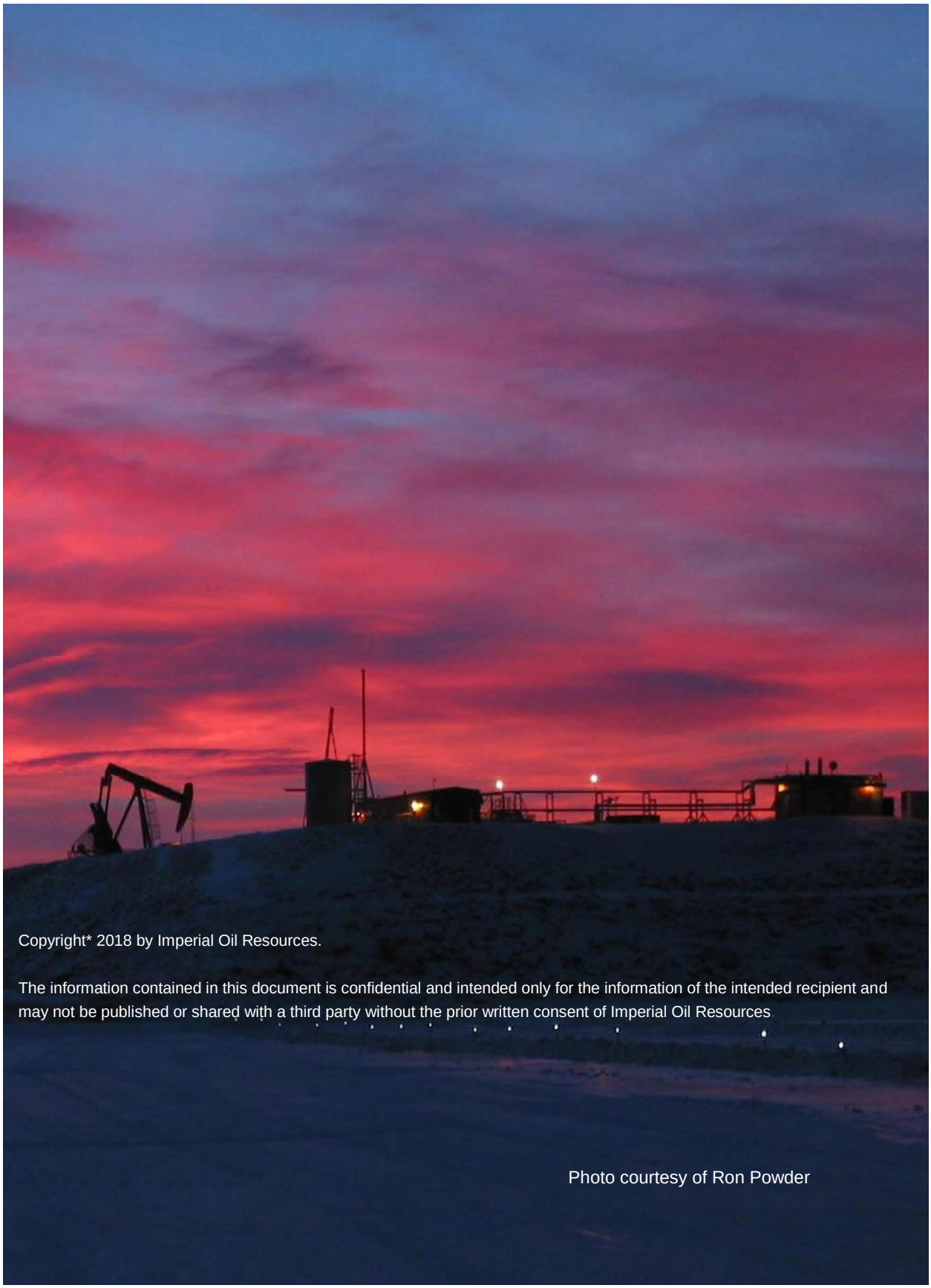
Christine Wickens
Environment and Regulatory Advisor
Imperial

Norman Wells Operations 2019 Annual Water Use Report

Operations Authorization 1210-001
Report No. 35

March 2020

Imperial Oil Resources NWT Limited
Bag 5000, 745 Mackenzie Drive
Norman Wells, NT X0E 0V0
Switch Board: (867) 587-3100



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1.0 Introduction

As required by Licence S13L1-007 (Part B: Item 11), the Licensee shall file an Annual Report with the Board not later than March 31st for the previous calendar year. Details on the licence requirements and corresponding applicable section(s) within the report can be found below.

Table 1-1: Concordance Table

Licence Requirement		Section of Report
a)	The monthly and annual quantities in cubic meters of freshwater obtained from all sources	3.0
b)	The monthly and annual quantities in cubic meters of each and all Waste discharged	3.0– 5.0
c)	The monthly and annual quantity in cubic meters of Waste discharged to the Mackenzie River at SNP station S13L1-007-2	3.0
d)	The monthly and annual quantities in cubic meters of freshwater and produced water injected to the Waterflood	4.0
e)	The monthly and annual quantities in cubic meters of Waters contained and discharged from the Surface Water Run-off Facilities	6.0
f)	The monthly and annual quantity in cubic meters of Produced Water recovered from the oilfield reservoir	4.0
g)	Tabular summaries of all data generated under the Surveillance Network Program (SNP)	Appendix A & B
h)	A list of unauthorized discharges, identification of waterbodies affected and the current status of mitigation measures	8.0
i)	An annual drilling schedule for the upcoming year to the Board	9.0
j)	The annual amounts in cubic meters of water and Waste generated from all drilling activities	9.0
k)	A summary of measures taken to minimize net water withdrawals from the hydrological cycle as required in Part D, Item 4 of the licence	3.0– 5.0
l)	Details on the handling, storage, treatment and disposal of Waste from the Norman Wells Proven Area	10.0
m)	A review of spill training and communication exercises of the previous year, including the success and failure, as well as recommendations for improvement	11.0
n)	A general schedule for any planned oil spill exercises for the following year	11.0
o)	A summary of any Modification(s) and / or major maintenance work carried out as per Part G of the licence	12.0
p)	Any other details on Water(s) use or Waste(s) disposal requested by the Board no later than March 31st of the following calendar year reported	n/a
q)	A summary of all spills and Unauthorized Discharges and follow up actions taken that occurred during the previous calendar year	8.0

2.0 Site Summary

Imperial Oil Resources Northwest Territories (N.W.T.) Limited (Imperial) is an upstream oil and gas facility located approximately 700 km northwest of Yellowknife, N.W.T. Operations include a central processing facility, which receives production from the mainland (along the north-eastern shore of the Mackenzie River), natural islands (Bear and Goose Island), and six artificial islands.

Imperial holds a Type A Water Licence S13L1-007 which was issued by the Sahtu Land and Water Board (SLWB) on March 5, 2015 and valid for 10 years. The licence serves to regulate the use of water and the deposits of waste as it relates to Imperial's site. Imperial also holds a Canada Energy Regulator (CER) Operations Authorization (OA) 1210-001 issued December 31, 2014 and also valid for 10 years. This authorization serves to regulate the oil and gas activity on Imperial's federally regulated site.

A key piece of Imperial's Norman Wells operations (NWO) and the Type A licence is the Surveillance Network Program (SNP). The SNP is detailed in Annex A of the licence and sets out the requirements for the three branches of the SNP program including but not limited to sampling expectations, water quality release limits and reporting. The three branches of the SNP are listed below:

- Freshwater – Mackenzie River water
- Surface Water – snow and rainwater
- Groundwater – below surface water

For more information on the SNP please refer to the Water Licence S13L1-007, Annex A. All other conditions are described above in Section 1.0.

In November 2016, Imperial was notified of Enbridge's Line 21 being temporarily suspended due to a slope instability concern at a Mackenzie River pipeline crossing near the Fort Simpson, N.W.T. area. As a result, in late November 2016 Imperial initiated efforts to reduce crude oil production to ensure that storage tanks would not exceed capacity. During this time, options for long term operations were being evaluated and in February/early March 2017, Imperial safely completed a temporary shutdown.

Throughout the beginning of 2018, Imperial worked with the CER and local stakeholders to keep them informed of startup progress. On October 13, 2018 Enbridge's Line 21 was re-opened and Imperial safely restarted the NWO. Post startup activities continued throughout the remainder of 2018 and regular operations continued through 2019.

3.0 SNP – Freshwater

The SNP - Freshwater covers the testing and analysis of the river water entering and leaving the central processing facility (CPF). There are two sampling locations, referred to as SNP Stations, included in this SNP program. The stations are S13L-007-1 (CPF inlet) and S13L1-007-2 (CPF outlet). The CPF inlet is the point at which the freshwater from the Mackenzie River enters the facility and the CPF outlet (or effluent) is the last point before it returns back to the Mackenzie River. This is described in more detail in Section 3.3.

3.1 Mackenzie River Withdrawal and Return Volumes

In 2019, Imperial withdrew approximately 2.2 milllion cubic metres (m^3) of water from the Mackenzie River (maximum licence allowable limit is 3.5 million m^3). All of this water was used for cooling in the CPF (Figure 3-1). Once the water was used for cooling, water was either returned to the Mackenzie River or injected to the reservoir via the freshwater injection system.



Figure 3-1: Mackenzie River Water Uses

Details on the monthly quantities of freshwater withdrawn and discharged to the Mackenzie River can be found below in Table 3-1. All injection volumes can be found in Table 5-1. Figure 3-2 shows the volume of water withdrawn from and returned to the Mackenzie River each year over a five year period. Freshwater intake and demand for cooling water will generally decrease over time as production volumes decrease.

Table 3-1: 2019 CPF Inlet and Outlet Volumes

Month	CPF Inlet (S13L1-007-1) (m^3)	CPF Outlet (S13L1-007-2) (m^3)
Jan	155,773	155,755
Feb	136,380	114,399
Mar	164,127	124,785
Apr	167,886	131,287
May	191,396	153,626
Jun	220,127	185,340
Jul	246,027	204,581
Aug	231,104	179,494
Sep	211,049	151,485
Oct	173,659	114,586
Nov	158,517	98,952
Dec	164,963	137,679
Total	**2,221,010**	**1,751,970**

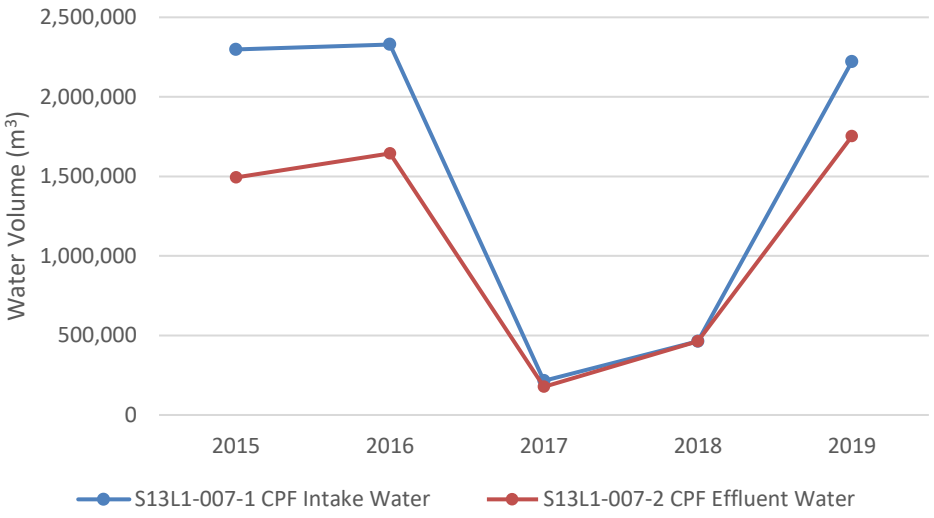


Figure 3-2: Mackenzie River Withdrawal and Return Volumes (2015 – 2019)

3.2 Volumes of Water Withdrawn from Other Sources

In 2019, Imperial did not withdraw any water from other sources.

3.3 Freshwater Cooling Loop Explained

As water enters the CPF facility it is tested as per licence conditions at the CPF inlet (Figure 3-3). After testing, chlorine is added to kill bacteria in the piping and prevent damage to the equipment. This is the same type of chlorine used to disinfect drinking water systems. In 2019, chloride injection was in operation throughout the year. As outlined in Section 3.1 of the *Norman Wells Quality Assurance & Quality Control Manual* (January 2018), two chemicals are added to the freshwater to reduce the amount of silt and sediment in the freshwater.

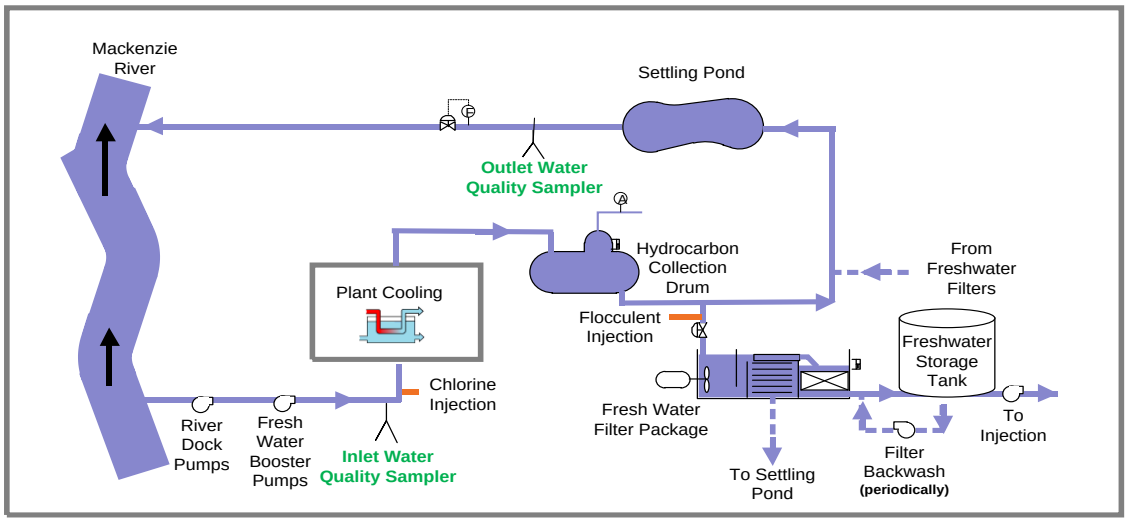


Figure 3-3: Freshwater Cooling Loop Flow Diagram

Once a water sample has been taken and chlorine is added, the water then flows through heat exchangers within the plant for the sole purposes of cooling. The Mackenzie River water does not come into contact with any process fluids during cooling. There is no chance for the water to become contaminated because the water and oil are separated by a steel barrier (Figure 3-4). After cooling, the water passes through the hydrocarbon collection drum. This hydrocarbon collection drum is engineer designed with sensors that can detect light hydrocarbons. It is also equipped with automatic shut in valves as a preventative measure in the unlikely event that light hydrocarbons were to be detected in the freshwater (e.g., exchanger failure).

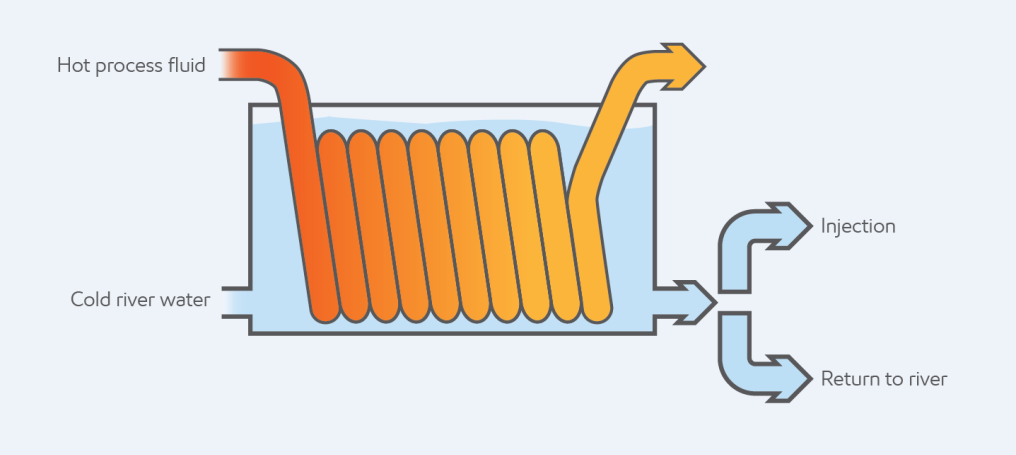


Figure 3-4: Simple Heat Exchanger

Once the water has passed through the hydrocarbon collection drum it either goes to the field for injection into the reservoir or to the settling pond where it is returned to the Mackenzie River. As the water is released from the settling pond it is tested as per licence conditions at a testing location referred to as the CPF outlet (Figure 3-3).

3.4 SNP – Freshwater Data Summary

All water results are reported to the SLWB as per licence conditions in the Monthly Water Use Report and are provided annually in this report (Appendix A).

In 2019, there were no exceedances of any of

water licence requirements

4.0 Aquatic Effects Monitoring Program

As part of the submission of the Aquatic Effects Monitoring Program (AEMP) Version 3.0 to the SLWB on December 24, 2019, Imperial committed to providing existing AEMP data as part of this Annual Water Use Report.

All surface water data collected under AEMP Version 1.0 and 2.0 between 2017 and 2019 is included within the report in Appendix D. Surface water samples were was analyzed for routine variables, hydrocarbons, and total and dissolved metals. All analyses of hydrocarbons were below detectable limits. The total concentrations of several metals, chloride, and sulphate were analyzed to understand spatial and temporal trends. Overall, the statistical analysis showed no evidence that position of sampling along the river had any effect on seasonal trends in water quality (i.e. seasonal changes were not attributed to the influence of the operation).

Additionally, no significant increasing trends in concentration for any parameter were identified, which means that there is no difference in concentration between upstream background and downstream locations. Variability in concentrations observed near the operation are likely due to the sampling density.

Data collected to date does not show an impact from the Norman Wells Operation on the water quality in the Mackenzie River. Changes to the AEMP surface water sampling program (number of sampling locations, frequency of sampling) are not recommended based on the data collected between 2017 and 2019.

5.0 Freshwater and Produced Water Injection

To maintain a constant pressure in the reservoir, all volumes removed from the producing reservoir must be replaced. Pressure is maintained by injecting fluid (such as produced water or freshwater) into the reservoir through injection wells. This is referred to as a waterflood. Without water injection the reservoir pressure would fall and production would quickly decline.

Water that is generated with the production of oil is called produced water and is re-injected into the reservoir. The volume of produced water is not enough to replace the amount of oil recovered; therefore, freshwater is used to supplement injection volumes required. The total volume of water injected in 2019 was approximately 2.5 million m^3 and was made up of freshwater and produced water (Table 5-1).

Table 5-1: 2019 Freshwater and Produced Water Injection Volumes

Month	Freshwater Injection (m^3)	Produced Water Injection (m^3)	Total Water Injection (m^3)
Jan	18	171,934	171,952
Feb	21,981	149,947	171,928
Mar	39,341	180,259	219,600
Apr	36,599	170,523	207,122
May	37,770	181,727	219,497
Jun	34,787	167,069	201,856
Jul	41,446	172,562	214,009
Aug	51,610	169,576	221,186
Sep	59,564	169,324	228,888
Oct	59,073	182,862	241,935
Nov	59,565	181,078	240,644
Dec	27,284	188,258	215,542
Total	**469,040**	**2,085,119**	**2,554,159**

As waterfloods mature, the produced water to oil ratio from the wells typically increase resulting in increased produced water volumes with time. As a result, the volume of produced water injection increases and the demand for freshwater injection decreases. This is shown in Figure 4-1.

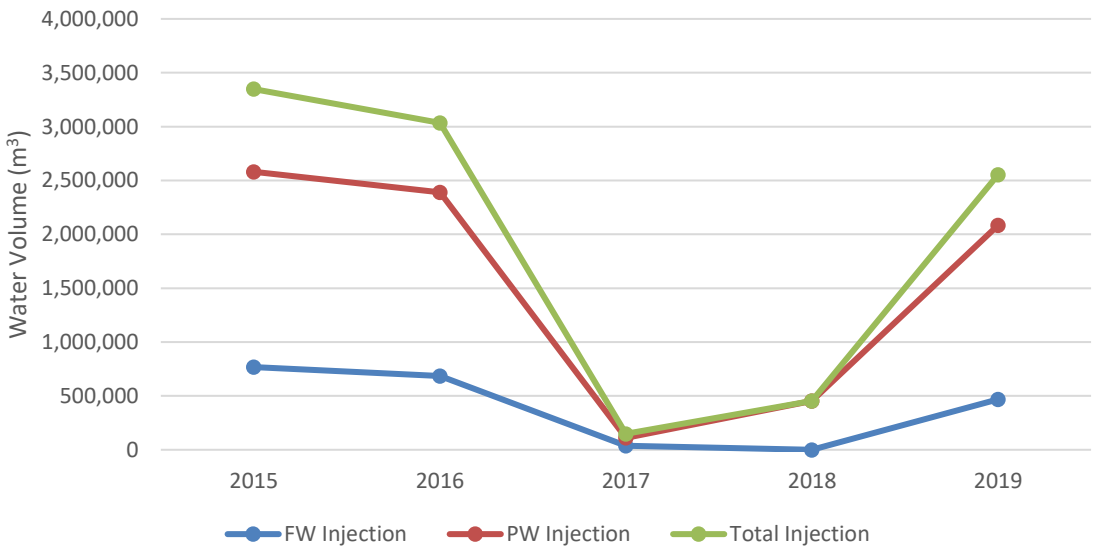


Figure 4-1: Freshwater and Produced Water Injection Volumes (2015 – 2019)

6.0 Facility Integrity Verification and Repairs

The SNP - Surface Water covers the testing and analysis of surface water run-off facilities. The major elements of the program include:

- collecting representative samples from surface water runoff facilities for field testing and/or laboratory analysis
- performing controlled releases of surface water from runoff facilities that meets the guidelines in the Water Licence

6.1 Surface Water Runoff Facilities (SWROF) Release Volumes

In 2019, 19,857 m^3 of surface water was released from impound basins back to the environment (Table 5-1).

7,871 m^3 of surface water was released back to the environment from ditches and bunkers on Goose Island and the Mainland (Table 5-1).

Table 5-1: 2019 SWROF Release Volumes

Month	CPF Impound	Mainland / Bear / Goose	LT11	D-42	Refinery Impound	Refinery Water Flood	Drilling Sumps	Other SWROF
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0
May	0	0	496	248	4,440	0	0	0
Jun	1,510	658	0	0	0	0	0	0
Jul	0	39	0	0	1,070	0	0	0
Aug	6,361	0	310	0	4,054	0	0	0
Sep	0	0	0	0	1,368	0	0	0
Oct	0	20	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Total	**7,871**	**717**	**806**	**248**	**10,932**	**0**	**0**	**0**

6.2 SNP – Surface Water Data Summary

There were no exceedances of water quality or uncontrolled releases in 2019.

All water results are reported to the SLWB as per licence conditions in the Monthly Water Use Report and are provided annually in this report (Appendix B).

7.0 SNP - Groundwater

A summary of the 2019 Groundwater Monitoring program and the results can be found in Appendix C. Monitoring well location BI-13-3-4.5 was found to be damaged during the September 2019 sampling event and will be replaced by contingency well BI-13-1-4 in future sampling events.

8.0 Reportable Releases

Imperial reported all 2019 government reportable releases to the CER Online Event Reporting System and the Northwest Territories – Nunavut (NT - NU) Spill Report Line.

8.1 Incident Prevention and Reduction

Imperial's integrity and reliability processes utilize a structured approach of prevention, detection, response and recovery. A variety of activities related to release prevention, reduction, mitigation, response and training is undertaken annually. These activities are designed to eliminate potential releases, detect releases should they occur and if they do occur, ensure an effective and timely clean up. Key elements for achieving this strategy include:

- awareness training for employees and contractors
- pre-job preparation and hazard recognition
- surveillance and monitoring
- flowline leak detection
- routine integrity testing and maintenance
- regularly scheduled emergency response training and exercises and;
- incident reporting processes

For any new to site workers (both employees and contractors) a safety and environmental training package is reviewed covering environmental topics such as release prevention, reporting, waste management, and wildlife. Other tools such as Environmental Alerts, a one page bulletin intended as a high level overview of key topics, may be used to communicate to workers specific environmental information on an as needed basis.

Release reduction initiatives and target areas are continuously evaluated based on existing trends. In 2019, a focus area was fostering a strong reporting culture for smaller, low consequence events and conducting deliberate and detailed periodic reviews of lower consequence events to understand trends, root causes and targeted actions to prevent future similar or higher consequence events. In addition, environmental incidents and associated learnings are reviewed real-time with the general workforce in daily operations and stewardship meetings.

8.2 Spill Summary

In 2019, Imperial reported eight events to the CER's Online Event Reporting System (OERS) and the Northwest Territories – Nunavut (NT-NU) Spill Report Line (Table 8-1). Two events were liquid releases, and the remaining six events were gas releases. Each event was reported and responded to immediately. Clean-up has been completed in all cases and the incident investigations have been closed. Incident investigation details and clean up status are provided to the CER through the Monthly Release Report and the OERS, and to the SLWB in a Supplemental Release Report (30 Day Report).

Table 8-1: Details on 2019 NT-NU Reportable Releases

Date Occurred	CER INC Number	NT/NU Spill Number	Location of Event	Product Released	Volume Released	Volume Contained (m^3)	Volume Reaching the Environment	Executive Summary	Direct Cause	Status of Clean Up
2019-01-19	INC2019-009	19-019	Field	Fuel Gas	86.8 kg	0.0	86.8 kg	Operator doing rounds on 19 Jan 2019 at 9AM. There was no observable issues when passing by E-35X. At 10:30AM the operator returned to complete additional rounds and heard gas releasing. The valve was shut at that time, ending the release.	Equipment Degradation	Complete
2019-04-14	INC2019-039	2019-160	Plant	Natural Gas	53100 kg	0	53100 kg	Plant operators performing rounds found the thief hatch open on top of a produced water tank (TK 204), resulting in blanket gas (fuel gas) escaping. Upon detection, the plant operator proceeded to close the hatch.	Process Safety – Other Government Compliance - Reportable	Complete
2019-06-19	INC2019-071	19-232	Crew Boat	Coolant	25 L	25 L	0 L	While in operation, the Norman Wells crew boat alarm went off. The boat was brought back to the mainland dock. It was determined that a hose and clamp had come off the cooling system. Approximately 25L of coolant was released into the hull of the boat. No coolant was released to the Mackenzie River. A vac truck was used to recover the released coolant from the hull. The coolant line was reattached, checked, and found to be satisfactory. The boat was put back into operation.	Equipment – Other Malfunctioned / Did Not Function	Complete
2019-07-18	INC2019-082	18-289	Mainland	Sewage	<5L	0L	<5L	While in the area of the wireline shop above ground septic holding tank, a contractor noticed a small leak at one of the corners of the tank. The contractor immediately notified their supervisor and began to investigate the leak. Upon investigation, it was identified that there was a loose fitting. The repair and clean-up were completed.	Equipment Other – Mechanical Integrity	Complete
2019-10-17	INC2019-11	19-426	Mainland	Hydrocarbon Impacted Soil	140 L	0 L	140 L	While handling hydrocarbon impacted soil onsite, material was spilled from a truck onto an onsite road (spill occurred on road between the "Waste Storage Yard" and laydown area west of the backwash pond).	People – Understood but Did Not Follow Acceptable Practices or Procedure	Complete
2019-06-11	INC2019-121	19-455	BIT 4	Biocide	20 Kg	18 Kg	2 Kg	During operator rounds on Bear Island at BIT 4 Terminal, it was observed that there had been a release of Nalco EC6536A, a biocide. The release was primarily contained to the building, but a	People – Lacked Information/ Interpretation/	Complete

								small amount of fluid did escape the building under the entrance doors. The operator proceeded to isolate the system and notified IOL supervision. The root causes of this event were determined to be lack of or inadequate procedures and lack of skill or knowledge. The investigation indicated that the leaking piece of equipment (chemical injection pump) had been over pressured (due to manual adjustment). In addition, operating procedures for the piece of equipment were found to reference the incorrect operating pressure range.	Understanding/ Communication Systems – Work Procedure/Defined Acceptable Practice Issue	
2019-11-13	INC2019-122	19-462	Canadian Helicopters Building	Domestic Wastewater	2L	0L	2L	Personnel reported that there was a strong smell of sewer coming from the washroom area of the Heli shack trailer. Another Imperial Oil worker who had been at the Heli shack also noticed the odour. There was a small amount of grey water (water/sewage) mix outside of the heli shack on a concrete pad and a small amount on the ground. The root cause of this event was determined to be inadequate tools or equipment. The potable water tank at the heli shack is larger than the sewage tank and the system has a high level switch, but the switch is not failsafe and malfunctioned.	Equipment – Instrument or Control System Malfunctioned / Did not Function	Complete
2019-12-19	INC2019-136	19-489	Central Processing facility	Produced Water	3.9 m3	3.9 m3	0 m3	A release of produced water from a building within the Norman Wells Plant site (mainland) was identified the morning of December 19, 2019. The impacted portions of the produced water system were pro-actively isolated. Work commenced to repair the source of the leak. Upon completion of the required repair work, the produced water system was started up.	Equipment – Other Mechanical Integrity	Complete

9.0 Drilling Activity Summary

There was no drilling activity in 2019 nor are there plans to drill in 2020. All drilling sumps have been capped and are in the remediation process. There were no drilling fluid releases in 2019.

10.0 Waste

Waste generated on site is collected and disposed of at appropriate waste facilities both on and off site. In 2019, approximately 70 tonnes of hazardous waste and 240 tonnes of non-hazardous waste was transported to approved facilities outside of Norman Wells.

Two Imperial owned soil treatment facilities (bio cell) continue to operate, treating impacted material for reuse on site. In 2018, no additional soil was added to the bio cell. Approximately 3000 m3 of treated material was moved to the mainland sump area for future usage onsite.

An active Waste Management Plan serves as a resource document and field guide for waste management on-site, and includes additional details about the bio cell and other waste facilities at the NWO. As updates to this plan are made, the plan is filed with the SLWB.

11.0 Emergency Response

Imperial's Emergency Response Plan (ERP) includes set objectives for responding to emergencies in an effective and timely manner. These objectives include the following:

- manage risks, inherent in all operations to minimize releases
- ensure that all employees understand their responsibility as it relates to emergencies and preventing them from occurring
- develop and maintain emergency response capabilities locally and have the ability to quickly expand and leverage other resources
- initiate appropriate response measures immediately and take all reasonable measures to ensure the safety of our workforce and the public and for the protection of the community and the environment

In addition to the ERP mentioned above, a Spill Contingency and Response Plan (SCARP) also exists as a supplement the ERP. The SCARP is a more detailed field level strategy guide. Copies of both the ERP and SCARP are filed with the SLWB and CER and other agencies as appropriate.

The local Norman Wells workforce, in the event of an emergency, would be known as the emergency response team (ERT). The ERT completes regular training on roles and responsibilities, the structure and organization of the incident command system, emergency response equipment, as well as various response techniques (e.g., boom deployment and oil recovery on water). Within the scope of any training, the objectives of the exercise, learnings and any improvement areas are discussed throughout and followed up as required.

A summary of the exercises completed in 2019 are included in Table 11-1.

Table 11-1: 2019 Emergency Response Exercises

Date	Description
30-Jan-19	Vehicle breaking through Ice Road
28-Feb-19	Brittle Fracture
15-Mar-19	Blocked Flare
23-Apr-19	Chlorine Release
29-May-19	Fire Fighting & Explosion (Products, Boilers, Vessels) combined with Grass Timber from June
13-Jun-19	Gas Release (H2S, Hydrocarbon) & Man Down (Confined Space Rescue)
July 31 - Aug 1 2019	Spill Response (Land, Water, Building)
7-Aug-19	Office Fire Drill
4-Nov-19	Business Continuity Plan
18-Oct-19	Helicopter Overdue
14-Nov-19	TG Fire & Man Down Medical Emergency (Injury, Illness, Fatality)
5-Dec-19	Security Scenario (Bomb Threat)
30-Jan-19	Vehicle breaking through Ice Road

A summary of the exercises planned for 2020 are included in Table 11-2.

Table 11-2: 2020 Planned Emergency Response Exercises

Date	Exercise Scenario / Substance
Feb	Gas Release (H2S, Hydrocarbon)
March	Ice Road Construction / Transport Incident
March	Blocked Flare
April	Helicopter Overdue
May	Fire Fighting & Explosion (Products, Boilers, Vessels)
June	Well Blow Out to MacKenzie River
TBD	BCP exercise - Cyber Security
July	Marine Transport Incident
Aug	Spill Response (Land, Water, Building)
Sept	Office Fire Drill
During Q3	Marine & Field Response Drills
Oct	Chlorine Release
Nov	TG Fire & Man Down Medical Emergency (Injury, Illness, Fatality)
Dec	Brittle Fracture

12.0 Work Summary

Below is a list of modification(s) and maintenance work carried out as per Part G of the licence in 2019:

- soil washing facility – work stopped
- temporary water withdrawal modification at Bear Island – no water withdrawn

Work related to the soil washing facility has been temporarily suspended. This work falls under Part G of the licence and more information can be found in the Annual Closure and Reclamation Report.

Acronyms

Acronym	Definition
AEMP	Aquatic Effects Monitoring Progam D
CER	Canad Energy Regulator
CPF	central processing facility
EC	specific conductivity
ERP	Emergency Response Plan
ERS	Event Reporting System
ERT	emergency response team
Imperial	Imperial Oil Resources N.W.T. Limited
L	litres
m^3	cubic metres
mg/l	milligrams per litre
n/a	Not applicable
NWO	Norman Wells Operations
N.W.T.	Northwest Territories
NT-NU	Northwest Territories – Nunavut
SCARP	Spill Contingency and Response Plan
SLWB	Sahtu Land and Water Board
SNP	Surveillance Network Program
SWROF	Surface water runoff facilities
TPH	Total Petroleum Hydrocarbons
TSS	total suspended solids
uS/cm	micro Siemens per centimetre

13.0 Glossary

Term	Description
Acute lethality	An effluent is deemed acutely lethal if the undiluted (100%) effluent kills 50% or more of the fish or *Daphnia magna* in the test. Biological test method: Acute Lethality Test Using Rainbow Trout Report EPS 1/RM/9 July 1990 (with May 1996 and May 2007 amendments) and Acute Lethality of Effluents to *Daphnia magna* EPS 1/RM/14 Second Edition December 2000, or as may be amended from time to time.
Average concentration	The running average of any four consecutive analytical results submitted to the Board in accordance with the sampling and analysis requirements specified in the "Surveillance Network Program".
Bathymetric survey	A survey used to measure the topography on the bottom of a waterbody. Imperial conducts these surveys on the Mackenzie River to help identify and understand what changes have occurred on the river bottom.
Central processing facility (CPF)	The plant where oil, gas, and produced water, are collected from the oilfield and separated.
Exceedance	Results are above the maximum concentrations listed in Water Licence S13L1-007
Flowline	A line that is used to transport fluids from a well to a production facility or vice versa, and includes intrafield export and all gathering lines
Phenols	Any of a family of organic compounds characterized by a hydroxyl (-OH) group attached to a carbon atom that is part of an aromatic ring. Phenols are widely used in household products such as cleaners and mouthwash. They are commonly found in nature and can be obtained from essential oils of plants. Phenols can also be obtained from the distillation of coal tar or crude petroleum. (Source: www.britannica.com).
Produced water	Water extracted from the reservoir as a mixture with oil and gas
SNP Station S13L1-007-1	The Surveillance Network Station for the CPF intake water.
SNP Station S13L1-007-2	The Surveillance Network Station for the CPF cooling flow return.
Surface water run-off facilities	The Refinery Impounding basin, Battery 3 impounding basin (also known as LT 11), Refinery waterflood Basin, CPF impounding area (also known as LT 2), miscellaneous Mainland impounding areas, miscellaneous Bear Island impounding areas, miscellaneous Goose Island impounding areas, and associated ditches provided for the collection, storage, and discharge of surface run-off waters from the NWO.
Surveillance network program	A network of devices or sampling points designed to test environmental conditions for comparison against baseline data obtained from a point or area designated as a control. This is a method of tracking and identifying the spread of deleterious substances in the environment.
Waste	Waste as defined by Section 2 of the *Northwest Territories Waters Act*
Waterflood	The injections of water into the Norman Wells oilfield reservoir for pressure maintenance and enhanced oil production
Water intake	The wetwell pump and associated facilities installed in the Mackenzie River and the water line to the CPF

Appendix A CPF Inlet and Outlet Water Data

Table A-1: Total Petroleum Hydrocarbons and Phenols

	CPF Inlet Total Petroleum Hydrocarbons (mg/L)	CPF Inlet Phenols (mg/L)	CPF Outlet Total Petroleum Hydrocarbons (mg/L)	CPF Outlet Phenols (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**5.0 mg/L**	**0.14mg/L**
7-Jan	<2.0	<0.0020	<2.0	<0.0020
14-Jan	<2.0	<0.0020	<2.0	<0.0020
21-Jan	<2.0	<0.0020	<2.0	<0.0020
28-Jan	<2.0	<0.0020	<2.0	<0.0020
4-Feb	<2.0	0.0023	<2.0	<0.0020
11-Feb	2	<0.0020	<2.0	0.0021
18-Feb	<2.0	<0.0020	<2.0	0.002
4-Mar	<2.0	<0.0020	<2.0	<0.0020
11-Mar	<2.0	<0.0020	<2.0	<0.0020
18-Mar	<2.0	<0.0020	<2.0	<0.0020
25-Mar	<2.0	<0.0020	<2.0	<0.0020
1-Apr	<2.0	<0.0020	<2.0	<0.0020
8-Apr	<2.0	<0.0020	<2.0	<0.0020
15-Apr	<2.0	0.003	<2.0	<0.0020
22-Apr	<2.0	<0.0020	<2.0	0.0021
29-Apr	<2.0	0.0022	<2.0	0.0018
6-May	<2.0	<0.0015	<2.0	<0.0015
13-May	<2.0	0.0019	<2.0	0.002
20-May	<2.0	0.0028	<2.0	0.0034
27-May	<2.0	<0.0015	<2.0	0.0026
3-Jun	<2.0	0.002	<2.0	<0.0015
10-Jun	<2.0	0.0016	<2.0	<0.0015
17-Jun	2	<0.0015	<2.0	<0.0015
24-Jun	<2.0	<0.0015	<2.0	<0.0015
1-Jul	<2.0	0.0015	<2.0	0.0015
8-Jul	<2.0	0.0025	<2.0	0.0021
15-Jul	<2.0	<0.0015	<2.0	<0.0015
22-Jul	<2.0	<0.0015	<2.0	<0.0015
29-Jul	<2.0	0.0026	<2.0	0.002
5-Aug	<2.0	<0.0015	<2.0	<0.0015
12-Aug	<2.0	<0.0015	<2.0	<0.0015
19-Aug	<2.0	0.0015	<2.0	0.0017

	CPF Inlet Total Petroleum Hydrocarbons (mg/L)	CPF Inlet Phenols (mg/L)	CPF Outlet Total Petroleum Hydrocarbons (mg/L)	CPF Outlet Phenols (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**5.0 mg/L**	**0.14mg/L**
26-Aug	<2.0	<0.0015	<2.0	<0.0015
2-Sep	<2.0	<0.0015	*	*
5-Sep	<2.0	<0.0015	*	*
9-Sep	<2.0	<0.0015	*	*
16-Sep	<2.0	<0.0015	<2.0	<0.0015
23-Sep	<2.0	<0.0015	<2.0	<0.0015
30-Sep	<2.0	<0.0015	<2.0	<0.0015
7-Oct	<2.0	<0.0015	<2.0	<0.0015
14-Oct	<2.0	<0.0015	<2.0	<0.0015
21-Oct	<2.0	<0.0015	<2.0	<0.0015
28-Oct	<2.0	<0.0015	<2.0	<0.0015
4-Nov	<2.0	<0.0015	<2.0	<0.0015
11-Nov	<2.0	<0.0015	<2.0	<0.0015
18-Nov	<2.0	<0.0015	<2.0	<0.0015
25-Nov	<2.0	<0.0015	<2.0	<0.0015
2-Dec	<2.0	<0.0015	<2.0	<0.0015
9-Dec	<2.0	<0.0015	<2.0	<0.0015
16-Dec	<2.0	<0.0015	<2.0	<0.0015
23-Dec	<2.0	<0.0015	<2.0	<0.0015
30-Dec	<2.0	<0.0015	<2.0	<0.0015

**Outlet samples taken at CPF Impound Basin during settling pond cleaning (included in Surface Water Runoff Release Report Below)*

Table A-2: Total Suspended Solids (TSS), pH and Specific Conductivity (EC)

	CPF Inlet Total TSS (mg/L)	CPF Inlet Total pH (mg/L)	CPF Inlet Total EC (mg/L)	CPF Outlet Total TSS (mg/L)	CPF Outlet Total pH (mg/L)	CPF Outlet Total EC (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**n/a**	**n/a**	**Between 6 – 9**	**n/a**
3-Jan	<1.0	8.11	240	3.3	8.02	240
7-Jan	<1.0	8.18	250	2	8.08	250
10-Jan	<1.0	8.09	240	<1.0	8.02	240
14-Jan	1.3	8.04	250	1.3	8.08	250
17-Jan	<1.0	8.15	250	1.3	8.04	250
21-Jan	<1.0	8.06	240	4.7	8.05	240
25-Jan	<1.0	8.13	250	<1.0	8.03	240
28-Jan	<1.0	8.14	240	<1.0	8.08	240
31-Jan	43	8.01	250	2.7	8.04	240

	CPF Inlet Total TSS (mg/L)	CPF Inlet Total pH (mg/L)	CPF Inlet Total EC (mg/L)	CPF Outlet Total TSS (mg/L)	CPF Outlet Total pH (mg/L)	CPF Outlet Total EC (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**n/a**	**n/a**	**Between 6 – 9**	**n/a**
4-Feb	<1.0	8.1	250	1	8.07	250
7-Feb	<1.0	8.07	250	1	8.01	250
11-Feb	<1.0	8.16	250	1.3	8.07	250
14-Feb	<1.0	8.18	250	<1.0	8.11	250
18-Feb	<1.0	8.07	250	<1.0	8.1	250
22-Feb	<1.0	8.12	260	1	8.06	260
28-Feb	<1.0	8.11	260	<1.0	8.01	260
4-Mar	2	8.11	250	2	8.03	260
7-Mar	<1.0	8.14	260	<1.0	8.04	260
11-Mar	1	8.18	270	<1.0	8.18	270
14-Mar	1.3	8.25	270	<1.0	8.2	270
18-Mar	<1.0	8.16	270	<1.0	8.07	280
21-Mar	5.3	7.98	280	<1.0	8.02	270
25-Mar	3.3	8.23	280	1.3	8.12	280
29-Mar	<1.0	8.13	270	<1.0	8.05	280
1-Apr	2	8.22	280	<1.0	8.06	280
4-Apr	4.7	8.17	280	<1.0	8.02	280
8-Apr	3.3	8.11	290	1.3	8.08	290
11-Apr	1.3	8.21	280	<1.0	8.09	280
15-Apr	1.3	8.19	280	1	8.1	280
18-Apr	<1.0	8.18	290	1	8.09	290
22-Apr	<1.0	8.18	270	1.3	8.15	280
25-Apr	1.3	8.14	280	2.7	8.07	280
29-Apr	<1.0	8.07	290	2.7	8.08	290
2-May	1.3	8.15	260	2.7	8.07	270
6-May	<1.0	8.05	260	2.7	8.1	260
9-May	1.3	8.21	250	4	8.03	250
13-May	<1.0	8.15	230	11	8	240
16-May	2.7	8.11	250	14	7.99	260
20-May	<1.0	8.14	240	15	8.05	250
23-May	1.3	8.19	250	11	7.96	260
27-May	2.7	8.12	250	14	7.9	250
30-May	2.7	8	250	22	7.98	250
3-Jun	3.3	8.09	270	8.7	8.04	260
6-Jun	<1.0	8.1	260	35	8.07	250
10-Jun	2.7	8.05	240	14	8.06	240
13-Jun	11	8.15	230	23	8.04	240
17-Jun	1.3	8.13	240	6.7	8.08	240
20-Jun	<1.0	8.19	250	5.3	8.03	250
24-Jun	4.7	8.12	260	13	7.94	270
27-Jun	4	8.14	250	62	8.07	260
1-Jul	4.7	8.11	260	11	8.09	260
4-Jul	72	8.15	260	73	8.1	260

	CPF Inlet Total TSS (mg/L)	CPF Inlet Total pH (mg/L)	CPF Inlet Total EC (mg/L)	CPF Outlet Total TSS (mg/L)	CPF Outlet Total pH (mg/L)	CPF Outlet Total EC (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**n/a**	**n/a**	**Between 6 – 9**	**n/a**
8-Jul	4.7	8.16	260	6.7	8.1	260
11-Jul	130	8.13	270	34	8.05	270
15-Jul	130	8.01	270	17	8.06	270
18-Jul	11	8.11	280	9.3	8.02	280
22-Jul	23	8.12	280	13	8.08	280
25-Jul	4	8.17	290	8.7	8.14	290
29-Jul	2.3	8.09	290	4	8.11	290
1-Aug	400	8.13	280	4.7	7.94	280
5-Aug	130	8.11	280	12	8.12	280
8-Aug	260	8.04	280	27	8.05	290
12-Aug	98	8.17	270	17	8.12	280
15-Aug	150	8.01	290	16	8.01	290
19-Aug	590	8.19	300	15	8.15	300
22-Aug	400	8.13	280	4.7	7.94	280
26-Aug	44	8.02	290	11	8.01	300
29-Aug	480	8.12	280	54	8	290
2-Sep	260	8.13	280	*	*	*
3-Sep	5.3	8.1	270	*	*	*
5-Sep	37	8.02	280	*	*	*
9-Sep	35	8.08	280	*	*	*
12-Sep	47	8.22	270	19	8.14	280
16-Sep	91	8.13	280	8	8.15	500
19-Sep	5.3	8.12	280	4.7	8.07	280
23-Sep	22	8.07	280	110	8.12	280
26-Sep	400	8.13	270	3.3	8.01	280
30-Sep	84	8.11	270	10	8.06	280
3-Oct	53	8.09	270	7.3	8.01	270
7-Oct	36	8.04	270	7.3	8.04	280
10-Oct	6	8.1	270	8	7.97	270
14-Oct	4	8.1	270	3.3	8.02	270
17-Oct	240	8.14	270	4.7	8.01	280
21-Oct	30	8.11	270	2.7	8.12	270
24-Oct	6	8.15	260	11	8.1	270
28-Oct	360	8.06	260	2.7	8.1	270
31-Oct	130	8.16	270	6	8.19	270
4-Nov	10	8.11	330	2.7	8.21	290
7-Nov	17	8.16	380	2	8.11	280
11-Nov	<1.0	8.1	310	5.3	8.08	290
14-Nov	4.7	8.12	320	6	8.15	310
18-Nov	3.2	7.88	310	3.9	7.6	300
21-Nov	1.3	7.75	300	<1.0	8.06	300
25-Nov	6.5	7.88	310	<1.0	7.88	310
28-Nov	4	7.88	310	<1.0	8.01	310

	CPF Inlet Total TSS (mg/L)	CPF Inlet Total pH (mg/L)	CPF Inlet Total EC (mg/L)	CPF Outlet Total TSS (mg/L)	CPF Outlet Total pH (mg/L)	CPF Outlet Total EC (mg/L)
SNP Station	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-1**	**S13L1-007-2**	**S13L1-007-2**	**S13L1-007-2**
Water Licence Criteria	**n/a**	**n/a**	**n/a**	**n/a**	**Between 6 – 9**	**n/a**
2-Dec	10	8.06	300	3.3	8.09	300
5-Dec **	-	-	-	-	-	-
9-Dec	6	6.96	280	<1.0	6.92	260
12-Dec	1.4	7.94	280	2.4	7.96	270
16-Dec	1.7	7.84	270	1.5	7.46	260
20-Dec	6.2	7.49	270	2.1	7.99	270
23-Dec	2	8.06	<1.0	1.8	8.05	<1.0
30-Dec	1.7	7.73	270	2.9	7.79	250
30-Dec	1.7	7.73	270	2	7.74	270

**Outlet samples taken at CPF Impound Basin during settling pond cleaning (included in Surface Water Runoff Release Report Below)*

***Sample missed due to logistical shipping issue*

Table A-3: Average Daily Chlorine and Temperature

	Daily Chlorine (mg/L)	CPF Outlet Temperature (ºC)
SNP Station	**S13L1-007-2**	
Water Licence Criteria	**n/a**	**n/a**
7-Jan	0*	19.0
14-Jan	0*	9.8
21-Jan	0*	10.4
28-Jan	0*	10.8
4-Feb	0*	7.4
11-Feb	0*	9.8
18-Feb	0*	8.5
3-Mar	0*	10.5
11-Mar	0*	12.9
18-Mar	0*	16.0
25-Mar	0*	14.1
1-Apr	0*	12.4
8-Apr	0*	14.8
15-Apr	0*	12.6
22-Apr	0*	15.8
29-Apr	0*	14.2
6-May	0.7	15.6
13-May	0.19	16.1
20-May	0.08	19.1
27-May	0.06	21.5
3-Jun	0.4	19.1

	Daily Chlorine (mg/L)	CPF Outlet Temperature (ºC)
SNP Station	**S13L1-007-2**	
Water Licence Criteria	**n/a**	**n/a**
10-Jun	0.19	21.9
17-Jun	0.01	20.6
24-Jun	0	25.3
1-Jul	0*	23.3
8-Jul	0*	23.1
15-Jul	0*	25.3
22-Jul	0*	26.6
29-Jul	0*	25.1
5-Aug	0.33	23.4
12-Aug	0.01	21.8
19-Aug	0.01	21.9
26-Aug	0.01	22.9
2-Sep**	-	-
9-Sep**	-	-
16-Sep	0.01	20.1
23-Sep	0.02	19.6
30-Sep	0*	19.1
7-Oct	0*	16.8
14-Oct	0*	16.0
21-Oct	0*	16.3
28-Oct	0*	11.8
4-Nov	0*	2.9
11-Nov	0*	2.8
18-Nov	0*	3.1
25-Nov	0.05	3.2
2-Dec	0.02	11.77
5-Dec***	-	-
9-Dec	0.01	9.33
16-Dec	0.10	6.48
23-Dec	0.02	6.92
30-Dec	0.02	8.40

**chlorine injection offline*

***Outlet samples taken at CPF Impound Basin during settling pond cleaning (included in Surface Water Runoff Release Report)*

****Sample missed due to logistical shipping issue*

Table A-4: Four Week Rolling Average (S13L1-007-02)

	TPH (mg/L)	Phenols (mg/L)	TSS (mg/L)	pH	Specific Conductivity (uS/cm)	Daily Chlorine (mg/L)*	Temperature (C)
Max. Average Limit	**(5 mg/L)**	**0.014**	**n/a**	**6.0-9.0**	**n/a**	**n/a**	**n/a**
Jan 1-31	1.0	0.0010	1	8.0	243	**	12
Feb 1-28	2.00	0.0020	1	8.06	253	**	9.39
March 1-31	<2.0	<0.0020	1	8.09	271	**	0.00
April 1-30	<2.0	0.0020	1	8.08	283	**	13.66
May 1-31	<2.0	0.0024	11	8.01	254	0.15	17.37
June 1-30	<2.0	<0.0015	21	8.04	251	0.19	21.45
July 1-31	<2.0	0.0017	20	8.08	273	**	24.89
August 1-31	<2.0	0.0016	18	8.04	288	0.09	22.50
September 1-30	<2.0	<0.0015	26	8.09	317	0.02	17.85
Oct 1-31	<2.0	<0.0015	6	8.06	272	**	16.10
Nov 1-30	<2.0	<0.0015	6	8.00	310	0.03	10.99
Dec 1-31	<0.0015	<2.0	2	7.75	235	0.02	7.75

**Average of daily chlorine when chlorine injection system is online*

***chlorine injection offline*

Table A-5: Quarterly Acute Lethality Data

CPF Outlet (S13L1-007-2)		
Date	Rainbow Trout (% Survival)	Daphnia Magna (% Survival)
Licence Criteria	> 50% Survival	> 50% Survival
Q1	100.00%	100.00%
Q2	100.00%	100.00%
Q3	100.00%	100.00%
Q4	100.00%	90%*

**October 70% survival (duplicate 100% survival), November 100% survival, December 100% survival*

Table A-6: Quarterly Inlet Data

SNP S13L1-007-1 (Inlet)	Q1 (mg/L)	Q2 (mg/L)	Q3 (mg/L)	Q4 (mg/L)	YTD Average (mg/L)
pH	8.15	8.17	8.07	8.08	8.1175
Phenols	<0.0020	<0.0015	<0.0015	<0.0015	<0.0015
Dissolved Sodium	9.9	11	8.4	8.5	9.45
Total Sodium	9.7	10	7.7	8.7	9.025
Dissolved Potassium	0.88	1.1	0.95	0.86	0.9475
Total Potassium	0.94	1.1	1.1	0.92	1.015
Dissolved Sulphate	35	40	44	40	39.75
Dissolved Chloride	13	14	9.9	9.5	11.6
Dissolved Calcium	30	31	37	32	32.5
Total Calcium	30	29	34	31	31
Dissolved Magnesium	11	11	11	9.9	10.725
Total Magnesium	10	9.8	10	9.8	9.9
Total Alkalinity	83	84	92	86	86.25
Specific Conductivity	280	290	290	260	280
Total Suspended Solids	7.3	2.7	3.3	85	24.575
Total Dissolved Solids	140	170	180	150	160
Total Petroleum Hydrocarbons	<2.0	2	<2.0	<2.0	<2.0
Total Phosphorus	<0.10	<0.10	<0.10	<0.1	<0.10
Total Hardness	120	120	140	120	125

Table A-7: Quarterly Outlet Data

SNP S13L1-007-1 (Inlet)	Q1 (mg/L)	Q2 (mg/L)	Q3 (mg/L)	Q4 (mg/L)	YTD Average (mg/L)
pH	8.06	8.06	8.07	8.04	8.06
Phenols	<0.0020	<0.0015	<0.0015	<0.0015	<0.0015
Dissolved Sodium	9.6	11	8.2	8.7	9.4
Total Sodium	9.8	10	7.7	8.7	9.1
Dissolved Potassium	0.88	1.1	0.9	0.91	0.95
Total Potassium	0.9	1.1	1.0	0.9	1.0
Dissolved Sulphate	35	40	43	35	38
Dissolved Chloride	14	14	10	9.8	12.0
Dissolved Calcium	29	32	36	32	32
Total Calcium	30	30	34	32	32
Dissolved Magnesium	10	11	11	9.9	10.5
Total Magnesium	10	9.9	9.8	9.7	9.9
Total Alkalinity	83	83	94	87	87
Specific Conductivity	270	290	290	260	278
Total Suspended Solids	<1.0	3	8	5	5
Total Dissolved Solids	140	180	170	150	160
Total Petroleum Hydrocarbons	<2.0	<2.0	<2.0	<2.0	<2.0
Total Phosphorus	<0.10	<0.10	<0.1	<0.1	<0.1
Total Hardness	120	130	130	120	125

Appendix B Surface Water Runoff Data

Table B-1: 2019 Surface Water Discharge Analytical Results for Category A Locations

	Date	Total Discharge Volume (m^3)	Chlorides (mg/L)	pH	Sheen Y/N
Sample Limits			< 500	6.0-9.0	N
Goose Island					
Frenchies	6-Jun	66	Y	7	N
L-15	15-Jun	4	Y	7	N
M-13	23-Jun	12	Y	*	N
	15-Jun	8	Y	6	N
M-15	15-Jun	6	Y	7	N
M-19	14-Jun	3	Y	7	N
N-14	28-Jun	20	Y	7	N
	15-Jun	8	Y	7	N
N-15	23-Jun	7	Y	*	N
	15-Jun	8	Y	7	N
N-17	15-Jun	4	Y	7	N
N-18	10-Jun	10	Y	7	N
	14-Jun	6	Y	7	N
N-19	14-Jun	6	Y	7	N
N-21	10-Jun	3	Y	7	N
	14-Jun	6	Y	6	N
N-22	10-Jun	10	Y	7	N
	14-Jun	6	Y	6	N
N-23	10-Jun	4	Y	7	N
	14-Jun	5	Y	7	N
N-27	14-Jun	6	Y	6	N
N-29	14-Jun	6	Y	6	N
N-31	14-Jun	4	Y	6	N
O-07	26-Jun	10	Y	7	N
O-08	17-Jun	10	Y	7	N
O-10	26-Jun	4	Y	7	N
O-14	15-Jun	8	Y	6	N
O-15	16-Jun	8	Y	7	N
O-16	10-Jun	8	Y	7	N
	14-Jun	6	Y	7	N
O-17	15-Jun	4	Y	7	N
O-18	17-Jun	5	Y	7	N
O-19	10-Jun	6	Y	7	N
	14-Jun	5	Y	7	N
P-11	16-Jun	6	Y	7	N
P-12	16-Jun	3	Y	6	N
P-13	16-Jun	3	Y	6	N
	23-Jun	4	Y	*	N
P-21	10-Jun	9	Y	7	N

	Date	Total Discharge Volume (m^3)	Chlorides (mg/L)	pH	Sheen Y/N
Sample Limits			< 500	6.0-9.0	N
P-22	17-Jun	20	Y	7	N
Q-12	17-Jun	4	Y	7	N
R-05	22-Jun	6	Y	6	N
	24-Jun	12	Y	7	N
R-09	21-Jun	3	Y	6	N
R-11	21-Jun	7	Y	6	N
R-13	18-Jun	3	Y	6	N
R-15	26-Jun	10	Y	7	N
R-27	24-Jun	6	Y	7	N
S-06	21-Jun	4	Y	6	N
S-08	17-Jun	5	Y	6	N
	21-Jun	3	Y	6	N
S-10	18-Jun	7	Y	7	N
	19-Jun	25	Y	7	N
S-12	18-Jun	6	Y	7	N
	19-Jun	25	Y	7	N
	25-Jun	5	Y	7	N
S-14	19-Jun	25	Y	7	N
S-26	24-Jun	25	Y	7	N
T-07	17-Jun	4	Y	7	N
T-08	17-Jun	4	Y	6	N
T-09	17-Jun	8	Y	6	N
T-10	21-Jun	6	Y	6	N
T-11	18-Jun	8	Y	6	N
	26-Jun	10	Y	7	N
T-13	18-Jun	6	Y	7	N
T-13	25-Jun	7	Y	7	N
T-14	19-Jun	8	Y	7	N
T-15	25-Jun	7	Y	7	N
	25-Jun	7	Y	7	N
T-16	25-Jun	7	Y	7	N
T-19	25-Jun	5	Y	7	N
T-21	25-Jun	3	Y	7	N
T-23	24-Jun	25	Y	6	N
T-25	24-Jun	25	Y	6	N
M-19	19-Jul	1	Y	6	N
N-14	19-Jul	6	Y	6	N
N-29	19-Jul	1	Y	6	N
N-31	19-Jul	1	Y	6	N
O-10	19-Jul	1	Y	6	N
P-13	19-Jul	1	Y	6	N
Q-10	20-Jul	5	Y	6	N
Q-12	20-Jul	5	Y	6	N
Q-14	19-Jul	1	Y	6	N

	Date	Total Discharge Volume (m^3)	Chlorides (mg/L)	pH	Sheen Y/N
Sample Limits			< 500	6.0-9.0	N
R-11	20-Jul	2	Y	6	N
R-27	20-Jul	2	Y	7	N
S-26	20-Jul	3	Y	7	N
T-15	20-Jul	2	Y	6	N
T-19	20-Jul	2	Y	6	N
T-23	20-Jul	3	Y	6	N
T-25	20-Jul	3	Y	6	N
K-48	13-Oct	10	Y	7.4	N
J-52x	13-Oct	10	Y	7	N

**Data not collected due to Operator error*

Table B-2: 2019 Surface Water Discharge Analytical Results for Category B Locations

	Date	Start/ Middle/ End	Total Discharge Volume (m^3)	Total Petroleum Hydrocarbons (mg/L)	Phenols (mg/L)	Chlorides (mg/L)	pH	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductivity (uS/cm)
Max Grab Sample Limit				**5**	**0.14**	**<500**	**6.0-9.0**			
Mainland Areas										
CPF Impound Basin	14-May	Start	0	<2.0	0.0038	12.0	8	41.0	150	260
	29-May	Start		<2.0	0.0035	14.0	7.91	10.0	860	1100
	12-Jun	Mid 2	1,510	<2.0	0.0026	11	7.43	130	1200	1500
	20-Jun	Mid 3		<2.0	0.0050	10	7.57	4.7	1300	1500
	25-Jun	Mid 4		<2.0	0.0016	9.3	7.57	15	1200	1400
	2-Jul	Mid 5	0	<2.0	0.0047	12	7.76	81	270	450
	20-Aug	Start	6,361	<2.0	0.0027	7	7.38	2	1300	1500
	27-Aug	Mid 1		<2.0	0.0120	41	8.5	2	600	1000
	1-Sep	Test 1	0	<2.0	0.0016	10	7.78	5.3	220	350
	2-Sep	Mid 2		<2.0	0.0027	10	7.79	13	200	340
	3-Sep	Mid 2		<2.0	0.0038	8	7.51	4	580	820
		Test 3		<2.0	0.0018	10	7.76	4.7	200	350
	5-Sep	Mid 5		<2.0	0.0016	10	7.99	27	160	280
	6-Sep	Mid 6		<2.0	0.0019	10	8.11	14	170	280
	7-Sep	Mid 7		<2.0	0.0033	11	7.81	2	200	330
	8-Sep	Mid 8		<2.0	0.0022	10	7.8	3.3	180	330
	9-Sep	Start		<2.0	0.0018	11	7.8	3.3	460	720
		Mid 9		<2.0	0.0028	10	7.77	3.3	190	320
	10-Sep	Mid 10		<2.0	0.0023	10	7.93	5.3	180	320
	11-Sep	Mid 11		<2.0	0.0015	10	7.94	2	190	310
	12-Sep	Mid 12		<2.0	<0.0015	10	7.87	2.7	190	320
	17-Sep	Mid 13		<2.0	0.0025	11	7.71	2.7	400	560
	24-Sep	Mid 14		<2.0	0.0020	11	7.65	3.3	560	840

	Date	Start/ Middle/ End	Total Discharge Volume (m^3)	Total Petroleum Hydrocarbons (mg/L)	Phenols (mg/L)	Chlorides (mg/L)	pH	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductivity (uS/cm)
Max Grab Sample Limit				5	0.14	<500	6.0-9.0			
CPF Laydown Area	10-Apr	-	0	<2.0	0.0690	12.0	7.57	16	360	570
CPF Refinery Impound	5-Jun	Mid 1	0	<2.0	0.0057	27	8.08	4	600	910
CPF Settling Pond	17-Sep	End	0	<2.0	<0.0015	10	8.09	19	190	290
D-42	1-May	Mid 1	248	<2.0	0.0097	6.0	8.05	5.3	470	670
	13-May	Mid 3		<2.0	0.0120	15.0	7.79	6.7	500	760
	22-May	End		<2.0	0.0047	12.0	8.11	4	1500	1700
	24-Apr	Start	0	<2.0	0.0084	7.1	8.1	14	440	610
LT 11 Impound Basin	24-Apr	Start	0	<2.0	0.0160	3.8	7.65	15	170	220
	1-May	Mid 1	496	<2.0	0.0160	5.8	7.65	2.7	210	310
	13-May	Mid 3		<2.0	0.0057	7.8	7.85	4.7	410	650
	22-May	Mid 4		<2.0	0.0065	4.4	7.54	3.3	510	710
	29-May	Mid 5		<2.0	0.0065	5.0	7.55	3.3	530	750
	5-Jun	Mid 6	0	<2.0	0.0022	4.1	7.87	13	510	760
	12-Jun	Mid 7		<2.0	0.0071	7.6	7.83	2.7	570	830
	20-Jun	Mid 8		<2.0	0.0058	9	7.54	2.7	600	810
	25-Jun	Mid 9		<2.0	0.0036	9.2	7.79	19	580	810
	2-Jul	Mid 10	0	<2.0	0.0068	9.4	7.68	3.3	520	850
	9-Jul	Mid 11		<2.0	0.0052	8.1	7.96	1.3	510	730
	15-Jul	Mid 12		<2.0	0.0086	8.7	7.65	2.7	580	860
	23-Jul	Mid 13		<2.0	0.00390	9	7.55	2	560	880
	30-Jul	Mid 14	310	<2.0	0.00390	9	7.83	15	530	800
	6-Aug	Mid 15		<2.0	0.0047	42	8.44	1.3	600	1000

	Date	Start/ Middle/ End	Total Discharge Volume (m^3)	Total Petroleum Hydrocarbons (mg/L)	Phenols (mg/L)	Chlorides (mg/L)	pH	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductivity (uS/cm)
Max Grab Sample Limit				5	0.14	<500	6.0-9.0			
	13-Aug	Mid 16		<2.0	0.0070	9	7.51	1.3	610	860
	20-Aug	Mid 17		<2.0	0.0054	6	7.51	13	500	750
	27-Aug	Mid 18		<2.0	0.0031	34	8.49	3.3	580	990
	3-Sep	Mid 19	0	<2.0	0.0041	9	7.66	4	580	830
	10-Sep	Mid 20		<2.0	0.0064	6	7.67	4	580	870
	17-Sep	Mid 21		<2.0	0.0040	9	7.4	16	580	820
	24-Sep	Mid 22		<2.0	<0.0015	10	7.71	5.3	560	830
Refinery Impound Basin	24-Apr	Start	0	<2.0	0.0190	6.9	7.82	45	230	330
	1-May	Mid 1	4,440	<2.0	0.0150	5.4	7.80	26.0	210	340
	13-May	Mid 3		<2.0	0.0046	13.0	8.07	4.0	400	620
	22-May	Mid 4		<2.0	0.0079	14.0	8.08	4.0	380	590
	29-May	Mid 5		<2.0	0.0042	24.0	7.94	8.0	590	870
	5-Jun	Mid 6	0	<2.0	0.0038	12	7.46	2	1100	1600
	12-Jun	Mid 7		<2.0	0.0053	30	8.29	3.3	580	890
	20-Jun	Mid 8		<2.0	0.0049	30	8.28	3.3	590	830
	25-Jun	Mid 9		<2.0	0.0028	34	8.2	12	600	920
	2-Jul	Mid 10	1070	<2.0	0.0041	36	8.24	1.3	600	890
	9-Jul	Mid 11		<2.0	0.0052	36	8.29	1.3	560	860
	15-Jul	Mid 12		<2.0	0.0096	37	8.21	1.3	540	840
	23-Jul	Mid 13		<2.0	0.00390	30	8.11	8	500	810
	30-Jul	Mid 14	4,054	<2.0	0.00430	33	8.35	9.3	440	740
	6-Aug	Mid 13		<2.0	0.0042	10	7.79	9.3	570	810
	13-Aug	Mid 16		<2.0	0.0066	40	8.4	2.7	460	700
	20-Aug	Mid 17		<2.0	0.0053	30	8.19	3.3	610	930

	Date	Start/ Middle/ End	Total Discharge Volume (m^3)	Total Petroleum Hydrocarbons (mg/L)	Phenols (mg/L)	Chlorides (mg/L)	pH	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductivity (uS/cm)
Max Grab Sample Limit				5	0.14	<500	6.0-9.0			
	27-Aug	Mid 18		<2.0	<0.0015	10	8.12	31	180	280
	3-Sep	Mid 15	1368	<2.0	0.0100	8	8.08	38	170	270
	3-Sep	Mid 19		<2.0	0.0041	10	7.47	6	580	810
	10-Sep	Mid 20		<2.0	0.0054	27	8.21	2.7	600	910
	17-Sep	Mid 21		<2.0	0.0046	26	8.21	4	600	900
	24-Sep	Mid 22		<2.0	<0.0015	10	7.67	3.3	560	830
Refinery Tank Farm Ditch	13-May	Start	0	<2.0	0.0075	8.9	7.76	1.3	380	580
	22-May	End		<2.0	0.0130	22.0	7.81	15.0	600	900
Refinery Waterflood	22-May	Start	0	<2.0	0.0041	27.0	8.3	2.0	460	840
	29-May	Mid 1		<2.0	0.0038	28.0	8.44	1.3	510	870
	5-Jun	Mid 2		<2.0	0.0035	29	8.29	<1.0	540	960
	12-Jun	Mid 3		<2.0	0.0040	30	8.62	<1.0	530	920
	20-Jun	Mid 4		<2.0	0.0040	32	8.59	2	560	900
	25-Jun	Mid 5		<2.0	0.0019	31	8.64	<1.0	540	920
	2-Jul	Mid 6		<2.0	0.0051	33	8.36	48	580	920
	9-Jul	Mid 7		<2.0	0.00350	33	8.59	<1.0	550	940
	15-Jul	Mid 8		<2.0	0.0051	33	8.72	1.3	540	940
	23-Jul	Mid 9		<2.0	0.00210	33	8.72	1.3	530	940
	30-Jul	Mid 10		<2.0	0.00170	34	8.58	1.3	560	990
	6-Aug	Mid 11		<2.0	0.0060	35	8.33	1.3	470	740
	13-Aug	Mid 12		<2.0	0.0050	40	8.38	1.3	600	1000
	20-Aug	Mid 13		<2.0	0.0049	35	8.39	1.3	570	1000
	27-Aug	Mid 14		<2.0	0.0030	9	7.64	13	620	850

	Date	Start/ Middle/ End	Total Discharge Volume (m^3)	Total Petroleum Hydrocarbons (mg/L)	Phenols (mg/L)	Chlorides (mg/L)	pH	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductivity (uS/cm)
Max Grab Sample Limit				5	0.14	<500	6.0-9.0			
	10-Sep	Mid 16	0	<2.0	0.0043	35	8.55	2	570	1000
	17-Sep	Mid 17		<2.0	0.0043	33	8.34	18	620	1000
	24-Sep	Mid 18		<2.0	<0.0015	10	7.69	4.7	570	820
Misc. Mainland Impound Areas										
CPF Impound Basin	9-Jul	End	0	<2.0	0.0045	9.5	7.59	13	1300	1500
RKT 105-112	13-Aug	Mid 12	0	<2.0	0.013	3.6	7.88	29	390	600
	20-Aug	Mid 3		<2.0	0.0034	15	7.80	7.3	390	660
RTK 109-111	12-Jul	Start	0	<2.0	0.011	8.6	8.32	2.7	460	480
RTK 116 - 118	12-Jul	Start	0	<2.0	0.0058	13	7.88	2	340	520
RTK 119	12-Jul	Start	0	<2.0	0.0059	2	8.2	2	280	380
Tank 105-112	6-Aug	Mid 1	0	<2.0	0.0064	42	8.45	1.3	600	1000
	27-Aug	End		<2.0	0.0031	34	8.49	1.3	590	1000
	30-Jul	Start		<2.0	0.0015	12	8.18	<1.0	390	640

Appendix C SNP – Groundwater



2019 Groundwater Quality Monitoring Program

Norman Wells, NT

Imperial

17 December 2019

407011-00440-400

Advisian
Worley Group

advisian.com

THIS REPORT CONTAINS PROVISIONS LIMITING LIABILITY, THE SCOPE OF THE REPORT AND THIRD-PARTY RELIANCE

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Table 1 Monitoring Well Installation Details: Datum/Groundwater Surface Elevations and Hydraulic Conductivities

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Appendix A **Limitation of Liability, Scope of Report, and Third-Party Reliance**

Appendix B **Background Geochemical Statistical Summary**

Appendix C **Field Methodologies**

Appendix D **Laboratory Analytical Reports**

Appendix E **Quality Assurance/Quality Control**

Appendix F **Mann–Kendall Statistical Analyses**

1 Introduction

The Imperial Oil Resources N.W.T. Limited (Imperial) Norman Wells Operation is an upstream oil and gas field located 700 km northwest of Yellowknife, Northwest Territories (Latitude 65° 17′ N, Longitude 126°51 W; the "Site"). Operations include a Central Processing Facility (CPF) on the northeastern shore of the Mackenzie River which receives production from wells on the mainland, three natural islands (Goose Island, Bear Island and Frenchy's Island) and six artificial islands (Figure 1). Work was conducted for Imperial under Imperial Oil Limited Contract A2275233.

Limitations of Liability, Scope of Report and Third-Party Reliance for this report are provided in Appendix A.

1.1 Background

The Norman Wells Operations Groundwater Management Plan (GMP) was created in September 2014 as part of Imperial's Water License Renewal Application submitted to the Sahtu Land and Water Board (Imperial 2014). A key component of the GMP is the sampling of a select subset of existing groundwater monitoring wells installed at strategic locations between operating facilities and potential receptors across the Site, referred to as the Groundwater Surveillance Network Program (SNP). These wells are sampled twice annually in accordance with the GMP, in order to provide ongoing monitoring of groundwater conditions adjacent to Site activities. The goal of the SNP is to identify existing groundwater quality issues and to provide early detection of groundwater changes across the Site.

2 Scope of Work

Worley Canada Services Ltd., operating as Advisian, was retained by Imperial to conduct groundwater monitoring and sampling activities for the established surveillance network. The scope of work for the 2019 groundwater monitoring program at the Site included the following:

- Check monitoring well integrity and measure static groundwater levels of 17 groundwater monitoring wells;
- Collect groundwater samples for laboratory analysis of dissolved chloride and benzene, toluene, ethylbenzene and total xylenes (BTEX), as well as petroleum hydrocarbon fractions F1 and F2, and select metals and major ions as per the GMP; and
- Provide a summary report presenting the results of the 2019 groundwater sampling program.

The GMP lists chloride, benzene, toluene, and ethylbenzene as the primary indicator parameters. Due to established laboratory analytical packages, additional analyses were also completed. The scope of this report is to review the primary indicator parameters per the GMP.

3 Environmental Assessment Guidelines

At present, no specific groundwater quality guidelines exist for the Northwest Territories. As a conservative measure, groundwater quality assessment parameters in this report are compared to the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for the Protection of Freshwater Aquatic Life (FWAL; CCME 2018), as surface water bodies (e.g. Bosworth Creek and the Mackenzie River) are potential receptors of groundwater in most areas of interest for this program.

Background concentrations of key geochemical parameters were calculated in 2018 for different geographical areas and geological units using data collected primarily between 1998 and 2016 (Appendix B). Background groundwater geochemical parameters were characterized throughout the Site, based on the hydrogeological zone where the monitoring well is completed, as well as evidence for the presence or absence of natural crude oil and saline water seepage in the vicinity. Relevant background concentrations are also provided in the analytical tables for comparison to the collected data.

It should be emphasized that the aforementioned guidelines are used for comparative purposes only in the context of this report.

4 Groundwater Monitoring Network

Twelve monitoring wells and three contingency wells make up the SNP per Imperial's Water Licence S13L1-007. These wells were selected based on proximity to operating facilities and potential receptors, historical groundwater quality, well completion information, and overall Site coverage. The contingency wells serve as replacement sampling locations in the event that a primary SNP monitoring well is dry, damaged, frozen, or otherwise cannot produce water during a scheduled sampling event.

The main receptors identified during the development of the SNP were the Mackenzie River, Bosworth Creek, and the Town of Norman Wells. A summary of the selected monitoring wells is provided below as Table A.

Table A SNP Monitoring Locations

Monitoring Well	Location	Rationale for Selection
CPF 97-7-5	Mainland West	Situated between CPF and Bosworth Creek
CPF 98-8-3	Mainland West	Situated between CPF and Mackenzie River
WSY 97-1-5	Mainland East	Situated between Well Services Yard and Bosworth Creek
ARB-12-3-3	Mainland East	Adjacent Biocell 1
C38 08-1-4	Mainland East	Situated between known historical well issues (C-36X) and Mackenzie River
TF 03-12-3	Mainland East	Situated between Tank Farm and Mackenzie River; downgradient of known hydrocarbon source
MTF 97-1-5	Mainland East	Situated between Tank Farm and Town of Norman Wells
BIS 97-1-3	Bear Island	Situated between Bear Island Sump #5 and the Mackenzie River
BI-13-3-4.5	Bear Island	Situated near Bear Island Sump #6 and the Mackenzie River
BIBG-12-1-7	Bear Island	Situated at western edge of development on Bear Island, near Mackenzie River
GIBG-10-2-3	Goose Island	Situated between well pads and Mackenzie River
GIQ8-10-2-4	Goose Island	Situated between fuel storage/handling area and the Mackenzie River
Contingency Wells*		
MEBG-10-1-3	Mainland East	Situated between Mainland Sumps and Mackenzie River

Monitoring Well	Location	Rationale for Selection
GIP11 09-1-4	Goose Island	Situated between a sump and the Mackenzie River – well was abandoned in 2018 and reinstalled as GIP11 09-1-4-R
GIP11 09-1-4-R	Goose Island	Reinstallation of destroyed well GIP11 09-1-4
BI-13-1-4	Bear Island	Situated near Bear Island Sump #6 and the Mackenzie River
Spatial Coverage Well**		
BIBG-10-1-4	Bear Island	Situated at western edge of Bear Island, south of the Mackenzie River – meant to replace damaged SNP well BIBG-12-1-7

* Wells serve as contingency monitoring locations in the event that a sample cannot be collected from all primary SNP locations.
** Wells not specified as primary or contingency SNP monitoring locations but included in this report to provide spatial coverage near the location of the damaged primary SNP well.

In 2018, GIP11 09-1-4 was abandoned and reinstalled as GIP11 09-1-4-R in the same location at the same depth, as the original well was damaged and could not be sampled. In 2019, BIBG-10-1-4 was sampled instead of the primary SNP well BIBG-12-1-7, which was damaged and could not be sampled. Historical data for GIP11 09-1-4 and BIBG-12-1-7 have been included in the report for comparison purposes.

5 Sampling and Methodology

5.1 Field Methodology

The SNP groundwater monitoring was conducted by Advisian personnel in June/July and September/October 2019.

Groundwater samples were collected using HydraSleeves™, dedicated Waterra™ tubing, or dedicated/disposable bailers following no-purge methodology. A total of 42 samples, including 29 groundwater samples, 5 field duplicate samples, 4 field blank samples and 4 trip blank samples, were collected in pre-cleaned laboratory-provided bottles as part of the SNP. Results were compared to the CCME FWAL guidelines, background chemistry, and historical records, as applicable.

All groundwater samples were submitted for laboratory analysis at an accredited third-party laboratory in Edmonton (Bureau Veritas, formerly Maxxam Analytics) in accordance with standard packaging, preservation, and chain-of-custody (COC) procedures.

The methodology for collecting groundwater samples is summarized in Appendix C and laboratory analytical reports are provided in Appendix D.

5.2 Statistical Analyses

5.2.1 Shewhart–Cumulative Sum Trend Analyses

Combined Shewhart–Cumulative Sum (CUSUM) control charts provide a common means of statistical trend evaluation in many environmental monitoring programs and are in fact the only statistical procedure that is directly recommended for use in intra-well monitoring by the United States Environmental Protection Agency (U.S. EPA 1989, 1992). The Shewhart control chart is designed to detect an immediate increase over the background distribution for a particular monitoring constituent, whereas the CUSUM control chart is designed to detect more gradual increases over background (Gibbons 1999).

5.2.2 Mann–Kendall Statistical Analyses

The non-parametric Mann–Kendall test for trend can be used in combination with a modified version of Sen's non-parametric slope estimator (Gibbons 1994). In both tests, four or more points of data are placed in chronological order, and the sign of the differences between all forward combinations of data pairs are used to compute the Mann–Kendall statistic (S). The Mann–Kendall statistic (S), along with the number of the data points (n), is used for the normal approximation test, and the results yield a probability from 0 to 1.

Sen's slope is used to provide an approximate magnitude of change on trend lines. Sen's slope is calculated by evaluating the slope between all forward combinations of data pairs. The slopes are then ranked, and the median slope value is selected. Unlike least squares regression, the Sen's slope is not greatly affected by gross outliers, which are occasionally encountered in groundwater chemistry data.

Slopes are presented in absolute terms [milligrams per litre (mg/L) per year] and/or normalized relative to the median concentration (% change per year).

In each case, trend analyses are conducted using the available data series collected following installation of the monitoring wells. The Mann–Kendall statistics are evaluated only on datasets where at least four data points exist. It is important to note that some parameters returned "below detection" results for part or all of the location's sampling history.

To indicate potentially significant temporal trends, results are screened according to three criteria:

- the probability of a trend;
- slope (e.g. in mg/L per year); and
- normalized slope (in % per year).

Location-specific discussions of statistical trend details and results are provided in Section 6.3.

6 Results and Interpretation

Water samples were collected in the summer and fall from all sampling locations, except for GIP11 09-1-4, BIBG-12-1-7, and BI-13-3-4.5 (fall). Well GIP11 09-1-4 was observed to be damaged in 2016 and was abandoned/reinstalled as GIP11 09-1-4-R in 2018. Well BIBG-12-1-7 was observed to be damaged in 2015. Samples were collected from nearby monitoring well BIBG-10-1-4 for the purposes of maintaining adequate spatial coverage. A sample was not collected from BI-13-3-4.5 in September 2019, as the well was observed to be damaged.

6.1 Site Hydrogeology

Monitoring well datum and groundwater surface elevations are presented in Table 1 and Figures 2A/B to 3A/B. Elevations are provided in metres above sea level (masl).

6.1.1 Mainland

Groundwater surface elevations do not indicate a consistent groundwater flow direction for the Mainland area. This is due, in part, to wide spatial distribution of SNP monitoring wells, and to the presence of discontinuous permafrost beneath the Site. Ice lenses in the subsurface act as barriers to groundwater movement, due to the comparatively low hydraulic conductivity associated with frozen soil. As a result, groundwater flow conditions beneath the Site are complex, and small-scale local variations are inferred to be present in many areas.

Generally speaking, groundwater is inferred to flow predominantly towards the Mackenzie River, with localized flow towards Bosworth Creek. More extensive monitoring events at the Site confirm this interpretation (Advisian 2019).

Groundwater surface elevations ranged from 56.88 to 63.60 masl in June/July (Figure 2A) and from 56.79 to 63.49 masl in September/October (Figure 2B). In general, hydraulic head is higher towards the north end of the Site and decreases with proximity to the Mackenzie River following local topography.

6.1.2 Bear Island and Goose Island

Generally, groundwater surface elevations on Bear Island and Goose Island mimic the surface topography, with local flow directions inferred to be from high ground towards the closest surface water body. In most cases, the closest water body is the Mackenzie River; however, a number of unnamed surface water bodies also exist on both Islands (Figure 1).

Groundwater surface elevations on Bear Island ranged from 47.95 to 50.24 masl in July (Figure 3A) and from 48.65 to 50.22 masl in September/October (Figure 3B).

Groundwater surface elevations on Goose Island ranged from 41.84 to 45.09 masl in July (Figure 3A) and from 41.74 to 45.12 masl in September/October (Figure 3B).

6.2 Groundwater Analytical Results

Current groundwater chemistry data for primary indicator parameters including chloride, benzene, toluene and ethylbenzene are presented in Tables 2 and 3. Analytical exceedances, as compared to the CCME FWAL guidelines and background chemistry, are presented in Figures 4A/B and 5A/B.

The 2019 laboratory analytical reports, including both primary indicator parameters and other associated chemistry data, are compiled in Appendix D. A description and summary of the quality assurance and quality control program is provided in Appendix E.

The background geochemistry for the Norman Wells field was revised in 2018 (Appendix B). Estimated natural background geochemistry for shallow groundwater has been included for comparison purposes in Tables 2 and 3. These background values are referred to periodically in the discussion below.

6.2.1 Chloride

Eight monitoring wells (ARB-12-3-3, C38 08-1-4, CPF 97-7-5, TF 03-12-3, WSY 97-1-5, BIBG-10-1-4, BIS 97-1-3, and GIQ8-10-2-4) had dissolved chloride concentrations below the CCME FWAL guideline but above the calculated background concentrations for Mainland or Island surficial sediments during one or both monitoring events in 2019 (Table 2).

All remaining 2019 analytical results were below both the CCME FWAL guideline and the calculated background concentrations for Mainland and Island surficial sediments (Figures 4A/B and Table 2).

6.2.2 Petroleum Hydrocarbon Parameters

All petroleum hydrocarbon parameter concentrations were below the applied guidelines and reported detection limits (RDLs), with the exception of below-guideline detections of benzene at C38 08-1-4 in July 2019 (Figures 5A/B and Table 3). Benzene was detected in both the original and duplicate samples at concentrations less than 5x the RDL. This was the first time that PHCs have been detected at this location, and the reported result from the subsequent sampling event in September 2019 was below the RDL.

6.3 Mann–Kendall Statistical Analyses

Mann–Kendall statistical analyses have been performed for all Indicator parameters having both an applied CCME FWAL guideline and four or more historical data points.

Locations were identified as exhibiting statistically-notable trends if the following criteria were met:

- >95% probability of occurrence (two-sided p-value <0.05); and
- Significant rate of change (normalized slope > ±10% per year).

A decreasing trend indicates that concentrations are decreasing over time, while an increasing trend indicates that concentrations are increasing over time. Statistical analyses, trend charts, and a summary table are presented in Appendix F, and relevant trends are summarized in Table B.

Table B Statistically-Notable Groundwater Hydrochemical Trends

Monitoring Location	Parameter	Trend	N*	Discussion
MEBG-10-1-3	Chloride	↓	15	Most recent analytical result was below the applied guideline and background concentrations.
BIBG-10-1-4	Chloride	↑	12	Most recent analytical result was below the applied guideline, above background concentrations, but within the historical range observed at this location.

Note: N = Number of supporting data points in historical dataset.

7 Field and Laboratory Quality Assurance/Quality Control

A quality assurance/quality control (QA/QC) program was followed to manage and quantify the quality of the investigation results. The program included field procedures, laboratory procedures and the use of QC samples to quantify the results of the program.

Field QC sampling included five duplicate samples, four groundwater field blank samples, and four groundwater trip blank samples.

The laboratory QA/QC analyses are provided in the laboratory certificates of analysis, presented in Appendix D. The laboratory QA/QC program included calibration checks, surrogate matrix spikes, blanks and laboratory duplicates during analyses. Any data quality issues are discussed in the laboratory data checklists provided in Appendix D.

The results of the field QA/QC sample analyses are presented in Appendix E. All field and trip blank results were below the laboratory RDLs (Table D-1).

Based on the QA/QC analyses, the data are considered fit for the purpose of this report.

8 Summary

Groundwater quality monitoring for the SNP was completed in June/July and September/October 2019. Activities included measurement of hydraulic head and collection of groundwater samples for laboratory analyses including primary indicator parameters (dissolved chloride, benzene, toluene and ethylbenzene). A summary of the general conclusions from the 2019 sampling program is as follows:

- Due to the areal variability of permafrost presence across the Site and the wide spatial distribution of SNP wells, groundwater surface elevations from the SNP well network alone are insufficient to interpret a consistent flow direction. Based on more extensive monitoring programs at the Site, groundwater on the Mainland is generally inferred to flow predominantly towards the Mackenzie River, with localized flow towards Bosworth Creek. Groundwater surface elevations on Bear and Goose Island reflect the surface topography, with local flow directions inferred to be from high ground towards the closest surface water body;
- Dissolved chloride concentrations were below the applied CCME FWAL guideline at all monitoring locations, and exceeded the expected background concentrations at eight locations;
- All analyzed petroleum hydrocarbon parameters results were below the applied guidelines and background concentrations. Most were also below reportable detection limits, with the exception of benzene detected at one monitoring well in July 2019;
- Mann–Kendall trend analyses indicated one statistically-significant decreasing trend (dissolved chloride at MEBG-10-1-3) and one statistically-significant increasing trend (dissolved chloride at BIBG-10-1-4). The chloride concentrations at BIBG-10-1-4 in 2019 were within the historical range observed at this location; and,
- BI-13-3-4.5 is a primary SNP location that is damaged, per the terms of the SNP/GMP, the location must be replaced, or a suitable adjacent location be used to maintain coverage.

9 Closure

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned at any time.

Report Prepared by:

Rebecca Reader, B.Sc., P.Geo.
Environmental Geologist

Senior Review by:

REGISTERED PROFESSIONAL GEOLOGIST
M.J. BROWN
LICENSEE
NWT/NU

Dec. 17/2019

Michael Brown, M.Sc., P.Geol.
Principal Hydrogeologist

Lorian Glatiotis, B.Sc., P.Geo.
Hydrogeologist

PERMIT TO PRACTICE
WORLEYPARSONS CANADA SERVICES LTD.
Signature
Date Dec. 17/2019
PERMIT NUMBER: P 029
NWT/NU Association of Professional Engineers and Geoscientists

10 References

Advisian 2019. Draft 2019 Groundwater and Surface Water Quality Monitoring Report – E&PS Areas – Norman Wells, NT. Prepared for Imperial. December 2019.

CCME (Canadian Council of Ministers of the Environment) 2018. Canadian Environmental Quality Guidelines – Water Quality Guidelines for the Protection of Freshwater Aquatic Life. Canadian Council of Ministers of the Environment. September 2018.

Gibbons, R.D. 1994. Statistical Methods for Groundwater Monitoring. Wiley Interscience. pp. 286.

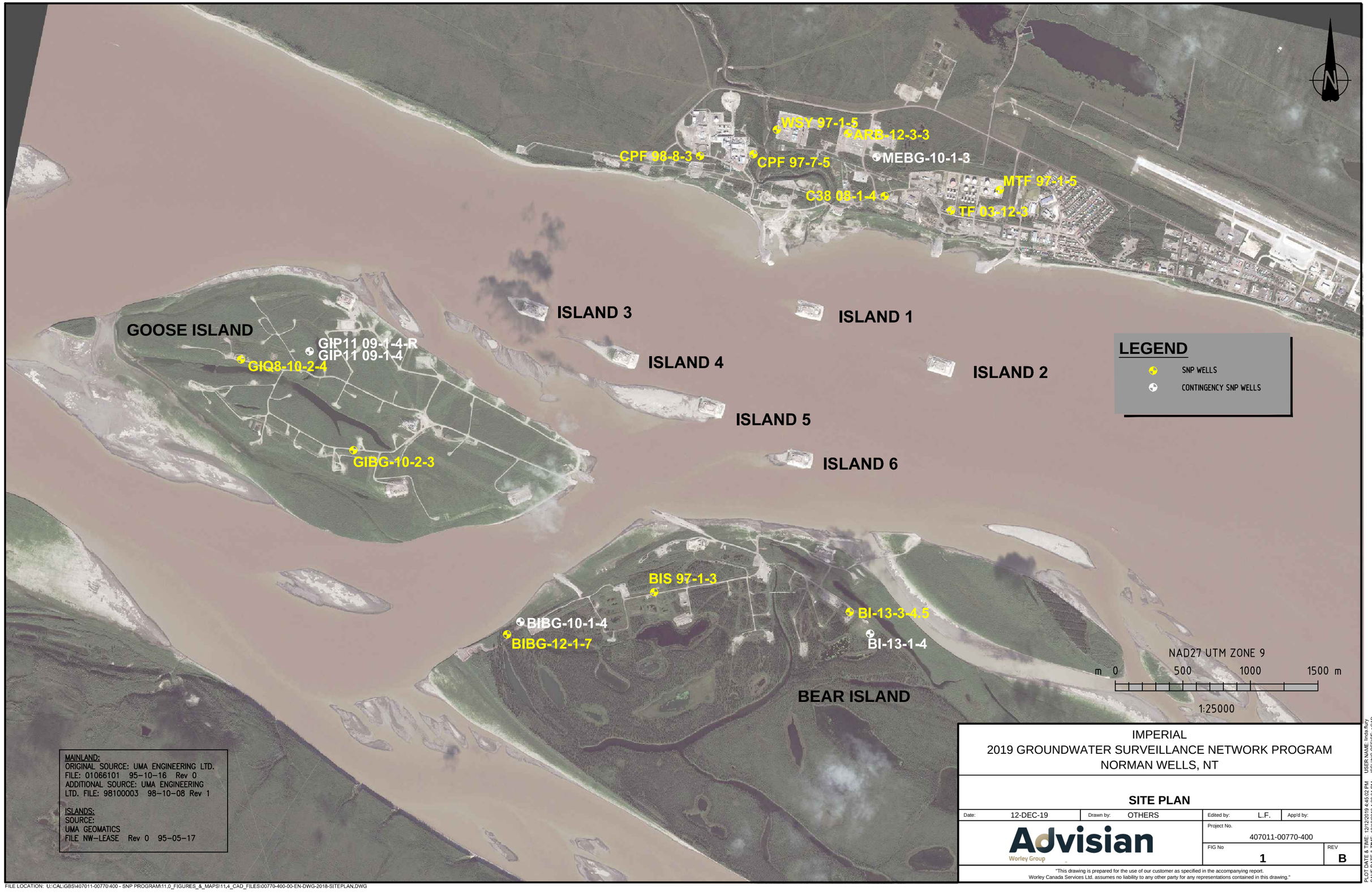
Gibbons, R.D. 1999. Use of Combined Shewhart-CUSUM Control Charts for Ground Water Monitoring Applications. Ground Water Journal, Vol. 37, No. 5, pp. 682-691. September-October 1999.

Imperial (Imperial Oil Resources) 2014. Norman Wells Operations Groundwater Management Plan. Report prepared for the Mackenzie Valley Land and Water Board. September 2014.

U.S. EPA (United States Environmental Protection Agency) 1989. Interim Final Guidance Document: Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities. April 1989.

U.S. EPA (United States Environmental Protection Agency) 1992. Addendum to Interim Final Guidance Document: Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities. July 1992.

Figures



MAINLAND:
ORIGINAL SOURCE: UMA ENGINEERING LTD.
FILE: 01066101 95-10-16 Rev 0
ADDITIONAL SOURCE: UMA ENGINEERING LTD. FILE: 98100003 98-10-08 Rev 1

ISLANDS:
SOURCE:
UMA GEOMATICS
FILE NW-LEASE Rev 0 95-05-17

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NORMAN WELLS, NT

SITE PLAN

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12-DEC-19	OTHERS	L.F.	

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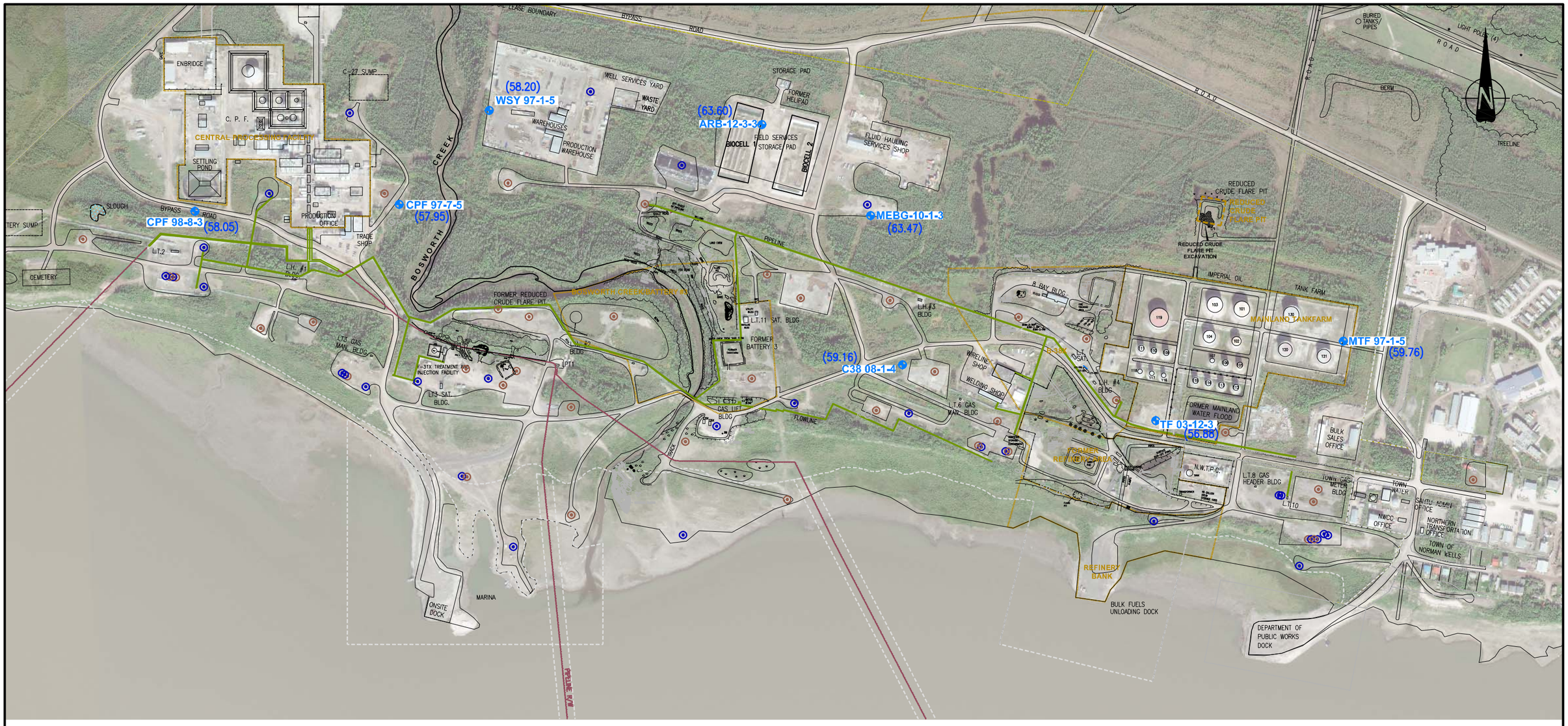
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FIG No 1 | REV B

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LEGEND

⊙	INJECTION WELL LOCATION	⊕	MONITORING WELL LOCATION
⊙	PRODUCTION WELL LOCATION	(63.60)	GROUNDWATER SURFACE ELEVATION (m.a.s.l.) (JUNE/JULY 2019)
-·-·-	ESSO LEASE BOUNDARY		
———	PIPELINES		
———	UTILIDOR LOCATION		

SOURCES:
1. SITE PLAN AS PER UMA ENGINEERING LTD. FILES 010166101 (REV 0 DATED 95-10-16) AND 98100003 (REV 1 DATED 98-10-08).
2. 2017 AERIAL PHOTOGRAPH FROM PLANT LABS GEOMATICS CORP. IMAGE DATE AUGUST 6 AND 30, 2017.

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NORMAN WELLS, NT

GROUNDWATER SURFACE ELEVATIONS - MAINLAND (JUNE/JULY 2019)

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12-DEC-19	OTHERS	L.F.	

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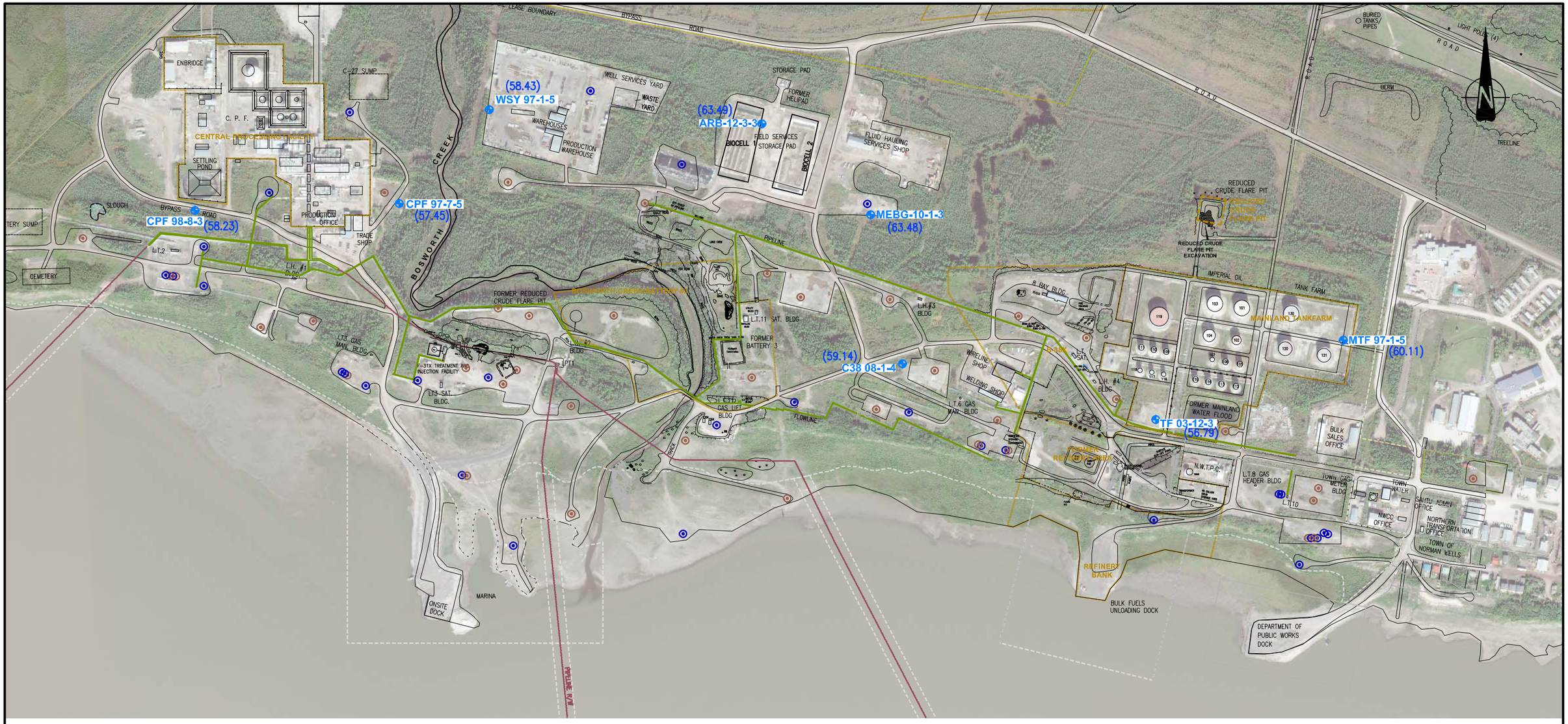
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FIG No 2A | REV B

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LEGEND

- INJECTION WELL LOCATION
- PRODUCTION WELL LOCATION
- ESSO LEASE BOUNDARY
- PIPELINES
- UTILIDOR LOCATION
- MONITORING WELL LOCATION
- (63.48) GROUNDWATER SURFACE ELEVATION (m.a.s.l.) (SEPTEMBER/OCTOBER 2019)

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GROUNDWATER SURFACE ELEVATIONS - MAINLAND (SEPTEMBER/OCTOBER 2019)

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FIG No 2B | REV B

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ISSUING OFFICE: CALGARY



LEGEND

◎	INJECTION WELL LOCATION	⊕	MONITORING WELL LOCATION
◎	PRODUCTION WELL LOCATION	⊗	DAMAGED/ABANDONED MONITORING WELL LOCATION
	ESSO LEASE BOUNDARY	(47.95)	GROUNDWATER SURFACE ELEVATION (m.a.s.l.) (JULY 2019)
	PIPELINES	(NM)	NOT MEASURED - WELL ABANDONED OR DAMAGED
	UTILIDOR LOCATION	(NA)	SURVEY DATA OR WATER LEVEL MEASUREMENT NOT AVAILABLE

SOURCES:
1. SITE PLAN AS PER UMA ENGINEERING LTD. FILES 010166101 (REV 0 DATED 95-10-16) AND 98100003 (REV 1 DATED 98-10-08).
2. 2017 AERIAL PHOTOGRAPH FROM PLANT LABS GEOMATICS CORP. IMAGE DATE AUGUST 6 AND 30, 2017.

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2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

**GROUNDWATER SURFACE ELEVATIONS -
GOOSE ISLAND AND BEAR ISLAND (JULY 2019)**

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Advisian Worley Group				Project No.	407011-00770-400		
				FIG No.	3A	REV	B

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ISSUING OFFICE: CALGARY



LEGEND

◎	INJECTION WELL LOCATION	⊕	MONITORING WELL LOCATION
◎	PRODUCTION WELL LOCATION	⊗	DAMAGED/ABANDONED MONITORING WELL LOCATION
	ESSO LEASE BOUNDARY	(45.12)	GROUNDWATER SURFACE ELEVATION (m.a.s.l.) (SEPTEMBER/OCTOBER 2019)
	PIPELINES	(NM)	NOT MEASURED - WELL ABANDONED OR DAMAGED
	UTILIDOR LOCATION	(NA)	SURVEY DATA NOT AVAILABLE

SOURCES:
1. SITE PLAN AS PER UMA ENGINEERING LTD. FILES 010166101 (REV 0 DATED 95-10-16) AND 98100003 (REV 1 DATED 98-10-08).
2. 2017 AERIAL PHOTOGRAPH FROM PLANT LABS GEOMATICS CORP. IMAGE DATE AUGUST 6 AND 30, 2017.

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2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

**GROUNDWATER SURFACE ELEVATIONS -
GOOSE ISLAND AND BEAR ISLAND (SEPTEMBER/OCTOBER 2019)**

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FIG No. 3B

REV B

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ARB-12-3-3
CPF 98-8-3
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MEBG-10-1-3
MTF 97-1-5
C38 08-1-4
TF 03-12-3
GIP11 09-1-4-R
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GIQ8-10-2-4
GIBG-10-2-3
BIS 97-1-3
BIBG-10-1-4
BIBG-12-1-7
BI-13-3-4.5
BI-13-1-4

LEGEND

- SNP WELLS
- CONTINGENCY SNP WELLS
- DAMAGED/ABANDONED MONITORING WELL LOCATION

ANALYTICAL RESULTS

- LOCATION WHERE GROUNDWATER SAMPLE LESS THAN OR EQUAL TO GUIDELINES AND/OR BACKGROUND CONCENTRATIONS FOR ALL PARAMETERS THAT WERE ANALYZED, SHOWN IN GREEN.
- LOCATION WHERE GROUNDWATER SAMPLE EXCEEDED GUIDELINES AND BACKGROUND CONCENTRATIONS FOR AT LEAST ONE PARAMETER THAT WAS ANALYZED, SHOWN IN RED
- LOCATION NOT SAMPLED IN SAMPLING EVENT

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ISLANDS:
SOURCE:
UMA GEOMATICS
FILE NW-LEASE Rev 0 95-05-17

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2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

GROUNDWATER ANALYTICAL RESULTS: DISSOLVED CHLORIDE (JUNE/JULY 2019)

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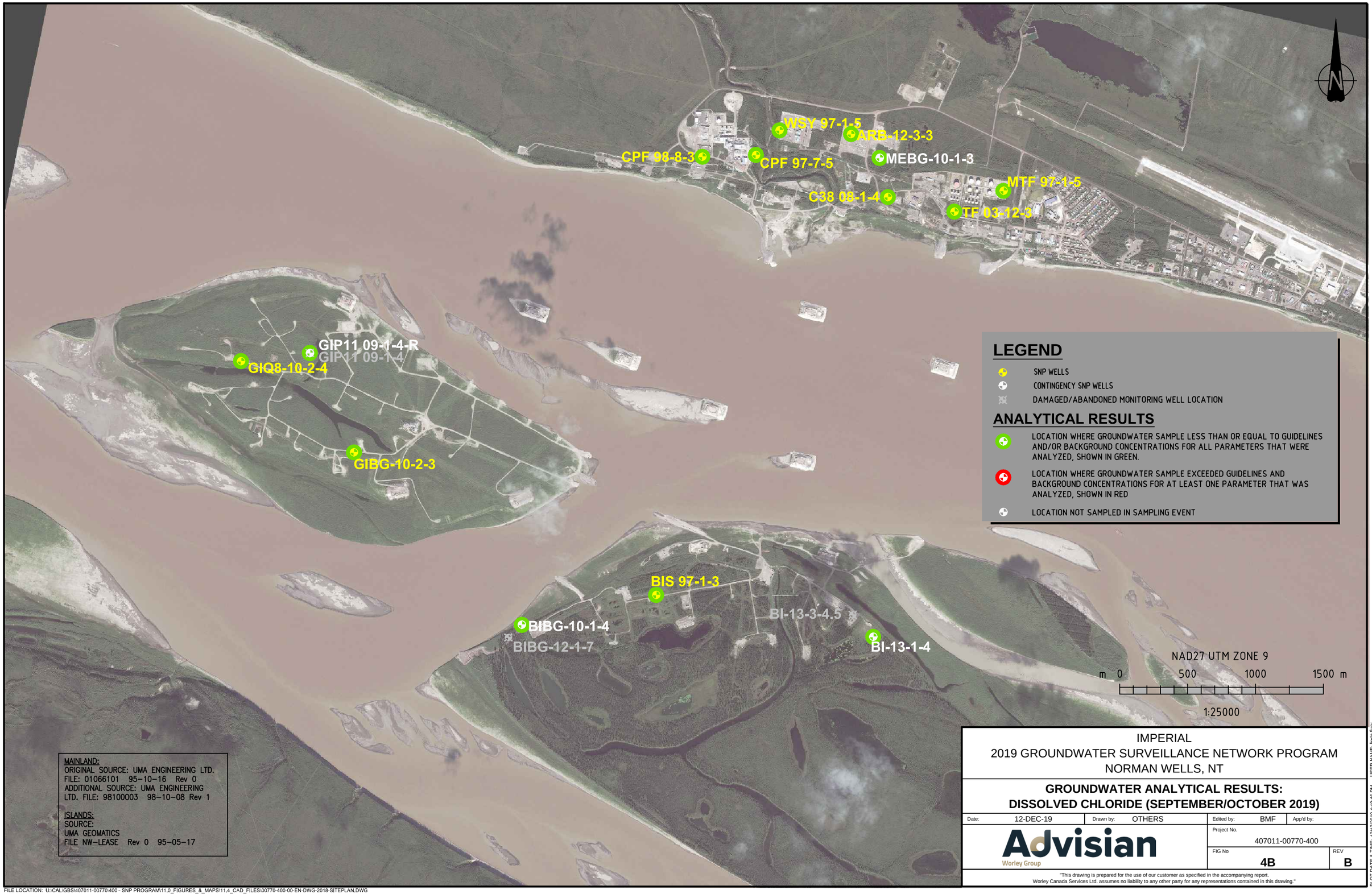
FIG No 4A

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LEGEND

- SNP WELLS
- CONTINGENCY SNP WELLS
- DAMAGED/ABANDONED MONITORING WELL LOCATION

ANALYTICAL RESULTS

- LOCATION WHERE GROUNDWATER SAMPLE LESS THAN OR EQUAL TO GUIDELINES AND/OR BACKGROUND CONCENTRATIONS FOR ALL PARAMETERS THAT WERE ANALYZED, SHOWN IN GREEN.
- LOCATION WHERE GROUNDWATER SAMPLE EXCEEDED GUIDELINES AND BACKGROUND CONCENTRATIONS FOR AT LEAST ONE PARAMETER THAT WAS ANALYZED, SHOWN IN RED
- LOCATION NOT SAMPLED IN SAMPLING EVENT

MAINLAND:
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UMA GEOMATICS
FILE NW-LEASE Rev 0 95-05-17

IMPERIAL
2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

GROUNDWATER ANALYTICAL RESULTS:
DISSOLVED CHLORIDE (SEPTEMBER/OCTOBER 2019)

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FIG No 4B | REV B

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ARB-12-3-3
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BIS 97-1-3
BIBG-10-1-4
BIBG-12-1-7
BI-13-3-4.5
BI-13-1-4

LEGEND

- SNP WELLS
- CONTINGENCY SNP WELLS
- DAMAGED/ABANDONED MONITORING WELL LOCATION

ANALYTICAL RESULTS

- LOCATION WHERE GROUNDWATER SAMPLE LESS THAN OR EQUAL TO GUIDELINES AND/OR BACKGROUND CONCENTRATIONS FOR ALL PARAMETERS THAT WERE ANALYZED, SHOWN IN GREEN.
- LOCATION WHERE GROUNDWATER SAMPLE EXCEEDED GUIDELINES AND BACKGROUND CONCENTRATIONS FOR AT LEAST ONE PARAMETER THAT WAS ANALYZED, SHOWN IN RED
- LOCATION NOT SAMPLED IN SAMPLING EVENT

NAD27 UTM ZONE 9

m 0 500 1000 1500 m

1:25000

MAINLAND:
ORIGINAL SOURCE: UMA ENGINEERING LTD.
FILE: 01066101 95-10-16 Rev 0
ADDITIONAL SOURCE: UMA ENGINEERING LTD. FILE: 98100003 98-10-08 Rev 1

ISLANDS:
SOURCE:
UMA GEOMATICS
FILE NW-LEASE Rev 0 95-05-17

IMPERIAL
2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

GROUNDWATER ANALYTICAL RESULTS:
PETROLEUM HYDROCARBON PARAMETERS (JUNE/JULY 2019)

Date:	Drawn by:	Edited by:	App'd by:
12-DEC-19	OTHERS	L.F.	

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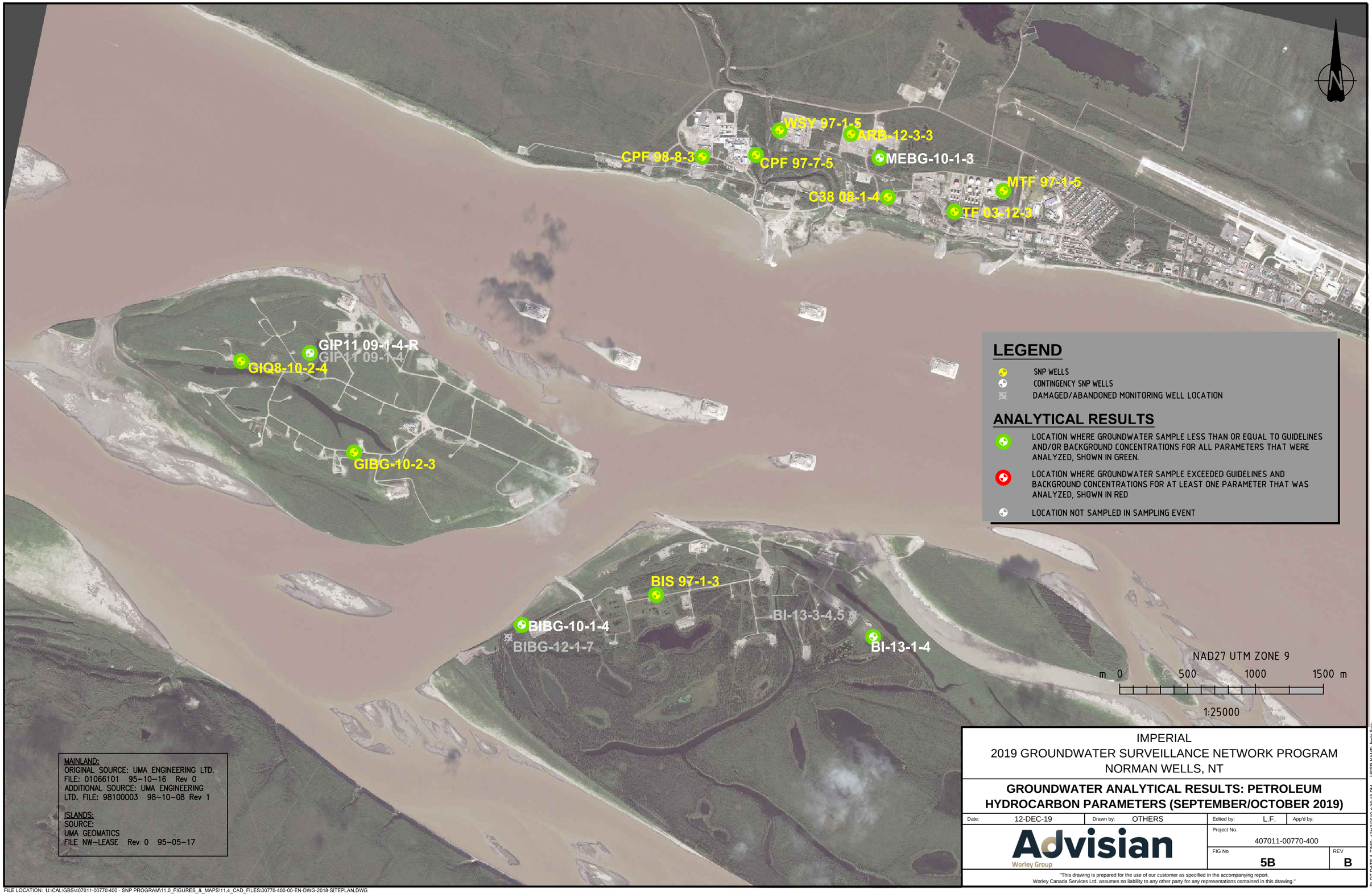
Project No. 407011-00770-400

FIG No 5A | REV B

"This drawing is prepared for the use of our customer as specified in the accompanying report. Worley Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

PLOT DATE & TIME: 12/12/2019 4:34:04 PM USER NAME: linda.flury
SAVE DATE & TIME: 12/12/2019 1:32:31 PM ISSUING OFFICE: eCAD

FILE LOCATION: U:\CAL\GBS\407011-00770\400 - SNP PROGRAM\11,0_FIGURES_&_MAPS\11,4_CAD_FILES\00770-400-00-EN-DWG-2018-SITEPLAN.DWG



LEGEND

- SNP WELLS
- CONTINGENCY SNP WELLS
- DAMAGED/ABANDONED MONITORING WELL LOCATION

ANALYTICAL RESULTS

- LOCATION WHERE GROUNDWATER SAMPLE LESS THAN OR EQUAL TO GUIDELINES AND/OR BACKGROUND CONCENTRATIONS FOR ALL PARAMETERS THAT WERE ANALYZED, SHOWN IN GREEN.
- LOCATION WHERE GROUNDWATER SAMPLE EXCEEDED GUIDELINES AND BACKGROUND CONCENTRATIONS FOR AT LEAST ONE PARAMETER THAT WAS ANALYZED, SHOWN IN RED
- LOCATION NOT SAMPLED IN SAMPLING EVENT

MAINLAND:
ORIGINAL SOURCE: UMA ENGINEERING LTD.
FILE: 01066101 95-10-16 Rev 0
ADDITIONAL SOURCE: UMA ENGINEERING LTD. FILE: 98100003 98-10-08 Rev 1

ISLANDS:
SOURCE:
UMA GEOMATICS
FILE NW-LEASE Rev 0 95-05-17

IMPERIAL
2019 GROUNDWATER SURVEILLANCE NETWORK PROGRAM
NORMAN WELLS, NT

GROUNDWATER ANALYTICAL RESULTS: PETROLEUM HYDROCARBON PARAMETERS (SEPTEMBER/OCTOBER 2019)

Date:	Drawn by:	Edited by:	App'd by:
12-DEC-19	OTHERS	L.F.	

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Project No. 407011-00770-400

FIG No 5B

REV B

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PLOT DATE & TIME: 12/12/2019 4:36:18 PM USER NAME: lroste.fllory
SAVE DATE & TIME: 12/12/2019 1:32:31 PM ISSUING OFFICE: eCAD

FILE LOCATION: U:\CAL\GBS\407011-00770\400 - SNP PROGRAM\11,0_FIGURES_&_MAPS\11,4_CAD_FILES\00770-400-00-EN-DWG-2018-SITEPLAN.DWG

Tables

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Table 1

Monitoring Well Installation Details: Datum/Groundwater Surface Elevations and Hydraulic Conductivities

PROJECT No.: 407011-00770-400

Monitoring Station	Status	Background Category	Easting (m)	Northing (m)	Ground Elevation (masl)	Datum Elevation (masl)	Surveyed Stickup (m)	Total Depth of Piezometer (mbgs)	Bottom of Piezometer Elevation (masl)	Depth Interval of Screen (mbgs)	Depth Interval of Sand (mbgs)	Date (dd-mmm-yyyy)	Depth to Groundwater (mbtoc)	Depth to Groundwater (mbgs)	Groundwater Surface Elevation (masl)	Hydraulic Conductivity (m/s)	Lithology	Comments
Surveillance Netowrk Program - Mainland Locations																		
ARB-12-3-3	**Active**	**W-CAT-1**	599801.144	7242007.048	65.33	66.02	0.69	2.70	62.63	1.20 - 2.70	0.80 - 2.70	07-Aug-2015	2.79	2.10	63.23		Gravel fill/Sand/Peat	
												14-Sep-2015	2.57	1.88	63.45			
												05-Aug-2016	2.71	2.02	63.31			Replaced waterra with dedicated bailer
												02-Oct-2016	2.54	1.85	63.48			
												04-Nov-2016	2.79	2.10	63.23			
												12-Aug-2017	2.62	1.93	63.40			
												12-Sep-2017	2.45	1.76	63.57			
												11-Jul-2018	2.44	1.75	63.58			
												15-Sep-2018	2.48	1.79	63.54			
												11-Jul-2019	2.42	1.73	63.60			
												28-Sep-2019	2.53	1.84	63.49			
C38 08-1-4	**Active**	**W-CAT-1**	600072.804	7241542.767	60.48	61.23	0.75	3.80	56.68	1.80 - 3.80	1.50 - 3.80	06-Aug-2015	1.82	1.07	59.41	5.9e-006	Sandy silt/peat/silty clay	
												14-Sep-2015	1.65	0.90	59.58			
												05-Aug-2016	1.92	1.17	59.31			
												02-Oct-2016	1.83	1.08	59.40			
												04-Nov-2016	2.17	1.42	59.06			
												12-Aug-2017	1.97	1.22	59.26			Frost jacked
												12-Sep-2017	1.74	0.99	59.49			
												13-Jul-2018	1.90	1.15	59.33			
												15-Sep-2018	1.97	1.22	59.26			
												15-Jul-2019	2.07	1.32	59.16			
												28-Sep-2019	2.09	1.34	59.14			
CPF 97-7-5	**Active**	**W-CAT-1**	599100.347	7241852.827	58.64	59.49	0.84	4.90	53.87	N/A	1.20 - 4.90	07-Aug-2015	1.37	0.53	58.12	1.1e-008	Silt/siltstone	
												14-Sep-2015	1.42	0.58	58.07			
												06-Aug-2016	1.35	0.51	58.14			Replaced lock
												02-Oct-2016	1.76	0.92	57.73			
												04-Nov-2016	4.71	3.87	54.78			
												17-Aug-2017	1.25	0.41	58.24			
												12-Sep-2017	1.39	0.55	58.10			
												20-Jul-2018	1.43	0.59	58.06			
												15-Sep-2018	1.56	0.72	57.93			
												11-Jul-2019	> 5.88	> 5.04	< 53.61			dry
												26-Jul-2019	1.54	0.70	57.95			
												28-Sep-2019	2.04	1.20	57.45			
CPF 98-8-3	**Active**	**W-CAT-1**	598705.553	7241839.552	58.79	59.54	0.75	2.70	55.95	1.40 - 2.90	0.80 - 2.90	07-Aug-2015	1.39	0.64	58.15	1.7e-006	Clay silt	
												14-Sep-2015	1.27	0.52	58.27			
												06-Aug-2016	1.72	0.97	57.82			
												02-Oct-2016	1.35	0.60	58.19			
												04-Nov-2016	1.89	1.14	57.65			
												17-Aug-2017	1.66	0.91	57.88			
												12-Sep-2017	1.31	0.56	58.23			
												22-Jul-2018	1.53	0.78	58.01			
												16-Sep-2018	1.31	0.56	58.23			
												11-Jul-2019	1.49	0.74	58.05			limited sample
												28-Sep-2019	1.31	0.56	58.23			
MEBG-10-1-3	**Active**	**W-CAT-2**	600011.383	7241831.078	63.73	64.47	0.75	3.00	60.73	1.50 - 3.00	1.00 - 3.00	06-Aug-2015	0.89	0.14	63.58	9.012e-007	Silty Sand / Clayey Silt	
												14-Sep-2015	0.88	0.13	63.59			
												03-Aug-2016	1.00	0.25	63.47			Clear
												02-Oct-2016	0.96	0.21	63.51			
												04-Nov-2016	1.10	0.35	63.37			
												12-Aug-2017	1.02	0.27	63.45			
												12-Sep-2017	0.92	0.17	63.55			
												16-Jul-2018	0.96	0.21	63.51			
												15-Sep-2018	0.93	0.18	63.54			
												15-Jul-2019	1.00	0.25	63.47			
												04-Oct-2019	0.99	0.24	63.48			

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Table 1

Monitoring Well Installation Details: Datum/Groundwater Surface Elevations and Hydraulic Conductivities

PROJECT No.: 407011-00770-400

Monitoring Station	Status	Background Category	Easting (m)	Northing (m)	Ground Elevation (masl)	Datum Elevation (masl)	Surveyed Stickup (m)	Total Depth of Piezometer (mbgs)	Bottom of Piezometer Elevation (masl)	Depth Interval of Screen (mbgs)	Depth Interval of Sand (mbgs)	Date (dd-mmm-yyyy)	Depth to Groundwater (mbtoc)	Depth to Groundwater (mbgs)	Groundwater Surface Elevation (masl)	Hydraulic Conductivity (m/s)	Lithology	Comments
MTF 97-1-5	**Active**	**W-CAT-1**	600924.768	7241588.497	63.49	64.39	0.91	4.70	58.76	1.70 - 4.70	1.10 - 4.70	08-Aug-2015	4.21	3.30	60.18	>1.0E-05	Silt	
												15-Sep-2015	4.04	3.13	60.35			
												02-Oct-2016	4.36	3.45	60.03			
												04-Nov-2016	> 5.61	> 4.70	< 58.79			Dry
												17-Aug-2017	4.30	3.39	60.09			
												14-Sep-2017	4.13	3.22	60.26			
												16-Jul-2018	4.25	3.34	60.14			
												16-Sep-2018	4.14	3.24	60.25			
												18-Jun-2019	4.63	3.72	59.76			
												28-Sep-2019	4.28	3.37	60.11			
TF 03-12-3	**Active**	**W-CAT-1**	600562.552	7241435.321	57.08	58.63	1.55	2.80	54.28	1.00 - 2.80	0.90 - 2.90	08-Aug-2015	1.74	0.19	56.89	>1.0E-05	Silty clay and shale fill	Frost jacked 15cm
												15-Sep-2015	1.74	0.19	56.89			
												06-Aug-2016	1.78	0.23	56.85			Frost jacked
												02-Oct-2016	1.78	0.23	56.85			
												04-Nov-2016	1.87	0.32	56.76			
												17-Aug-2017	1.72	0.17	56.91			
												13-Sep-2017	1.73	0.18	56.90			
												16-Jul-2018	1.82	0.27	56.81			
												16-Sep-2018	1.77	0.22	56.86			
												18-Jun-2019	1.75	0.20	56.88			
												28-Sep-2019	1.84	0.29	56.79			
WSY 97-1-5	**Active**	**W-CAT-1**	599274.168	7242034.279	62.61	63.40	0.79	4.70	57.96	1.70 - 4.70	1.10 - 4.70	06-Aug-2015	4.26	3.47	59.14	1.7e-007	Silt	Frost jacked, cannot close red casing
												14-Sep-2015	4.12	3.33	59.28			
												05-Aug-2016	5.24	4.45	58.16			Well bent downhole, hard to get bailer down
												02-Oct-2016	4.15	3.36	59.25			
												04-Nov-2016	5.48	4.69	57.92			
												18-Aug-2017	2.69	1.90	60.71			
												12-Sep-2017	2.86	2.07	60.54			
												11-Jul-2018	5.15	4.36	58.25			
												18-Sep-2018	4.32	3.53	59.08			
												15-Jul-2019	5.20	4.41	58.20			clear
												28-Sep-2019	4.97	4.18	58.43			
Surveillance Netowrk Program - Bear Island Locations																		
BI-13-1-4	**Active**	**W-CAT-2**	599964.584	7238301.752	49.70	49.70	0.00	N/A	N/A	1.30 - 4.30	1.00 - 4.60	07-Aug-2015	1.02	1.02	48.68	2.60E-06		
												07-Aug-2016	1.13	1.13	48.57			
												15-Aug-2017	1.30	1.30	48.40			
												22-Nov-2017	1.89	1.89	47.81			
												18-Jul-2018	1.08	1.08	48.62			casing loose
												20-Sep-2018	1.00	1.00	48.70			
												12-Jul-2019	1.15	1.15	48.55			potential blockage or bailer at bottom. limited sample.
												29-Sep-2019	1.05	1.05	48.65			
BI-13-3-4.5	**Active**	**W-CAT-2**	599813.864	7238463.124	50.62	51.57	0.95	N/A	N/A	1.50 - 4.50	1.20 - 4.80	07-Aug-2015	1.65	0.70	49.92	1.40E-06		
												08-Aug-2016	1.74	0.79	49.83			
												15-Aug-2017	1.81	0.86	49.76			
												22-Nov-2017	N/M	N/M	N/A			Frozen @ 0.99m
												18-Jul-2018	1.67	0.72	49.90			
												20-Sep-2018	1.69	0.74	49.88			
												12-Jul-2019	N/M	N/M	N/A			
												29-Sep-2019	N/M	N/M	N/A			Damaged - no sample
BIBG-10-1-4	**Active**	**W-CAT-2**	597436.110	7238366.063	50.11	50.89	0.78	4.10	46.01	1.10 - 4.10	0.78 - 4.10	09-Aug-2015	1.22	0.44	49.67	1.90E-06	Silty Clay / Sand	
												08-Aug-2016	1.87	1.09	49.02			
												11-Aug-2017	3.57	2.79	47.32			
												17-Jul-2018	3.39	2.61	47.50			
												20-Sep-2018	1.63	0.85	49.26			
												17-Jul-2019	2.94	2.16	47.95			
												29-Sep-2019	1.96	1.18	48.93			

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Table 1

Monitoring Well Installation Details: Datum/Groundwater Surface Elevations and Hydraulic Conductivities

PROJECT No.: 407011-00770-400

Monitoring Station	Status	Background Category	Easting (m)	Northing (m)	Ground Elevation (masl)	Datum Elevation (masl)	Surveyed Stickup (m)	Total Depth of Piezometer (mbgs)	Bottom of Piezometer Elevation (masl)	Depth Interval of Screen (mbgs)	Depth Interval of Sand (mbgs)	Date (dd-mmm-yyyy)	Depth to Groundwater (mbtoc)	Depth to Groundwater (mbgs)	Groundwater Surface Elevation (masl)	Hydraulic Conductivity (m/s)	Lithology	Comments
BIBG-12-1-7	**Active**	**W-CAT-2**	597275.824	7238297.135	49.40	50.20	0.80	7.50	41.90	4.20 - 7.20	3.80 - 7.50	09-Aug-2015	1.20	0.40	49.00		Silty Sand/Sandy Silt	
												17-Sep-2015	N/M	N/M	N/A			Blocked at approximately 1.5 mbtoc. Bentonite on water level probe.
												07-Aug-2016	1.35	0.55	48.85			Bentonite on WL tape and bailer when sampling. Well appears broken downhole.
												02-Oct-2016	N/M	N/M	N/A			WELL NOT ACCESSIBLE. Well previously noted as damaged
												04-Nov-2016	1.83	1.03	48.37			
												15-Aug-2017	> 1.31	> 0.51	< 48.89			Dry, Compromised, bentonite on water level tape
BIS 97-1-3	**Active**	**W-CAT-2**	598365.067	7238610.352	51.00	51.93	0.93	2.60	48.47	N/A	0.60 - 2.60	22-Nov-2017	1.82	0.89	50.11	6.5e-005	Silty peat/silt	
												20-Jul-2018	1.79	0.86	50.14			
												20-Sep-2018	1.69	0.76	50.24			
												17-Jul-2019	1.69	0.76	50.24			orange
												29-Sep-2019	1.71	0.78	50.22			
Surveillance Netowrk Program - Goose Island Locations																		
GIBG-10-2-3	**Active**	**W-CAT-2**	596138.596	7239661.038	43.66	44.20	0.54	3.00	40.66	1.43 - 3.00	1.30 - 3.00	10-Aug-2015	2.05	1.52	42.15	1.7e-005	Sand	Frost jacked
												16-Sep-2015	2.13	1.59	42.07			
												06-Aug-2016	1.99	1.45	42.21			
												02-Oct-2016	2.24	1.70	41.96			
												04-Nov-2016	2.38	1.84	41.82			
												20-Aug-2017	1.84	1.30	42.36			Fished out bailer
												12-Sep-2017	1.65	1.11	42.55			
												14-Jul-2018	2.16	1.62	42.04			
												20-Sep-2018	2.14	1.60	42.06			
												16-Jul-2019	2.36	1.82	41.84			limited sample, silty
												30-Sep-2019	2.46	1.92	41.74			
GIP11 09-1-4	**Replaced**	**W-CAT-2**	595813.546	7240393.423	45.55	45.90	0.35	4.00	41.55	1.00 - 4.00	0.72 - 4.00	10-Aug-2015	3.17	2.82	42.73	1.6e-005	Silty sand/sandy silt and clay/sand	
												16-Sep-2015	3.29	2.94	42.61			
												02-Oct-2016	> 1.32	> 0.97	< 44.58			Dry
GIP11 09-1-4-R	**Active**	**W-CAT-2**	N/M	N/M	N/M	N/M	N/A	4.00	N/A	1.00 - 4.00	0.72 - 4.00	14-Jul-2018	3.39	N/A	N/A	N/M	Silty Sand	
												20-Sep-2018	3.51	N/A	N/A			
												16-Jul-2019	3.58	N/A	N/A			
												04-Oct-2019	3.80	N/A	N/A			
GIQ8-10-2-4	**Active**	**W-CAT-2**	595306.125	7240333.425	47.50	47.72	0.22	3.95	43.55	0.95 - 3.95	0.75 - 3.70	10-Aug-2015	> 5.67	> 5.45	< 42.05	3.3e-006	Sandy Silt	Dry
												16-Sep-2015	2.11	1.89	45.61			
												07-Aug-2016	1.72	1.50	46.00			
												02-Oct-2016	2.48	2.26	45.24			
												04-Nov-2016	2.66	2.44	45.06			
												20-Aug-2017	2.43	2.21	45.29			
												12-Sep-2017	2.25	2.03	45.47			
												14-Jul-2018	2.53	2.31	45.19			
												20-Sep-2018	2.21	1.99	45.51			
												16-Jul-2019	2.63	2.41	45.09			
												30-Sep-2019	2.60	2.38	45.12			

NOTES: 1. Data may be entered to the nearest mm, but are reported above to the nearest cm.□
Apparent rounding errors may occasionally occur in calculated fields (e.g. Groundwater Surface Elevation).
2. All coordinates are provided in the UTM Zone 9N referenced to North American Datum of 1927 coordinate system.
3. N/M - Denotes not measured.
4. N/A - Denotes not available.
5. masl - Denotes metres above sea level.
6. mbgs - Denotes metres below ground surface.
7. mbtoc - Denotes metres below top of PVC casing.
8. Where a measurement is not available due to the source being dry, depths and elevations are displayed as greater than the measured depth of well, where available, and where not the installed depth is used.
9. Background 95th Percentile Statistical Category:
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background

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Table 2

Groundwater Analytical Results: Dissolved Chloride

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Chloride (mg/L)
CCME CEQG Freshwater Aquatic Life			**120**
W-CAT-1			**18**
W-CAT-2			**18**
Surveillance Network Program - Mainland Locations			
ARB-12-3-3	07-Aug-2015	**W-CAT-1**	16
	14-Sep-2015		8.7
	05-Aug-2016		**19**
	02-Oct-2016		12
	12-Aug-2017		12
	12-Sep-2017		**22**
	11-Jul-2018		**27**
	15-Sep-2018		16
	11-Jul-2019		**26**
	28-Sep-2019		17
C38 08-1-4	06-Aug-2015	**W-CAT-1**	**19**
	14-Sep-2015		**20**
	05-Aug-2016		**23**
	02-Oct-2016		**21**
	12-Aug-2017		**19**
	12-Sep-2017		14 [#1]
	13-Jul-2018		**21**
	16-Sep-2018		18
	15-Jul-2019		18
(Duplicate)	15-Jul-2019		18
	28-Sep-2019		**19**
CPF 97-7-5	07-Aug-2015	**W-CAT-1**	11
	14-Sep-2015		11
	06-Aug-2016		**22**
(Duplicate)	06-Aug-2016		**22**
	02-Oct-2016		**23**
	17-Aug-2017		**19**
(Duplicate)	17-Aug-2017		**19**
	12-Sep-2017		18
	20-Jul-2018		16
(Duplicate)	20-Jul-2018		16
	15-Sep-2018		15
	27-Jul-2019		16
	28-Sep-2019		**74**
CPF 98-8-3	07-Aug-2015	**W-CAT-1**	7.1
	14-Sep-2015		8.7
	06-Aug-2016		13
	02-Oct-2016		12
	17-Aug-2017		9.4
	12-Sep-2017		9.1
	22-Jul-2018		6.8
	16-Sep-2018		8.5
	11-Jul-2019		6.8
	28-Sep-2019		9.7

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Table 2

Groundwater Analytical Results: Dissolved Chloride

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Chloride (mg/L)
CCME CEQG Freshwater Aquatic Life			**120**
W-CAT-1			**18**
W-CAT-2			**18**
MEBG-10-1-3	06-Aug-2015	**W-CAT-1**	3.0
	14-Sep-2015		2.4
	03-Aug-2016		2.2
	02-Oct-2016		2.3
	12-Aug-2017		2.4
	12-Sep-2017		2.4
	16-Jul-2018		1.9
	15-Sep-2018		2.3
	15-Jul-2019		2.0
	04-Oct-2019		1.9
MTF 97-1-5	08-Aug-2015	**W-CAT-1**	1.2
	15-Sep-2015		< 1.0
	03-Oct-2016		1.2
	17-Aug-2017		1.5
	14-Sep-2017		1.0
	16-Jul-2018		1.9
	16-Sep-2018		< 1.0
	18-Jun-2019		< 1.0
	28-Sep-2019		1.7
TF 03-12-3	08-Aug-2015	**W-CAT-1**	**140**
	15-Sep-2015		**140**
	06-Aug-2016		**130**
	02-Oct-2016		**120**
	17-Aug-2017		**160**
	13-Sep-2017		**190**
(Duplicate)	13-Sep-2017		**160**
	16-Jul-2018		**170**
(Duplicate)	16-Jul-2018		**170**
	16-Sep-2018		**110**
	19-Jun-2019		**110**
	28-Sep-2019		**80**
(Duplicate)	28-Sep-2019		**78**
WSY 97-1-5	06-Aug-2015	**W-CAT-1**	14
	14-Sep-2015		13
	05-Aug-2016		11
	03-Oct-2016		6.5
	18-Aug-2017		15
	12-Sep-2017		**26**
	11-Jul-2018		**24**
	15-Jul-2019		**23**
	28-Sep-2019		**24**
Surveillance Network Program - Bear Island Locations			
BI-13-1-4	07-Aug-2015	**W-CAT-2**	7.7
	07-Aug-2016		7.9
	15-Aug-2017		6.2
	18-Jul-2018		4.6
	20-Sep-2018		8.3
	12-Jul-2019		2.5
	29-Sep-2019		8.7

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Table 2

Groundwater Analytical Results: Dissolved Chloride

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Chloride (mg/L)
CCME CEQG Freshwater Aquatic Life			**120**
W-CAT-1			**18**
W-CAT-2			**18**
BI-13-3-4.5	07-Aug-2015	**W-CAT-2**	11
	08-Aug-2016		8.5
	15-Aug-2017		8.7
	22-Nov-2017		6.5
	18-Jul-2018		7.2
	20-Sep-2018		10
	12-Jul-2019		8.4
BIBG-10-1-4	09-Aug-2015	**W-CAT-2**	12
	10-Aug-2016		25
	11-Aug-2017		18
	17-Jul-2018		16
	20-Sep-2018		23
	17-Jul-2019		23
	29-Sep-2019		20
BIBG-12-1-7	09-Aug-2015	**W-CAT-2**	8.1
	07-Aug-2016		7.5
BIS 97-1-3	22-Nov-2017	**W-CAT-2**	20
	20-Jul-2018		16
	20-Sep-2018		22
	17-Jul-2019		19
(Duplicate)	17-Jul-2019		19
	29-Sep-2019		22
Surveillance Network Program - Goose Island Locations			
GIBG-10-2-3	10-Aug-2015	**W-CAT-2**	1.9
	16-Sep-2015		3.1
	07-Aug-2016		< 1.0
(Duplicate)	07-Aug-2016		< 1.0
	03-Oct-2016		2.3
	20-Aug-2017		2.4
(Duplicate)	20-Aug-2017		2.3
	12-Sep-2017		2.9
	14-Jul-2018		6.9
(Duplicate)	14-Jul-2018		6.8
	20-Sep-2018		6.9
	16-Jul-2019		9.9
(Duplicate)	16-Jul-2019		9.9
	30-Sep-2019		11
GIP11 09-1-4	10-Aug-2015	**W-CAT-2**	4.5
	16-Sep-2015		6.3
GIP11 09-1-4-R	14-Jul-2018	**W-CAT-2**	50
	20-Sep-2018		14
	16-Jul-2019		14
	04-Oct-2019		17

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Table 2

Groundwater Analytical Results: Dissolved Chloride

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Chloride (mg/L)
CCME CEQG Freshwater Aquatic Life			**120**
W-CAT-1			**18**
W-CAT-2			**18**
GIQ8-10-2-4	16-Sep-2015	**W-CAT-2**	**20**
	07-Aug-2016		14
	03-Oct-2016		18
(Duplicate)	03-Oct-2016		**19**
	20-Aug-2017		5.8
	12-Sep-2017		9.4
	14-Jul-2018		**21**
	20-Sep-2018		**21**
(Duplicate)	20-Sep-2018		**21**
	16-Jul-2019		**20**
	30-Sep-2019		**20**
(Duplicate)	30-Sep-2019		**20**
Relative Percent Difference (RPD) Report			
C38 08-1-4	15-Jul-2019	**W-CAT-1**	18
(Duplicate)	15-Jul-2019		18
RPD(%)			**0.0%**
TF 03-12-3	28-Sep-2019	**W-CAT-1**	**80**
(Duplicate)	28-Sep-2019		**78**
RPD(%)			**2.5%**
BIS 97-1-3	17-Jul-2019	**W-CAT-2**	**19**
(Duplicate)	17-Jul-2019		**19**
RPD(%)			**0.0%**
GIBG-10-2-3	16-Jul-2019	**W-CAT-2**	9.9
(Duplicate)	16-Jul-2019		9.9
RPD(%)			**0.0%**
GIQ8-10-2-4	30-Sep-2019	**W-CAT-2**	**20**
(Duplicate)	30-Sep-2019		**20**
RPD(%)			**0.0%**

NOTES:

Bold 1. Denotes values exceeding applied background concentrations and CCME guidelines
(CCME 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1).

Bold 2. Denotes values exceeding applied background concentrations only.

3. Superscript [#1] - Detection limits raised due to sample matrix.

4. Background 95th Percentile Statistical Category:
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background

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Table 3

Groundwater Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]			**0.37**	**0.002**	**0.09**
W-CAT-1			**0.0005**	**0.0005**	**0.0005**
W-CAT-2			**0.0004**	**0.0004**	**0.0004**
Surveillance Network Program - Mainland Locations					
ARB-12-3-3	07-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	05-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	12-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	11-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	15-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	11-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
C38 08-1-4	06-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	05-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	12-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	12-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	13-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	16-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	15-Jul-2019		0.00093	< 0.00040	< 0.00040
(Duplicate)	15-Jul-2019		0.00061	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
CPF 97-7-5	07-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	07-Aug-2015		< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	06-Aug-2016		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	06-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	17-Aug-2017		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	17-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	20-Jul-2018		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	20-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	15-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	27-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
CPF 98-8-3	07-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	06-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	17-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	22-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	16-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	11-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040

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Table 3

Groundwater Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]			**0.37**	**0.002**	**0.09**
W-CAT-1			**0.0005**	**0.0005**	**0.0005**
W-CAT-2			**0.0004**	**0.0004**	**0.0004**
MEBG-10-1-3	06-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	03-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	12-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	15-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	15-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	04-Oct-2019		< 0.00040	< 0.00040	< 0.00040
MTF 97-1-5	08-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	15-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	03-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	17-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	14-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	16-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	18-Jun-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
TF 03-12-3	08-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	15-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	06-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	02-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	17-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	13-Sep-2017		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	13-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2018		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	16-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	16-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	19-Jun-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
WSY 97-1-5	06-Aug-2015	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
	14-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	05-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	03-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	18-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	11-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	18-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	15-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
Surveillance Network Program - Bear Island Locations					
BI-13-1-4	07-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	07-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	15-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	12-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	29-Sep-2019		< 0.00040	< 0.00040	< 0.00040

Table 3

Groundwater Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]			0.37	0.002	0.09
W-CAT-1			0.0005	0.0005	0.0005
W-CAT-2			0.0004	0.0004	0.0004

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Table 3

Groundwater Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]			**0.37**	**0.002**	**0.09**
W-CAT-1			**0.0005**	**0.0005**	**0.0005**
W-CAT-2			**0.0004**	**0.0004**	**0.0004**
BI-13-3-4.5	07-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	08-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	15-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	22-Nov-2017		< 0.00040	< 0.00040	< 0.00040
	18-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	12-Jul-2019		< 0.00040	< 0.00040	< 0.00040
BIBG-10-1-4	09-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	10-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	11-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	17-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	17-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	29-Sep-2019		< 0.00040	< 0.00040	< 0.00040
BIBG-12-1-7	09-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	07-Aug-2016		< 0.00040	< 0.00040	< 0.00040
BIS 97-1-3	22-Nov-2017	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	20-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	17-Jul-2019		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	17-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	29-Sep-2019		< 0.00040	< 0.00040	< 0.00040
Surveillance Network Program - Goose Island Locations					
GIBG-10-2-3	10-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	10-Aug-2015		< 0.00040	< 0.00040	< 0.00040
	16-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	07-Aug-2016		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	07-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	03-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	20-Aug-2017		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	20-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	14-Jul-2018		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	14-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2019		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	16-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	30-Sep-2019		< 0.00040	< 0.00040	< 0.00040
GIP11 09-1-4	10-Aug-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	16-Sep-2015		< 0.00040	< 0.00040	< 0.00040
GIP11 09-1-4-R	14-Jul-2018	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	04-Oct-2019		< 0.00040	< 0.00040	< 0.00040

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Table 3

Groundwater Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Sampling Location	Date (dd-mmm-yyyy)	Background Category	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]			**0.37**	**0.002**	**0.09**
W-CAT-1			**0.0005**	**0.0005**	**0.0005**
W-CAT-2			**0.0004**	**0.0004**	**0.0004**
GIQ8-10-2-4	16-Sep-2015	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	16-Sep-2015		< 0.00040	< 0.00040	< 0.00040
	07-Aug-2016		< 0.00040	< 0.00040	< 0.00040
	03-Oct-2016		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	03-Oct-2016		< 0.00040	< 0.00040	< 0.00040
	20-Aug-2017		< 0.00040	< 0.00040	< 0.00040
	12-Sep-2017		< 0.00040	< 0.00040	< 0.00040
	14-Jul-2018		< 0.00040	< 0.00040	< 0.00040
	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	20-Sep-2018		< 0.00040	< 0.00040	< 0.00040
	16-Jul-2019		< 0.00040	< 0.00040	< 0.00040
	30-Sep-2019		< 0.00040	< 0.00040	< 0.00040
(Duplicate)	30-Sep-2019		< 0.00040	< 0.00040	< 0.00040
Relative Percent Difference (RPD) Report					
C38 08-1-4	15-Jul-2019	**W-CAT-1**	0.00093	< 0.00040	< 0.00040
(Duplicate)	15-Jul-2019		0.00061	< 0.00040	< 0.00040
RPD(%)			**41.6%**	**---**	**---**
TF 03-12-3	28-Sep-2019	**W-CAT-1**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	28-Sep-2019		< 0.00040	< 0.00040	< 0.00040
RPD(%)			**---**	**---**	**---**
BIS 97-1-3	17-Jul-2019	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	17-Jul-2019		< 0.00040	< 0.00040	< 0.00040
RPD(%)			**---**	**---**	**---**
GIBG-10-2-3	16-Jul-2019	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	16-Jul-2019		< 0.00040	< 0.00040	< 0.00040
RPD(%)			**---**	**---**	**---**
GIQ8-10-2-4	30-Sep-2019	**W-CAT-2**	< 0.00040	< 0.00040	< 0.00040
(Duplicate)	30-Sep-2019		< 0.00040	< 0.00040	< 0.00040
RPD(%)			**---**	**---**	**---**

NOTES:

1. Superscript [#1] - Denotes CCME guidelines
   (CCME 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1).
2. Background 95th Percentile Statistical Category:
   W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background
   W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background

Appendix A
Limitation of Liability, Scope of Report, and Third-Party Reliance

Limitation of Liability, Scope of Report, and Third-Party Reliance

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Appendix B
Background Geochemical Statistical Summary

Imperial

Background Geochemical Statistical Summary (Appendix 3)

Norman Wells, NT

30 May 2019

407011-00622-500 – CA-REP-0006

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Project No. 407011-00622-500-CA-REP-0006 - Background Geochemical Statistical Summary (Appendix 3): Norman Wells, NT

Rev	Description	Originator Approval	Reviewer Approval	Project Manager Approval	Date
0	Issued as Final	M. Brown	A. Glatiotis	S. Gibb	30-May-19

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1. Introduction and Methodology

1.1 Introduction

Soil, bedrock, and groundwater analytical results from numerous Phase II Environmental Site Assessments (ESAs) conducted to date within the Norman Wells Field (the Site) have indicated that there are concentrations of select hydrocarbon, salt and metals parameters in certain lithologic/stratigraphic units that are naturally elevated above generic federal and territorial environmental quality guidelines. Understanding background (pre-industrial disturbance) environmental quality is required to properly evaluate site characterization data and determine appropriate site remediation objectives and endpoints for the Norman Wells Field. The evaluation of background geochemical conditions is complicated by the presence of natural crude oil, gas, and saline water seepage in several Mainland areas of the Site.

This document includes a summary review and assessment of available data with the objective of determining background soil, bedrock and groundwater geochemical conditions, both within the natural seepage areas and outside of them, for the primary near surface (i.e. upper 20 metres (m)) lithologic/stratigraphic units present within the Norman Wells Field. To provide context the statistically evaluated results are compared to appropriate CCME federal regulatory guidelines for soil and groundwater quality, as summarized in the main text of this report.

1.2 Background Sampling Location Selection

1.2.1 Soil and Bedrock

The majority of the background soils/bedrock data was collected between 1998 and 2016. Data were collected for a range of environmental projects and it is possible that a location considered suitable for background purposes for a groundwater or subsurface soils investigation may not necessarily provide suitable background surface soils data due to disturbance of surface soils, or due to the presence of shale fill material. Only data from those background locations considered to have minimal or no potential industrial impact were included in the background assessment.

Background soil and bedrock sampling locations are shown on Figures 1 and 2 and summarized on Table 1. For the purposes of the Norman Wells environmental background assessment, Site soils were categorized as either organic or mineral. Organic soils are derived from living matter (e.g. plant matter, microorganisms, etc.) and have a relatively high humus or organic matter content. This category would include A and LFH horizons generally described as topsoil, as well as peat or muskeg deposits. Mineral soils are generally derived from poorly consolidated, weathered bedrock, and may be of glacial or post glacial origin. Mineral soils as differentiated in this document would include B and/or C horizons which have little humus or organic matter content.

Soil and bedrock background locations were summarized into the following general categories/stratigraphic units:

- Surface organic soil generally above 0.5 metres below ground surface (mbgs):
  - Mainland (17 locations, 17 samples);

  - Mainland Seeps (4 locations, 4 samples); and
  - Islands (4 locations, 5 samples).
- Surface mineral soil (generally upper 0.5 m of soil profile):
  - Mainland (15 locations, 18 samples);
  - Mainland Seeps (5 locations, 8 samples); and
  - Islands (14 locations, 14 samples).
- Subsurface mineral soil (>0.5 mbgs to bedrock contact):
  - Mainland (28 locations, 53 samples);
  - Mainland Seeps (4 locations, 8 samples); and
  - Islands (19 locations, 45 samples).
- Bedrock:
  - Siltstone on Mainland (10 locations, 11 samples);
  - Mainland Seeps (2 locations, 4 samples); and
  - Shale Fill Material from Quarry (4 locations, 4 samples).

There were no natural seepage areas identified on the Islands and no bedrock was encountered or sampled during intrusive investigations on the Islands.

1.2.2 Groundwater

Background monitoring wells would ideally be installed in an undisturbed, up-gradient area, isolated from any potential sources of anthropogenic impact. However, these locations tend to be heavily influenced by permafrost in the vicinity of Norman Wells. Previous attempts to install background wells in up-gradient areas of the lease, removed from the Imperial facilities and in areas of natural vegetation, have resulted in rapidly frozen groundwater monitoring wells that consistently remain frozen. As such, the use of the term "background" in this report does not necessarily mean the groundwater monitoring well is installed in an undisturbed, up-gradient area. Rather, the term is used for locations inferred to be removed from site facilities and free of facility-related impacts.

Background groundwater sampling locations are shown on Figures 3 and 4 and summarized on Table 2. These background wells are separated into five groups, as follows. These groups are based on the hydrogeological zone where the monitoring well screen is completed, as well as evidence for the presence or absence of natural seepage in the vicinity:

- Surficial sediments on Mainland (14 wells, total of 64 samples);
- Surficial sediments on Natural Islands (10 wells, total of 65 samples);
- Shallow bedrock on Mainland inferred to represent natural saline water and hydrocarbon seepage (7 wells, total of 69 samples);

- Surficial sediments on Mainland inferred to represent natural saline water and hydrocarbon seepage (5 wells, total of 27 samples); and
- Surficial sediments on Mainland inferred to represent natural gas seepage without saline water (4 wells, total of 30 samples).

1.2.3 Surface Water

Background surface water locations were selected from undisturbed up-gradient areas, located either on or off-lease, and isolated from any potential sources of anthropogenic impact.

Characterization of representative background surface water quality is expected to be complex, due to variable conditions influenced by several factors as listed below:

- flowing river/creek water versus relatively stagnant water bodies (muskeg);
- variable flows in response to short-term weather events and seasonal changes;
- spatially variable vegetation and biological communities nearby;
- spatially and temporally variable total suspended solids;
- presence of natural hydrocarbon seeps and naturally elevated metals/salts in some areas; and
- variability in sample collection protocols.

Background surface water sampling locations are shown on Figure 5 and summarized on Table 3. The background surface water locations were separated by area into the following three groups:

- Mainland (10 locations, total of 41 samples);
- Bear Island (6 locations, total of 29 samples); and
- Goose Island (5 locations, total of 24 samples).

1.3 Analytical Data Compilation & Screening

1.3.1 Statistical Trend Analyses

Statistics were evaluated generally following protocols in U.S. EPA Unified Guidance (2009). Statistical trend analyses were used to evaluate temporal changes in key parameters at background locations for groundwater samples. A similar analysis could not be done on soil/bedrock data since these results do not have a temporal history, as they are derived from one-time drilling and sampling events. The presence of statistically significant temporal trends would suggest facility-related water quality impacts, meaning that the monitoring well in question may not be suitable as a background location. Key parameters considered for trend analyses were benzene, toluene, ethylbenzene, arsenic, copper, cadmium, iron and chloride.

The analysis was performed using the non-parametric Mann-Kendall trend test (Mann 1945; Kendall 1975; Gilbert 1987). The purpose of the Mann-Kendall (MK) test is to statistically assess if there is an upward or downward trend of the variable of interest over time. In each case, the trend analysis was conducted using the

available data series from 2007 to 2013. The Mann-Kendall test was performed on data sets where at least four data points were available. To identify potentially significant trends, the trend analysis data was filtered using the probability of the trend: a probability of 95% or greater was used as the first level of screening, based on the statistical convention of $p < 0.05$ for rejection of the null hypothesis of "no trend".

1.3.2 Outliers Assessment

High outliers were reviewed for each sample group. High outliers were defined as data points which exist at three times the interquartile range (IQR) of the data set above the 75th percentile (>P75+3*IQR) for one of the analyzed parameters (AMSRP 2008). The IQR is the 75th percentile minus the 25th percentile (P75-P25).

Samples detected as high outliers were reassessed by checking against the borehole log, location, other samples from the location, typographical error, and laboratory error. Samples deemed to be not impacted (false outliers) were still considered for the calculation of background statistical values while real outliers (potentially impacted or not reliable) were removed.

1.3.3 Statistical Analysis of Data

One of the key aspects of the statistical calculations is the method of dealing with results reported below the laboratory method detection limit (MDL), which is a frequent occurrence with some of the dissolved trace metals and hydrocarbons in particular. In order to calculate statistical values, a real number is required rather than a "less than" result. In the background statistical calculations analytical results reported below the MDL were conservatively considered as real numbers at the MDL value.

A geometric mean, minimum, maximum, and 95th percentile value for each parameter of interest was determined for each of the soil, bedrock and groundwater groups of interest.

2. Summary of Key Findings

2.1 Soil Statistical Background

Based on the review of the available statistical background data, the following general trends were inferred from data summarized on Table 4:

- concentrations of one or more metals/trace elements (As, Mo, Ni, Se and Tl) exceeding CCME Industrial use guidelines have been confirmed in background organic surface soil and mineral subsurface soil on the Mainland;
- above guideline SAR values have been measured/calculated for a limited number of mineral subsurface soil samples on the Mainland;
- in the Island soils, background metals concentrations in surface mineral soil are typically below CCME Parkland use guidelines. However, Mo may be present at concentrations above guidelines in the subsurface soil;
- EC levels above CCME Parkland use guidelines (2 dS/m) may be present in both organic and mineral soil on the Islands. The EC is typically associated with concentrations of sulphate, calcium and magnesium ions (considered to be naturally occurring) rather than chloride (considered to be an indicator of industrial activities);
- one or more BTEX and PHC F1 through F4 parameter concentrations above detection limits but generally below CCME guidelines have been reported in all strata and may be associated with organic matter and/or hydrocarbon seeps at the bedrock/soil interface, particularly in close proximity to the Mackenzie River; and
- background data sets for the organic and mineral surface soil on the Islands and natural seeps areas on the Mainland are limited and should be interpreted/referenced with caution.

2.2 Bedrock Statistical Background

General trends in bedrock geochemistry are based on a limited data set, and the following conclusions are derived from the data in Table 4:

- concentrations of one or more metals/trace elements (As and Ni) exceeding CCME Industrial use guidelines have been confirmed in siltstone bedrock on the Mainland;
- concentrations of As, Mo, Se and Tl exceeding CCME Industrial use guidelines have also been confirmed in shale bedrock samples collected from the Town of Norman Wells quarry. This shale material is used as fill throughout the Site and the adjacent Town;
- above CCME Industrial use guideline SAR values have been measured/calculated for a limited number of siltstone bedrock samples from the Mainland; and
- background data sets for the bedrock are limited and should be interpreted/referenced with caution.

2.3 Groundwater Statistical Background

In terms of groundwater geochemistry, key characteristics noted for groundwater background locations in surficial sediments on both the Mainland and Islands areas are summarized below. Characteristics related to natural seepage areas are considered separately in Section 2.4 below:

- nitrate, nitrite and phenols levels were close to or exceeded the applied CCME Freshwater Aquatic Life (FWAL) guidelines in the near surface groundwater (Table 6);
- concentrations of several metals/trace elements (As, Cd, Cu, Fe, Pb, Hg, Se, Ag, Tl, U) exceeding CCME FWAL guidelines have been confirmed in shallow groundwater at Mainland locations (Table 7);
- at Islands background locations, a shorter list of metals/trace elements with groundwater concentrations exceeding CCME FWAL guidelines (Cd, Cu, Fe, U) is identified (Table 7); and
- concentrations of PHC and/or PAH parameters are generally non-detectable in shallow groundwater background locations on the Islands, and at Mainland locations which are not identified as natural seepage zones (Tables 8 and 9).

2.4 Natural Seepage Zones Statistical Background

General trends in soil and bedrock geochemistry for natural seeps areas are based on a limited data set, and include the following preliminary conclusions as summarized in Table 5:

- Soil/bedrock concentrations of one or more metals/trace elements (As and Ni) exceeding CCME Industrial use guidelines have been confirmed in natural seeps organic surface soil and mineral subsurface soil and/or bedrock on the Mainland;
- One or more natural seeps soil samples contained concentrations of benzene, PHC F1, PHC F2, PHC F3, and/or select PAHs (fluorene, naphthalene, phenanthrene) exceeding CCME guidelines for industrial and/or parkland use. Hydrocarbon concentrations appear to increase with depth in the natural seep areas; and
- SAR levels in one or more natural seep mineral subsurface soil samples exceeded CCME parkland use guidelines.

In terms of groundwater geochemistry, key characteristics noted for the natural seepage zones are summarized below:

- chloride and phenols levels exceeded the applied CCME FWAL guidelines in the natural oil seeps in both upper bedrock and surficial sediments (Table 6);
- seeps identified as related to natural gas without saline water also exceeded the phenols guideline, but had chloride levels more typical of background non-seep surficial sediments (Table 5);
- concentrations of several metals/trace elements (Al, As, Cd, Cu, Fe, Pb, Hg, Se, Tl, U, Zn) exceeding CCME FWAL guidelines have been confirmed in groundwater near natural oil and gas seeps from both upper bedrock and surficial sediments (Table 7); and

- concentrations of several PHC and PAH parameters are detected in groundwater near natural oil and gas seeps, with toluene, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, naphthalene, phenanthrene and pyrene exceeding CCME FWAL guidelines based on the statistical analyses. Benzene may also exceed the applied guideline in the inferred natural gas seeps but is generally lower in the oil-related seeps (Tables 8 and 9).

2.5 Surface Water Statistical Background

In terms of surface water geochemistry, key characteristics noted for surface water background locations on the Mainland, Bear Island, and Goose Island areas (Table 10) are summarized below:

- concentrations of Al, As, Cd, Cr, Cu, Fe, Pb, Se, Tl, Zn, toluene and phenols exceeding CCME FWAL guidelines were measured in one or more background surface water samples from surface water bodies on the Mainland portion of the Site;
- one or more background surface water samples collected from Bear Island contained concentrations of Al, As, Cd, Cu, Fe, U, Zn and phenols above CCME FWAL guidelines; and
- one or more background surface water samples collected from Goose Island contained concentrations of Al, Fe, Zn and phenols above CCME FWAL guidelines.

2.6 Summary of Geochemical Background Categories

For ease of use, the background categories for soil, bedrock, groundwater, and surface water were named as follows in Tables A and B below.

Table A Soil and Bedrock Background Categories

Background Category	Description
S-CAT-1	Mainland - Organic Surface Soil - 95th Percentile Background
S-CAT-2	Mainland - Mineral Surface Soil - 95th Percentile Background
S-CAT-3	Mainland - Mineral Subsurface Soil - 95th Percentile Background
S-CAT-4	Mainland - Bedrock Siltstone - 95th Percentile Background
S-CAT-5	Mainland - Bedrock Shale - 95th Percentile Background
S-CAT-6	Mainland Natural Seeps - Organic Surface Soil - 95th Percentile Background
S-CAT-7	Mainland Natural Seeps - Mineral Surface Soil - 95th Percentile Background
S-CAT-8	Mainland Natural Seeps - Mineral Subsurface Soil - 95th Percentile Background

Background Category	Description
S-CAT-9	Mainland Natural Seeps - Bedrock Siltstone - 95th Percentile Background
S-CAT-10	Islands - Organic Surface Soil - 95th Percentile Background
S-CAT-11	Islands - Mineral Surface Soil - 95th Percentile Background
S-CAT-12	Islands - Mineral Subsurface Soil - 95th Percentile Background

Table B Groundwater and Surface Water Categories

Background Category	Description
W-CAT-1	Mainland - Surficial Sediments - 95th Percentile Background
W-CAT-2	Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background
W-CAT-3	Mainland - Shallow Bedrock - Natural Saline Water & Oil Seepage - 95th Percentile Background
W-CAT-4	Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - 95th Percentile Background
W-CAT-5	Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - 95th Percentile Background
W-CAT-6	Mainland - Surface Water - 95th Percentile Background
W-CAT-7	Bear Island - Surface Water - 95th Percentile Background
W-CAT-8	Goose Island - Surface Water - 95th Percentile Background

3. References

AMSRP (Abandoned Military Site Remediation Protocol) 2008. Abandoned Military Site Remediation Protocol. Vol II - Technical Supporting Documentation. Indian and Northern Affairs Canada (INAC) Contaminated Site Program. December 2008.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring, Wiley, NY.

Kendall, M.G. 1975. Rank Correlation Methods, 4th edition, Charles Griffin, London.

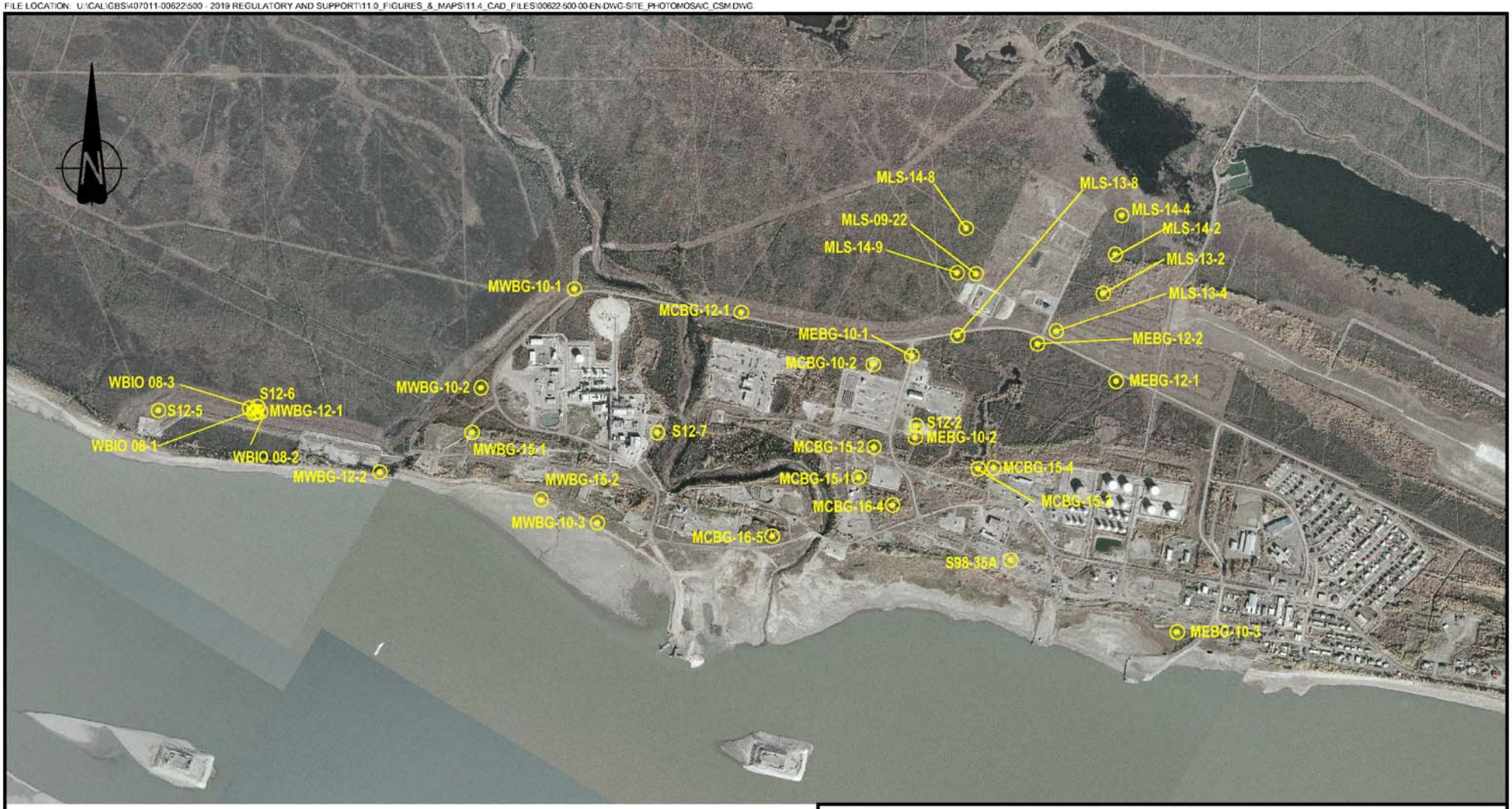
Mann, H.B. 1945. Non-parametric tests against trend, Econometrica 13:163-171.

U.S. EPA Unified Guidance 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009. EPA 530/R-09-007. United States Environmental Protection Agency, Office of Resource Conservation and Recovery.

Figures



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LEGEND

- BACKGROUND SOIL/BEDROCK SAMPLE LOCATION

NAD27 UTM ZONE 9N

m 0 500 1000 m

1:20000

IMPERIAL

APPENDIX 3 - BACKGROUND GEOCHEMICAL STATISTICAL SUMMARY

NORMAN WELLS, NT

BACKGROUND SOIL/BEDROCK SAMPLING LOCATIONS (MAINLAND)

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FIG No 1 REV A

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LEGEND

- BACKGROUND SOIL/BEDROCK SAMPLE LOCATION

NAD27 UTM ZONE 9N

m 0 500 1000 2500 m

1:50000

IMPERIAL

APPENDIX 3 - BACKGROUND GEOCHEMICAL STATISTICAL SUMMARY

NORMAN WELLS, NT

BACKGROUND SOIL/BEDROCK SAMPLING LOCATIONS (ALL AREAS)

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FIG No: 2 REV: A

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LEGEND

- BACKGROUND MONITORING WELL LOCATION

NAD27 UTM ZONE 9N

m 0 500 1000 m

1:20000

IMPERIAL

APPENDIX 3 - BACKGROUND GEOCHEMICAL STATISTICAL SUMMARY

NORMAN WELLS, NT

BACKGROUND MONITORING WELL LOCATIONS (MAINLAND)

Date:	Drawn by:	Edited by:	App'd by:
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LEGEND

- BACKGROUND MONITORING WELL LOCATION

NAD27 UTM ZONE 9N

m 0 500 1000 1500 m

1:25000

IMPERIAL

APPENDIX 3 - BACKGROUND GEOCHEMICAL STATISTICAL SUMMARY

NORMAN WELLS, NT

BACKGROUND MONITORING WELL LOCATIONS (ISLANDS)

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LEGEND

▲ SURFACE WATER SAMPLING LOCATION

NAD27 UTM ZONE 9N

m 0 500 1000 2000 m

1:40000

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APPENDIX 3 - BACKGROUND GEOCHEMICAL STATISTICAL SUMMARY

NORMAN WELLS, NT

BACKGROUND SURFACE WATER SAMPLING LOCATIONS (ALL AREAS)

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Tables



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Table 1
Background Soil / Bedrock Locations (1998-2016)

AREA	LOCATIONS							
	Organic Surface Soil		*Mineral Surface Soil*		*Mineral Subsurface Soil*		*Bedrock*	
	Borehole ID	Sample Depths	Borehole ID	Sample Depths	Borehole ID	Sample Depths	Borehole ID	Sample Depth
Mainland	P98-35A	0.0-0.15 m	MCBG-12-1	0.1-0.5 m	CLAY PIT#1	Surface	**SILTSTONE**	
	MCBG-10-02	0.3-0.6 m	MLS-09-22	0.0-0.4 m	CLAY PIT#2	Surface	MEBG-12-2	3.5-4.0 m
	MEBG-10-01	0.0-0.3 m	MWBG-12-2	0.3-0.6 m	A45X OVERBURDEN 1	Surface	MWBG-10-01	2.4-2.7 m
	MEBG-12-1	0.0-0.3 m	S12-2D	0.3-0.35 m	A45X OVERBURDEN 2	Surface	MWBG-12-2	2.0-2.2 m
	MEBG-12-2	0.2-0.5 m	S12-2E	0.3-0.35 m	WBIO 08-1	0.76-1.5, 2.3-3.0 m	MLS-13-4	2.0-2.2 m; 2.8-3.0 m
	MWBG-10-01	0.0-0.3 m	S12-2F	0.3-0.35 m	WBIO 08-2	0.76-1.5, 2.3-3.0 m	MLS-14-4	3.0 m
	MWBG-10-02	0.0-0.3 m	S12-5D	0.5-0.6 m	WBIO 08-3	0.76-1.5, 3.0-3.8 m	MLS-14-8	3.0 m
	MWBG-12-1	0.0-0.4 m	S12-6D	0.1-0.2; 0.3-0.4 m	MCBG-10-02	0.6-1.0 m; 1.5-2.0 m	MLS-14-9	3.0 m
	S12-2D	0.15-0.3 m	S12-6E	0.1-0.2; 0.3-0.4 m	MCBG-12-1	0.6-0.9 m; 1.0-1.5 m; 1.7-2.1 m	MWBG-15-2	2.4-3.0 m
	S12-2E	0.15-0.3 m	S12-6F	0.1-0.2; 0.3-0.4 m	MEBG-10-01	0.3-0.6 m; 0.6-1.0 m; 2.5-3.0 m	MLS-14-2	2-2.5 m
	S12-2F	0.15-0.3 m	MCBG-15-2	0.1-0.3 m	MEBG-10-2	0.3-0.6 m; 0.6-1.0 m; 1.8-2.3 m; 2.5-3.0 m	P98-35A	2.0-3.0 m
	S12-5D	0.1-0.2 m	MWBG-15-1	0.1-0.3 m	MEBG-12-1	1.5-2.0 m; 3.0-3.4 m		
	MLS-13-8	0.5-0.7 m	MWBG-10-01	0.3-0.6 m	MEBG-12-2	1.0-1.5 m; 2.0-2.5 m		
	MLS-14-4	1.0 m	MWBG-10-02	0.3-0.6 m	MWBG-10-01	0.6-1.0 m		
	MWBG-15-1	0.0-0.1 m	MLS-14-2	1 m	MWBG-10-02	0.6-1.0 m; 2.4-2.7 m		
	MCBG-15-2	0.0-0.1 m			MLS-09-22	1.0-1.3 m		
	MEBG-10-2	0.0-0.3 m			MWBG-12-1	0.4-0.8 m; 1.5-2.0 m		
					MLS-13-2	1.5-1.7 m; 2.0-2.2 m		
					MLS-13-4	1.2-1.5 m	**SHALE**	
					MLS-13-8	1.3-1.5 m; 2.8-3.0 m	S12-Quarry 1	Surface
					MLS-14-4	2.0 m	S12-Quarry 2	Surface
					MLS-14-8	1.0 m; 2.0 m	S12-Quarry 3	Surface
					MLS-14-9	1.0 m; 2.0 m	SHALE-1	Surface
					MCBG-15-2	0.3-0.5 m; 2.4-3.0 m		
					MWBG-15-1	0.3-0.8 m; 1.8-2.4 m		
					MLS-14-2	2 m		
					MCBG-16-4	0.7-1.1 m; 2.4-3.0 m; 4.0-4.5 m		
					MEBG-16-5	0.6-1.2 m; 2.5-3.0 m; 4.2-4.8 m		
Mainland Natural Seepage Zones	MEBG-10-3	0.0-0.3 m	MCBG-15-1	0.1-0.3 m; 0.3-0.5 m	MWBG-10-03	0.6-1.0; 2.2-2.7 m; 4.0-4.5 m	MCBG-15-1	4.2-4.8 m
	MCBG-15-1	0.0-0.1 m	MWBG-10-03	0.0-0.3 m; 0.3-0.6 m	MEBG-15-3	0.5-1.2 m; 2.4-3.0 m	MEBG-10-3	0.3-0.6 m; 0.6-1.0 m; 2.5-3.0 m
	MEBG-15-3	0.0-0.1 m	MEBG-15-3	0.1-0.5 m	MEBG-15-4	0.5-0.8 m; 1.8-2.4 m		
	MEBG-15-4	0.0-0.2 m	MEBG-15-4	0.2-0.5 m	MWBG-15-2	2.4-3.0 m		
			MWBG-15-2	0.0-0.15 m; 0.15-0.6 m				
Bear / Frenchy's/Goose Islands	BI 08-01	0.0-0.3 m	BIBG-10-3	0.0-0.3 m	BI 08-01	0.8-1.2 m; 2.0-2.4 m	NA	NA
	BIBG-15-1	0.0-0.05 m; 0.05-0.4 m	BIBG-10-2	0.0-0.3 m	BIBG-10-3	0.3-0.6 m; 0.6-1.0 m; 1.8-2.1 m; 4.2-4.5 m		
	BIBG-15-2	0.0-0.4 m	FIBG-10-1	0.0-0.3 m	BIBG-10-2	0.3-0.6 m; 0.6-1.0 m; 2.5-3.0 m; 4.0-4.5 m		
	BIBG-15-3	0.0-0.2 m	GIBG-10-1	0.0-0.3 m	BIBG-10-1	0.9-1.2 m; 1.2-1.5 m; 1.5-1.8 m; 4.0-4.3 m		
			GIBG-10-2	0.0-0.3 m	BIBG-12-1	0.5-0.8 m; 2.7-3.0 m; 4.2-4.5 m; 6.0-6.5 m; 7.0-7.5 m		
			S12-8D	0.1-0.2 m	BIBG-12-2	1.0-1.5 m; 3.5-4.0 m; 4.5-5.0 m		
			S12-9D	0.2-0.3 m	FIBG-10-1	0.3-0.6 m; 0.6-1.0 m; 2.3-2.8 m		
			BIBG-15-1	0.4-0.8 m	GIBG-10-1	0.3-0.6 m; 0.6-1.0 m; 2.5-3.0 m		
			BIBG-15-2	0.4-0.8 m	GIBG-10-2	0.3-0.6 m; 0.6-1.0 m; 1.8-2.3 m; 3.0-3.3 m		
			BIBG-15-3	0.2-0.5 m	S12-8D	0.5-0.6 m		
			GIBG-15-13	0.6 m	BIBG-15-1	1.8-2.4 m		
			GIBG-15-14	0.3 m	BIBG-15-2	1.8-2.4 m		
			GIBG-15-15	1.0 m	BIBG-15-3	0.5-1.0 m		
			GIBG-15-16	0.3 m	BIBG-15-3	1.8-2.4 m		
					GIBG-15-13	0.8 m; 4.8 m		
					GIBG-15-14	1.8 m; 3.6 m		
					GIBG-15-15	3.5 m		
					GIBG-15-16	1.8 m; 3.2 m		
					BIBG-16-12	1.0-1.3 m		

Notes:
NA = not applicable. No bedrock or seeps observed/sampled on Natural Islands.

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Table 2
Background Groundwater Sampling Locations (1997-2017)

Monitoring Well	Original Location Code (soil borehole / piezometer)	Depth Interval of Sandpack (m bgs)	Hydrogeologic Unit	Lithology Within Screened Interval
Background – Surficial Sediments - Not Associated with Natural Seepage Zones				
Mainland Locations - Surficial Sediments				
B38 93-2-4	B38 93-2-4	less than 4 m	Surficial sediment	no borehole log
BT3 97-2-5	BT3 97-2-5	1.10 - 4.60	Surficial sediment	Silt
MCBG-10-1-3	MCBG-10-02 / 10-1-3	0.80 - 2.50	Surficial sediment	Clayey Silt / Peat / Silty Clay
MCBG-12-1-2	MCBG-12-1 / BH-12-1-2	0.50 - 3.00	Surficial sediment	Topsoil, Sand, Silty Clay
MEBG-10-1-3	MEBG-10-2 / 10-1-3	1.00 - 3.00	Surficial sediment	Silty Sand / Clayey Silt
MEBG-12-2-3	MEBG-12-2 / 12-2-3	0.80 - 3.00	Surficial sediment	Silty Clay and Bedrock
MLS 09-6-2	MLS 09-06-2	0.80 - 2.20	Surficial sediment	Silty clay and bedrock
MLS-13-9-3	MLS-13-9 / MLS-13-9-3	0.90 - 2.40	Surficial sediment	
MLS-14-3-3	MLS14-3 / MLS-14-3-3	1.50 - 3.00	Surficial sediment	Silt
MLS-14-4-3	MLS14-4 / MLS-14-4-3	1.50 - 3.00	Surficial sediment	Clayey silt, silt and gravel
MLS-14-8-3	MLS14-8 / MLS-14-8-3	1.50 - 3.00	Surficial sediment	Clayey silt
MWBG-10-1-3	MWBG-10-02 / 10-1-3	0.80 - 2.70	Surficial sediment	Silt / Clay
MWBG-12-1-3	MWBG-12-2 / 12-1-3	1.20 - 3.00	Surficial sediment	Silt and Siltstone
WBIO 08-1-2	WBIO 08-1-2	0.60 - 2.40	Surficial sediment	Sandy clay / Silty sand
Bear and Frenchy's Island Locations - Surficial Sediments				
BI 08-1-4	BI 08-1-4	0.60 - 2.40	Surficial sediment	Silty clay
BI-13-6-2	BI-13-6 / 13-6-2.4	0.60 - 2.70	Surficial sediment	Silt and Clayey silt
BI-14-8-3	BI-14-8 / 14-8-3	1.66 - 3.16	Surficial sediment	Silty clay
BIBG-10-1-4	BIBG-10-3 / 10-1-4	0.78 - 4.10	Surficial sediment	Silty Clay / Sand
BIBG-10-2-4	BIBG-10-2 / 10-2-4	0.50 - 3.77	Surficial sediment	Sand
BIBG-12-1-7	BIBG-12-1 / 12-1-7	3.80 - 7.50	Surficial sediment	Silty Sand / Sandy Silt
BIBG-12-2-4	BIBG-12-02 / 12-2-4	0.70 - 4.20	Surficial sediment	Silty Clay / Sandy Silt
FIBG-10-1-4	FIBG-10-1 / 10-1-4	0.69 - 3.97	Surficial sediment	Silty Clay / Sand
Goose Island Locations - Surficial Sediments				
GIBG-10-1-5	GIBG-10-1 / 10-1-5	1.20 - 4.50	Surficial sediment	Sandy Silt
GIBG-10-2-3	GIBG-10-2 / 10-2-3	1.30 - 3.00	Surficial sediment	Sand

Monitoring Well	Original Location Code (soil borehole / piezometer)	Depth Interval of Sandpack (m bgs)	Hydrogeologic Unit	Lithology Within Screened Interval
Background – Surficial Sediments and Bedrock - Associated with Natural Seepage Zones				
Background – Shallow Bedrock - Inferred to Represent Natural Hydrocarbon and Saline Water Seepage				
NWR 98-18-15	NWR 98-18-15	11.00 - 14.70	Shallow bedrock	Siltstone
NWR 99-16-17	NWR 99-16-17	12.60 - 17.00	Shallow bedrock	Siltstone
RB 02-3-2	RB 02-3-2	0.60 - 3.30	Shallow bedrock	Siltstone / Shale
NWR-09-1-20	NWR-09-1-20	16.50 - 20.00	Shallow bedrock	Shale / Siltstone / Sandstone
NWR-09-3-20	NWR-09-3-20	16.10 - 20.20	Shallow bedrock	Sandstone
NWR-09-4-17	NWR-09-4-17	15.24 - 17.30	Shallow bedrock	Siltstone
BT3-99-21-12	BT3-99-21-12	8.50 - 12.20	Shallow bedrock	Siltstone
Background – Surficial Sediments - Inferred to Represent Natural Hydrocarbon and Saline Water Seepage				
NWR 03-38-3	NWR 03-38-3	0.50 - 3.00	Surficial sediment	Sand and clay
RB-13-2-2.4	RB-13-2 / RB-13-2-2.4	0.60 - 2.55	Surficial sediment	Gravelly Sand and Clay
RB-13-4-3	RB-13-4 / RB-13-4-3	1.20 - 3.30	Surficial sediment	Sandy Gravel
RB-13-5-2.4	RB-13-5 / RB-13-5-2.4	0.60 - 2.55	Surficial sediment	Sandy Clay and Siltstone
RB-13-8-1.5	RB-13-8 / RB-13-8-1.5	0.16 - 1.50	Surficial sediment	Sandy Clay
Background – Surficial Sediments - Inferred to Represent Natural Gas Seepage Without Saline Water				
MEBG-15-4-3	MEBG-15-4	1.50 - 3.60	Surficial sediment	Silty Clay
MLS-14-2-3	MLS14-2 / MLS-14-2-3	1.00 - 2.50	Surficial sediment	Silty Clay and Siltstone
B38 02-33-3	B38X-02-2 / B38X 02-33-3	1.10 - 3.10	Surficial sediment	Sandy Silt
B38 02-34-3	B38X-02-3 / B38X 02-34-3	1.50 - 3.50	Surficial sediment	Clayey Silt

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Table 3
Background Surface Water Sampling Locations (2009-2016)

Surface Water Location
Mainland Locations - Surface Water
ARB-13-7-SW
B38 SW01
BOS SW01
BOS SW-13-1
CEM SW03
MLS SW02
MLS SW03
RCFP SW01
Upstream #3
Upstream #4
Bear Island Locations - Surface Water
BI SW07
BI SW08
BI SW10
BI SW-13-1
BI-13-11
BIN42 SW01
Goose Island Locations - Surface Water
GI SW02
GI SW03
GI SW04
GI SW05
GI SW06

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Table 4
Soil and Bedrock Background Geochemical Statistical Summary (1998-2016)

Background Geochemical Statistics for Soil and Bedrock: Salinity Parameters			
Imperial Oil - Norman Wells			
	pH (pH units)	EC (dS/m)	SAR (ratio)
CCME Residential/Parkland Fine Surface (Islands)	6 - 8	2	5
CCME Industrial Fine Surface (Mainland)	6 - 8	4	12
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-1	7.52	1.13	1.38
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-1	7.57	1.5	1.5
95th Percentile Background - Organic Surface Soil (Islands) - S-CAT-10	7.83	2.9	0.7
Maximum Background - Organic Surface Soil (Islands) - S-CAT-10	7.9	3.3	0.75
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-2	7.49	0.71	1.65
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-2	7.61	0.73	2
95th Percentile Background - Mineral Surface Soil (Islands) - S-CAT-11	7.76	2.9	1.04
Maximum Background - Mineral Surface Soil (Islands) - S-CAT-11	7.77	2.9	1.4
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	8.04	1.91	5.68
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	8.1	2.4	22
95th Percentile Background - Mineral Subsurface Soil (Islands) - S-CAT-12	7.76	2.5	0.64
Maximum Background - Mineral Subsurface Soil (Islands) - S-CAT-12	7.81	2.9	1.1
95th Percentile Background - Bedrock (Mainland Siltstone) - S-CAT-4	7.67	1.52	22.85
Maximum Background - Bedrock (Mainland Siltstone) - S-CAT-4	7.72	1.26	26
95th Percentile Background - Bedrock (Mainland Shale) - S-CAT-5	NC	NC	NC
Maximum Background - Bedrock (Mainland Shale) - S-CAT-5	NC	NC	NC

NA	Denotes guideline not available
NC	Denotes parameters not measured / not calculated
	Shading indicates parameters above most restrictive guidelines selected

Background Geochemical Statistics for Soil and Bedrock: Metals and Trace Elements																			
Imperial Oil - Norman Wells																			
	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (Hot Water Soluble) (mg/kg)	Cadmium (mg/kg)	Chromium (6+) (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Thallium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
CCME Residential/Parkland Fine Surface (Islands)	20	12	500	4	---	10	0.4	64	50	63	140	6.6	10	50	1	1	23	130	200
CCME Industrial Fine Surface (Mainland)	40	12	2000	8	---	22	1.4	87	300	91	600	50	40	50	2.9	1	300	130	360
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-1	2	9.05	471	0.83	2.64	1.01	0.15	51	10.7	22.7	12	0.13	17.2	33.8	1.62	1.26	4.2	45.7	90.2
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-1	2	11	515	0.9	3	1.03	0.15	86.4	12	26	14	0.14	44	39	2.7	2.5	4.5	47	100
95th Percentile Background - Organic Surface Soil (Islands) - S-CAT-10	1	9.7	356	0.8	0.45	0.94	0.14	16.4	8.9	20.6	10.6	0.1	2.1	28.2	1	0.36	0.8	26.2	116
Maximum Background - Organic Surface Soil (Islands) - S-CAT-10	1	10	380	0.8	0.45	1	0.15	17	9	21	11	0.1	2.2	29	1	0.4	0.9	27	120
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-2	1	12.6	397	0.84	1.13	0.89	0.15	29.8	14	26	13.2	0.08	2.6	41.6	0.89	0.3	1.5	46.1	142
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-2	1	19	402	0.87	1.2	1.09	0.15	37	18	35	14	0.09	2.8	56	0.9	0.3	1.9	50	150
95th Percentile Background - Mineral Surface Soil (Islands) - S-CAT-11	1	8.8	353	0.62	0.31	0.9	0.15	21.5	9.54	21.8	12.6	0.07	3.2	29.6	0.88	0.3	1	29.4	108.5
Maximum Background - Mineral Surface Soil (Islands) - S-CAT-11	1	9.4	360	0.63	0.31	1.32	0.15	30	9.8	23	13.9	0.08	4.1	32	1.01	0.3	1.2	29.5	140
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	1	25.2	398	1.06	1.86	0.89	0.18	35	18.9	37.8	18.4	0.11	5.58	60.4	1.28	0.7	2	48.6	148
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	2	49	660	1.4	3.7	2	0.3	39	24.7	45	25.6	0.33	11	127	2.7	1	2.3	66	350
95th Percentile Background - Mineral Subsurface Soil (Islands) - S-CAT-12	1	9.25	368	0.6	0.52	0.7	0.15	18	9.4	22.9	11	0.06	2.4	29.9	0.8	0.3	1	30	99.9
Maximum Background - Mineral Subsurface Soil (Islands) - S-CAT-12	2	9.9	408	0.8	0.58	0.9	0.15	20	10	25	12	0.1	14	31	1	1	2	36	120
95th Percentile Background - Bedrock (Mainland Siltstone) - S-CAT-4	1	23.8	454	0.93	3	0.12	0.15	41.8	21.8	50	14.8	0.11	0.74	63.2	0.5	0.3	1	62.2	148
Maximum Background - Bedrock (Mainland Siltstone) - S-CAT-4	1	24	500	0.95	3.1	0.12	0.15	42	22	53	15	0.12	0.81	64	0.5	0.3	1	64	150
95th Percentile Background - Bedrock (Mainland Shale) - S-CAT-5	NC	39.6	NC	0.65	NC	0.74	NC	51.2	6.97	42.5	10.8	0.284	64.7	49.2	7.56	2.29	NC	125.7	106.2
Maximum Background - Bedrock (Mainland Shale) - S-CAT-5	NC	42.9	NC	0.66	NC	0.82	NC	53.6	7.16	43.6	11	0.312	66.4	49.6	7.9	2.33	NC	129	108

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Table 4
Soil and Bedrock Background Geochemical Statistical Summary (1998-2016)

Background Geochemical Statistics for Soil and Bedrock: Petroleum Hydrocarbon Parameters

Imperial Oil - Norman Wells

	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (Total) (mg/kg)	PHC-F1 (-BTEX) (mg/kg)	PHC-F2 (mg/kg)	PHC-F3 (mg/kg)	PHC-F4 (mg/kg)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo[b&j]fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo[a,h]anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno[1,2,3-cd]pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
CCME Residential/Parkland Fine Surface (Islands)	2.1	110	120	65	210	150	1300	5600	0.28	320	2.5	1	0.6	1	6.2	1	15.4	0.25	1	0.013	0.046	7.7
CCME Industrial Fine Surface (Mainland)	2.8	330	430	230	320	260	2500	6600	0.28	320	32	10	72	10	NA	10	180	0.25	10	0.013	0.046	100
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-1	0.018	0.073	0.036	0.144	43.3	111.5	831.5	195.5	0.016	0.016	0.012	0.02	0.02	0.02	0.15	0.0158	0.0196	0.026	0.0196	0.0226	0.3224	0.0476
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-1	0.019	0.076	0.038	0.15	45	150	1200	200	0.019	0.019	0.015	0.02	0.02	0.02	0.23	0.019	0.02	0.03	0.02	0.025	0.52	0.066
95th Percentile Background - Organic Surface Soil (Islands) - S-CAT-10	0.0234	0.0704	0.0436	0.288	25.2	41.2	422	157	0.005	0.005	0.004	0.005	0.005	0.0145	0.008	0.005	0.0078	0.0069	0.005	0.0301	0.035	0.0135
Maximum Background - Organic Surface Soil (Islands) - S-CAT-10	0.028	0.083	0.052	0.35	27	44	440	160	0.005	0.005	0.004	0.005	0.005	0.015	0.008	0.005	0.0083	0.0072	0.005	0.033	0.037	0.014
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-2	0.011	0.044	0.022	0.088	14.1	33.8	277	118	0.005	0.005	0.004	0.01	0.01	0.014	0.01	0.005	0.01	0.018	0.01	0.0117	0.0289	0.0134
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-2	0.012	0.046	0.023	0.092	15	38	310	120	0.005	0.005	0.004	0.01	0.01	0.015	0.01	0.005	0.01	0.019	0.01	0.012	0.031	0.014
95th Percentile Background - Mineral Surface Soil (Islands) - S-CAT-11	0.0182	0.0656	0.047	0.34	29.2	43.8	274	90	0.005	0.005	0.004	0.008	0.008	0.0255	0.0176	0.007	0.012	0.01	0.011	0.0395	0.0379	0.0192
Maximum Background - Mineral Surface Soil (Islands) - S-CAT-11	0.038	0.095	0.089	0.72	52	72	370	96	0.005	0.005	0.004	0.009	0.009	0.029	0.019	0.008	0.014	0.011	0.012	0.05	0.04	0.021
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	0.015	0.02	0.016	0.081	18.3	83.7	536.5	209.5	0.006	0.006	0.004	0.006	0.009	0.022	0.025	0.006	0.011	0.013	0.01	0.018	0.045	0.02
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-3	0.02	0.18	0.059	0.34	42	180	1800	830	0.01	0.01	0.004	0.01	0.01	0.027	0.026	0.01	0.012	0.03	0.01	0.022	0.063	0.022
95th Percentile Background - Mineral Subsurface Soil (Islands) - S-CAT-12	0.005	0.02	0.01	0.04	15.5	27	207	86	0.005	0.005	0.004	0.005	0.005	0.019	0.034	0.005	0.008	0.005	0.0064	0.025	0.059	0.0164
Maximum Background - Mineral Subsurface Soil (Islands) - S-CAT-12	0.02	0.048	0.021	0.04	30	79	380	96	0.005	0.005	0.004	0.005	0.005	0.02	0.059	0.005	0.008	0.005	0.009	0.028	0.11	0.019
95th Percentile Background - Bedrock (Mainland) - S-CAT-4	0.0775	0.4	0.96	6.08	96.8	825.5	1265	288	0.034	0.023	0.004	0.023	0.0065	0.027	0.122	0.007	0.014	0.236	0.005	0.048	0.771	0.08
Maximum Background - Bedrock (Mainland) - S-CAT-4	0.15	0.78	1.9	12.1	140	920	1400	410	0.037	0.025	0.004	0.025	0.0067	0.027	0.13	0.007	0.014	0.26	0.005	0.05	0.83	0.086

Table 5

Natural Seeps Soil and Bedrock Background Geochemical Statistical Summary (1998-2016)

Background Geochemical Statistics for Natural Seeps Soil and Bedrock: Salinity Parameters

Imperial Oil - Norman Wells

	pH (pH units)	EC (dS/m)	SAR (ratio)
CCME Industrial Fine Surface	6 - 8	4	12
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-6	7.45	1.32	1.27
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-6	7.49	1.4	1.4
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-7	7.72	0.79	0.64
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-7	7.72	0.8	0.7
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	7.78	0.98	7.28
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	7.8	1.1	11
95th Percentile Background - Bedrock (Mainland Siltstone) - S-CAT-9	7.75	0.9	2.84
Maximum Background - Bedrock (Mainland Siltstone) - S-CAT-9	7.78	0.97	2.9

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

Background Geochemical Statistics for Natural Seeps Soil and Bedrock: Metals and Trace Elements

Imperial Oil - Norman Wells

	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (Hot Water Soluble) (mg/kg)	Cadmium (mg/kg)	Chromium (6+) (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Thallium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
CCME Industrial Fine Surface	40	12	2000	8	---	22	1.4	87	300	91	600	50	40	50	2.9	1	300	130	360
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-6	1	10.4	476.5	0.8	3.1	1.35	0.14	29.5	14.4	23.7	20.7	0.11	12.5	45.1	1.08	0.55	2.83	43	127
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-6	1	11	520	0.8	3.5	1.5	0.15	33	16	24	21	0.11	14	49	1.1	0.6	3	46	130
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-7	1	11.6	419.5	0.83	0.68	0.9	0.15	23.55	10.3	18.6	13.6	0.08	2.23	29.6	0.91	0.3	1.6	41.8	113
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-7	1	13	430	0.85	0.7	1.1	0.15	26	11	19	14	0.1	2.3	31	1	0.3	1.6	46	120
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	1	20.2	360	0.87	1.65	0.96	0.15	33.6	17.4	41.8	15.4	0.05	2.84	52.2	0.98	0.3	1.28	46.8	154
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	1	25	380	0.99	2.3	1.2	0.15	42	21	49	17	0.05	3	63	1.1	0.3	1.4	54	170
95th Percentile Background - Bedrock (Mainland Siltstone) - S-CAT-9	1	21	194	0.61	1.2	0.1	0.15	36.4	18.7	30.1	11	0.076	0.4	55.1	0.5	0.3	1	86.8	135.5
Maximum Background - Bedrock (Mainland Siltstone) - S-CAT-9	1	21	200	0.65	1.2	0.1	0.15	37	19	31	11	0.08	0.4	56	0.5	0.3	1	94	140

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Table 5
Natural Seeps Soil and Bedrock Background Geochemical Statistical Summary (1998-2016)

Background Geochemical Statistics for Natural Seeps Soil and Bedrock: Petroleum Hydrocarbon Parameters

Imperial Oil - Norman Wells

	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (Total) (mg/kg)	PHC-F1 (-BTEX) (mg/kg)	PHC-F2 (mg/kg)	PHC-F3 (mg/kg)	PHC-F4 (mg/kg)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo[b&j]fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo[a,h]anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno[1,2,3-cd]pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
CCME Industrial Fine Surface	2.8	330	430	230	320	260	2500	6600	0.28	320	32	10	72	10	NA	10	180	0.25	10	0.013	0.046	100
95th Percentile Background - Organic Surface Soil (Mainland) - S-CAT-6	0.011	0.044	0.022	0.09	18	150.7	4645	3019	0.01	0.01	0.008	0.01	0.0117	0.029	0.121	0.0117	0.011	0.0117	0.011	0.015	0.254	0.019
Maximum Background - Organic Surface Soil (Mainland) - S-CAT-6	0.011	0.044	0.022	0.09	19	160	5200	3400	0.01	0.01	0.008	0.01	0.012	0.032	0.14	0.012	0.011	0.012	0.011	0.016	0.29	0.019
95th Percentile Background - Mineral Surface Soil (Mainland) - S-CAT-7	0.009	0.037	0.184	0.074	12.6	215.5	4750	3135	0.0165	0.011	0.009	0.013	0.026	0.016	0.107	0.009	0.019	0.017	0.012	0.034	0.045	0.043
Maximum Background - Mineral Surface Soil (Mainland) - S-CAT-7	0.012	0.046	0.023	0.092	13	240	5100	3800	0.02	0.012	0.01	0.014	0.032	0.017	0.15	0.01	0.024	0.021	0.013	0.047	0.052	0.059
95th Percentile Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	2.655	0.078	2.96	18.55	973	2706.5	4438.5	1691.5	0.149	0.02	0.004	0.076	0.005	0.065	0.633	0.006	0.034	0.646	0.005	1.386	2.366	0.286
Maximum Background - Mineral Subsurface Soil (Mainland) - S-CAT-8	2.9	0.097	4.3	21	1400	3900	6500	2500	0.21	0.026	0.004	0.11	0.005	0.091	0.95	0.006	0.048	0.93	0.005	2.1	3.5	0.43
95th Percentile Background - Bedrock (Mainland Siltstone) - S-CAT-9	0.034	0.02	0.018	0.06	139.5	1185	2780	1035.5	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Maximum Background - Bedrock (Mainland Siltstone) - S-CAT-9	0.039	0.02	0.02	0.063	150	1200	2900	1100	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

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Table 6
Groundwater Indicator Parameters - Background Geochemical Statistical Summary (1997-2017)

PROJECT No.: 407011-00622

Monitoring Station	Bicarbonate (mg/L)	Calcium (mg/L)	Carbonate (CO3) (mg/L)	Chloride (mg/L)	Electrical Conductivity (uS/cm)	Hardness (as CaCO3) (mg/L)	Hydroxide (mg/L)	Nitrate (as N) (mg/L)	Nitrite (as N) (mg/L)	pH (pH units)	Phenols (mg/L)	Potassium (mg/L)	PP Alkalinity (as CaCO3) (mg/L)	Sodium (mg/L)	Sulphate (mg/L)	Total Dissolved Solids (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**NA**	**NA**	**NA**	**120**	**NA**	**NA**	**NA**	**3**	**0.06**	**(6.5 - 9)**	**0.004**	**NA**	**NA**	**NA**	**NA**	**NA**
Background - Surficial Sediments																
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background	1000	322	0.5	18	2355	1253	0.5	5.4	0.03	8.1	0.013	5.4	1.0	160	728	1640
W-CAT-1: Mainland Locations - Surficial Sediments - Maximum Background	1100	400	0.5	26	2800	1600	0.5	36	0.11	8.1	0.021	12.0	1.0	180	980	2200
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background	987	480	0.5	18	2600	1600	0.5	2.5	0.04	8.0	0.014	4.5	0.5	125	970	2295
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - Maximum Background	1200	540	0.5	25	3000	1800	0.5	23	0.17	8.1	0.048	5.3	0.5	520	1200	2700
Background - Shallow Bedrock - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage																
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline Water & Oil Seepage - 95th Percentile Background	1570	147	26	314	2954	350	0.5	1.8	0.06	8.5	0.019	6.4	21	747	98	1956
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline water & Oil Seepage - Maximum Background	1680	170	40	346	3100	390	1.0	4.0	0.26	8.6	0.025	6.8	33	771	185	2600
Background - Surficial Sediments - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage																
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - 95th Percentile Background	1220	350	62	280	2780	1200	1.0	0.2	0.06	8.7	0.020	7.5	51	440	990	2015
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - Maximum Background	1300	390	200	291	2800	1300	1.0	0.4	0.06	10.1	0.023	8.6	160	680	1000	2300
Background - Surficial Sediments - Inferred to Represent Natural Gas Seepage without Saline Water																
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - 95th Percentile Background	879	270	1.0	11	1392	741	1.0	0.2	0.06	7.7	0.063	7.0	1.0	49	204	948
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - Maximum Background	950	330	1.0	13	1600	750	1.0	0.2	0.06	7.9	0.072	10.0	1.0	72	330	1200

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

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Table 7
Groundwater Dissolved Metals - Background Geochemical Statistical Summary (1997-2017)

PROJECT No.: 407011-00622

Monitoring Station	Aluminum (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Uranium (mg/L)	Zinc (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**0.1**	**0.005**	**NA**	**1.5**	**0.00009**	**0.0089**	**0.004**	**0.3**	**0.007**	**NA**	**0.000026**	**0.073**	**0.15**	**0.001**	**0.00025**	**0.0008**	**0.015**	**0.007**
Background - Surficial Sediments																		
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background	0.05	0.006	0.55	0.29	0.0020	0.007	0.012	5	0.020	3	0.00037	0.005	0.03	0.003	0.0100	0.020	0.040	0.030
W-CAT-1: Mainland Locations - Surficial Sediments - Maximum Background	0.08	0.070	0.88	0.34	0.0020	0.010	0.020	10	0.100	4	0.00094	0.005	0.04	0.030	0.0100	0.030	1.0	0.042
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background	0.03	0.002	0.22	0.04	0.00047	0.001	0.010	12	0.001	6	0.00000	0.025	0.02	0.001	0.0001	0.0002	0.029	0.030
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - Maximum Background	0.04	0.004	0.23	0.09	0.00073	0.010	0.014	64	0.002	10	0.00000	0.041	0.04	0.002	0.0010	0.002	0.082	0.034
Background - Shallow Bedrock - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage																		
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.12	0.050	7.5	1.34	0.0020	0.007	0.012	2	0.030	0.3	0.00025	0.009	0.02	0.004	0.0002	0.030	0.076	0.018
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline water & Oil Seepage - Maximum Background	5.35	0.066	9.3	1.37	0.0020	0.007	0.019	12	0.100	0.8	0.00058	0.031	0.04	0.030	0.0100	0.030	1.0	0.212
Background - Surficial Sediments - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage																		
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.07	0.031	1.4	1.13	0.0014	0.007	0.012	25	0.042	3	0.00005	0.020	0.02	0.001	0.0001	0.0012	0.41	1.40
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - Maximum Background	0.12	0.035	2.0	1.40	0.0020	0.007	0.014	28	0.100	3	0.00005	0.020	0.02	0.002	0.0002	0.0016	1.0	1.70
Background - Surficial Sediments - Inferred to Represent Natural Gas Seepage without Saline Water																		
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - 95th Percentile Background	0.03	0.016	1.3	0.09	0.0013	0.007	0.008	14	0.051	5	0.00005	0.006	0.02	0.002	0.0001	0.0008	0.51	0.022
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - Maximum Background	0.14	0.021	1.4	0.12	0.0020	0.007	0.009	19	0.100	6	0.00005	0.006	0.03	0.003	0.0002	0.0008	1.0	0.037

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

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Table 8
Groundwater PHCs
Background Geochemical Statistical Summary (1997-2017)

PROJECT No.: 407011-00622

Monitoring Station	Benzene (mg/L)	Ethylbenzene (mg/L)	PHC F1 (C6-C10) - BTEX (mg/L)	PHC F2 (C10-C16) (mg/L)	Toluene (mg/L)	Xylenes-Total (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**0.37**	**0.09**	**NA**	**NA**	**0.002**	**NA**
Background - Surficial Sediments						
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background	0.0005	0.0005	0.1	0.1	0.0005	0.0010
W-CAT-1: Mainland Locations - Surficial Sediments - Maximum Background	0.01	0.01	0.19	0.20	0.01	0.01
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background	0.0004	0.0004	0.1	0.1	0.0004	0.0008
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - Maximum Background	0.0004	0.0004	0.1	0.1	0.0004	0.0008
Background - Shallow Bedrock - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage						
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.06	0.002	0.89	35	0.003	0.010
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline water & Oil Seepage - Maximum Background	0.17	0.05	3.90	130	0.050	0.10
Background - Surficial Sediments - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage						
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.09	0.002	0.24	1.6	0.0009	0.014
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - Maximum Background	0.10	0.003	0.60	3.0	0.0014	0.08
Background - Surficial Sediments - Inferred to Represent Natural Gas Seepage without Saline Water						
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - 95th Percentile Background	0.97	0.007	0.28	2.1	0.016	0.22
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - Maximum Background	1.25	0.025	0.82	2.8	0.025	0.37

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

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Table 9
Groundwater PAHs - Background Geochemical Statistical Summary (1997-2017)

PROJECT No.: 407011-00622

Monitoring Station	Acenaphthene (mg/L)	Acridine (mg/L)	Anthracene (mg/L)	Benzo[a]anthracene (mg/L)	Benzo[a]pyrene (mg/L)	Fluoranthene (mg/L)	Fluorene (mg/L)	Naphthalene (mg/L)	Phenanthrene (mg/L)	Pyrene (mg/L)	Quinoline (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**0.0058**	**0.0044**	**0.000012**	**0.000018**	**0.000015**	**0.00004**	**0.003**	**0.0011**	**0.0004**	**0.000025**	**0.0034**
Background - Surficial Sediments											
W-CAT-1: Mainland Locations - Surficial Sediments - 95th Percentile Background	0.00010	0.00005	0.000010	0.000009	0.0000075	0.00004	0.00005	0.0001	0.00008	0.000036	0.0002
W-CAT-1: Mainland Locations - Surficial Sediments - Maximum Background	0.00010	0.00005	0.000032	0.000068	0.0000075	0.00039	0.00005	0.0001	0.00036	0.00028	0.0002
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - 95th Percentile Background	0.00010	0.00005	0.000010	0.000009	0.0000075	0.00001	0.00005	0.0001	0.00006	0.000020	0.0002
W-CAT-2: Bear, Goose, and Frenchy's Islands - Surficial Sediments - Maximum Background	0.00010	0.00005	0.000010	0.000009	0.0000075	0.00001	0.00005	0.0001	0.00007	0.000020	0.0002
Background - Shallow Bedrock - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage											
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.00053	0.00005	0.000012	0.000088	0.000035	0.00007	0.0016	0.0054	0.0037	0.00026	0.0002
W-CAT-3: Mainland - Shallow Bedrock - Natural Saline water & Oil Seepage - Maximum Background	0.00096	0.00005	0.000034	0.000110	0.000077	0.00009	0.0022	0.0066	0.0047	0.00049	0.0002
Background - Surficial Sediments - Inferred to Represent Natural Saline Water & Hydrocarbon Seepage											
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - 95th Percentile Background	0.00042	NC	0.000024	0.000009	0.0000075	0.00006	0.0018	0.0031	0.0017	0.00020	NC
W-CAT-4: Mainland - Surficial Sediments - Natural Saline Water & Oil Seepage - Maximum Background	0.00062	NC	0.000076	0.000016	0.0000075	0.00006	0.0020	0.0038	0.0037	0.00021	NC
Background - Surficial Sediments - Inferred to Represent Natural Gas Seepage without Saline Water											
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - 95th Percentile Background	0.00016	0.00005	0.000049	0.000038	0.000013	0.00030	0.0002	0.0035	0.00042	0.00022	0.0002
W-CAT-5: Mainland - Surficial Sediments - Natural Gas & Non-Saline Water Seepage - Maximum Background	0.00016	0.00005	0.000051	0.000040	0.000013	0.00032	0.0002	0.0037	0.00044	0.00023	0.0002

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

Advisian
WorleyParsons Group

Table 10
Surface Water Background Geochemical Statistical Summary (2009-2016)

Background Geochemical Statistics for Surface Water: Salinity and Phenols Parameters

Imperial Oil - Norman Wells

	Calcium (mg/L)	Chloride (mg/L)	Electrical Conductivity (uS/cm)	pH (pH units)	Sulphate (mg/L)	Phenols (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**NA**	**120**	**NA**	**(6.5 - 9)**	**NA**	**0.004**
95th Percentile Background - Mainland - W-CAT-6	138	49	865	8.3	180	0.0099
Maximum Background - Mainland - W-CAT-6	190	120	920	8.4	220	0.01
95th Percentile Background - Bear Island - W-CAT-7	197	35	1520	8.3	422	0.011
Maximum Background - Bear Island - W-CAT-7	300	36	1800	8.4	680	0.019
95th Percentile Background - Goose Island - W-CAT-8	79	5	514	8.5	72	0.007
Maximum Background - Goose Island - W-CAT-8	88	6	590	9.1	77	0.0083

NA Denotes guideline not available
NC Denotes parameters not measured / not calculated
Shading indicates parameters above most restrictive guidelines selected

Background Geochemical Statistics for Surface Water: Metals and Trace Elements

Imperial Oil - Norman Wells

	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Thallium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**0.1**	**NA**	**0.005**	**NA**	**NA**	**1.5**	**0.00009**	**0.0089**	**NA**	**0.004**	**0.3**	**0.007**	**NA**	**NA**	**NA**	**0.000026**	**0.073**	**0.15**	**0.001**	**0.0008**	**0.015**	**NA**	**0.007**
95th Percentile Background - Mainland - W-CAT-6	0.85	0.006	0.007	0.30	0.010	0.04	0.0001	0.010	0.004	0.005	31	0.002	0.020	32	1.6	0.000005	0.011	0.007	0.002	0.002	0.005	0.010	0.040
Maximum Background - Mainland - W-CAT-6	9.9	0.006	0.022	0.57	0.010	0.11	0.001	0.019	0.014	0.043	71	0.025	0.020	33	2.9	0.000005	0.070	0.063	0.006	0.002	0.008	0.071	0.17
95th Percentile Background - Bear Island - W-CAT-7	0.64	0.001	0.005	0.26	0.001	0.02	0.0001	0.001	0.003	0.003	3.9	0.001	0.0218	128	0.88	NC	0.003	0.009	0.0006	0.0002	0.003	0.006	0.025
Maximum Background - Bear Island - W-CAT-7	1.9	0.003	0.01	0.66	0.001	0.03	0.0002	0.004	0.004	0.006	7.0	0.003	0.028	150	1.7	NC	0.017	0.013	0.001	0.0002	0.0230	0.006	0.036
95th Percentile Background - Goose Island - W-CAT-8	0.58	0.0006	0.003	0.24	0.001	0.02	0.00007	0.001	0.001	0.004	2.4	0.001	0.020	14	0.40	NC	0.003	0.004	0.0003	0.0002	0.0008	0.006	0.009
Maximum Background - Goose Island - W-CAT-8	0.74	0.001	0.003	0.29	0.001	0.03	0.00008	0.002	0.002	0.004	3.7	0.002	0.020	17	0.95	NC	0.003	0.005	0.0003	0.0002	0.001	0.006	0.012

Imperial Oil - Norman Wells

	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes-Total (mg/L)	PHC F1 (C6-C10) (mg/L)	PHC F1 (C6-C10) - BTEX (mg/L)	PHC F2 (C10-C16) (mg/L)	Acenaphthene (ug/L)	Acenaphthylene (ug/L)	Anthracene (ug/L)	Benzo[a]anthracene (ug/L)	Benzo[a]pyrene (ug/L)	Benzo[a]pyrene Total Potency Equivalent (ug/L)	Benzo[b&j]fluoranthene (ug/L)	Benzo[g,h,i]perylene (ug/L)	Benzo[k]fluoranthene (ug/L)	Chrysene (ug/L)	Dibenzo[a,h]anthracene (ug/L)	Fluoranthene (ug/L)	Fluorene (ug/L)	Indeno[1,2,3-cd]pyrene (ug/L)	Naphthalene (ug/L)	Phenanthrene (mg/L)	Pyrene (mg/L)
CCME 2018. CEQG Freshwater Aquatic Life	**0.37**	**0.002**	**0.09**	**NA**	**NA**	**NA**	**NA**	**0.0058**	**NA**	**0.000012**	**0.000018**	**0.000015**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00004**	**0.003**	**NA**	**0.0011**	**0.0004**	**0.0034**
95th Percentile Background - Mainland - W-CAT-6	0.0004	0.00053	0.0004	0.0008	0.1	0.1	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Maximum Background - Mainland - W-CAT-6	0.0011	0.0046	0.0004	0.0008	0.1	0.1	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
95th Percentile Background - Bear Island - W-CAT-7	0.0004	0.0004	0.0004	0.0008	0.1	0.1	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Maximum Background - Bear Island - W-CAT-7	0.0004	0.0004	0.0004	0.0008	0.10	0.10	0.10	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
95th Percentile Background - Goose Island - W-CAT-8	0.0004	0.0004	0.0004	0.0008	0.1	0.1	0.1	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Maximum Background - Goose Island - W-CAT-8	0.0004	0.0004	0.0004	0.0008	0.10	0.10	0.10	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Appendix C
Field Methodologies

Groundwater Sampling Methods

Field Measurements, Sampling and Handling

Prior to collection of groundwater samples, the water and/or hydrocarbon level was measured from the top of the piezometer casing using a commercially-available electric water level meter.

Subsequently, groundwater from each monitoring well was collected for and laboratory analysis, using either dedicated or disposable bailers, Waterra^{TM}, or HydraSleeves^{TM} with no-purge methodology for the following primary indicator analyses per the GMP:

Dissolved Chloride: 1 x 500 mL aliquot (unfiltered and chemically unpreserved) for analysis of major ions.

BTE: 3 x 44 mL aliquots (placed in glass vials containing $NaHSO_4$ preservative, no headspace) for analysis of BTE compounds (benzene, toluene, and ethylbenzene).

Additional samples were collected for the secondary indicators as per the GMP. Upon completion of sampling at each location, all equipment was thoroughly rinsed with deionized water. New bailing rope (as required) and clean disposable nitrile gloves were used at each piezometer to reduce the potential for cross-contamination. Samples were stored in iced coolers to maintain approximate in situ temperatures, and were promptly shipped to Maxxam Analytics Inc., in Edmonton, Alberta. Standard chain-of-custody procedures were followed.

Appendix D
Laboratory Analytical Reports

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 18-Jun-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B948836

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	Yes
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: No

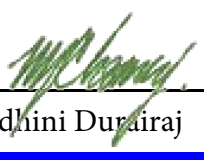
Date DQO was received:

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj

Date: 04-Jul-19

Data Reviewed by (Signature): 

Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299331

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/06/27
Report #: R2744199
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B948836
Received: 2019/06/20, 13:05

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	1	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	1		Auto Calc
Cadmium - low level CCME - Dissolved	1		Auto Calc
Chloride/Sulphate by Auto Colourimetry	1	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Container Supply & Nonhazardous Disposal	1		
Conductivity @25C	1	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	1	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	1		Auto Calc
Mercury (Dissolved) by CV (1)	1	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Elements by ICP - Dissolved (3)	1	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (3)	1	AB SOP-00043	EPA 6020b R2 m
Ion Balance	1		Auto Calc
Nitrate and Nitrite	1		Auto Calc
Nitrate + Nitrite-N (calculated)	1		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	1	AB SOP-00023	SM 23 4110 B m
Filter and HNO3 Preserve for Metals (1)	1	BBY7 WI-00004	SM 23 3030B m
Phenols (4-AAP)	1	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	1	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299331

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/06/27
Report #: R2744199
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B948836
Received: 2019/06/20, 13:05

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 BV Labs Vancouver
(2) Silica gel clean up employed.
(3) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs 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.

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		VY0375		
Sampling Date		2019/06/18 14:30		
COC Number		299331		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9478161
Volatiles				
Benzene	mg/L	<0.00040	0.00040	9478084
Toluene	mg/L	<0.00040	0.00040	9478084
Ethylbenzene	mg/L	<0.00040	0.00040	9478084
m & p-Xylene	mg/L	<0.00080	0.00080	9478084
o-Xylene	mg/L	<0.00040	0.00040	9478084
Xylenes (Total)	mg/L	<0.00089	0.00089	9476254
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9476254
LH (C5-C10)	mg/L	<0.10	0.10	9478084
F1 (C6-C10)	mg/L	<0.10	0.10	9478084
Extraction Surrogate Recovery (%)				
O-TERPHENYL (sur.)	%	99		9478161
Instrument Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	98		9478084
4-Bromofluorobenzene (sur.)	%	99		9478084
D4-1,2-Dichloroethane (sur.)	%	91		9478084
RDL = Reportable Detection Limit				

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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		VY0375		
Sampling Date		2019/06/18 14:30		
COC Number		299331		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**
Low Level Elements				
Dissolved Cadmium (Cd)	mg/L	0.00016	0.000020	9475198
Elements				
Dissolved Mercury (Hg)	ug/L	<0.0020	0.0020	9479817
Dissolved Aluminum (Al)	mg/L	0.0032	0.0030	9478512
Dissolved Antimony (Sb)	mg/L	0.00090	0.00060	9478512
Dissolved Arsenic (As)	mg/L	<0.00020	0.00020	9478512
Dissolved Barium (Ba)	mg/L	0.035	0.010	9477656
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9478512
Dissolved Boron (B)	mg/L	<0.020	0.020	9477656
Dissolved Calcium (Ca)	mg/L	290	0.30	9477656
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9478512
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	9478512
Dissolved Copper (Cu)	mg/L	0.0036	0.00020	9478512
Dissolved Iron (Fe)	mg/L	<0.060	0.060	9477656
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9478512
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9477656
Dissolved Magnesium (Mg)	mg/L	69	0.20	9477656
Dissolved Manganese (Mn)	mg/L	<0.0040	0.0040	9477656
Dissolved Molybdenum (Mo)	mg/L	0.033	0.00020	9478512
Dissolved Nickel (Ni)	mg/L	0.011	0.00050	9478512
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9477656
Dissolved Potassium (K)	mg/L	1.2	0.30	9477656
Dissolved Selenium (Se)	mg/L	0.23	0.00020	9478512
Dissolved Silicon (Si)	mg/L	4.9	0.10	9477656
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9478512
Dissolved Sodium (Na)	mg/L	3.2	0.50	9477656
Dissolved Strontium (Sr)	mg/L	0.43	0.020	9477656
Dissolved Sulphur (S)	mg/L	270	0.20	9477656
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9478512
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9478512
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9478512
RDL = Reportable Detection Limit				

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		VY0375		
Sampling Date		2019/06/18 14:30		
COC Number		299331		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**
Dissolved Uranium (U)	mg/L	0.049	0.00010	9478512
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9478512
Dissolved Zinc (Zn)	mg/L	0.0064	0.0030	9478512
RDL = Reportable Detection Limit				

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BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		VY0375			VY0375		
Sampling Date		2019/06/18 14:30			2019/06/18 14:30		
COC Number		299331			299331		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**	**MTF 97-1-5 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD		ONSITE			
Hardness (CaCO3)	mg/L	1000	0.50	9476262			
Ion Balance (% Difference)	%	6.9	N/A	9476264			
Dissolved Nitrate (NO3)	mg/L	15	0.044	9476265			
Nitrate plus Nitrite (N)	mg/L	3.3	0.014	9476266			
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9476265			
Misc. Inorganics							
Conductivity	uS/cm	1600	2.0	9481664			
Total Dissolved Solids	mg/L	1400	10	9476987			
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9481662			
Alkalinity (Total as CaCO3)	mg/L	170	1.0	9481662			
Bicarbonate (HCO3)	mg/L	210	1.0	9481662			
Carbonate (CO3)	mg/L	<1.0	1.0	9481662			
Hydroxide (OH)	mg/L	<1.0	1.0	9481662			
Dissolved Chloride (Cl)	mg/L	<1.0	1.0	9479588	<1.0	1.0	9479588
Dissolved Sulphate (SO4)	mg/L	680 (1)	5.0	9479588	770 (1)	5.0	9479588
Nutrients							
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9477686			
Dissolved Nitrate (N)	mg/L	3.3	0.010	9477686			
Misc. Organics							
Phenols	mg/L	<0.0015	0.0015	9483052			

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: VY0375
Sample ID: MTF 97-1-5
Matrix: Water

Collected: 2019/06/18
Relinquished: 2019/06/19
Received: 2019/06/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9481662	N/A	2019/06/25	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9478084	N/A	2019/06/22	Niloufar Behin Aein
F1-BTEX	CALC/MS	9476254	N/A	2019/06/24	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9475198	N/A	2019/06/25	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9479588	N/A	2019/06/23	Marissa Richard
Conductivity @25C	COND	9481664	N/A	2019/06/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9478161	2019/06/21	2019/06/23	Preeti Patel
Hardness	CALC	9476262	N/A	2019/06/24	Automated Statchk
Mercury (Dissolved) by CV	CV	9479817	2019/06/24	2019/06/24	Edwin Lamigo
Elements by ICP - Dissolved	ICPA	9477656	N/A	2019/06/23	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9478512	N/A	2019/06/24	Julie Harrison
Ion Balance	CALC	9476264	N/A	2019/06/20	Automated Statchk
Nitrate and Nitrite	CALC	9476265	N/A	2019/06/22	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9476266	N/A	2019/06/22	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9477686	N/A	2019/06/22	Christine Albrecht
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2019/06/20	David Tidman
Phenols (4-AAP)	TECH/4AAP	9483052	N/A	2019/06/26	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9476987	2019/06/21	2019/06/22	May Al-Jarah

BV Labs ID: VY0375 Dup
Sample ID: MTF 97-1-5
Matrix: Water

Collected: 2019/06/18
Relinquished: 2019/06/19
Received: 2019/06/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride/Sulphate by Auto Colourimetry	KONE	9479588	N/A	2019/06/23	Marissa Richard

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

GENERAL COMMENTS

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

Package 1	4.0°C

Temperatures upon receipt at BV Labs Vancouver
Package 1: 3.3 degrees C
Each temperature is the average of up to three cooler temperatures taken at receipt

Sample VY0375 [MTF 97-1-5] : Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Results relate only to the items tested.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9476987	MJA	Method Blank	Total Dissolved Solids	2019/06/22	<10		mg/L	
9477656	MSD	Method Blank	Dissolved Iron (Fe)	2019/06/23	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/06/23	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/06/23	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/06/23	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/06/23	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/06/23	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/06/23	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/06/23	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/06/23	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/06/23	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/06/23	<0.10		mg/L	
			Dissolved Boron (B)	2019/06/23	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/06/23	<0.30		mg/L	
9477686	CAR	Method Blank	Dissolved Nitrite (N)	2019/06/21	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/06/21	<0.010		mg/L	
9478084	NBA	Method Blank	1,4-Difluorobenzene (sur.)	2019/06/22		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/06/22		99	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/06/22		92	%	50 - 140
			Benzene	2019/06/22	<0.00040		mg/L	
			Toluene	2019/06/22	<0.00040		mg/L	
			Ethylbenzene	2019/06/22	<0.00040		mg/L	
			m & p-Xylene	2019/06/22	<0.00080		mg/L	
			o-Xylene	2019/06/22	<0.00040		mg/L	
			LH (C5-C10)	2019/06/22	<0.10		mg/L	
			F1 (C6-C10)	2019/06/22	<0.10		mg/L	
9478161	REE	Method Blank	O-TERPHENYL (sur.)	2019/06/22		103	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/06/22	<0.10		mg/L	
9478512	JHS	Method Blank	Dissolved Aluminum (Al)	2019/06/24	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/06/24	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/06/24	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/06/24	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/06/24	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/06/24	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/06/24	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/06/24	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/06/24	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/06/24	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/06/24	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/06/24	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/06/24	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/06/24	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/06/24	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/06/24	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/06/24	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/06/24	<0.0010		mg/L	
9479588	MRD	Method Blank	Dissolved Chloride (Cl)	2019/06/23	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/06/23	<1.0		mg/L	
9479817	EL2	Method Blank	Dissolved Mercury (Hg)	2019/06/24	<0.0020		ug/L	
9481662	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/06/25	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/06/25	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/06/25	<1.0		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Carbonate (CO3)	2019/06/25	<1.0		mg/L	
			Hydroxide (OH)	2019/06/25	<1.0		mg/L	
9481664	MA4	Method Blank	Conductivity	2019/06/25	<2.0		uS/cm	
9483052	FFE	Method Blank	Phenols	2019/06/26	<0.0015		mg/L	
9479588	MRD	RPD [VY0375-01]	Dissolved Chloride (Cl)	2019/06/23	NC		%	20
			Dissolved Sulphate (SO4)	2019/06/23	14 (1)		%	20
9479588	MRD	Matrix Spike [VY0375-01]	Dissolved Chloride (Cl)	2019/06/23		105	%	80 - 120
			Dissolved Sulphate (SO4)	2019/06/23		NC	%	80 - 120
9476987	MJA	LCS	Total Dissolved Solids	2019/06/22		103	%	80 - 120
9477656	MSD	LCS	Dissolved Iron (Fe)	2019/06/23		98	%	80 - 120
			Dissolved Lithium (Li)	2019/06/23		94	%	80 - 120
			Dissolved Magnesium (Mg)	2019/06/23		96	%	80 - 120
			Dissolved Manganese (Mn)	2019/06/23		97	%	80 - 120
			Dissolved Potassium (K)	2019/06/23		100	%	80 - 120
			Dissolved Sodium (Na)	2019/06/23		99	%	80 - 120
			Dissolved Strontium (Sr)	2019/06/23		91	%	80 - 120
			Dissolved Sulphur (S)	2019/06/23		99	%	80 - 120
			Dissolved Phosphorus (P)	2019/06/23		98	%	80 - 120
			Dissolved Barium (Ba)	2019/06/23		98	%	80 - 120
			Dissolved Silicon (Si)	2019/06/23		96	%	80 - 120
			Dissolved Boron (B)	2019/06/23		98	%	80 - 120
			Dissolved Calcium (Ca)	2019/06/23		98	%	80 - 120
9477686	CAR	LCS	Dissolved Nitrite (N)	2019/06/21		101	%	80 - 120
			Dissolved Nitrate (N)	2019/06/21		101	%	80 - 120
9478084	NBA	LCS	1,4-Difluorobenzene (sur.)	2019/06/22		99	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/06/22		98	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/06/22		92	%	50 - 140
			Benzene	2019/06/22		100	%	60 - 130
			Toluene	2019/06/22		104	%	60 - 130
			Ethylbenzene	2019/06/22		104	%	60 - 130
			m & p-Xylene	2019/06/22		106	%	60 - 130
			o-Xylene	2019/06/22		105	%	60 - 130
			LH (C5-C10)	2019/06/22		110	%	60 - 140
			F1 (C6-C10)	2019/06/22		110	%	60 - 140
9478161	REE	LCS	O-TERPHENYL (sur.)	2019/06/22		92	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/06/22		107	%	60 - 140
9478512	JHS	LCS	Dissolved Aluminum (Al)	2019/06/24		97	%	80 - 120
			Dissolved Chromium (Cr)	2019/06/24		98	%	80 - 120
			Dissolved Cobalt (Co)	2019/06/24		98	%	80 - 120
			Dissolved Copper (Cu)	2019/06/24		99	%	80 - 120
			Dissolved Lead (Pb)	2019/06/24		98	%	80 - 120
			Dissolved Antimony (Sb)	2019/06/24		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/06/24		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/06/24		97	%	80 - 120
			Dissolved Selenium (Se)	2019/06/24		96	%	80 - 120
			Dissolved Silver (Ag)	2019/06/24		97	%	80 - 120
			Dissolved Arsenic (As)	2019/06/24		96	%	80 - 120
			Dissolved Thallium (Tl)	2019/06/24		96	%	80 - 120
			Dissolved Tin (Sn)	2019/06/24		98	%	80 - 120
			Dissolved Titanium (Ti)	2019/06/24		96	%	80 - 120
			Dissolved Uranium (U)	2019/06/24		95	%	80 - 120
			Dissolved Vanadium (V)	2019/06/24		100	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Zinc (Zn)	2019/06/24		99	%	80 - 120
			Dissolved Beryllium (Be)	2019/06/24		93	%	80 - 120
9479588	MRD	LCS	Dissolved Chloride (Cl)	2019/06/23		106	%	80 - 120
			Dissolved Sulphate (SO4)	2019/06/23		106	%	80 - 120
9479817	EL2	LCS	Dissolved Mercury (Hg)	2019/06/24		97	%	80 - 120
9481662	MA4	LCS	Alkalinity (Total as CaCO3)	2019/06/25		99	%	80 - 120
9481664	MA4	LCS	Conductivity	2019/06/25		101	%	90 - 110
9483052	FFE	LCS	Phenols	2019/06/26		93	%	80 - 120

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.

LCS: 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) Detection limits raised due to dilution to bring analyte within the calibrated range.

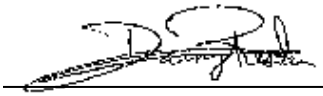
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B948836
Report Date: 2019/06/27

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

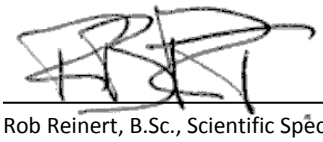
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



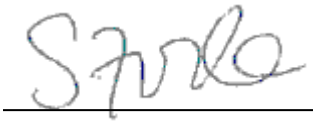
Daniel Reslan, cCT, QP, Organics Manager



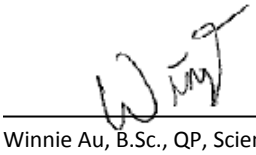
Justin Geisel, B.Sc., Organics Supervisor



Rob Reinert, B.Sc., Scientific Specialist



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst



Winnie Au, B.Sc., QP, Scientific Specialist

BV Labs 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.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Maxxam
A Bureau Veritas Group Company

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☒ Edmonton
9331 - 48 Street, T6B 2R4
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Fax: (780) 450-4187
Toll Free: (800) 386-7247

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

WYS.

C of C # 299331

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: Worleyparsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Melissa Lord, Alex Haigh	Consultant Project #: 407011-00770-400

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	ANALYSIS REQUESTED: VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS TOT ☐ DIS ☒	MERCURY TOTAL ☐ DISSOLVED ☒	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP
1 MTF 97-1-5	X				10	2019/06/18	14:30	X				X							X	X					X			X
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS also email:
canada.chemistry@worleyparsons.com
cacal_IORdatatrack@worleyparsons.com
melissa.lord@advisian.com
IES A26014 36

JARS USED & NOT SUBMITTED Enter N/A for Water: N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	4	4	4
SEAL INTACT	✓			1	2	3
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB #: B948836

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1.	Melissa Lord	2019/06/19	12:00	1.	Testi Al.	2019/06/20	13:05
2.				2.			
3.				3.			

SAMPLES
LABELED BY: TAL
VERIFIED BY:

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

Sent to: **BV Labs Vancouver**
4606 Canada Way
Burnaby, BC, V5G 1K5
Tel: (604) 734-7276

BV LABS INTERLAB CHAIN OF CUSTODY RECORD

DMX

COC # B948836-MVAN-01-01

REPORT INFORMATION	
Company:	Bureau Veritas Laboratories
Address:	9331 - 48th Street, Edmonton, Alberta, T6B 2R4
Contact Name:	Rhecie Phayouphone
Email:	RPhayouphone@bvlabs.com, customerservice@bvlabs.com
Phone:	(403) 735-2283
BV Labs Project #:	B948836
Client Invoice To:	Imperial Oil Ltd - Worley Parsons (12794)
Client Report To:	Advisian (38038) — Incl. on Report? Yes / No

ANALYSIS REQUESTED

Job Barcode Label

B948836

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Filter and HNO3 Preserve for Metals	Mercury (Dissolved) by CV								ADDITIONAL SAMPLE INFORMATION
1	VY0375-MTF 97-1-5	GW	2019/06/18	14:30	ML	1	X	X								(P: 04)
2																
3																
4																
5																
6																
7																
8																
9																
10																

B948836_ISUB;COC

SITE LOCATION:	REGULATORY CRITERIA	SPECIAL INSTRUCTIONS	REQUIRED EDDs	TURNAROUND TIME
Norman Wells, NT	CCME FWAL	Please inform BV Labs immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**	National Excel (N001) Worley Parsons Komex Equis (N026) Standard DBF (Old DBase Names) (A002)	☐ Rush Required 2019/06/26 Date Required *Please inform us if rush charges will be incurred.*
SITE #:				
N/A				
PROJECT #:				
407011-00770-400 (SNP Ops)				
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM:				
A2601436, 407011-00770-400				

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present	✓					
Custody Seal Intact	✓					
Cooling Media Present	✓					
				3	4	3

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RECEIVING LAB USE ONLY

BV Labs Job #

B948836

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	Samples Labelled By:	Labels Verified By:
1. Kyle Van Thournout	2019/06/21	15:40	1. Rong to Lyang	2019/06/22	15:30	TAL	RLC
2.			2.				

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 19-Jun-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B949542

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD			x	
Matrix Spike Recovery			x	
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

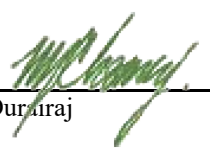
Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 02-Jul-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): 

Date: 04-Jul-19 | Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299334

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/02
Report #: R2746367
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B949542
Received: 2019/06/22, 11:46

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	1	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	1		Auto Calc
Cadmium - low level CCME - Dissolved	1		Auto Calc
Chloride/Sulphate by Auto Colourimetry	1	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	1	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	1	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	1		Auto Calc
Mercury (Dissolved) by CV (1)	1	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Elements by ICP - Dissolved (3)	1	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (3)	1	AB SOP-00043	EPA 6020b R2 m
Ion Balance	1		Auto Calc
Nitrate and Nitrite	1		Auto Calc
Nitrate + Nitrite-N (calculated)	1		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	1	AB SOP-00023	SM 23 4110 B m
Filter and HNO3 Preserve for Metals (1)	1	BBY7 WI-00004	SM 23 3030B m
Phenols (4-AAP)	1	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	1	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299334

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/02
Report #: R2746367
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B949542
Received: 2019/06/22, 11:46

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 BV Labs Vancouver
(2) Silica gel clean up employed.
(3) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283

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BV Labs 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.

BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		VY4473		
Sampling Date		2019/06/19 14:40		
COC Number		299334		
	UNITS	**TF 03-12-3**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9479945
Volatiles				
Benzene	mg/L	<0.00040	0.00040	9479738
Toluene	mg/L	<0.00040	0.00040	9479738
Ethylbenzene	mg/L	<0.00040	0.00040	9479738
m & p-Xylene	mg/L	<0.00080	0.00080	9479738
o-Xylene	mg/L	<0.00040	0.00040	9479738
Xylenes (Total)	mg/L	<0.00089	0.00089	9479667
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9479667
LH (C5-C10)	mg/L	<0.10	0.10	9479738
F1 (C6-C10)	mg/L	<0.10	0.10	9479738
Extraction Surrogate Recovery (%)				
O-TERPHENYL (sur.)	%	95		9479945
Instrument Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	103		9479738
4-Bromofluorobenzene (sur.)	%	100		9479738
D4-1,2-Dichloroethane (sur.)	%	86		9479738
RDL = Reportable Detection Limit				

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BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		VY4473		
Sampling Date		2019/06/19 14:40		
COC Number		299334		
	UNITS	**TF 03-12-3**	**RDL**	**QC Batch**
Low Level Elements				
Dissolved Cadmium (Cd)	mg/L	0.000096	0.000020	9479671
Elements				
Dissolved Mercury (Hg)	ug/L	<0.0020	0.0020	9482786
Dissolved Aluminum (Al)	mg/L	0.0060	0.0030	9480497
Dissolved Antimony (Sb)	mg/L	0.00098	0.00060	9480497
Dissolved Arsenic (As)	mg/L	0.0018	0.00020	9480497
Dissolved Barium (Ba)	mg/L	0.053	0.010	9480493
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9480497
Dissolved Boron (B)	mg/L	0.035	0.020	9480493
Dissolved Calcium (Ca)	mg/L	180	0.30	9480493
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9480497
Dissolved Cobalt (Co)	mg/L	0.0025	0.00030	9480497
Dissolved Copper (Cu)	mg/L	0.0012	0.00020	9480497
Dissolved Iron (Fe)	mg/L	0.78	0.060	9480493
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9480497
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9480493
Dissolved Magnesium (Mg)	mg/L	67	0.20	9480493
Dissolved Manganese (Mn)	mg/L	0.22	0.0040	9480493
Dissolved Molybdenum (Mo)	mg/L	0.18	0.00020	9480497
Dissolved Nickel (Ni)	mg/L	0.020	0.00050	9480497
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9480493
Dissolved Potassium (K)	mg/L	3.7	0.30	9480493
Dissolved Selenium (Se)	mg/L	0.0033	0.00020	9480497
Dissolved Silicon (Si)	mg/L	9.8	0.10	9480493
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9480497
Dissolved Sodium (Na)	mg/L	29	0.50	9480493
Dissolved Strontium (Sr)	mg/L	0.53	0.020	9480493
Dissolved Sulphur (S)	mg/L	55	0.20	9480493
Dissolved Thallium (Tl)	mg/L	0.0011	0.00020	9480497
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9480497
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9480497
RDL = Reportable Detection Limit				

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REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		VY4473		
Sampling Date		2019/06/19 14:40		
COC Number		299334		
	UNITS	**TF 03-12-3**	**RDL**	**QC Batch**
Dissolved Uranium (U)	mg/L	0.024	0.00010	9480497
Dissolved Vanadium (V)	mg/L	0.0027	0.0010	9480497
Dissolved Zinc (Zn)	mg/L	0.0047	0.0030	9480497
RDL = Reportable Detection Limit				

BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		VY4473		
Sampling Date		2019/06/19 14:40		
COC Number		299334		
	UNITS	**TF 03-12-3**	**RDL**	**QC Batch**
Calculated Parameters				
Filter and HNO3 Preservation	N/A	FIELD		ONSITE
Hardness (CaCO3)	mg/L	730	0.50	9479649
Ion Balance (% Difference)	%	1.6	N/A	9479672
Dissolved Nitrate (NO3)	mg/L	0.12	0.044	9479650
Nitrate plus Nitrite (N)	mg/L	0.026	0.014	9479651
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9479650
Misc. Inorganics				
Conductivity	uS/cm	1400	2.0	9481674
Total Dissolved Solids	mg/L	970	10	9480012
Anions				
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9481673
Alkalinity (Total as CaCO3)	mg/L	480	1.0	9481673
Bicarbonate (HCO3)	mg/L	590	1.0	9481673
Carbonate (CO3)	mg/L	<1.0	1.0	9481673
Hydroxide (OH)	mg/L	<1.0	1.0	9481673
Dissolved Chloride (Cl)	mg/L	110	1.0	9481333
Dissolved Sulphate (SO4)	mg/L	140	1.0	9481333
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9479762
Dissolved Nitrate (N)	mg/L	0.026	0.010	9479762
Misc. Organics				
Phenols	mg/L	0.0055	0.0015	9485990

RDL = Reportable Detection Limit
N/A = Not Applicable

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BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: VY4473
Sample ID: TF 03-12-3
Matrix: Water

Collected: 2019/06/19
Relinquished: 2019/06/20
Received: 2019/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9481673	N/A	2019/06/25	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9479738	N/A	2019/06/23	Michael Fernandez
F1-BTEX	CALC/MS	9479667	N/A	2019/06/24	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9479671	N/A	2019/06/25	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9481333	N/A	2019/06/25	Marissa Richard
Conductivity @25C	COND	9481674	N/A	2019/06/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9479945	2019/06/24	2019/06/24	Grace Guo
Hardness	CALC	9479649	N/A	2019/06/25	Automated Statchk
Mercury (Dissolved) by CV	CV	9482786	2019/06/26	2019/06/26	Edwin Lamigo
Elements by ICP - Dissolved	ICPA	9480493	N/A	2019/06/24	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9480497	N/A	2019/06/25	Julie Harrison
Ion Balance	CALC	9479672	N/A	2019/06/23	Automated Statchk
Nitrate and Nitrite	CALC	9479650	N/A	2019/06/25	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9479651	N/A	2019/06/25	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9479762	N/A	2019/06/23	Christine Albrecht
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2019/06/23	David Tidman
Phenols (4-AAP)	TECH/4AAP	9485990	N/A	2019/06/28	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9480012	2019/06/24	2019/06/25	Amy Aston

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BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

GENERAL COMMENTS

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

Package 1	2.3°C

.Temperatures upon receipt at bv Burnbay 2019/06/25
Package 1: 3.7 degrees C
Package 2: -1.5 degrees C
Each temperature is the average of up to three cooler temperatures taken at receipt

Sample VY4473 [TF 03-12-3] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
VY4473	TF 03-12-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may represent a low bias for this parameter.

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BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9479738	MF3	Method Blank	1,4-Difluorobenzene (sur.)	2019/06/23		109	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/06/23		95	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/06/23		87	%	50 - 140
			Benzene	2019/06/23	<0.00040		mg/L	
			Toluene	2019/06/23	<0.00040		mg/L	
			Ethylbenzene	2019/06/23	<0.00040		mg/L	
			m & p-Xylene	2019/06/23	<0.00080		mg/L	
			o-Xylene	2019/06/23	<0.00040		mg/L	
			LH (C5-C10)	2019/06/23	<0.10		mg/L	
			F1 (C6-C10)	2019/06/23	<0.10		mg/L	
9479762	CAR	Method Blank	Dissolved Nitrite (N)	2019/06/23	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/06/23	<0.010		mg/L	
9479945	GG3	Method Blank	O-TERPHENYL (sur.)	2019/06/24		96	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/06/24	<0.10		mg/L	
9480012	AAZ	Method Blank	Total Dissolved Solids	2019/06/25	<10		mg/L	
9480493	MSD	Method Blank	Dissolved Iron (Fe)	2019/06/24	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/06/24	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/06/24	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/06/24	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/06/24	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/06/24	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/06/24	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/06/24	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/06/24	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/06/24	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/06/24	<0.10		mg/L	
			Dissolved Boron (B)	2019/06/24	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/06/24	<0.30		mg/L	
9480497	JHS	Method Blank	Dissolved Aluminum (Al)	2019/06/24	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/06/24	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/06/24	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/06/24	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/06/24	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/06/24	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/06/24	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/06/24	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/06/24	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/06/24	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/06/24	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/06/24	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/06/24	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/06/24	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/06/24	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/06/24	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/06/24	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/06/24	<0.0010		mg/L	
9481333	MRD	Method Blank	Dissolved Chloride (Cl)	2019/06/25	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/06/25	<1.0		mg/L	
9481673	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/06/25	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/06/25	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/06/25	<1.0		mg/L	
			Carbonate (CO3)	2019/06/25	<1.0		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Hydroxide (OH)	2019/06/25	<1.0		mg/L	
9481674	MA4	Method Blank	Conductivity	2019/06/25	<2.0		uS/cm	
9482786	EL2	Method Blank	Dissolved Mercury (Hg)	2019/06/26	<0.0020		ug/L	
9485990	FFE	Method Blank	Phenols	2019/06/28	<0.0015		mg/L	
9479738	MF3	LCS	1,4-Difluorobenzene (sur.)	2019/06/23		115	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/06/23		94	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/06/23		101	%	50 - 140
			Benzene	2019/06/23		111	%	60 - 130
			Toluene	2019/06/23		100	%	60 - 130
			Ethylbenzene	2019/06/23		100	%	60 - 130
			m & p-Xylene	2019/06/23		103	%	60 - 130
			o-Xylene	2019/06/23		95	%	60 - 130
			LH (C5-C10)	2019/06/23		105	%	60 - 140
			F1 (C6-C10)	2019/06/23		105	%	60 - 140
9479762	CAR	LCS	Dissolved Nitrite (N)	2019/06/23		100	%	80 - 120
			Dissolved Nitrate (N)	2019/06/23		100	%	80 - 120
9479945	GG3	LCS	O-TERPHENYL (sur.)	2019/06/24		96	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/06/24		119	%	60 - 140
9480012	AAZ	LCS	Total Dissolved Solids	2019/06/25		102	%	80 - 120
9480493	MSD	LCS	Dissolved Iron (Fe)	2019/06/25		100	%	80 - 120
			Dissolved Lithium (Li)	2019/06/25		98	%	80 - 120
			Dissolved Magnesium (Mg)	2019/06/25		99	%	80 - 120
			Dissolved Manganese (Mn)	2019/06/25		98	%	80 - 120
			Dissolved Potassium (K)	2019/06/25		101	%	80 - 120
			Dissolved Sodium (Na)	2019/06/25		100	%	80 - 120
			Dissolved Strontium (Sr)	2019/06/25		93	%	80 - 120
			Dissolved Sulphur (S)	2019/06/25		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/06/25		101	%	80 - 120
			Dissolved Barium (Ba)	2019/06/25		100	%	80 - 120
			Dissolved Silicon (Si)	2019/06/25		99	%	80 - 120
			Dissolved Boron (B)	2019/06/25		101	%	80 - 120
			Dissolved Calcium (Ca)	2019/06/25		99	%	80 - 120
9480497	JHS	LCS	Dissolved Aluminum (Al)	2019/06/24		109	%	80 - 120
			Dissolved Chromium (Cr)	2019/06/24		95	%	80 - 120
			Dissolved Cobalt (Co)	2019/06/24		92	%	80 - 120
			Dissolved Copper (Cu)	2019/06/24		96	%	80 - 120
			Dissolved Lead (Pb)	2019/06/24		94	%	80 - 120
			Dissolved Antimony (Sb)	2019/06/24		93	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/06/24		96	%	80 - 120
			Dissolved Nickel (Ni)	2019/06/24		95	%	80 - 120
			Dissolved Selenium (Se)	2019/06/24		99	%	80 - 120
			Dissolved Silver (Ag)	2019/06/24		95	%	80 - 120
			Dissolved Arsenic (As)	2019/06/24		94	%	80 - 120
			Dissolved Thallium (Tl)	2019/06/24		96	%	80 - 120
			Dissolved Tin (Sn)	2019/06/24		96	%	80 - 120
			Dissolved Titanium (Ti)	2019/06/24		97	%	80 - 120
			Dissolved Uranium (U)	2019/06/24		93	%	80 - 120
			Dissolved Vanadium (V)	2019/06/24		94	%	80 - 120
			Dissolved Zinc (Zn)	2019/06/24		105	%	80 - 120
			Dissolved Beryllium (Be)	2019/06/24		99	%	80 - 120
9481333	MRD	LCS	Dissolved Chloride (Cl)	2019/06/25		108	%	80 - 120
			Dissolved Sulphate (SO4)	2019/06/25		104	%	80 - 120

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9481673	MA4	LCS	Alkalinity (Total as CaCO3)	2019/06/25		101	%	80 - 120
9481674	MA4	LCS	Conductivity	2019/06/25		100	%	90 - 110
9482786	EL2	LCS	Dissolved Mercury (Hg)	2019/06/26		98	%	80 - 120
9485990	FFE	LCS	Phenols	2019/06/28		97	%	80 - 120

LCS: 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.

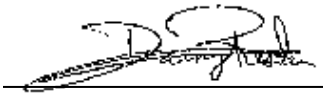
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B949542
Report Date: 2019/07/02

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

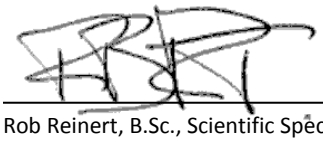
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



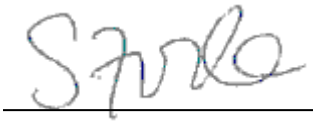
Daniel Reslan, cCT, QP, Organics Manager



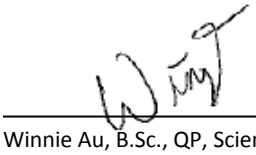
Justin Geisel, B.Sc., Organics Supervisor



Rob Reinert, B.Sc., Scientific Specialist



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst



Winnie Au, B.Sc., QP, Scientific Specialist

BV Labs 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.

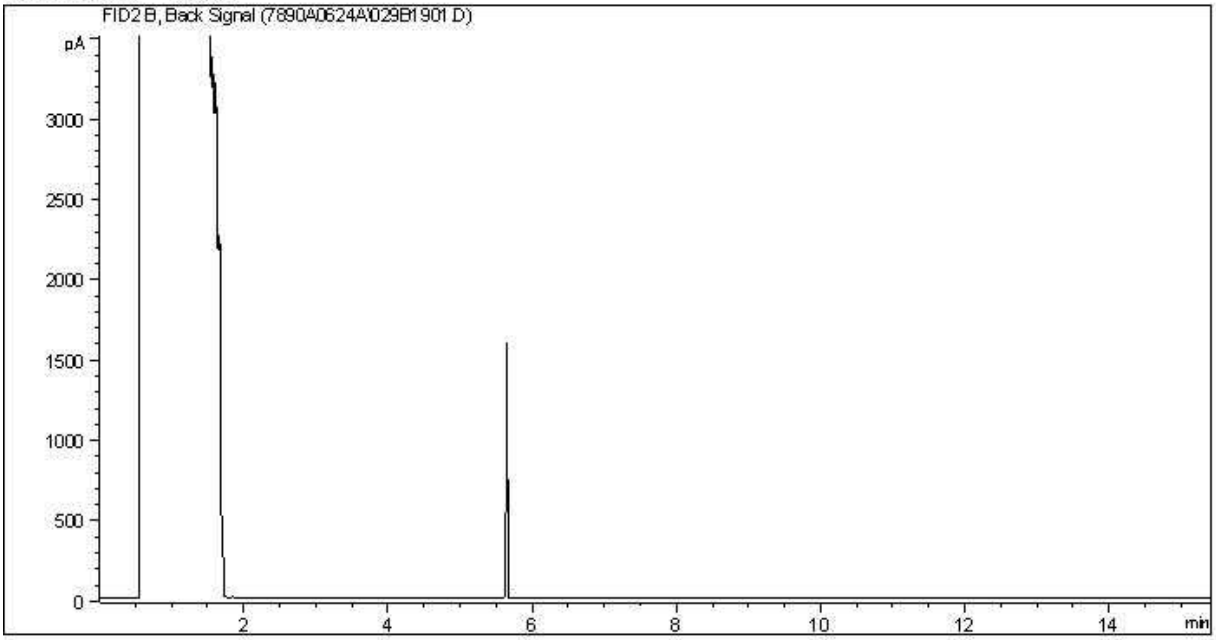
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B949542
Report Date: 2019/07/02
BV Labs Sample: VY4473

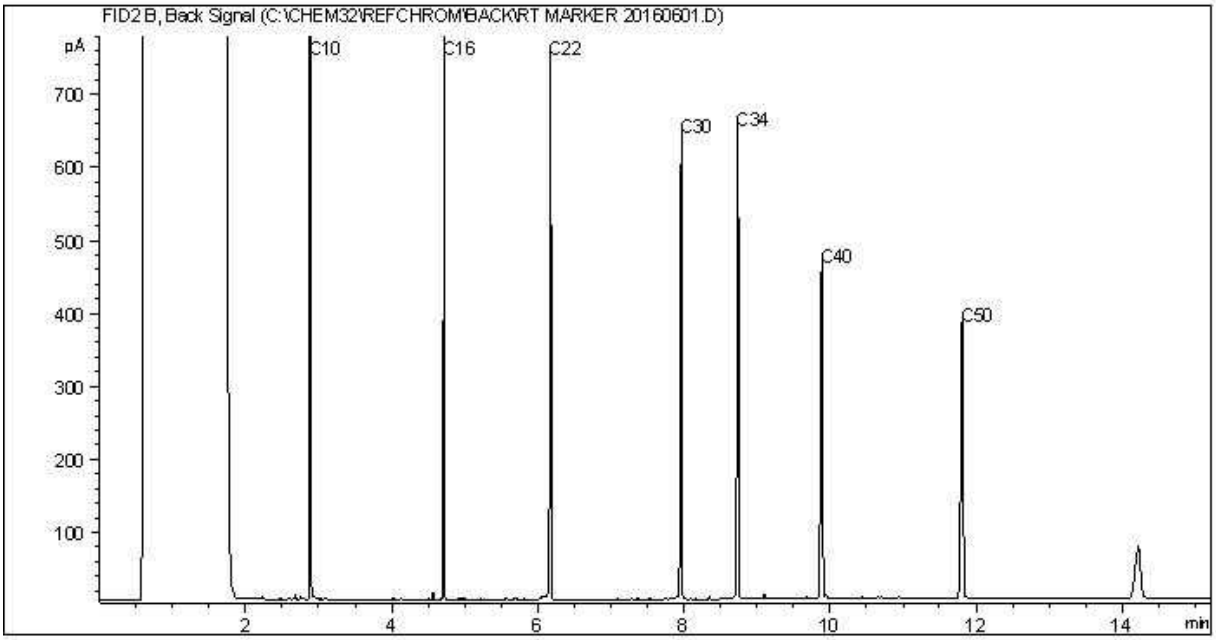
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: TF 03-12-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

1186 KVT

C of C # 299334

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Melissa Lord, Alex Haigh	Consultant Project #: 407011-00770-400

	FIELD SAMPLE ID	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	SAMPLING: TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☒ DIS ☐ TOT	MERCURY ☒ DISSOLVED ☐ TOTAL	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY ☐ pH ☐ EC ☐ ALKALINITY	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP
1	TF 03-12-3	X				10	2019/06/19	14:40	X				X							X	X					X		X
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS Also email:
canada.chemistry@worleyparsons.com
cacal-10Rdatatrack@worleyparsons.com
melissa.lord@advisian.com

IES A2601436

JARS USED & NOT SUBMITTED Enter N/A for Water: N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT	✓					
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓			2	2	3

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B949542

SAMPLES
LABELED BY: TAL
VERIFIED BY: KVT

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1.	Melissa Lord	2019/06/20	11:00	1.	Testi Ali	2019/06/22	11:46
2.				2.			
3.				3.			

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

Sent to: **BV Labs Vancouver**
4606 Canada Way
Burnaby, BC, V5G 1K5
Tel: (604) 734-7276

BV LABS INTERLAB CHAIN OF CUSTODY RECORD

-18

COC # B949542-MVAN-01-01

REPORT INFORMATION	
Company:	Bureau Veritas Laboratories
Address:	9331 - 48th Street, Edmonton, Alberta, T6B 2R4
Contact Name:	Rhecie Phayouphone
Email:	RPhayouphone@bvlabs.com, customerservice@bvlabs.com
Phone:	(403) 735-2283
BV Labs Project #:	B949542
Client Invoice To:	Imperial Oil Ltd - Worley Parsons (12794)
Client Report To:	Advisian (38038) Incl. on Report? Yes / No

ANALYSIS REQUESTED

Job Barcode Label

B949542

B949542_ISUB;COC

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Filter and HNO3 Preserve for Metals	Mercury (Dissolved) by CV	ADDITIONAL SAMPLE INFORMATION
1	VY4473-TF 03-12-3	GW	2019/06/19	14:40	ML	1	X	X	(P: 04)
2									
3									
4									
5									
6									
7									
8									
9									
10									

SITE LOCATION:	REGULATORY CRITERIA	SPECIAL INSTRUCTIONS	REQUIRED EDDs	TURNAROUND TIME
Norman Wells, NT	CCME FWAL	Please inform BV Labs immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**	National Excel (N001) Worley Parsons Komex Equis (N026) Standard DBF (Old DBase Names) (A002)	☐ Rush Required 2019/06/28 Date Required *Please inform us if rush charges will be incurred.*
SITE #: N/A				
PROJECT #: 407011-00770-400 (SNP Ops)				
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM: A2601436, 407011-00770-400				

COOLER ID: 1	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present	✓					
Custody Seal Intact	✓			4	4	3
Cooling Media Present	✓					

COOLER ID: 2	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present	✓					
Custody Seal Intact	✓			0	-3	-2
Cooling Media Present	✓					

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RECEIVING LAB USE ONLY

BV Labs Job #

B949542

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	Samples Labelled By:	Labels Verified By:
1. David Tidman	2019/06/23	11:24	1. ADEJUMOKE AKINTOLA	2019/6/25	10:15	TAL	RLC
2.			2.				

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian

Sampling Date: 11-Jul-19

Location: Norman Wells

Laboratory : Maxxam

Consultant Project Number: 407011-00770-400

Sample Submission Number: B956681

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration	x			All field QC samples met alert limits.
Trip Blank Concentration	x			
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

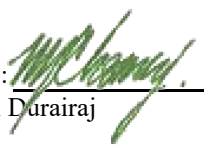
Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 22-Jul-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj

Data Reviewed by (Signature): 

Myrna Chorney for Nandhini Durairaj

Date: 02-Aug-19

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298601

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/22
Report #: R2755574
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B956681
Received: 2019/07/14, 10:52

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	4	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	4		Auto Calc
Cadmium - low level CCME - Dissolved	2		Auto Calc
Chloride/Sulphate by Auto Colourimetry	3	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	3	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons (F2-F4 in water) (1)	4	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	2		Auto Calc
Mercury (Dissolved) by CV	2	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	2	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	2	AB SOP-00043	EPA 6020b R2 m
Ion Balance	2		Auto Calc
Nitrate and Nitrite	3		Auto Calc
Nitrate + Nitrite-N (calculated)	3		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	3	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (3)	2		Auto Calc
PAH in Water by GC/MS	2	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	2	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	2	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298601

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/22
Report #: R2755574
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B956681
Received: 2019/07/14, 10:52

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

AT1 BTEX AND F1-F4 IN WATER (WATER)

BV Labs ID		WC1327			WC1327			WC1329		
Sampling Date		2019/07/11 13:00			2019/07/11 13:00			2019/07/11 12:30		
COC Number		298601			298601			298601		
	UNITS	**CPF 98-8-3**	**RDL**	**QC Batch**	**CPF 98-8-3 Lab-Dup**	**RDL**	**QC Batch**	**ARB-12-3-3**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9508054				<0.10	0.10	9508054
F3 (C16-C34 Hydrocarbons)	mg/L	<0.10	0.10	9508054				<0.10	0.10	9508054
F4 (C34-C50 Hydrocarbons)	mg/L	<0.20	0.20	9508054				<0.20	0.20	9508054
Volatiles										
Benzene	mg/L	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481
Toluene	mg/L	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481
Ethylbenzene	mg/L	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481
m & p-Xylene	mg/L	<0.00080	0.00080	9507481	<0.00080	0.00080	9507481	<0.00080	0.00080	9507481
o-Xylene	mg/L	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481	<0.00040	0.00040	9507481
Xylenes (Total)	mg/L	<0.00089	0.00089	9506830				<0.00089	0.00089	9506830
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9506830				<0.10	0.10	9506830
LH (C5-C10)	mg/L	<0.10	0.10	9507481	<0.10	0.10	9507481	<0.10	0.10	9507481
F1 (C6-C10)	mg/L	<0.10	0.10	9507481	<0.10	0.10	9507481	<0.10	0.10	9507481
Extraction Surrogate Recovery (%)										
O-TERPHENYL (sur.)	%	111		9508054				112		9508054
Instrument Surrogate Recovery (%)										
1,4-Difluorobenzene (sur.)	%	102		9507481	100		9507481	99		9507481
4-Bromofluorobenzene (sur.)	%	101		9507481	101		9507481	102		9507481
D4-1,2-Dichloroethane (sur.)	%	100		9507481	100		9507481	100		9507481

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

AT1 BTEX AND F1-F4 IN WATER (WATER)

BV Labs ID		WC1330	WC1331		
Sampling Date		2019/07/11 11:10	2019/07/11 18:00		
COC Number		298601	298601		
	UNITS	**NWD19-18**	**NWD19-08**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	9508054
F3 (C16-C34 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	9508054
F4 (C34-C50 Hydrocarbons)	mg/L	<0.20	<0.20	0.20	9508054
Volatiles					
Benzene	mg/L	<0.00040	<0.00040	0.00040	9507481
Toluene	mg/L	<0.00040	<0.00040	0.00040	9507481
Ethylbenzene	mg/L	<0.00040	<0.00040	0.00040	9507481
m & p-Xylene	mg/L	<0.00080	<0.00080	0.00080	9507481
o-Xylene	mg/L	<0.00040	<0.00040	0.00040	9507481
Xylenes (Total)	mg/L	<0.00089	<0.00089	0.00089	9506830
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	0.10	9506830
LH (C5-C10)	mg/L	<0.10	<0.10	0.10	9507481
F1 (C6-C10)	mg/L	<0.10	<0.10	0.10	9507481
Extraction Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	110	111		9508054
Instrument Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	102	101		9507481
4-Bromofluorobenzene (sur.)	%	100	100		9507481
D4-1,2-Dichloroethane (sur.)	%	99	99		9507481
RDL = Reportable Detection Limit					

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		WC1327			WC1327			WC1329		
Sampling Date		2019/07/11 13:00			2019/07/11 13:00			2019/07/11 12:30		
COC Number		298601			298601			298601		
	UNITS	**CPF 98-8-3**	**RDL**	**QC Batch**	**CPF 98-8-3 Lab-Dup**	**RDL**	**QC Batch**	**ARB-12-3-3**	**RDL**	**QC Batch**
Low Level Elements										
Dissolved Cadmium (Cd)	mg/L	0.000061	0.000020	9507099				0.000024	0.000020	9507099
Elements										
Dissolved Mercury (Hg)	ug/L	<0.0020	0.0020	9511884	<0.0020	0.0020	9511884	0.0025	0.0020	9511884
Dissolved Aluminum (Al)	mg/L	0.034	0.0030	9507557	0.031	0.0030	9507557	0.018	0.0030	9507557
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9507557	<0.00060	0.00060	9507557	<0.00060	0.00060	9507557
Dissolved Arsenic (As)	mg/L	0.00038	0.00020	9507557	0.00045	0.00020	9507557	0.00099	0.00020	9507557
Dissolved Barium (Ba)	mg/L	0.16	0.010	9507548	0.16	0.010	9507548	0.10	0.010	9507548
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557
Dissolved Boron (B)	mg/L	0.022	0.020	9507548	<0.020	0.020	9507548	<0.020	0.020	9507548
Dissolved Calcium (Ca)	mg/L	190	0.30	9507548	190	0.30	9507548	150	0.30	9507548
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557
Dissolved Cobalt (Co)	mg/L	0.00067	0.00030	9507557	0.00069	0.00030	9507557	<0.00030	0.00030	9507557
Dissolved Copper (Cu)	mg/L	0.0017	0.00020	9507557	0.0016	0.00020	9507557	0.0018	0.00020	9507557
Dissolved Iron (Fe)	mg/L	0.069	0.060	9507548	0.063	0.060	9507548	<0.060	0.060	9507548
Dissolved Lead (Pb)	mg/L	0.00022	0.00020	9507557	<0.00020	0.00020	9507557	<0.00020	0.00020	9507557
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9507548	<0.020	0.020	9507548	<0.020	0.020	9507548
Dissolved Magnesium (Mg)	mg/L	34	0.20	9507548	34	0.20	9507548	50	0.20	9507548
Dissolved Manganese (Mn)	mg/L	0.63	0.0040	9507548	0.63	0.0040	9507548	0.033	0.0040	9507548
Dissolved Molybdenum (Mo)	mg/L	0.00083	0.00020	9507557	0.00083	0.00020	9507557	0.0025	0.00020	9507557
Dissolved Nickel (Ni)	mg/L	0.0044	0.00050	9507557	0.0041	0.00050	9507557	0.0025	0.00050	9507557
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9507548	<0.10	0.10	9507548	0.38	0.10	9507548
Dissolved Potassium (K)	mg/L	2.5	0.30	9507548	2.4	0.30	9507548	2.9	0.30	9507548
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	9507557	<0.00020	0.00020	9507557	0.00068	0.00020	9507557
Dissolved Silicon (Si)	mg/L	3.6	0.10	9507548	3.6	0.10	9507548	5.5	0.10	9507548
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9507557	<0.00010	0.00010	9507557	<0.00010	0.00010	9507557
Dissolved Sodium (Na)	mg/L	12	0.50	9507548	12	0.50	9507548	25	0.50	9507548
Dissolved Strontium (Sr)	mg/L	0.63	0.020	9507548	0.63	0.020	9507548	0.46	0.020	9507548
Dissolved Sulphur (S)	mg/L	100	0.20	9507548	100	0.20	9507548	62	0.20	9507548
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9507557	<0.00020	0.00020	9507557	<0.00020	0.00020	9507557

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		WC1327			WC1327			WC1329		
Sampling Date		2019/07/11 13:00			2019/07/11 13:00			2019/07/11 12:30		
COC Number		298601			298601			298601		
	UNITS	**CPF 98-8-3**	**RDL**	**QC Batch**	**CPF 98-8-3 Lab-Dup**	**RDL**	**QC Batch**	**ARB-12-3-3**	**RDL**	**QC Batch**
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557
Dissolved Uranium (U)	mg/L	0.00098	0.00010	9507557	0.00092	0.00010	9507557	0.0061	0.00010	9507557
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557	<0.0010	0.0010	9507557
Dissolved Zinc (Zn)	mg/L	0.036	0.0030	9507557	0.035	0.0030	9507557	0.0054	0.0030	9507557

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WC1327			WC1327			WC1328		
Sampling Date		2019/07/11 13:00			2019/07/11 13:00			2019/07/11 11:00		
COC Number		298601			298601			298601		
	UNITS	**CPF 98-8-3**	**RDL**	**QC Batch**	**CPF 98-8-3 Lab-Dup**	**RDL**	**QC Batch**	**CPF 97-2-7**	**RDL**	**QC Batch**
Calculated Parameters										
Hardness (CaCO3)	mg/L	610	0.50	9507102						
Ion Balance (% Difference)	%	0.84	N/A	9507105						
Dissolved Nitrate (NO3)	mg/L	0.072	0.044	9507106				<0.044	0.044	9507106
Nitrate plus Nitrite (N)	mg/L	0.016	0.014	9507107				<0.014	0.014	9507107
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9507106				<0.033	0.033	9507106
Misc. Inorganics										
Conductivity	uS/cm	1100	2.0	9508475				2400	2.0	9514568
Total Dissolved Solids	mg/L	820	10	9507343						
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9508472						
Alkalinity (Total as CaCO3)	mg/L	300	1.0	9508472						
Bicarbonate (HCO3)	mg/L	360	1.0	9508472						
Carbonate (CO3)	mg/L	<1.0	1.0	9508472						
Hydroxide (OH)	mg/L	<1.0	1.0	9508472						
Dissolved Chloride (Cl)	mg/L	6.8	1.0	9509009				25	1.0	9508246
Dissolved Sulphate (SO4)	mg/L	320 (1)	5.0	9509009				14	1.0	9508246
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9507357	<0.010	0.010	9507357	<0.010	0.010	9507357
Dissolved Nitrate (N)	mg/L	0.016	0.010	9507357	0.017	0.010	9507357	<0.010	0.010	9507357
Misc. Organics										
Phenols	mg/L	0.0067	0.0015	9511224						

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WC1329		
Sampling Date		2019/07/11 12:30		
COC Number		298601		
	UNITS	**ARB-12-3-3**	**RDL**	**QC Batch**
Calculated Parameters				
Hardness (CaCO3)	mg/L	580	0.50	9507102
Ion Balance (% Difference)	%	2.2	N/A	9507105
Dissolved Nitrate (NO3)	mg/L	1.8	0.044	9507106
Nitrate plus Nitrite (N)	mg/L	0.41	0.014	9507107
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9507106
Misc. Inorganics				
Conductivity	uS/cm	1000	2.0	9508475
Total Dissolved Solids	mg/L	740	10	9507343
Anions				
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9508472
Alkalinity (Total as CaCO3)	mg/L	370	1.0	9508472
Bicarbonate (HCO3)	mg/L	450	1.0	9508472
Carbonate (CO3)	mg/L	<1.0	1.0	9508472
Hydroxide (OH)	mg/L	<1.0	1.0	9508472
Dissolved Chloride (Cl)	mg/L	26	1.0	9509009
Dissolved Sulphate (SO4)	mg/L	190 (1)	2.0	9509009
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9507357
Dissolved Nitrate (N)	mg/L	0.41	0.010	9507357
Misc. Organics				
Phenols	mg/L	0.0096	0.0015	9511224

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to matrix interference.

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WC1327	WC1329		
Sampling Date		2019/07/11 13:00	2019/07/11 12:30		
COC Number		298601	298601		
	UNITS	**CPF 98-8-3**	**ARB-12-3-3**	**RDL**	**QC Batch**
Polycyclic Aromatics					
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	<0.000010	0.000010	9507108
Acenaphthene	mg/L	<0.00010	<0.00010	0.00010	9508051
Acenaphthylene	mg/L	<0.00010	<0.00010	0.00010	9508051
Acridine	mg/L	<0.000040	<0.000040	0.000040	9508051
Anthracene	mg/L	<0.000010	<0.000010	0.000010	9508051
Benzo(a)anthracene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
Benzo(b&j)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
Benzo(k)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
Benzo(g,h,i)perylene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
Benzo(c)phenanthrene	mg/L	<0.000050	<0.000050	0.000050	9508051
Benzo(a)pyrene	mg/L	<0.0000075	<0.0000075	0.0000075	9508051
Benzo(e)pyrene	mg/L	<0.000050	<0.000050	0.000050	9508051
Chrysene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
Dibenz(a,h)anthracene	mg/L	<0.0000075	<0.0000075	0.0000075	9508051
Fluoranthene	mg/L	0.00014	<0.000010	0.000010	9508051
Fluorene	mg/L	<0.000050	<0.000050	0.000050	9508051
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	<0.0000085	0.0000085	9508051
1-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9508051
2-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9508051
Naphthalene	mg/L	<0.00010	<0.00010	0.00010	9508051
Phenanthrene	mg/L	0.00023	<0.000050	0.000050	9508051
Perylene	mg/L	<0.000050	<0.000050	0.000050	9508051
Pyrene	mg/L	0.000091	<0.000020	0.000020	9508051
Quinoline	mg/L	<0.00020	<0.00020	0.00020	9508051
Extraction Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	85	93		9508051
D8-ACENAPHTHYLENE (sur.)	%	87	95		9508051
D8-NAPHTHALENE (sur.)	%	82	90		9508051
TERPHENYL-D14 (sur.)	%	96	110		9508051
RDL = Reportable Detection Limit					

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

TEST SUMMARY

BV Labs ID: WC1327
Sample ID: CPF 98-8-3
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9508472	N/A	2019/07/16	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9507481	N/A	2019/07/16	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/16	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9507099	N/A	2019/07/19	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9509009	N/A	2019/07/16	Marissa Richard
Conductivity @25C	COND	9508475	N/A	2019/07/16	Malina Alamyar
CCME Hydrocarbons (F2-F4 in water)	GC/FID	9508054	2019/07/16	2019/07/16	Raymond Blumenschein
Hardness	CALC	9507102	N/A	2019/07/16	Automated Statchk
Mercury (Dissolved) by CV	CV	9511884	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9507548	N/A	2019/07/15	Rana Elsadig
Elements by ICPMS - Dissolved	ICPM	9507557	N/A	2019/07/16	Julie Harrison
Ion Balance	CALC	9507105	N/A	2019/07/16	Automated Statchk
Nitrate and Nitrite	CALC	9507106	N/A	2019/07/16	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9507107	N/A	2019/07/16	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht
Benzo[a]pyrene Equivalency	GC/MSD	9507108	N/A	2019/07/17	Automated Statchk
PAH in Water by GC/MS	GC/MS	9508051	2019/07/16	2019/07/16	Harneet Gill
Phenols (4-AAP)	TECH/4AAP	9511224	N/A	2019/07/18	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9507343	2019/07/15	2019/07/16	Luminita Chiosa

BV Labs ID: WC1327 Dup
Sample ID: CPF 98-8-3
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9507481	N/A	2019/07/15	Niloufar Behin Aein
Mercury (Dissolved) by CV	CV	9511884	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9507548	N/A	2019/07/15	Rana Elsadig
Elements by ICPMS - Dissolved	ICPM	9507557	N/A	2019/07/16	Julie Harrison
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht

BV Labs ID: WC1328
Sample ID: CPF 97-2-7
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride/Sulphate by Auto Colourimetry	KONE	9508246	N/A	2019/07/16	Marissa Richard
Conductivity @25C	COND	9514568	N/A	2019/07/19	Bozena Joyes
Nitrate and Nitrite	CALC	9507106	N/A	2019/07/16	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9507107	N/A	2019/07/16	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht

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BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

TEST SUMMARY

BV Labs ID: WC1329
Sample ID: ARB-12-3-3
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9508472	N/A	2019/07/16	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9507481	N/A	2019/07/15	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/16	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9507099	N/A	2019/07/19	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9509009	N/A	2019/07/16	Marissa Richard
Conductivity @25C	COND	9508475	N/A	2019/07/16	Malina Alamyar
CCME Hydrocarbons (F2-F4 in water)	GC/FID	9508054	2019/07/16	2019/07/16	Raymond Blumenschein
Hardness	CALC	9507102	N/A	2019/07/16	Automated Statchk
Mercury (Dissolved) by CV	CV	9511884	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9507548	N/A	2019/07/15	Rana Elsadig
Elements by ICPMS - Dissolved	ICPM	9507557	N/A	2019/07/16	Julie Harrison
Ion Balance	CALC	9507105	N/A	2019/07/16	Automated Statchk
Nitrate and Nitrite	CALC	9507106	N/A	2019/07/16	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9507107	N/A	2019/07/16	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht
Benzo[a]pyrene Equivalency	GC/MSD	9507108	N/A	2019/07/17	Automated Statchk
PAH in Water by GC/MS	GC/MS	9508051	2019/07/16	2019/07/16	Harneet Gill
Phenols (4-AAP)	TECH/4AAP	9511224	N/A	2019/07/18	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9507343	2019/07/15	2019/07/16	Luminita Chiosa

BV Labs ID: WC1330
Sample ID: NWD19-18
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9507481	N/A	2019/07/15	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/16	Automated Statchk
CCME Hydrocarbons (F2-F4 in water)	GC/FID	9508054	2019/07/16	2019/07/16	Raymond Blumenschein

BV Labs ID: WC1331
Sample ID: NWD19-08
Matrix: Water

Collected: 2019/07/11
Relinquished: 2019/07/12
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9507481	N/A	2019/07/15	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/16	Automated Statchk
CCME Hydrocarbons (F2-F4 in water)	GC/FID	9508054	2019/07/16	2019/07/16	Raymond Blumenschein

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

GENERAL COMMENTS

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

Package 1	3.0°C

Sample WC1327 [CPF 98-8-3] : 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.

Sample WC1328 [CPF 97-2-7] : 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.

Sample WC1329 [ARB-12-3-3] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WC1327	CPF 98-8-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WC1328	CPF 97-2-7	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WC1329	ARB-12-3-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9507343	LCA	Method Blank	Total Dissolved Solids	2019/07/16	<10		mg/L	
9507357	CAR	Method Blank	Dissolved Nitrite (N)	2019/07/16	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/16	<0.010		mg/L	
9507481	NBA	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/15		101	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/15		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/15		98	%	50 - 140
			Benzene	2019/07/15	<0.00040		mg/L	
			Toluene	2019/07/15	<0.00040		mg/L	
			Ethylbenzene	2019/07/15	<0.00040		mg/L	
			m & p-Xylene	2019/07/15	<0.00080		mg/L	
			o-Xylene	2019/07/15	<0.00040		mg/L	
			LH (C5-C10)	2019/07/15	<0.10		mg/L	
			F1 (C6-C10)	2019/07/15	<0.10		mg/L	
9507548	REL	Method Blank	Dissolved Iron (Fe)	2019/07/15	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/15	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/15	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/15	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/15	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/15	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/15	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/15	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/15	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/15	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/15	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/15	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/15	<0.30		mg/L	
9507557	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/19	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/19	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/19	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/19	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/19	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/19	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/19	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/19	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/19	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/19	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/19	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/19	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/19	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/19	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/19	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/19	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/19	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/19	<0.0010		mg/L	
9508051	HG3	Method Blank	D10-ANTHRACENE (sur.)	2019/07/16		88	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/16		100	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/16		89	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/16		84	%	50 - 130
			Acenaphthene	2019/07/16	<0.00010		mg/L	
			Acenaphthylene	2019/07/16	<0.00010		mg/L	
			Acridine	2019/07/16	<0.000040		mg/L	
			Anthracene	2019/07/16	<0.000010		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(a)anthracene	2019/07/16	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/07/16	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/07/16	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/07/16	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/07/16	<0.000050		mg/L	
			Benzo(a)pyrene	2019/07/16	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/07/16	<0.000050		mg/L	
			Chrysene	2019/07/16	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/07/16	<0.0000075		mg/L	
			Fluoranthene	2019/07/16	<0.000010		mg/L	
			Fluorene	2019/07/16	<0.000050		mg/L	
			Indeno(1,2,3-cd)pyrene	2019/07/16	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/07/16	<0.00010		mg/L	
			2-Methylnaphthalene	2019/07/16	<0.00010		mg/L	
			Naphthalene	2019/07/16	<0.00010		mg/L	
			Phenanthrene	2019/07/16	<0.000050		mg/L	
			Perylene	2019/07/16	<0.000050		mg/L	
			Pyrene	2019/07/16	<0.000020		mg/L	
			Quinoline	2019/07/16	<0.00020		mg/L	
9508054	RBN	Method Blank	O-TERPHENYL (sur.)	2019/07/16		114	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/16	<0.10		mg/L	
			F3 (C16-C34 Hydrocarbons)	2019/07/16	<0.10		mg/L	
			F4 (C34-C50 Hydrocarbons)	2019/07/16	<0.20		mg/L	
9508246	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/16	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/16	<1.0		mg/L	
9508472	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/16	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/16	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/16	<1.0		mg/L	
			Carbonate (CO3)	2019/07/16	<1.0		mg/L	
			Hydroxide (OH)	2019/07/16	<1.0		mg/L	
9508475	MA4	Method Blank	Conductivity	2019/07/16	<2.0		uS/cm	
9509009	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/16	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/16	<1.0		mg/L	
9511224	YY	Method Blank	Phenols	2019/07/18	<0.0015		mg/L	
9511884	MHD	Method Blank	Dissolved Mercury (Hg)	2019/07/18	<0.0020		ug/L	
9514568	BJO	Method Blank	Conductivity	2019/07/19	<2.0		uS/cm	
9507357	CAR	RPD [WC1327-01]	Dissolved Nitrite (N)	2019/07/16	NC		%	20
			Dissolved Nitrate (N)	2019/07/16	2.7		%	20
9507481	NBA	RPD [WC1327-06]	Benzene	2019/07/15	NC		%	30
			Toluene	2019/07/15	NC		%	30
			Ethylbenzene	2019/07/15	NC		%	30
			m & p-Xylene	2019/07/15	NC		%	30
			o-Xylene	2019/07/15	NC		%	30
			LH (C5-C10)	2019/07/15	NC		%	30
			F1 (C6-C10)	2019/07/15	NC		%	30
9507548	REL	RPD [WC1327-02]	Dissolved Iron (Fe)	2019/07/15	9.0		%	20
			Dissolved Lithium (Li)	2019/07/15	NC		%	20
			Dissolved Magnesium (Mg)	2019/07/15	0.54		%	20
			Dissolved Manganese (Mn)	2019/07/15	0.97		%	20
			Dissolved Potassium (K)	2019/07/15	2.7		%	20
			Dissolved Sodium (Na)	2019/07/15	0.73		%	20
			Dissolved Strontium (Sr)	2019/07/15	0.69		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sulphur (S)	2019/07/15	1.1		%	20
			Dissolved Phosphorus (P)	2019/07/15	NC		%	20
			Dissolved Barium (Ba)	2019/07/15	0.87		%	20
			Dissolved Silicon (Si)	2019/07/15	0.61		%	20
			Dissolved Boron (B)	2019/07/15	11		%	20
			Dissolved Calcium (Ca)	2019/07/15	0.95		%	20
9507557	JHS	RPD [WC1327-02]	Dissolved Aluminum (Al)	2019/07/16	9.1		%	20
			Dissolved Chromium (Cr)	2019/07/16	NC		%	20
			Dissolved Cobalt (Co)	2019/07/16	2.9		%	20
			Dissolved Copper (Cu)	2019/07/16	5.8		%	20
			Dissolved Lead (Pb)	2019/07/16	7.2		%	20
			Dissolved Antimony (Sb)	2019/07/16	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/16	0.24		%	20
			Dissolved Nickel (Ni)	2019/07/16	8.4		%	20
			Dissolved Selenium (Se)	2019/07/16	NC		%	20
			Dissolved Silver (Ag)	2019/07/16	NC		%	20
			Dissolved Arsenic (As)	2019/07/16	16		%	20
			Dissolved Thallium (Tl)	2019/07/16	NC		%	20
			Dissolved Tin (Sn)	2019/07/16	NC		%	20
			Dissolved Titanium (Ti)	2019/07/16	NC		%	20
			Dissolved Uranium (U)	2019/07/16	5.9		%	20
			Dissolved Vanadium (V)	2019/07/16	NC		%	20
			Dissolved Zinc (Zn)	2019/07/16	2.8		%	20
			Dissolved Beryllium (Be)	2019/07/16	NC		%	20
9511884	MHD	RPD [WC1327-04]	Dissolved Mercury (Hg)	2019/07/18	NC		%	20
9507357	CAR	Matrix Spike [WC1327-01]	Dissolved Nitrite (N)	2019/07/16		101	%	80 - 120
			Dissolved Nitrate (N)	2019/07/16		101	%	80 - 120
9507481	NBA	Matrix Spike [WC1329-07]	1,4-Difluorobenzene (sur.)	2019/07/15		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/15		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/15		102	%	50 - 140
			Benzene	2019/07/15		96	%	50 - 140
			Toluene	2019/07/15		92	%	50 - 140
			Ethylbenzene	2019/07/15		95	%	50 - 140
			m & p-Xylene	2019/07/15		93	%	50 - 140
			o-Xylene	2019/07/15		93	%	50 - 140
			LH (C5-C10)	2019/07/15		88	%	60 - 140
			F1 (C6-C10)	2019/07/15		89	%	60 - 140
9507548	REL	Matrix Spike [WC1327-02]	Dissolved Iron (Fe)	2019/07/15		102	%	80 - 120
			Dissolved Lithium (Li)	2019/07/15		101	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		99	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/15		98	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		105	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/15		96	%	80 - 120
			Dissolved Sulphur (S)	2019/07/15		NC	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/15		105	%	80 - 120
			Dissolved Barium (Ba)	2019/07/15		98	%	80 - 120
			Dissolved Silicon (Si)	2019/07/15		94	%	80 - 120
			Dissolved Boron (B)	2019/07/15		102	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Calcium (Ca)	2019/07/15		NC	%	80 - 120
9507557	JHS	Matrix Spike [WC1327-02]	Dissolved Aluminum (Al)	2019/07/16		93	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/16		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/16		97	%	80 - 120
			Dissolved Copper (Cu)	2019/07/16		96	%	80 - 120
			Dissolved Lead (Pb)	2019/07/16		95	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/16		99	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/16		103	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/16		95	%	80 - 120
			Dissolved Selenium (Se)	2019/07/16		99	%	80 - 120
			Dissolved Silver (Ag)	2019/07/16		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/16		95	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/16		95	%	80 - 120
			Dissolved Tin (Sn)	2019/07/16		102	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/16		97	%	80 - 120
			Dissolved Uranium (U)	2019/07/16		96	%	80 - 120
			Dissolved Vanadium (V)	2019/07/16		102	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/16		94	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/16		98	%	80 - 120
9511884	MHD	Matrix Spike [WC1329-05]	Dissolved Mercury (Hg)	2019/07/18		103	%	80 - 120
9507343	LCA	LCS	Total Dissolved Solids	2019/07/16		98	%	80 - 120
9507357	CAR	LCS	Dissolved Nitrite (N)	2019/07/16		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/16		100	%	80 - 120
9507481	NBA	LCS	1,4-Difluorobenzene (sur.)	2019/07/15		102	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/15		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/15		101	%	50 - 140
			Benzene	2019/07/15		95	%	60 - 130
			Toluene	2019/07/15		91	%	60 - 130
			Ethylbenzene	2019/07/15		94	%	60 - 130
			m & p-Xylene	2019/07/15		92	%	60 - 130
			o-Xylene	2019/07/15		92	%	60 - 130
			LH (C5-C10)	2019/07/15		100	%	60 - 140
			F1 (C6-C10)	2019/07/15		100	%	60 - 140
9507548	REL	LCS	Dissolved Iron (Fe)	2019/07/15		102	%	80 - 120
			Dissolved Lithium (Li)	2019/07/15		102	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		103	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/15		102	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		105	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/15		99	%	80 - 120
			Dissolved Sulphur (S)	2019/07/15		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/15		102	%	80 - 120
			Dissolved Barium (Ba)	2019/07/15		99	%	80 - 120
			Dissolved Silicon (Si)	2019/07/15		99	%	80 - 120
			Dissolved Boron (B)	2019/07/15		103	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/15		102	%	80 - 120
9507557	JHS	LCS	Dissolved Aluminum (Al)	2019/07/16		108	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/16		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/16		96	%	80 - 120
			Dissolved Copper (Cu)	2019/07/16		98	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lead (Pb)	2019/07/16		97	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/16		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/16		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/16		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/16		100	%	80 - 120
			Dissolved Silver (Ag)	2019/07/16		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/16		94	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/16		95	%	80 - 120
			Dissolved Tin (Sn)	2019/07/16		97	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/16		97	%	80 - 120
			Dissolved Uranium (U)	2019/07/16		96	%	80 - 120
			Dissolved Vanadium (V)	2019/07/16		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/16		97	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/16		98	%	80 - 120
9508051	HG3	LCS	D10-ANTHRACENE (sur.)	2019/07/16		84	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/16		91	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/16		86	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/16		82	%	50 - 130
			Acenaphthene	2019/07/16		77	%	50 - 130
			Acenaphthylene	2019/07/16		82	%	50 - 130
			Acridine	2019/07/16		80	%	50 - 130
			Anthracene	2019/07/16		80	%	50 - 130
			Benzo(a)anthracene	2019/07/16		79	%	50 - 130
			Benzo(b&j)fluoranthene	2019/07/16		80	%	50 - 130
			Benzo(k)fluoranthene	2019/07/16		77	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/16		75	%	50 - 130
			Benzo(c)phenanthrene	2019/07/16		84	%	50 - 130
			Benzo(a)pyrene	2019/07/16		78	%	50 - 130
			Benzo(e)pyrene	2019/07/16		84	%	50 - 130
			Chrysene	2019/07/16		76	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/16		70	%	50 - 130
			Fluoranthene	2019/07/16		80	%	50 - 130
			Fluorene	2019/07/16		79	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/16		78	%	50 - 130
			1-Methylnaphthalene	2019/07/16		83	%	50 - 130
			2-Methylnaphthalene	2019/07/16		85	%	50 - 130
			Naphthalene	2019/07/16		80	%	50 - 130
			Phenanthrene	2019/07/16		78	%	50 - 130
			Perylene	2019/07/16		85	%	50 - 130
			Pyrene	2019/07/16		80	%	50 - 130
			Quinoline	2019/07/16		110	%	50 - 130
9508054	RBN	LCS	O-TERPHENYL (sur.)	2019/07/16		113	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/16		124	%	60 - 140
			F3 (C16-C34 Hydrocarbons)	2019/07/16		126	%	60 - 140
			F4 (C34-C50 Hydrocarbons)	2019/07/16		118	%	60 - 140
9508246	MRD	LCS	Dissolved Chloride (Cl)	2019/07/16		108	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/16		110	%	80 - 120
9508472	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/16		98	%	80 - 120
9508475	MA4	LCS	Conductivity	2019/07/16		100	%	90 - 110
9509009	MRD	LCS	Dissolved Chloride (Cl)	2019/07/16		109	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/16		108	%	80 - 120
9511224	YY	LCS	Phenols	2019/07/18		95	%	80 - 120

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9511884	MHD	LCS	Dissolved Mercury (Hg)	2019/07/18		104	%	80 - 120
9514568	BJO	LCS	Conductivity	2019/07/19		99	%	90 - 110

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.

LCS: 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).

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B956681
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

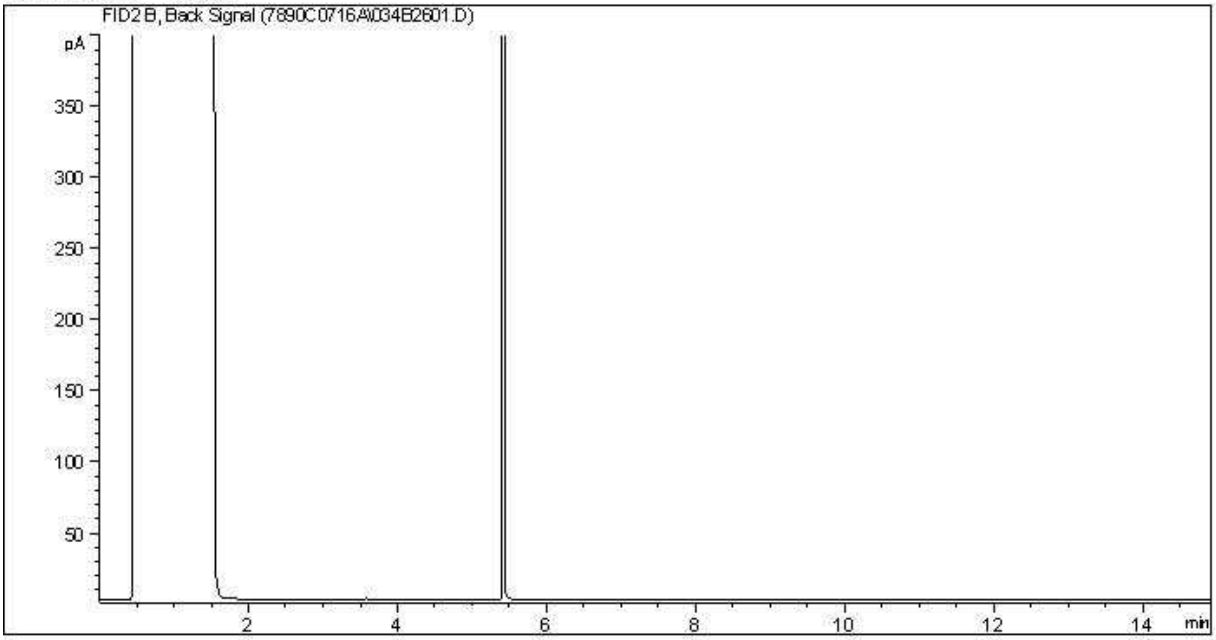
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B956681
Report Date: 2019/07/22
BV Labs Sample: WC1327

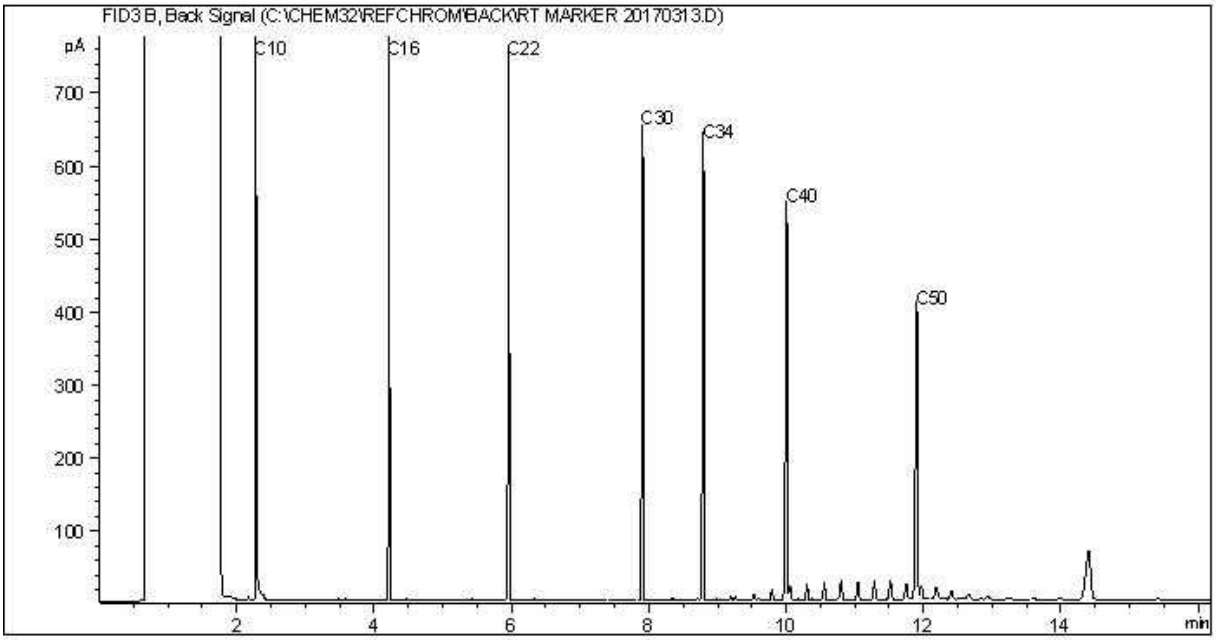
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: CPF 98-8-3

CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

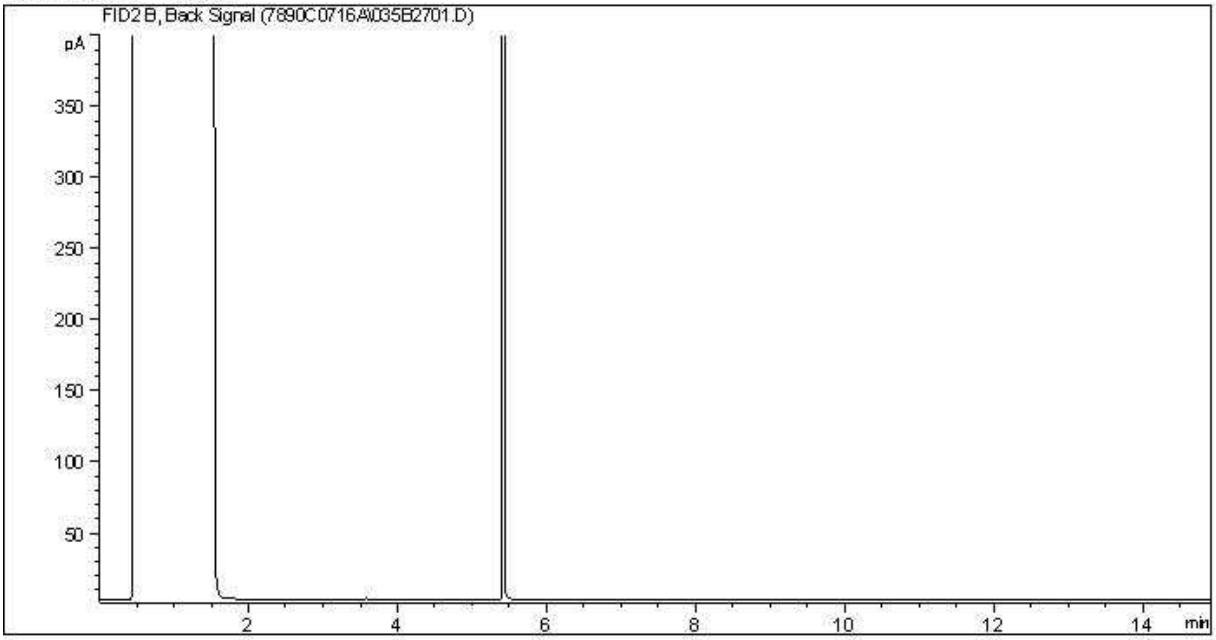
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B956681
Report Date: 2019/07/22
BV Labs Sample: WC1329

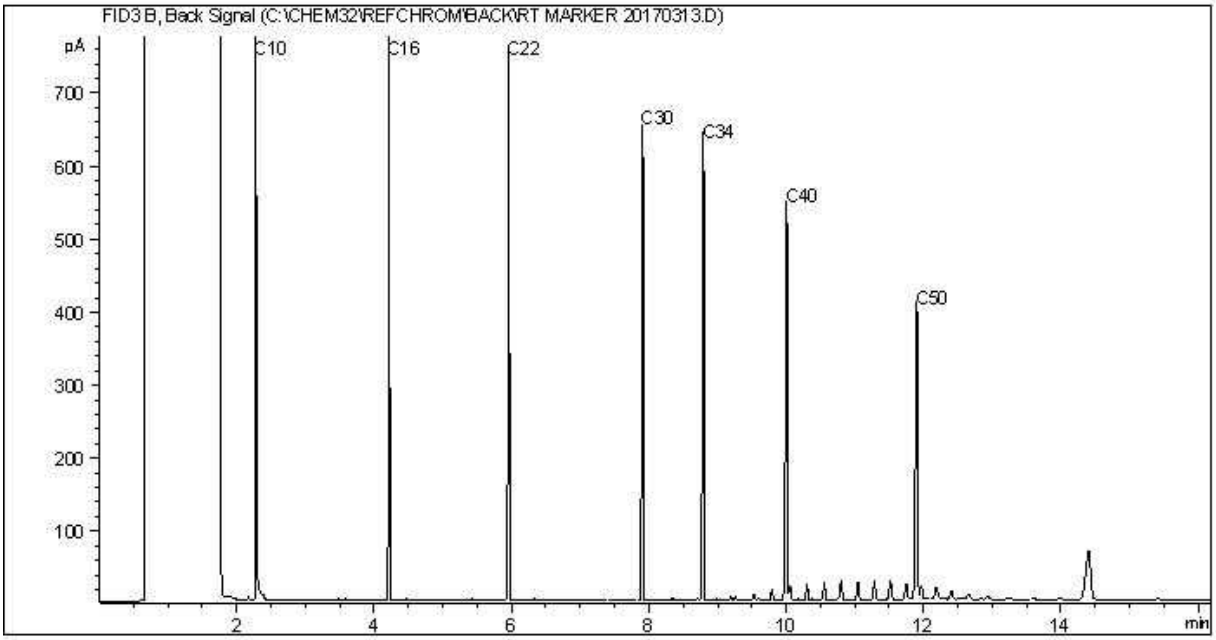
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: ARB-12-3-3

CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

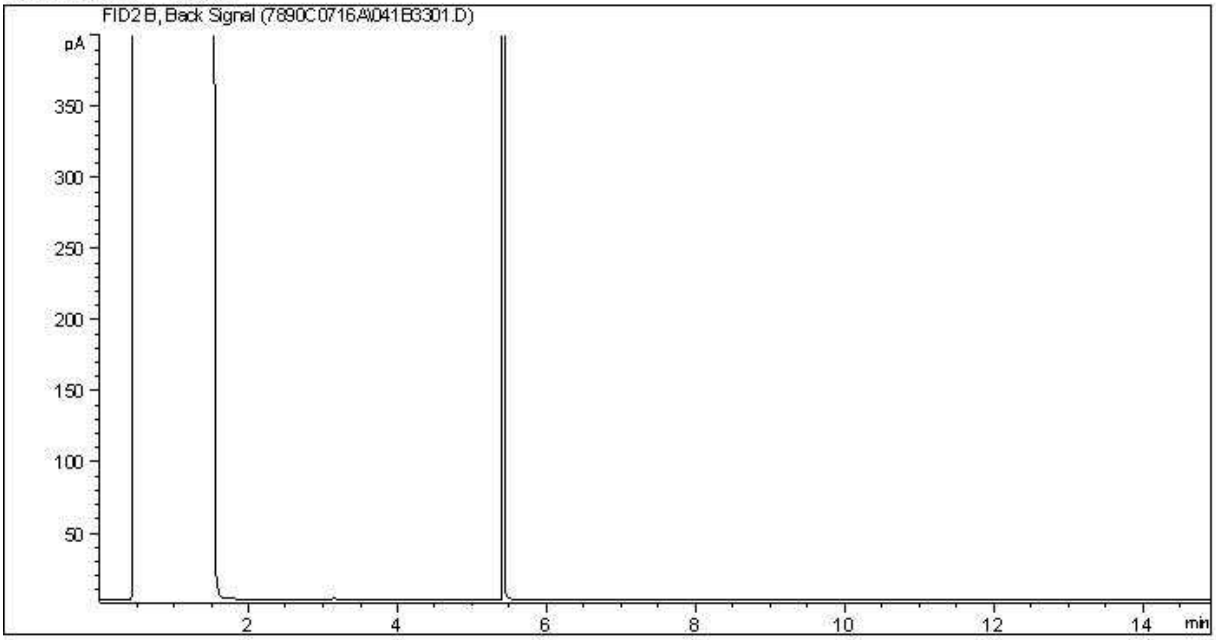
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B956681
Report Date: 2019/07/22
BV Labs Sample: WC1330

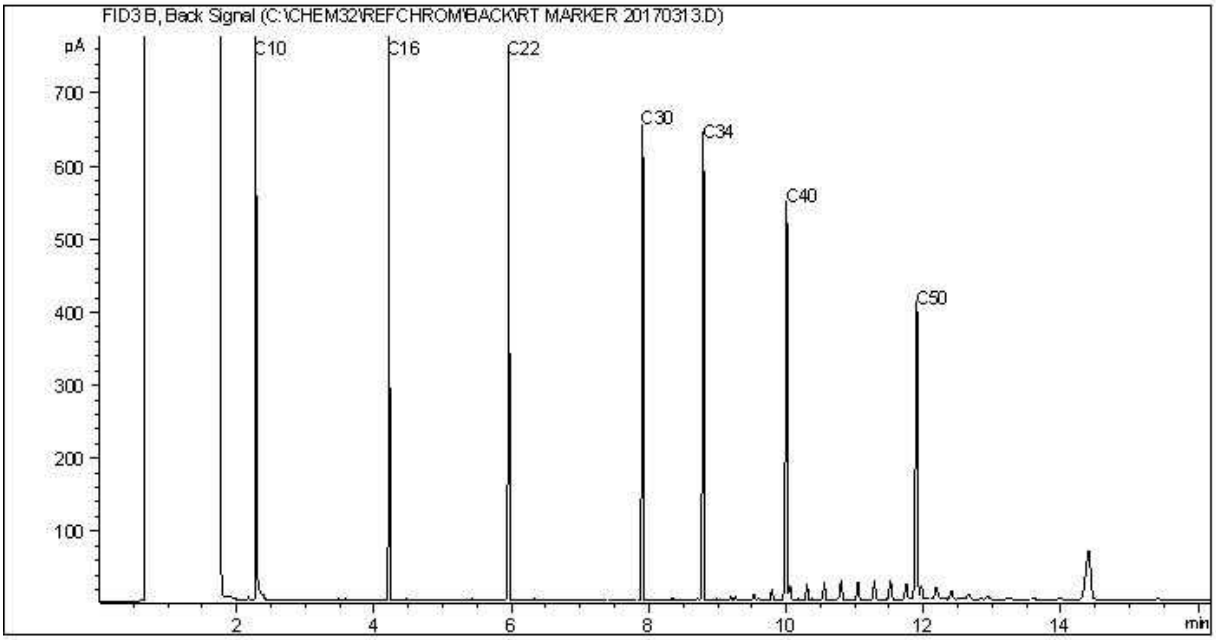
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-18

CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

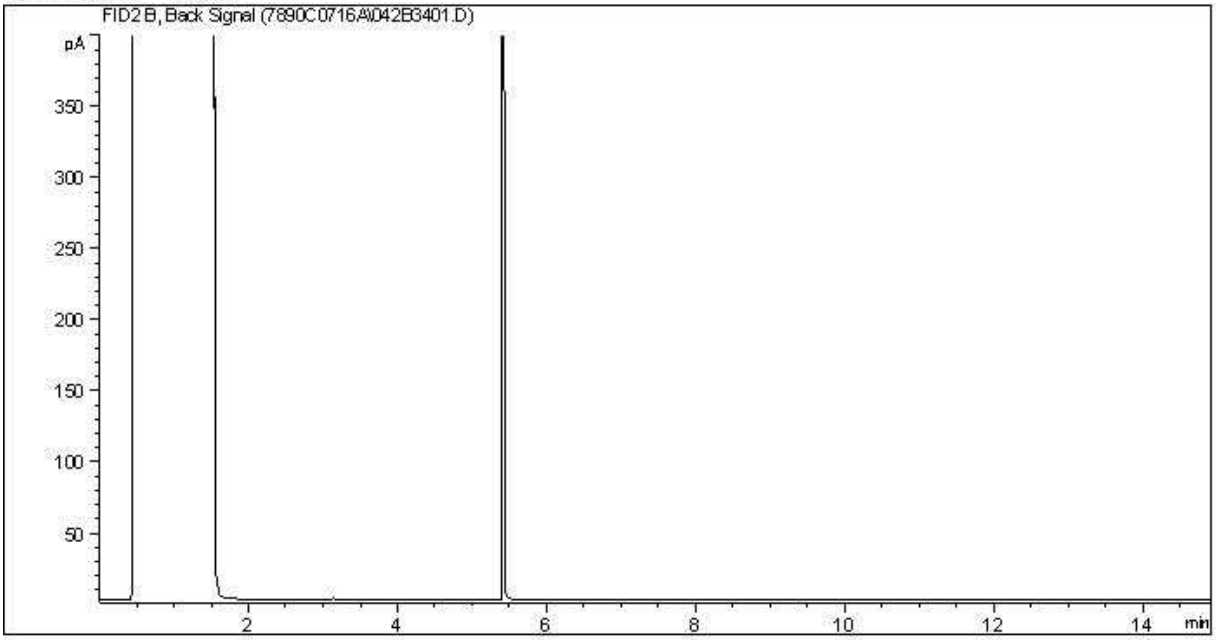
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B956681
Report Date: 2019/07/22
BV Labs Sample: WC1331

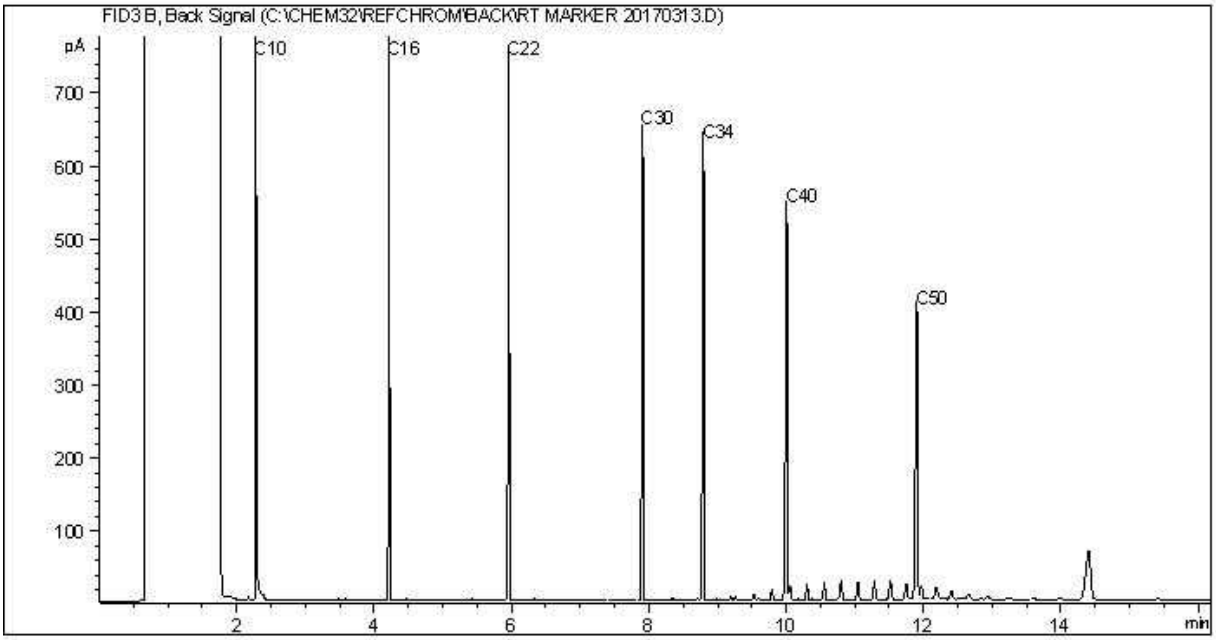
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-08

CCME Hydrocarbons (F2-F4 in water) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

EXXON MOBIL/IMPERIAL OIL - MAXXAM
CHAIN-OF-CUSTODY RECORD

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Page 1 of 1

C of C # 298601

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: MorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Michelle Vokaty, Jessica Appleton	Consultant Project #: 407011-00770-400

ANALYSIS REQUESTED

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS: TOT ☐ DIS ☒	MERCURY: TOTAL ☐ DISSOLVED ☒	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP	limited sample, missing bottle(s)	EC, Cl, SO4, NO2, NO3, NO2+NO3
1 CPF 98-8-3	X				9 MW	2019/07/11	13:00	X			X	X							X	X					X			X	X	
2 CPF 97-2-7	X				1		11:06																							X
3 ARB-12-3-3	X				12		12:30	X			X	X							X	X					X			X		
4 ~~DUPLICATE~~ NWD19-18	X			MW	5		11:10					X																		
5 NWD19-08				X	5	↓	13:00					X																		
6																														
7																														
8																														
9																														
10																														

IOL SITE LOCATION: Norman Wells, NT
IOL PROJECT # (if applicable): N/A
MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email:
cacal_IOR_datatrack@worleyparsons.com
canada.chemistry@worleyparsons.com
melissa.lord@advisian.com
IESA2601436

JARS USED & NOT SUBMITTED Enter N/A for Water: N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT	✓		TEMP °C	3	3	3
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT			TEMP °C			
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT			TEMP °C			
SEAL INTACT						
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B956681

RELINQUISHED BY:	printed name	DATE:	TIME (24 HR)	RECEIVED BY:	printed name	DATE:	TIME (24 HR)
1. Michelle Vokaty	Michelle Vokaty	2019/07/12	08:00	1.	DEJ LWV	2019/07/14	10:52
2.				2.			
3.				3.			

SAMPLES LABELED BY: CG VERIFIED BY: LR

COC-1010 (06/2016) IOL-AB

White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian

Sampling Date: 12-Jul-19

Location: Norman Wells

Laboratory : Maxxam

Consultant Project Number: 407011-00770-400

Sample Submission Number: B956702

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD			x	
Matrix Spike Recovery			x	
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

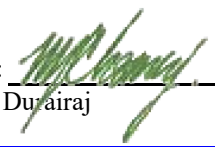
Date DQO was received: 22-Jul-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj

Date: 23-Jul-19

Data Reviewed by (Signature): 

Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298600

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/22
Report #: R2755588
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B956702
Received: 2019/07/14, 10:52

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	2	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	2		Auto Calc
Cadmium - low level CCME - Dissolved	2		Auto Calc
Chloride/Sulphate by Auto Colourimetry	2	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	2	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	2	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	2		Auto Calc
Mercury (Dissolved) by CV	2	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	2	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	2	AB SOP-00043	EPA 6020b R2 m
Ion Balance	2		Auto Calc
Nitrate and Nitrite	2		Auto Calc
Nitrate + Nitrite-N (calculated)	2		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	AB SOP-00023	SM 23 4110 B m
Phenols (4-AAP)	2	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	2	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298600

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/22
Report #: R2755588
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B956702
Received: 2019/07/14, 10:52

dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WC1423	WC1424		
Sampling Date		2019/07/12 09:45	2019/07/12 10:00		
COC Number		298600	298600		
	UNITS	**BI-13-1-4**	**BI-13-3-4.5**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	9507558
Volatiles					
Benzene	mg/L	<0.00040	<0.00040	0.00040	9508305
Toluene	mg/L	<0.00040	<0.00040	0.00040	9508305
Ethylbenzene	mg/L	<0.00040	<0.00040	0.00040	9508305
m & p-Xylene	mg/L	<0.00080	<0.00080	0.00080	9508305
o-Xylene	mg/L	<0.00040	<0.00040	0.00040	9508305
Xylenes (Total)	mg/L	<0.00089	<0.00089	0.00089	9506830
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	0.10	9506830
LH (C5-C10)	mg/L	<0.10	<0.10	0.10	9508305
F1 (C6-C10)	mg/L	<0.10	<0.10	0.10	9508305
Extraction Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	104	120		9507558
Instrument Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	99	97		9508305
4-Bromofluorobenzene (sur.)	%	100	105		9508305
D4-1,2-Dichloroethane (sur.)	%	98	101		9508305
RDL = Reportable Detection Limit					

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		WC1423	WC1424		
Sampling Date		2019/07/12 09:45	2019/07/12 10:00		
COC Number		298600	298600		
	UNITS	**BI-13-1-4**	**BI-13-3-4.5**	**RDL**	**QC Batch**
Low Level Elements					
Dissolved Cadmium (Cd)	mg/L	<0.000020	0.00015	0.000020	9507099
Elements					
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	9511884
Dissolved Aluminum (Al)	mg/L	0.0068	0.0075	0.0030	9507557
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	9507557
Dissolved Arsenic (As)	mg/L	0.00032	0.00072	0.00020	9507557
Dissolved Barium (Ba)	mg/L	0.015	0.048	0.010	9507548
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	9507557
Dissolved Boron (B)	mg/L	<0.020	<0.020	0.020	9507548
Dissolved Calcium (Ca)	mg/L	68	280	0.30	9507548
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	9507557
Dissolved Cobalt (Co)	mg/L	0.0015	0.0018	0.00030	9507557
Dissolved Copper (Cu)	mg/L	0.0012	0.0043	0.00020	9507557
Dissolved Iron (Fe)	mg/L	1.6	0.27	0.060	9507548
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	9507557
Dissolved Lithium (Li)	mg/L	<0.020	0.026	0.020	9507548
Dissolved Magnesium (Mg)	mg/L	25	140	0.20	9507548
Dissolved Manganese (Mn)	mg/L	0.43	0.28	0.0040	9507548
Dissolved Molybdenum (Mo)	mg/L	0.00074	0.020	0.00020	9507557
Dissolved Nickel (Ni)	mg/L	0.0037	0.023	0.00050	9507557
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	9507548
Dissolved Potassium (K)	mg/L	0.41	3.7	0.30	9507548
Dissolved Selenium (Se)	mg/L	<0.00020	0.0042	0.00020	9507557
Dissolved Silicon (Si)	mg/L	1.3	3.9	0.10	9507548
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	9507557
Dissolved Sodium (Na)	mg/L	4.6	14	0.50	9507548
Dissolved Strontium (Sr)	mg/L	0.49	0.85	0.020	9507548
Dissolved Sulphur (S)	mg/L	26	300	0.20	9507548
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	9507557
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	9507557
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	9507557
RDL = Reportable Detection Limit					

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

REGULATED METALS INCLUDING MERCURY-DISS (WATER)

BV Labs ID		WC1423	WC1424		
Sampling Date		2019/07/12 09:45	2019/07/12 10:00		
COC Number		298600	298600		
	UNITS	**BI-13-1-4**	**BI-13-3-4.5**	**RDL**	**QC Batch**
Dissolved Uranium (U)	mg/L	0.0015	0.013	0.00010	9507557
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	9507557
Dissolved Zinc (Zn)	mg/L	0.0042	0.019	0.0030	9507557
RDL = Reportable Detection Limit					

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WC1423		WC1424		
Sampling Date		2019/07/12 09:45		2019/07/12 10:00		
COC Number		298600		298600		
	UNITS	**BI-13-1-4**	**RDL**	**BI-13-3-4.5**	**RDL**	**QC Batch**
Calculated Parameters						
Hardness (CaCO3)	mg/L	270	0.50	1300	0.50	9507102
Ion Balance (% Difference)	%	1.7	N/A	2.1	N/A	9507105
Dissolved Nitrate (NO3)	mg/L	1.5	0.044	0.082	0.044	9507106
Nitrate plus Nitrite (N)	mg/L	0.35	0.014	0.019	0.014	9507107
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	<0.033	0.033	9507106
Misc. Inorganics						
Conductivity	uS/cm	540	2.0	1900	2.0	9508475
Total Dissolved Solids	mg/L	300	10	1700	10	9507343
Anions						
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	<1.0	1.0	9508472
Alkalinity (Total as CaCO3)	mg/L	200	1.0	340	1.0	9508472
Bicarbonate (HCO3)	mg/L	240	1.0	420	1.0	9508472
Carbonate (CO3)	mg/L	<1.0	1.0	<1.0	1.0	9508472
Hydroxide (OH)	mg/L	<1.0	1.0	<1.0	1.0	9508472
Dissolved Chloride (Cl)	mg/L	2.5	1.0	8.4	1.0	9509009
Dissolved Sulphate (SO4)	mg/L	88	1.0	870 (1)	5.0	9509009
Nutrients						
Dissolved Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	9507357
Dissolved Nitrate (N)	mg/L	0.35	0.010	0.019	0.010	9507357
Misc. Organics						
Phenols	mg/L	0.0029	0.0015	0.0049	0.0015	9511224

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

BV Labs Job #: B956702
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Advisian
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TEST SUMMARY

BV Labs ID: WC1423
Sample ID: BI-13-1-4
Matrix: Water

Collected: 2019/07/12
Relinquished: 2019/07/13
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9508472	N/A	2019/07/16	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9508305	N/A	2019/07/17	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/17	Roland Menard
Cadmium - low level CCME - Dissolved	CALC/MS	9507099	N/A	2019/07/19	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9509009	N/A	2019/07/16	Marissa Richard
Conductivity @25C	COND	9508475	N/A	2019/07/16	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9507558	2019/07/15	2019/07/16	Grace Guo
Hardness	CALC	9507102	N/A	2019/07/16	Automated Statchk
Mercury (Dissolved) by CV	CV	9511884	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9507548	N/A	2019/07/15	Rana Elsadig
Elements by ICPMS - Dissolved	ICPM	9507557	N/A	2019/07/16	Julie Harrison
Ion Balance	CALC	9507105	N/A	2019/07/16	Automated Statchk
Nitrate and Nitrite	CALC	9507106	N/A	2019/07/16	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9507107	N/A	2019/07/16	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9511224	N/A	2019/07/18	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9507343	2019/07/15	2019/07/16	Luminita Chiosa

BV Labs ID: WC1424
Sample ID: BI-13-3-4.5
Matrix: Water

Collected: 2019/07/12
Relinquished: 2019/07/13
Received: 2019/07/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9508472	N/A	2019/07/16	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9508305	N/A	2019/07/16	Niloufar Behin Aein
F1-BTEX	CALC/MS	9506830	N/A	2019/07/17	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9507099	N/A	2019/07/19	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9509009	N/A	2019/07/16	Marissa Richard
Conductivity @25C	COND	9508475	N/A	2019/07/16	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9507558	2019/07/15	2019/07/16	Grace Guo
Hardness	CALC	9507102	N/A	2019/07/16	Automated Statchk
Mercury (Dissolved) by CV	CV	9511884	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9507548	N/A	2019/07/15	Rana Elsadig
Elements by ICPMS - Dissolved	ICPM	9507557	N/A	2019/07/16	Julie Harrison
Ion Balance	CALC	9507105	N/A	2019/07/16	Automated Statchk
Nitrate and Nitrite	CALC	9507106	N/A	2019/07/16	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9507107	N/A	2019/07/16	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9507357	N/A	2019/07/16	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9511224	N/A	2019/07/18	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9507343	2019/07/15	2019/07/16	Luminita Chiosa

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

GENERAL COMMENTS

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

Package 1	2.0°C

Sample WC1423 [BI-13-1-4] : 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.

Sample WC1424 [BI-13-3-4.5] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WC1423	BI-13-1-4	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WC1424	BI-13-3-4.5	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9507343	LCA	Method Blank	Total Dissolved Solids	2019/07/16	<10		mg/L	
9507357	CAR	Method Blank	Dissolved Nitrite (N)	2019/07/16	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/16	<0.010		mg/L	
9507548	REL	Method Blank	Dissolved Iron (Fe)	2019/07/15	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/15	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/15	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/15	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/15	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/15	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/15	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/15	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/15	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/15	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/15	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/15	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/15	<0.30		mg/L	
9507557	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/19	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/19	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/19	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/19	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/19	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/19	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/19	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/19	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/19	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/19	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/19	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/19	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/19	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/19	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/19	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/19	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/19	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/19	<0.0010		mg/L	
9507558	GG3	Method Blank	O-TERPHENYL (sur.)	2019/07/15		120	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/15	<0.10		mg/L	
9508305	NBA	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/16		97	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/16		104	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/16		102	%	50 - 140
			Benzene	2019/07/16	<0.00040		mg/L	
			Toluene	2019/07/16	<0.00040		mg/L	
			Ethylbenzene	2019/07/16	<0.00040		mg/L	
			m & p-Xylene	2019/07/16	<0.00080		mg/L	
			o-Xylene	2019/07/16	<0.00040		mg/L	
			LH (C5-C10)	2019/07/16	<0.10		mg/L	
			F1 (C6-C10)	2019/07/16	<0.10		mg/L	
9508472	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/16	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/16	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/16	<1.0		mg/L	
			Carbonate (CO3)	2019/07/16	<1.0		mg/L	
			Hydroxide (OH)	2019/07/16	<1.0		mg/L	
9508475	MA4	Method Blank	Conductivity	2019/07/16	<2.0		uS/cm	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9509009	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/16	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/16	<1.0		mg/L	
9511224	YY	Method Blank	Phenols	2019/07/18	<0.0015		mg/L	
9511884	MHD	Method Blank	Dissolved Mercury (Hg)	2019/07/18	<0.0020		ug/L	
9507343	LCA	LCS	Total Dissolved Solids	2019/07/16		98	%	80 - 120
9507357	CAR	LCS	Dissolved Nitrite (N)	2019/07/16		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/16		100	%	80 - 120
9507548	REL	LCS	Dissolved Iron (Fe)	2019/07/15		102	%	80 - 120
			Dissolved Lithium (Li)	2019/07/15		102	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		103	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/15		102	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		105	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/15		99	%	80 - 120
			Dissolved Sulphur (S)	2019/07/15		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/15		102	%	80 - 120
			Dissolved Barium (Ba)	2019/07/15		99	%	80 - 120
			Dissolved Silicon (Si)	2019/07/15		99	%	80 - 120
			Dissolved Boron (B)	2019/07/15		103	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/15		102	%	80 - 120
9507557	JHS	LCS	Dissolved Aluminum (Al)	2019/07/16		108	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/16		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/16		96	%	80 - 120
			Dissolved Copper (Cu)	2019/07/16		98	%	80 - 120
			Dissolved Lead (Pb)	2019/07/16		97	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/16		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/16		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/16		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/16		100	%	80 - 120
			Dissolved Silver (Ag)	2019/07/16		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/16		94	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/16		95	%	80 - 120
			Dissolved Tin (Sn)	2019/07/16		97	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/16		97	%	80 - 120
			Dissolved Uranium (U)	2019/07/16		96	%	80 - 120
			Dissolved Vanadium (V)	2019/07/16		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/16		97	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/16		98	%	80 - 120
9507558	GG3	LCS	O-TERPHENYL (sur.)	2019/07/15		117	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/15		129	%	60 - 140
9508305	NBA	LCS	1,4-Difluorobenzene (sur.)	2019/07/16		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/16		106	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/16		105	%	50 - 140
			Benzene	2019/07/16		116	%	60 - 130
			Toluene	2019/07/16		116	%	60 - 130
			Ethylbenzene	2019/07/16		120	%	60 - 130
			m & p-Xylene	2019/07/16		115	%	60 - 130
			o-Xylene	2019/07/16		111	%	60 - 130
			LH (C5-C10)	2019/07/16		100	%	60 - 140
			F1 (C6-C10)	2019/07/16		101	%	60 - 140
9508472	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/16		98	%	80 - 120
9508475	MA4	LCS	Conductivity	2019/07/16		100	%	90 - 110

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9509009	MRD	LCS	Dissolved Chloride (Cl)	2019/07/16		109	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/16		108	%	80 - 120
9511224	YY	LCS	Phenols	2019/07/18		95	%	80 - 120
9511884	MHD	LCS	Dissolved Mercury (Hg)	2019/07/18		104	%	80 - 120

LCS: 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.

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BV Labs Job #: B956702
Report Date: 2019/07/22

Advisian
Task Order#: 407011-00770-400
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Project #: 407011-00770-400

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

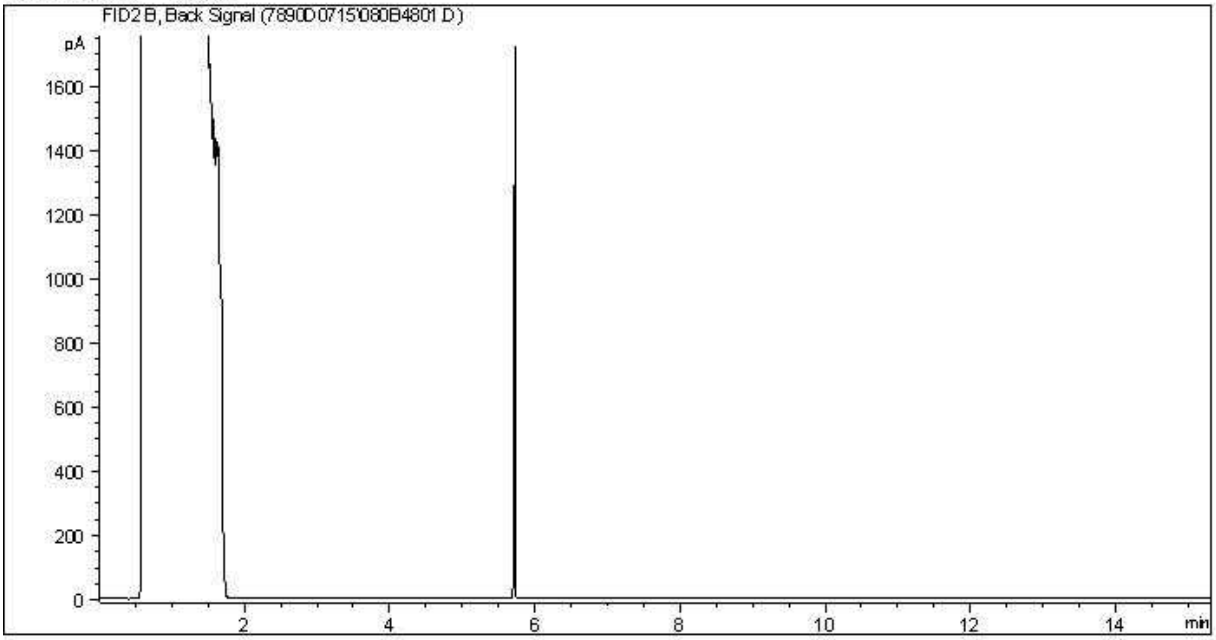
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BV Labs Job #: B956702
Report Date: 2019/07/22
BV Labs Sample: WC1423

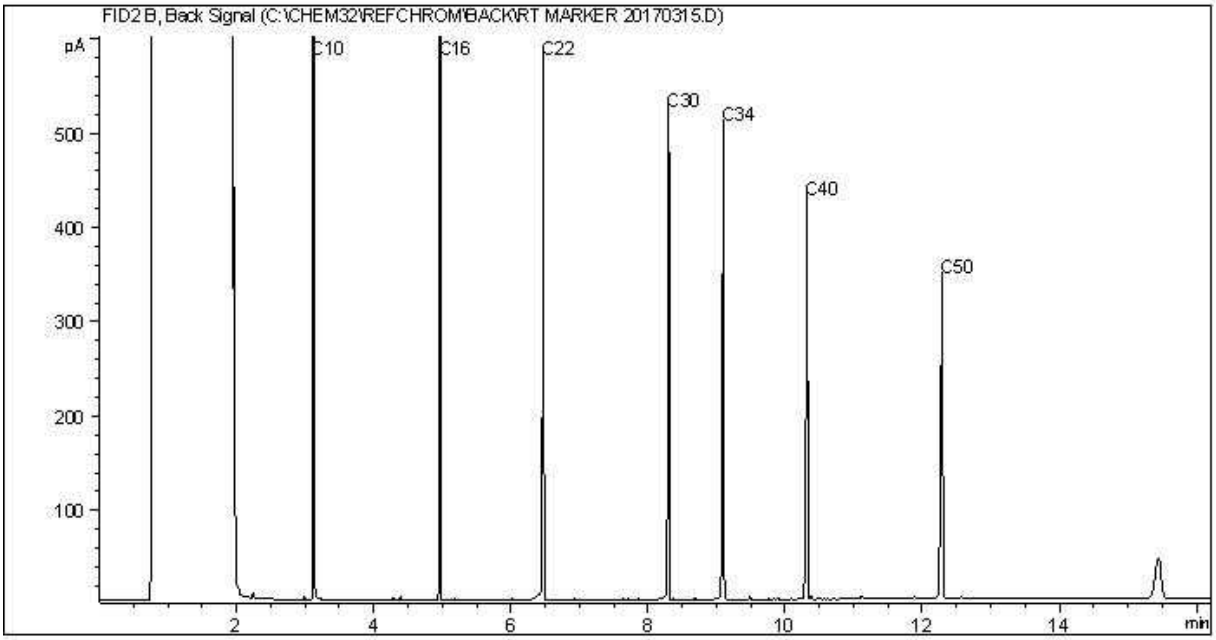
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BI-13-1-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

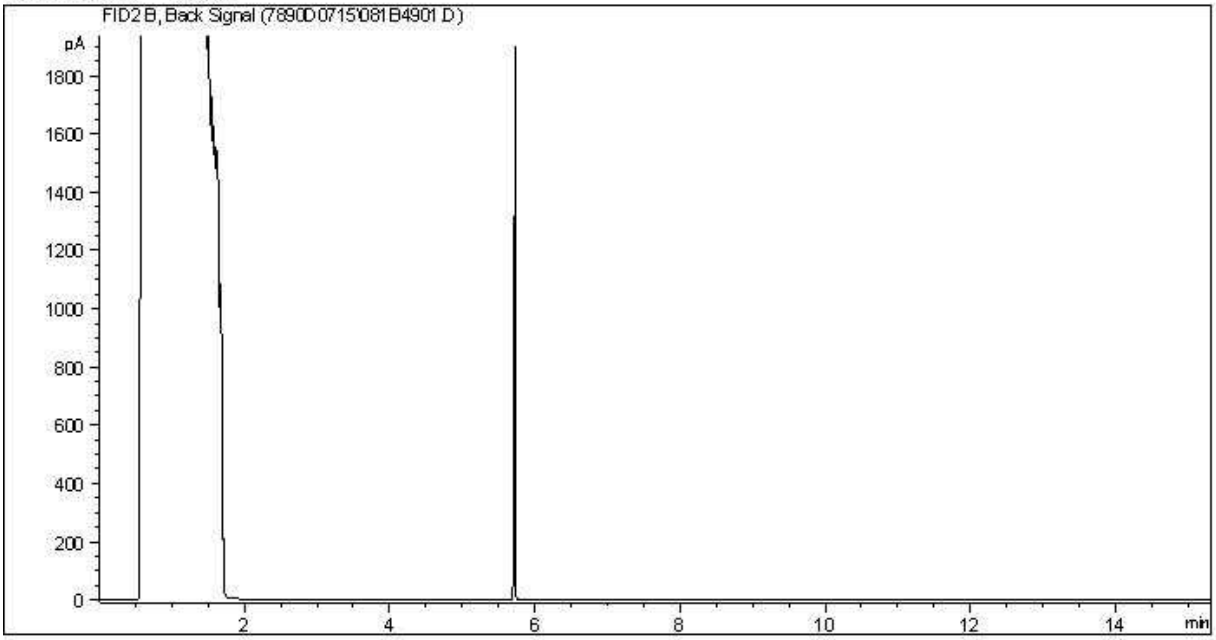
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B956702
Report Date: 2019/07/22
BV Labs Sample: WC1424

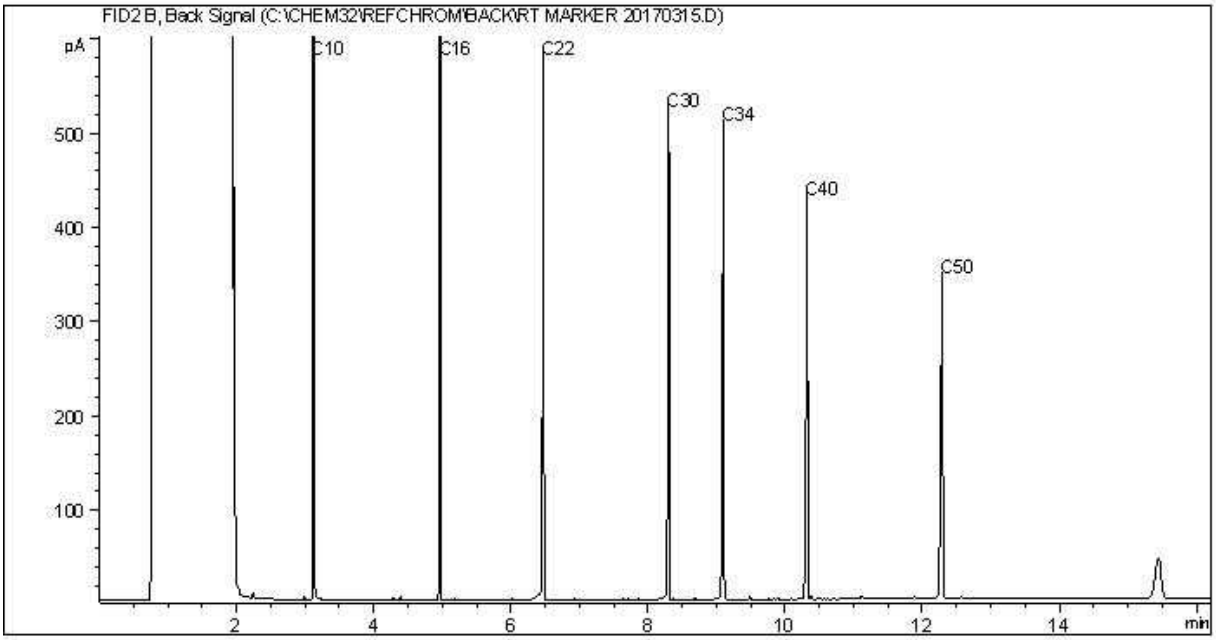
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BI-13-3-4.5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
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EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

LR2

C of C # 298600

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: Worley Parsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-157 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-157 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Michelle Vokaty	Consultant Project #: 407011-00770-400

ANALYSIS REQUESTED

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☐ TOT ☒ DIS	MERCURY ☐ TOTAL ☒ DISSOLVED	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG							
1 BI-13-1-4	X				10	2019/07/12	09:45	X				X							X	X					X		X	Phenols by 4AAP						X Limited Sample - partial bottles
2 BI-13-3-4.5	X				10	↓	10:00	X				X							X	X					X		X							
3																																	
4																																	
5																																	
6																																	
7																																	
8																																	
9																																	
10																																	

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email: canada.chemistry@worleyparsons.com cacal-10Rdatatrack@worleyparsons.com melissa.lord@advisian.com

IES A2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #				YES	NO	COOLER ID #				YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	2	2	2	SEAL PRESENT		TEMP °C	1	2	3	SEAL PRESENT		TEMP °C	1	2	3
SEAL INTACT	✓			1	2	3	SEAL INTACT						SEAL INTACT					
COOLING MEDIA PRESENT	✓						COOLING MEDIA PRESENT						COOLING MEDIA PRESENT					

LAB USE ONLY
MAXXAM JOB # B956702

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1. signature	Melissa Lord printed name	2019/07/13	08:00	1. signature	DE JZ WV printed name	2019/07/14	10:52
2. signature	printed name	YYYY/MM/DD	HH:MM	2. signature	printed name	YYYY/MM/DD	HH:MM
3. signature	printed name	YYYY/MM/DD	HH:MM	3. signature	printed name	YYYY/MM/DD	HH:MM

SAMPLES
LABELED BY: LR2
VERIFIED BY: GT

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 15-Jul-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B957734

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD			x	
Matrix Spike Recovery			x	
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	Sample C38 08-1-4 and its field duplicate NWD19-29 exceeded the 50% alert limit for Ion Balance (% Difference) (91%). All other QC samples met alert limits.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD		x		

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	Yes
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: No

Date DQO was received:

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): Myrna Chorney for Nandhini Durairaj

Date: 02-Aug-19

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298602

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/24
Report #: R2756914
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B957734
Received: 2019/07/17, 11:11

Sample Matrix: Ground Water
Samples Received: 4

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	4	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	4	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	4		Auto Calc
Cadmium - low level CCME - Dissolved	4		Auto Calc
Chloride/Sulphate by Auto Colourimetry	4	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	4	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	4	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	4		Auto Calc
Mercury (Dissolved) by CV	4	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	4	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	4	AB SOP-00043	EPA 6020b R2 m
Ion Balance	4		Auto Calc
Nitrate and Nitrite	4		Auto Calc
Nitrate + Nitrite-N (calculated)	4		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	4	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (3)	1		Auto Calc
PAH in Water by GC/MS	1	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	4	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	4	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298602

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/24
Report #: R2756914
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B957734
Received: 2019/07/17, 11:11

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (GROUND WATER)

BV Labs ID		WC7072	WC7073	WC7074		WC7075		
Sampling Date		2019/07/15 15:25	2019/07/15 08:50	2019/07/15 07:30		2019/07/15 15:20		
COC Number		298602	298602	298602		298602		
	UNITS	**C38 08-1-4**	**WSY 97-1-5**	**MEBG-10-1-3**	**QC Batch**	**NWD19-29**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	9511886	<0.10	0.10	9511886
Volatiles								
Benzene	mg/L	0.00093	<0.00040	<0.00040	9510388	0.00061	0.00040	9508247
Toluene	mg/L	<0.00040	<0.00040	<0.00040	9510388	<0.00040	0.00040	9508247
Ethylbenzene	mg/L	<0.00040	<0.00040	<0.00040	9510388	<0.00040	0.00040	9508247
m & p-Xylene	mg/L	<0.00080	<0.00080	<0.00080	9510388	<0.00080	0.00080	9508247
o-Xylene	mg/L	<0.00040	<0.00040	<0.00040	9510388	<0.00040	0.00040	9508247
Xylenes (Total)	mg/L	<0.00089	<0.00089	<0.00089	9510436	<0.00089	0.00089	9510436
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	<0.10	9510436	<0.10	0.10	9510436
LH (C5-C10)	mg/L	<0.10	<0.10	<0.10	9510388	<0.10	0.10	9508247
F1 (C6-C10)	mg/L	<0.10	<0.10	<0.10	9510388	<0.10	0.10	9508247
Extraction Surrogate Recovery (%)								
O-TERPHENYL (sur.)	%	96	94	90	9511886	94		9511886
Instrument Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	99	100	99	9510388	100		9508247
4-Bromofluorobenzene (sur.)	%	100	100	99	9510388	100		9508247
D4-1,2-Dichloroethane (sur.)	%	100	100	99	9510388	102		9508247

RDL = Reportable Detection Limit

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BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC7072	WC7073	WC7074	WC7075		
Sampling Date		2019/07/15 15:25	2019/07/15 08:50	2019/07/15 07:30	2019/07/15 15:20		
COC Number		298602	298602	298602	298602		
	UNITS	**C38 08-1-4**	**WSY 97-1-5**	**MEBG-10-1-3**	**NWD19-29**	**RDL**	**QC Batch**
Low Level Elements							
Dissolved Cadmium (Cd)	mg/L	<0.000020	0.000058	0.000051	<0.000020	0.000020	9510958
Elements							
Dissolved Aluminum (Al)	mg/L	0.068	0.012	<0.0030	0.065	0.0030	9511328
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	<0.00060	<0.00060	0.00060	9511328
Dissolved Arsenic (As)	mg/L	0.0061	0.00035	<0.00020	0.0054	0.00020	9511328
Dissolved Barium (Ba)	mg/L	0.39	0.054	0.14	0.37	0.010	9511223
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9511328
Dissolved Boron (B)	mg/L	<0.020	0.067	<0.020	<0.020	0.020	9511223
Dissolved Calcium (Ca)	mg/L	140	260	97	140	0.30	9511223
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9511328
Dissolved Cobalt (Co)	mg/L	0.0029	0.00090	0.0012	0.0028	0.00030	9511328
Dissolved Copper (Cu)	mg/L	0.00028	0.0025	0.00070	0.00039	0.00020	9511328
Dissolved Iron (Fe)	mg/L	16	0.18	0.27	15	0.060	9511223
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9511328
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	<0.020	<0.020	0.020	9511223
Dissolved Magnesium (Mg)	mg/L	54	47	22	52	0.20	9511223
Dissolved Manganese (Mn)	mg/L	0.85	0.37	0.97	0.81	0.0040	9511223
Dissolved Molybdenum (Mo)	mg/L	0.00040	0.014	0.00079	0.00022	0.00020	9511328
Dissolved Nickel (Ni)	mg/L	0.0049	0.0039	0.0024	0.0049	0.00050	9511328
Dissolved Phosphorus (P)	mg/L	0.67	<0.10	<0.10	0.64	0.10	9511223
Dissolved Potassium (K)	mg/L	2.9	2.0	0.66	2.8	0.30	9511223
Dissolved Selenium (Se)	mg/L	0.00077	0.0063	<0.00020	0.00054	0.00020	9511328
Dissolved Silicon (Si)	mg/L	10	5.3	2.1	10	0.10	9511223
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	9511328
Dissolved Sodium (Na)	mg/L	28	14	7.1	27	0.50	9511223
Dissolved Strontium (Sr)	mg/L	0.42	0.63	0.33	0.41	0.020	9511223
Dissolved Sulphur (S)	mg/L	6.4	170	35	6.9	0.20	9511223
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9511328
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9511328
Dissolved Titanium (Ti)	mg/L	0.0020	<0.0010	<0.0010	0.0016	0.0010	9511328
Dissolved Uranium (U)	mg/L	0.00055	0.0098	0.0023	0.00049	0.00010	9511328
RDL = Reportable Detection Limit							

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BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC7072	WC7073	WC7074	WC7075		
Sampling Date		2019/07/15 15:25	2019/07/15 08:50	2019/07/15 07:30	2019/07/15 15:20		
COC Number		298602	298602	298602	298602		
	UNITS	**C38 08-1-4**	**WSY 97-1-5**	**MEBG-10-1-3**	**NWD19-29**	**RDL**	**QC Batch**
Dissolved Vanadium (V)	mg/L	0.0011	<0.0010	<0.0010	0.0010	0.0010	9511328
Dissolved Zinc (Zn)	mg/L	0.0031	0.020	0.0048	0.0037	0.0030	9511328
RDL = Reportable Detection Limit							

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF GROUND WATER

BV Labs ID		WC7072		WC7073		WC7074		WC7075		
Sampling Date		2019/07/15 15:25		2019/07/15 08:50		2019/07/15 07:30		2019/07/15 15:20		
COC Number		298602		298602		298602		298602		
	UNITS	**C38 08-1-4**	**RDL**	**WSY 97-1-5**	**RDL**	**MEBG-10-1-3**	**RDL**	**NWD19-29**	**RDL**	**QC Batch**
Calculated Parameters										
Hardness (CaCO3)	mg/L	580	0.50	850	0.50	330	0.50	560	0.50	9510438
Ion Balance (% Difference)	%	1.7	N/A	0.21	N/A	0.69	N/A	0.64	N/A	9510439
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	<0.044	0.044	0.11	0.044	<0.22	0.22	9510959
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	<0.014	0.014	0.024	0.014	<0.071	0.071	9510961
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	<0.033	0.033	<0.033	0.033	<0.16	0.16	9510959
Misc. Inorganics										
Conductivity	uS/cm	1200	2.0	1400	2.0	630	2.0	1200	2.0	9515618
Total Dissolved Solids	mg/L	760 (1)	25	1100	10	310	10	760 (1)	25	9512415
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	9515617
Alkalinity (Total as CaCO3)	mg/L	620	1.0	340	1.0	230	1.0	630	1.0	9515617
Bicarbonate (HCO3)	mg/L	760	1.0	420	1.0	290	1.0	760	1.0	9515617
Carbonate (CO3)	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	9515617
Hydroxide (OH)	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	9515617
Dissolved Chloride (Cl)	mg/L	18	1.0	23	1.0	2.0	1.0	18	1.0	9511857
Dissolved Sulphate (SO4)	mg/L	4.5	1.0	480 (2)	5.0	110	1.0	5.6	1.0	9511857
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	<0.010	0.010	<0.050 (3)	0.050	9510775
Dissolved Nitrate (N)	mg/L	<0.010	0.010	<0.010	0.010	0.024	0.010	<0.050 (3)	0.050	9510775
Misc. Organics										
Phenols	mg/L	0.024	0.0015	0.0033	0.0015	<0.0015	0.0015	0.024	0.0015	9517464

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limit raised based on sample volume used and sample matrix
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.
(3) Detection limits raised due to matrix interference.

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

SEMIVOLATILE ORGANICS BY GC-MS (GROUND WATER)

BV Labs ID		WC7074		
Sampling Date		2019/07/15 07:30		
COC Number		298602		
	UNITS	**MEBG-10-1-3**	**RDL**	**QC Batch**
Polycyclic Aromatics				
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	0.000010	9510963
Acenaphthene	mg/L	<0.00010	0.00010	9509906
Acenaphthylene	mg/L	<0.00010	0.00010	9509906
Acridine	mg/L	<0.000040	0.000040	9509906
Anthracene	mg/L	<0.000010	0.000010	9509906
Benzo(a)anthracene	mg/L	<0.0000085	0.0000085	9509906
Benzo(b&j)fluoranthene	mg/L	<0.0000085	0.0000085	9509906
Benzo(k)fluoranthene	mg/L	<0.0000085	0.0000085	9509906
Benzo(g,h,i)perylene	mg/L	<0.0000085	0.0000085	9509906
Benzo(c)phenanthrene	mg/L	<0.000050	0.000050	9509906
Benzo(a)pyrene	mg/L	<0.0000075	0.0000075	9509906
Benzo(e)pyrene	mg/L	<0.000050	0.000050	9509906
Chrysene	mg/L	<0.0000085	0.0000085	9509906
Dibenz(a,h)anthracene	mg/L	<0.0000075	0.0000075	9509906
Fluoranthene	mg/L	<0.000010	0.000010	9509906
Fluorene	mg/L	<0.000050	0.000050	9509906
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	0.0000085	9509906
1-Methylnaphthalene	mg/L	<0.00010	0.00010	9509906
2-Methylnaphthalene	mg/L	<0.00010	0.00010	9509906
Naphthalene	mg/L	<0.00010	0.00010	9509906
Phenanthrene	mg/L	<0.000050	0.000050	9509906
Perylene	mg/L	<0.000050	0.000050	9509906
Pyrene	mg/L	<0.000020	0.000020	9509906
Quinoline	mg/L	<0.00020	0.00020	9509906
Extraction Surrogate Recovery (%)				
D10-ANTHRACENE (sur.)	%	76		9509906
D8-ACENAPHTHYLENE (sur.)	%	76		9509906
D8-NAPHTHALENE (sur.)	%	74		9509906
TERPHENYL-D14 (sur.)	%	84		9509906
RDL = Reportable Detection Limit				

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BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

MERCURY BY COLD VAPOR (GROUND WATER)

BV Labs ID		WC7072		WC7073	WC7074		WC7075		
Sampling Date		2019/07/15 15:25		2019/07/15 08:50	2019/07/15 07:30		2019/07/15 15:20		
COC Number		298602		298602	298602		298602		
	UNITS	**C38 08-1-4**	**RDL**	**WSY 97-1-5**	**MEBG-10-1-3**	**RDL**	**NWD19-29**	**RDL**	**QC Batch**
Elements									
Dissolved Mercury (Hg)	ug/L	<0.020 (1)	0.020	<0.0020	<0.0020	0.0020	<0.020 (1)	0.020	9511897

RDL = Reportable Detection Limit
(1) Detection limits raised due to sample matrix.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WC7072
Sample ID: C38 08-1-4
Matrix: Ground Water

Collected: 2019/07/15
Relinquished: 2019/07/16
Received: 2019/07/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9510388	N/A	2019/07/18	Adriana Munoz
F1-BTEX	CALC/MS	9510436	N/A	2019/07/19	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9510958	N/A	2019/07/18	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9511857	N/A	2019/07/18	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9511886	2019/07/18	2019/07/19	Grace Guo
Hardness	CALC	9510438	N/A	2019/07/20	Automated Statchk
Mercury (Dissolved) by CV	CV	9511897	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9511223	N/A	2019/07/19	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9511328	N/A	2019/07/18	Julie Harrison
Ion Balance	CALC	9510439	N/A	2019/07/18	Automated Statchk
Nitrate and Nitrite	CALC	9510959	N/A	2019/07/18	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9510961	N/A	2019/07/18	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9510775	N/A	2019/07/17	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9517464	N/A	2019/07/22	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9512415	2019/07/18	2019/07/19	Luminita Chiosa

BV Labs ID: WC7073
Sample ID: WSY 97-1-5
Matrix: Ground Water

Collected: 2019/07/15
Relinquished: 2019/07/16
Received: 2019/07/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9510388	N/A	2019/07/18	Adriana Munoz
F1-BTEX	CALC/MS	9510436	N/A	2019/07/19	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9510958	N/A	2019/07/18	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9511857	N/A	2019/07/18	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9511886	2019/07/18	2019/07/19	Grace Guo
Hardness	CALC	9510438	N/A	2019/07/20	Automated Statchk
Mercury (Dissolved) by CV	CV	9511897	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9511223	N/A	2019/07/19	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9511328	N/A	2019/07/18	Julie Harrison
Ion Balance	CALC	9510439	N/A	2019/07/18	Automated Statchk
Nitrate and Nitrite	CALC	9510959	N/A	2019/07/18	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9510961	N/A	2019/07/18	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9510775	N/A	2019/07/17	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9517464	N/A	2019/07/22	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9512415	2019/07/18	2019/07/19	Luminita Chiosa

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WC7074
Sample ID: MEBG-10-1-3
Matrix: Ground Water

Collected: 2019/07/15
Relinquished: 2019/07/16
Received: 2019/07/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9510388	N/A	2019/07/18	Adriana Munoz
F1-BTEX	CALC/MS	9510436	N/A	2019/07/19	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9510958	N/A	2019/07/18	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9511857	N/A	2019/07/18	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9511886	2019/07/18	2019/07/19	Grace Guo
Hardness	CALC	9510438	N/A	2019/07/20	Automated Statchk
Mercury (Dissolved) by CV	CV	9511897	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9511223	N/A	2019/07/19	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9511328	N/A	2019/07/18	Julie Harrison
Ion Balance	CALC	9510439	N/A	2019/07/18	Automated Statchk
Nitrate and Nitrite	CALC	9510959	N/A	2019/07/18	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9510961	N/A	2019/07/18	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9510775	N/A	2019/07/17	Krista Dawe
Benzo[a]pyrene Equivalency	GC/MSD	9510963	N/A	2019/07/22	Automated Statchk
PAH in Water by GC/MS	GC/MS	9509906	2019/07/18	2019/07/19	Harneet Gill
Phenols (4-AAP)	TECH/4AAP	9517464	N/A	2019/07/22	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9512415	2019/07/18	2019/07/19	Luminita Chiosa

BV Labs ID: WC7075
Sample ID: NWD19-29
Matrix: Ground Water

Collected: 2019/07/15
Relinquished: 2019/07/16
Received: 2019/07/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9508247	N/A	2019/07/18	Niloufar Behin Aein
F1-BTEX	CALC/MS	9510436	N/A	2019/07/19	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9510958	N/A	2019/07/18	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9511857	N/A	2019/07/18	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9511886	2019/07/18	2019/07/19	Grace Guo
Hardness	CALC	9510438	N/A	2019/07/20	Automated Statchk
Mercury (Dissolved) by CV	CV	9511897	2019/07/18	2019/07/18	Michelle Rivest
Elements by ICP - Dissolved	ICPA	9511223	N/A	2019/07/19	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9511328	N/A	2019/07/18	Julie Harrison
Ion Balance	CALC	9510439	N/A	2019/07/18	Automated Statchk
Nitrate and Nitrite	CALC	9510959	N/A	2019/07/18	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9510961	N/A	2019/07/18	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9510775	N/A	2019/07/18	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9517464	N/A	2019/07/22	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9512415	2019/07/18	2019/07/19	Luminita Chiosa

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
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GENERAL COMMENTS

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

Package 1	2.7°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9508247	NBA	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/16		102	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/16		97	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/16		101	%	50 - 140
			Benzene	2019/07/16	<0.00040		mg/L	
			Toluene	2019/07/16	<0.00040		mg/L	
			Ethylbenzene	2019/07/16	<0.00040		mg/L	
			m & p-Xylene	2019/07/16	<0.00080		mg/L	
			o-Xylene	2019/07/16	<0.00040		mg/L	
			LH (C5-C10)	2019/07/16	<0.10		mg/L	
			F1 (C6-C10)	2019/07/16	<0.10		mg/L	
9509906	HG3	Method Blank	D10-ANTHRACENE (sur.)	2019/07/18		84	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/18		99	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/18		87	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/18		82	%	50 - 130
			Acenaphthene	2019/07/18	<0.00010		mg/L	
			Acenaphthylene	2019/07/18	<0.00010		mg/L	
			Acridine	2019/07/18	<0.000040		mg/L	
			Anthracene	2019/07/18	<0.000010		mg/L	
			Benzo(a)anthracene	2019/07/18	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/07/18	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/07/18	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/07/18	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/07/18	<0.000050		mg/L	
			Benzo(a)pyrene	2019/07/18	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/07/18	<0.000050		mg/L	
			Chrysene	2019/07/18	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/07/18	<0.0000075		mg/L	
			Fluoranthene	2019/07/18	<0.000010		mg/L	
			Fluorene	2019/07/18	<0.000050		mg/L	
			Indeno(1,2,3-cd)pyrene	2019/07/18	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/07/18	<0.00010		mg/L	
			2-Methylnaphthalene	2019/07/18	<0.00010		mg/L	
			Naphthalene	2019/07/18	<0.00010		mg/L	
			Phenanthrene	2019/07/18	<0.000050		mg/L	
			Perylene	2019/07/18	<0.000050		mg/L	
			Pyrene	2019/07/18	<0.000020		mg/L	
			Quinoline	2019/07/18	<0.00020		mg/L	
9510388	AMJ	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/18		99	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/18		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/18		100	%	50 - 140
			Benzene	2019/07/18	<0.00040		mg/L	
			Toluene	2019/07/18	<0.00040		mg/L	
			Ethylbenzene	2019/07/18	<0.00040		mg/L	
			m & p-Xylene	2019/07/18	<0.00080		mg/L	
			o-Xylene	2019/07/18	<0.00040		mg/L	
			LH (C5-C10)	2019/07/18	<0.10		mg/L	
			F1 (C6-C10)	2019/07/18	<0.10		mg/L	
9510775	KD5	Method Blank	Dissolved Nitrite (N)	2019/07/17	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/17	<0.010		mg/L	
9511223	ACY	Method Blank	Dissolved Iron (Fe)	2019/07/19	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/19	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/19	<0.20		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Manganese (Mn)	2019/07/19	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/19	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/19	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/19	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/19	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/19	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/19	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/19	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/19	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/19	<0.30		mg/L	
9511328	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/18	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/18	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/18	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/18	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/18	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/18	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/18	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/18	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/18	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/18	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/18	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/18	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/18	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/18	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/18	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/18	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/18	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/18	<0.0010		mg/L	
9511857	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/18	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/18	<1.0		mg/L	
9511886	GG3	Method Blank	O-TERPHENYL (sur.)	2019/07/19		94	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/19	<0.10		mg/L	
9511897	MHD	Method Blank	Dissolved Mercury (Hg)	2019/07/18	<0.0020		ug/L	
9512415	LCA	Method Blank	Total Dissolved Solids	2019/07/19	<10		mg/L	
9515617	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/20	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/20	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/20	<1.0		mg/L	
			Carbonate (CO3)	2019/07/20	<1.0		mg/L	
			Hydroxide (OH)	2019/07/20	<1.0		mg/L	
9515618	MA4	Method Blank	Conductivity	2019/07/20	<2.0		uS/cm	
9517464	YY	Method Blank	Phenols	2019/07/22	<0.0015		mg/L	
9508247	NBA	LCS	1,4-Difluorobenzene (sur.)	2019/07/16		104	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/16		99	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/16		101	%	50 - 140
			Benzene	2019/07/16		103	%	60 - 130
			Toluene	2019/07/16		105	%	60 - 130
			Ethylbenzene	2019/07/16		107	%	60 - 130
			m & p-Xylene	2019/07/16		109	%	60 - 130
			o-Xylene	2019/07/16		105	%	60 - 130
			LH (C5-C10)	2019/07/16		72	%	60 - 140
			F1 (C6-C10)	2019/07/16		72	%	60 - 140
9509906	HG3	LCS	D10-ANTHRACENE (sur.)	2019/07/18		81	%	50 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			TERPHENYL-D14 (sur.)	2019/07/18		89	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/18		84	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/18		81	%	50 - 130
			Acenaphthene	2019/07/18		73	%	50 - 130
			Acenaphthylene	2019/07/18		79	%	50 - 130
			Acridine	2019/07/18		75	%	50 - 130
			Anthracene	2019/07/18		80	%	50 - 130
			Benzo(a)anthracene	2019/07/18		83	%	50 - 130
			Benzo(b&j)fluoranthene	2019/07/18		86	%	50 - 130
			Benzo(k)fluoranthene	2019/07/18		83	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/18		85	%	50 - 130
			Benzo(c)phenanthrene	2019/07/18		88	%	50 - 130
			Benzo(a)pyrene	2019/07/18		87	%	50 - 130
			Benzo(e)pyrene	2019/07/18		92	%	50 - 130
			Chrysene	2019/07/18		80	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/18		83	%	50 - 130
			Fluoranthene	2019/07/18		81	%	50 - 130
			Fluorene	2019/07/18		77	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/18		91	%	50 - 130
			1-Methylnaphthalene	2019/07/18		76	%	50 - 130
			2-Methylnaphthalene	2019/07/18		78	%	50 - 130
			Naphthalene	2019/07/18		76	%	50 - 130
			Phenanthrene	2019/07/18		77	%	50 - 130
			Perylene	2019/07/18		92	%	50 - 130
			Pyrene	2019/07/18		81	%	50 - 130
			Quinoline	2019/07/18		115	%	50 - 130
9510388	AMJ	LCS	1,4-Difluorobenzene (sur.)	2019/07/18		99	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/18		102	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/18		101	%	50 - 140
			Benzene	2019/07/18		88	%	60 - 130
			Toluene	2019/07/18		86	%	60 - 130
			Ethylbenzene	2019/07/18		93	%	60 - 130
			m & p-Xylene	2019/07/18		90	%	60 - 130
			o-Xylene	2019/07/18		93	%	60 - 130
			LH (C5-C10)	2019/07/18		81	%	60 - 140
			F1 (C6-C10)	2019/07/18		80	%	60 - 140
9510775	KD5	LCS	Dissolved Nitrite (N)	2019/07/17		101	%	80 - 120
			Dissolved Nitrate (N)	2019/07/17		101	%	80 - 120
9511223	ACY	LCS	Dissolved Iron (Fe)	2019/07/19		101	%	80 - 120
			Dissolved Lithium (Li)	2019/07/19		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/19		102	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/19		97	%	80 - 120
			Dissolved Potassium (K)	2019/07/19		101	%	80 - 120
			Dissolved Sodium (Na)	2019/07/19		102	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/19		99	%	80 - 120
			Dissolved Sulphur (S)	2019/07/19		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/19		99	%	80 - 120
			Dissolved Barium (Ba)	2019/07/19		98	%	80 - 120
			Dissolved Silicon (Si)	2019/07/19		97	%	80 - 120
			Dissolved Boron (B)	2019/07/19		101	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/19		96	%	80 - 120
9511328	JHS	LCS	Dissolved Aluminum (Al)	2019/07/18		104	%	80 - 120

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Chromium (Cr)	2019/07/18		101	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/18		100	%	80 - 120
			Dissolved Copper (Cu)	2019/07/18		103	%	80 - 120
			Dissolved Lead (Pb)	2019/07/18		103	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/18		101	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/18		104	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/18		99	%	80 - 120
			Dissolved Selenium (Se)	2019/07/18		105	%	80 - 120
			Dissolved Silver (Ag)	2019/07/18		103	%	80 - 120
			Dissolved Arsenic (As)	2019/07/18		100	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/18		102	%	80 - 120
			Dissolved Tin (Sn)	2019/07/18		106	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/18		104	%	80 - 120
			Dissolved Uranium (U)	2019/07/18		101	%	80 - 120
			Dissolved Vanadium (V)	2019/07/18		103	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/18		104	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/18		101	%	80 - 120
9511857	MRD	LCS	Dissolved Chloride (Cl)	2019/07/18		103	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/18		103	%	80 - 120
9511886	GG3	LCS	O-TERPHENYL (sur.)	2019/07/19		95	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/19		107	%	60 - 140
9511897	MHD	LCS	Dissolved Mercury (Hg)	2019/07/18		109	%	80 - 120
9512415	LCA	LCS	Total Dissolved Solids	2019/07/19		102	%	80 - 120
9515617	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/20		99	%	80 - 120
9515618	MA4	LCS	Conductivity	2019/07/20		99	%	90 - 110
9517464	YY	LCS	Phenols	2019/07/22		93	%	80 - 120

LCS: 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.

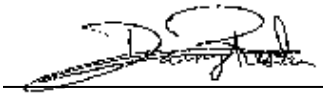
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B957734
Report Date: 2019/07/24

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

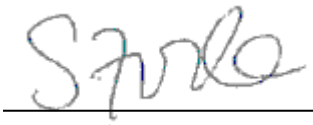
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Daniel Reslan, cCT, QP, Organics Manager



Justin Geisel, B.Sc., Organics Supervisor



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

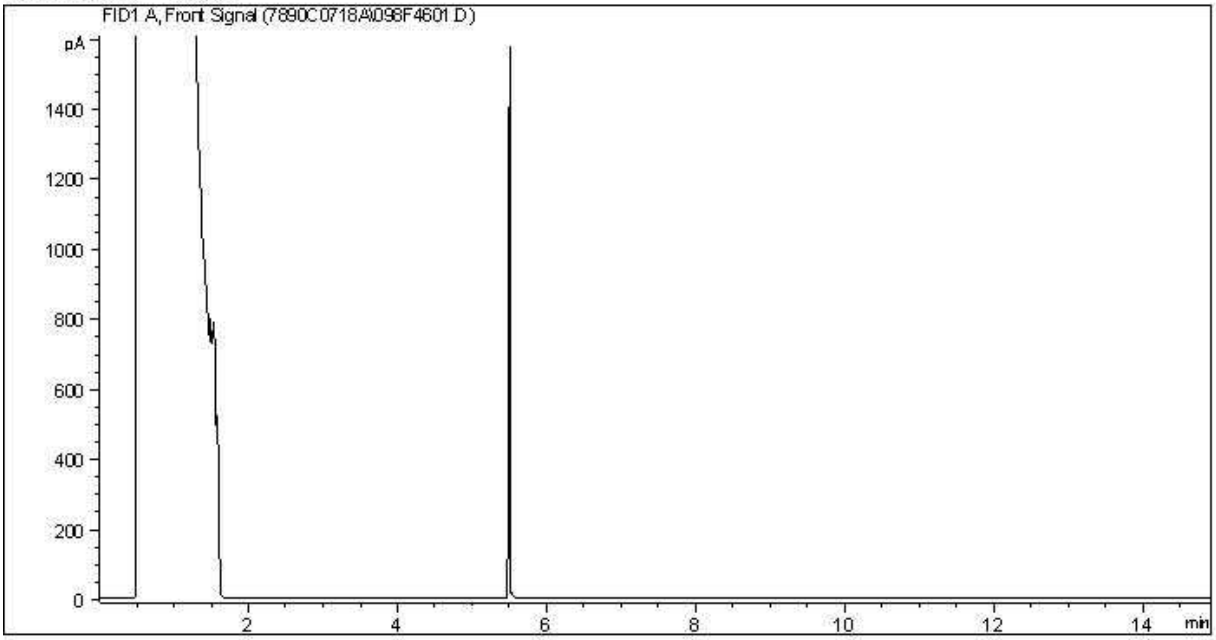
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BV Labs Job #: B957734
Report Date: 2019/07/24
BV Labs Sample: WC7072

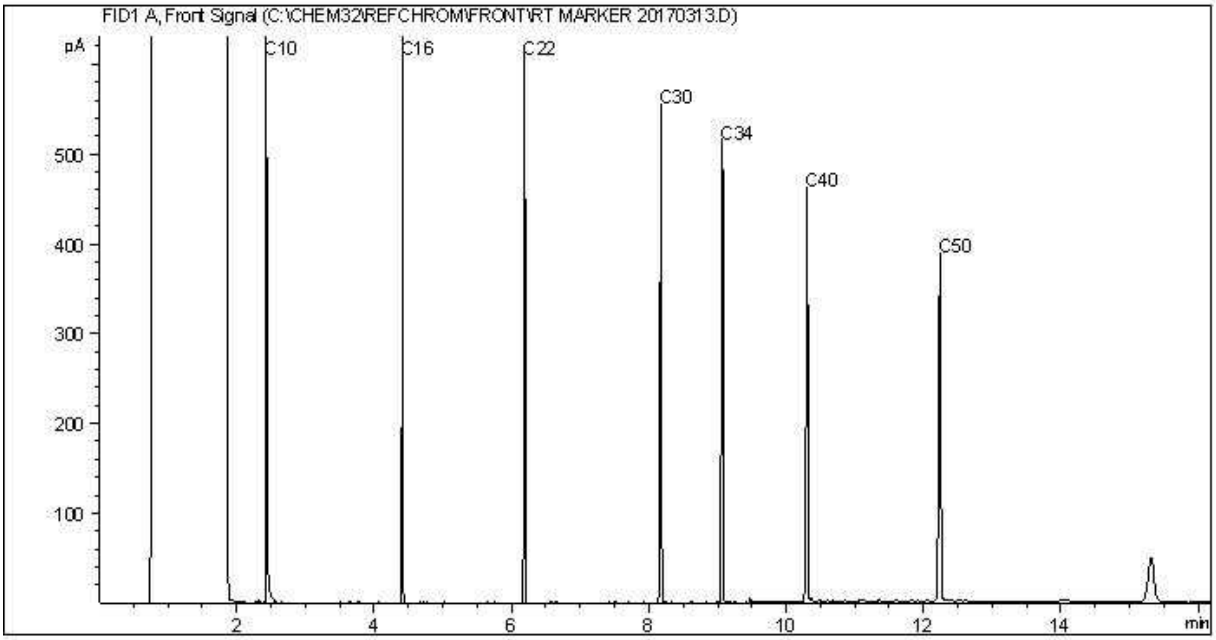
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: C38 08-1-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

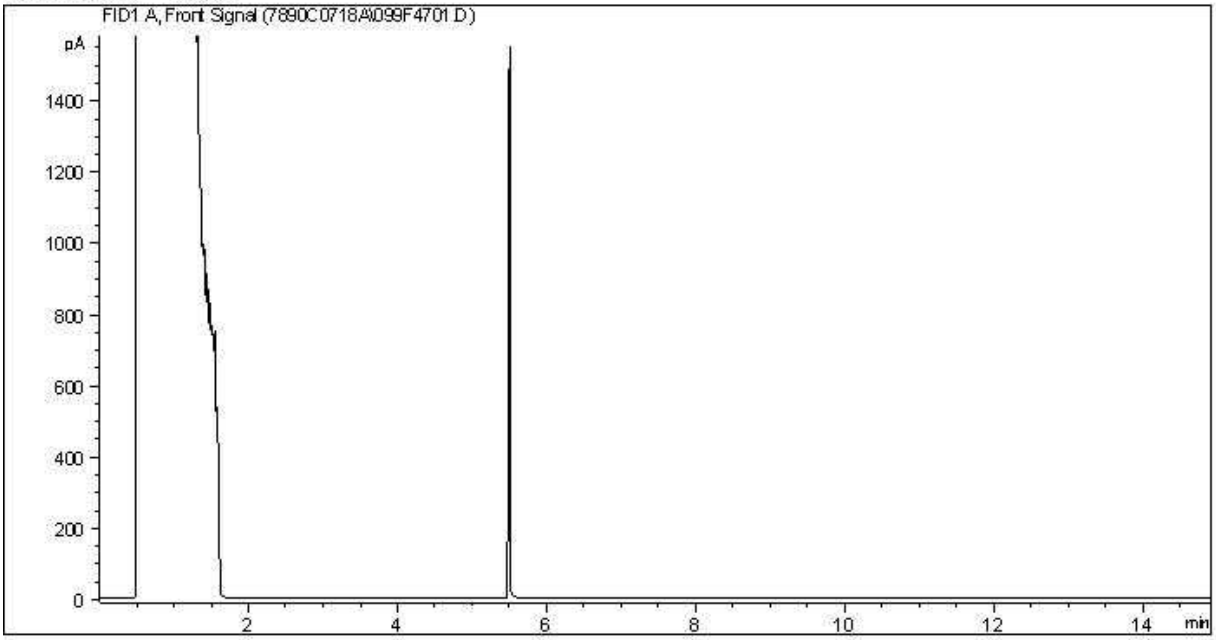
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B957734
Report Date: 2019/07/24
BV Labs Sample: WC7073

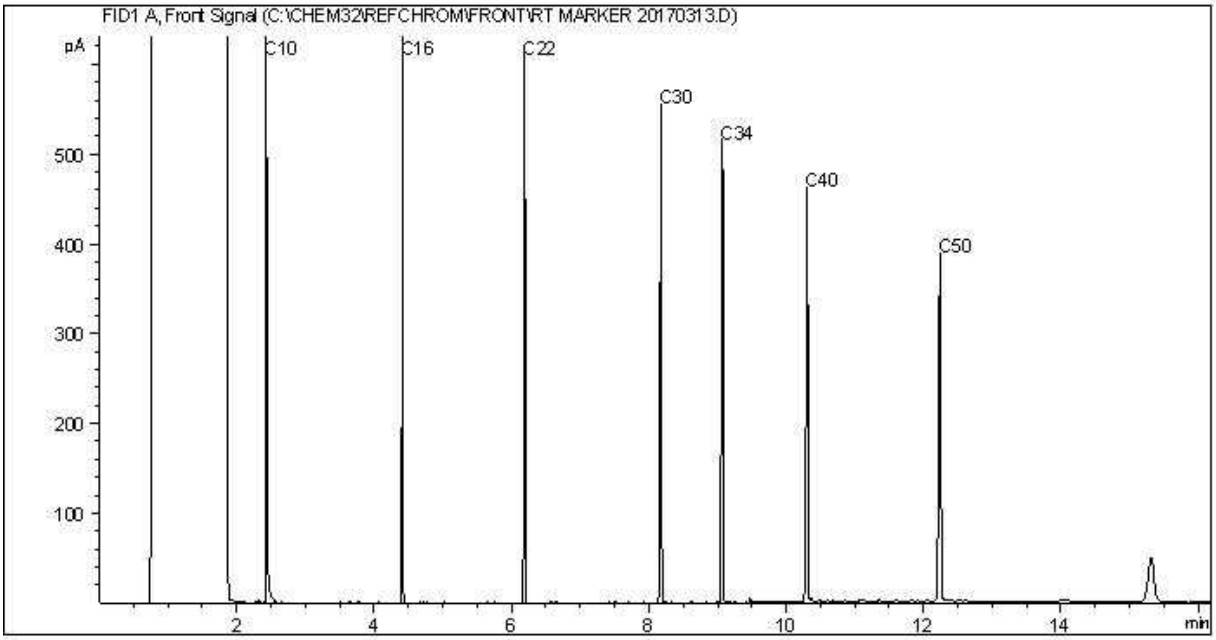
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: WSY 97-1-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

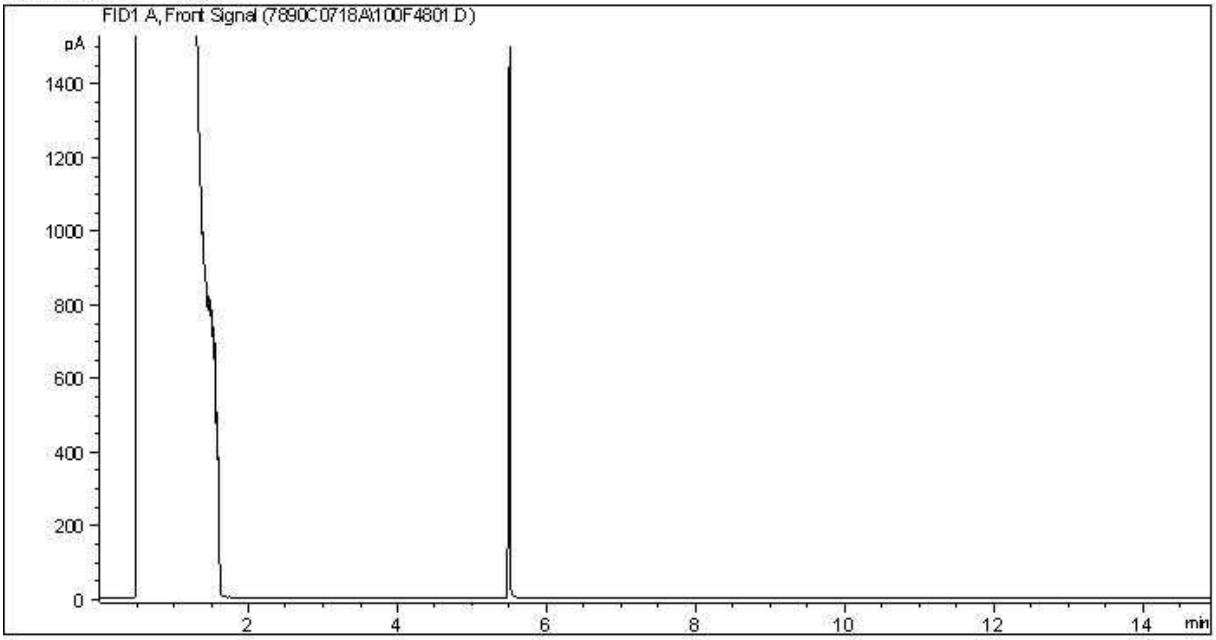
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B957734
Report Date: 2019/07/24
BV Labs Sample: WC7074

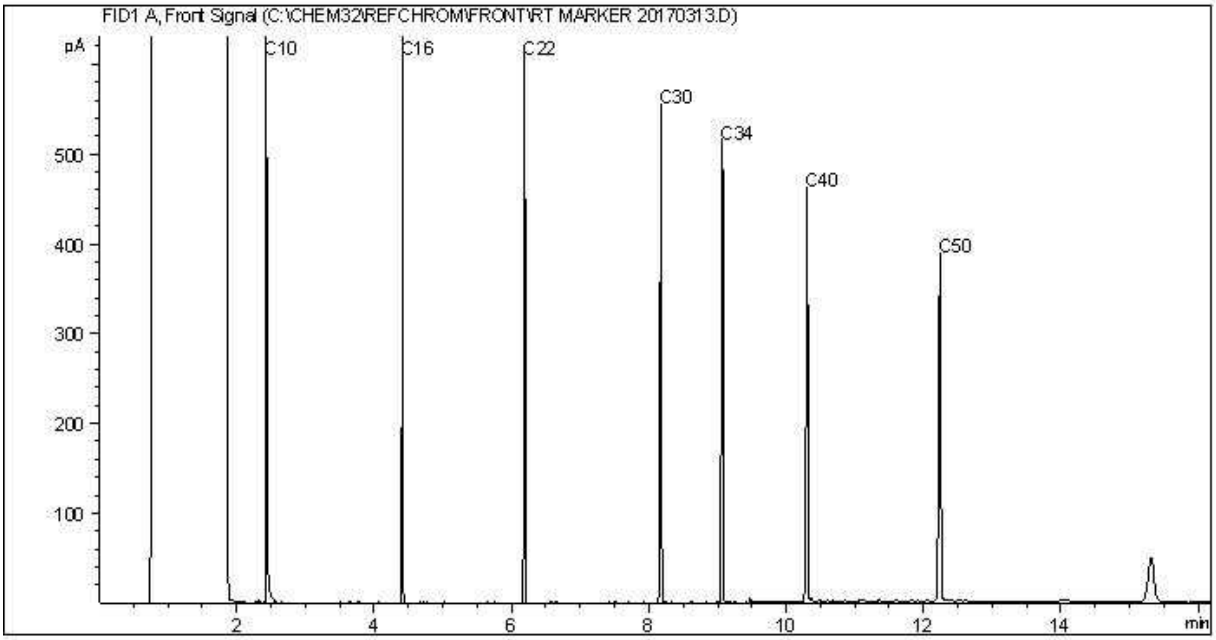
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: MEBG-10-1-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

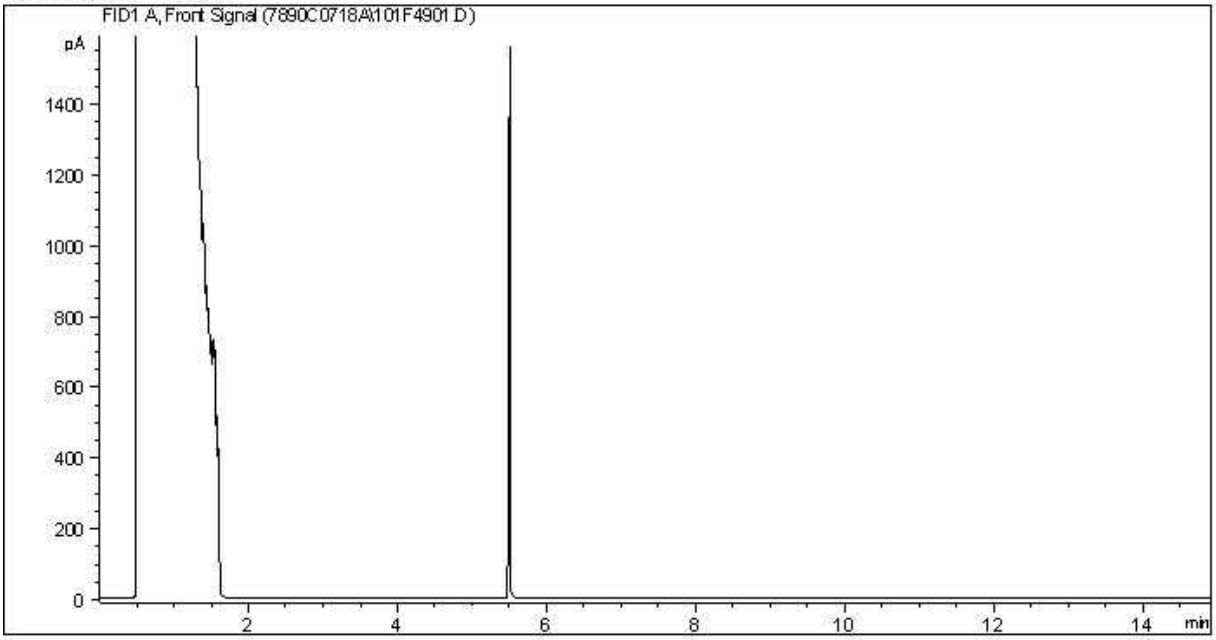
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B957734
Report Date: 2019/07/24
BV Labs Sample: WC7075

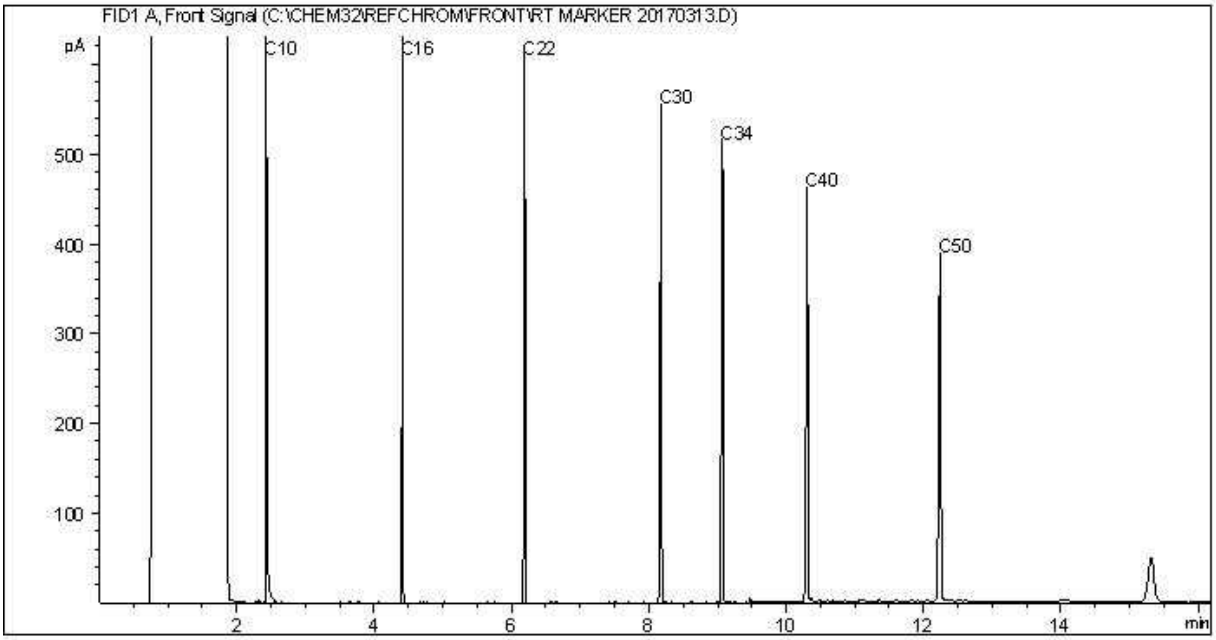
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-29

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

780

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

C of C # 298602

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: Worley Parsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Chelsea Rowe	Consultant Project #: 407011-00770-400

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☒ DIS ☐ TOT	MERCURY ☒ DISSOLVED ☐ TOTAL	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	☐ pH ☐ EC ☐ ALKALINITY	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP (limited quantity sample missing bottles)
1 C38 08-1-4	X				9	2019/07/15	15:25	X				X							X	X					X		X	X
2 W6Y 97-1-5	X						08:50	X				X							X	X					X		X	X
3 MEBG-10-1-3	X				12		07:30	X			X	X							X	X					X		X	
4 NWD19-29	X				9		15:20	X				X							X	X					X		X	X
5																												
6																												
7																												
8																												
9																												
10																												

IOL SITE LOCATION: Norman Wells NT
IOL PROJECT # (if applicable): N/A
MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: Also email: canada.chemistry@worleyparsons.com, cccalforddatatracker@worleyparsons.com, melissa.lord@advisian.com
IES A2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT	✓			5	2	1
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT				-		
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B957734

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1. signature	Chelsea Rowe printed name	2019/07/16	08:00	1. signature	Testi Ali printed name	2019/07/17	1111
2. signature	printed name	YYYY/MM/DD	HH:MM	2. signature	printed name	YYYY/MM/DD	HH:MM
3. signature	printed name	YYYY/MM/DD	HH:MM	3. signature	printed name	YYYY/MM/DD	HH:MM

SAMPLES
LABELED BY: GG
VERIFIED BY: LR

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 16-Jul-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B958262

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 25-Jul-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): 

Date: 02-Aug-19 | Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298598

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/25
Report #: R2757642
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958262
Received: 2019/07/18, 09:55

Sample Matrix: Ground Water
Samples Received: 2

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	2	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	2		Auto Calc
Cadmium - low level CCME - Dissolved	2		Auto Calc
Chloride/Sulphate by Auto Colourimetry	2	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	2	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	2	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	2		Auto Calc
Mercury (Dissolved) by CV	2	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	2	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	2	AB SOP-00043	EPA 6020b R2 m
Ion Balance	2		Auto Calc
Nitrate and Nitrite	2		Auto Calc
Nitrate + Nitrite-N (calculated)	2		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	AB SOP-00023	SM 23 4110 B m
Phenols (4-AAP)	2	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	2	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298598

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/25
Report #: R2757642
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958262
Received: 2019/07/18, 09:55

dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
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BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (GROUND WATER)

BV Labs ID		WC9722	WC9723		
Sampling Date		2019/07/16 08:15	2019/07/16 09:25		
COC Number		298598	298598		
	UNITS	**GIQ8-10-2-4**	**GIP11 09-1-4-R**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	2.7	<0.10	0.10	9513919
Volatiles					
Benzene	mg/L	<0.00040	<0.00040	0.00040	9514401
Toluene	mg/L	<0.00040	<0.00040	0.00040	9514401
Ethylbenzene	mg/L	<0.00040	<0.00040	0.00040	9514401
m & p-Xylene	mg/L	<0.00080	<0.00080	0.00080	9514401
o-Xylene	mg/L	<0.00040	<0.00040	0.00040	9514401
Xylenes (Total)	mg/L	<0.00089	<0.00089	0.00089	9512118
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	0.10	9512118
LH (C5-C10)	mg/L	<0.10	<0.10	0.10	9514401
F1 (C6-C10)	mg/L	<0.10	<0.10	0.10	9514401
Extraction Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	104	96		9513919
Instrument Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	100	100		9514401
4-Bromofluorobenzene (sur.)	%	99	96		9514401
D4-1,2-Dichloroethane (sur.)	%	102	102		9514401
RDL = Reportable Detection Limit					

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC9722			WC9722			WC9723		
Sampling Date		2019/07/16 08:15			2019/07/16 08:15			2019/07/16 09:25		
COC Number		298598			298598			298598		
	UNITS	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIQ8-10-2-4 Lab-Dup**	**RDL**	**QC Batch**	**GIP11 09-1-4-R**	**RDL**	**QC Batch**
Low Level Elements										
Dissolved Cadmium (Cd)	mg/L	0.00038	0.000020	9512961				0.00039	0.000020	9512961
Elements										
Dissolved Aluminum (Al)	mg/L	0.0080	0.0030	9515131	0.0075	0.0030	9515131	0.0068	0.0030	9515131
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9515131	<0.00060	0.00060	9515131	0.00070	0.00060	9515131
Dissolved Arsenic (As)	mg/L	0.0014	0.00020	9515131	0.0014	0.00020	9515131	0.00045	0.00020	9515131
Dissolved Barium (Ba)	mg/L	0.096	0.010	9515127	0.096	0.010	9515127	0.12	0.010	9515127
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131
Dissolved Boron (B)	mg/L	0.024	0.020	9515127	0.024	0.020	9515127	0.033	0.020	9515127
Dissolved Calcium (Ca)	mg/L	370	0.30	9515127	360	0.30	9515127	170	0.30	9515127
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131
Dissolved Cobalt (Co)	mg/L	0.014	0.00030	9515131	0.014	0.00030	9515131	0.0021	0.00030	9515131
Dissolved Copper (Cu)	mg/L	0.0034	0.00020	9515131	0.0035	0.00020	9515131	0.0026	0.00020	9515131
Dissolved Iron (Fe)	mg/L	5.5	0.060	9515127	5.5	0.060	9515127	<0.060	0.060	9515127
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9515131	<0.00020	0.00020	9515131	<0.00020	0.00020	9515131
Dissolved Lithium (Li)	mg/L	0.025	0.020	9515127	0.025	0.020	9515127	<0.020	0.020	9515127
Dissolved Magnesium (Mg)	mg/L	92	0.20	9515127	92	0.20	9515127	29	0.20	9515127
Dissolved Manganese (Mn)	mg/L	4.7	0.0040	9515127	4.7	0.0040	9515127	0.42	0.0040	9515127
Dissolved Molybdenum (Mo)	mg/L	0.00067	0.00020	9515131	0.00071	0.00020	9515131	0.00072	0.00020	9515131
Dissolved Nickel (Ni)	mg/L	0.027	0.00050	9515131	0.027	0.00050	9515131	0.0097	0.00050	9515131
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9515127	<0.10	0.10	9515127	<0.10	0.10	9515127
Dissolved Potassium (K)	mg/L	3.5	0.30	9515127	3.5	0.30	9515127	6.0	0.30	9515127
Dissolved Selenium (Se)	mg/L	0.00080	0.00020	9515131	0.00089	0.00020	9515131	0.0010	0.00020	9515131
Dissolved Silicon (Si)	mg/L	6.2	0.10	9515127	6.2	0.10	9515127	4.4	0.10	9515127
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9515131	<0.00010	0.00010	9515131	<0.00010	0.00010	9515131
Dissolved Sodium (Na)	mg/L	43	0.50	9515127	43	0.50	9515127	8.8	0.50	9515127
Dissolved Strontium (Sr)	mg/L	1.4	0.020	9515127	1.4	0.020	9515127	0.60	0.020	9515127
Dissolved Sulphur (S)	mg/L	240	0.20	9515127	240	0.20	9515127	29	0.20	9515127
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9515131	<0.00020	0.00020	9515131	<0.00020	0.00020	9515131
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC9722			WC9722			WC9723		
Sampling Date		2019/07/16 08:15			2019/07/16 08:15			2019/07/16 09:25		
COC Number		298598			298598			298598		
	UNITS	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIQ8-10-2-4 Lab-Dup**	**RDL**	**QC Batch**	**GIP11 09-1-4-R**	**RDL**	**QC Batch**
Dissolved Uranium (U)	mg/L	0.0089	0.00010	9515131	0.0089	0.00010	9515131	0.0045	0.00010	9515131
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131	<0.0010	0.0010	9515131
Dissolved Zinc (Zn)	mg/L	0.027	0.0030	9515131	0.027	0.0030	9515131	0.021	0.0030	9515131

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B958262
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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF GROUND WATER

BV Labs ID		WC9722			WC9723		
Sampling Date		2019/07/16 08:15			2019/07/16 09:25		
COC Number		298598			298598		
	UNITS	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIP11 09-1-4-R**	**RDL**	**QC Batch**
Calculated Parameters							
Hardness (CaCO3)	mg/L	1300	0.50	9513098	550	0.50	9513098
Ion Balance (% Difference)	%	0.11	N/A	9512972	2.2	N/A	9512972
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	9513176	0.54	0.044	9513176
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9513177	0.12	0.014	9513177
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9513176	<0.033	0.033	9513176
Misc. Inorganics							
Conductivity	uS/cm	2100	2.0	9515618	1000	2.0	9515618
Total Dissolved Solids	mg/L	1800 (1)	50	9513892	690	10	9516424
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9515617	<1.0	1.0	9515617
Alkalinity (Total as CaCO3)	mg/L	640	1.0	9515617	470	1.0	9515617
Bicarbonate (HCO3)	mg/L	780	1.0	9515617	580	1.0	9515617
Carbonate (CO3)	mg/L	<1.0	1.0	9515617	<1.0	1.0	9515617
Hydroxide (OH)	mg/L	<1.0	1.0	9515617	<1.0	1.0	9515617
Dissolved Chloride (Cl)	mg/L	20	1.0	9516753	14	1.0	9516753
Dissolved Sulphate (SO4)	mg/L	710 (2)	5.0	9516753	110	1.0	9516753
Nutrients							
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9513385	<0.010	0.010	9513385
Dissolved Nitrate (N)	mg/L	<0.010	0.010	9513385	0.12	0.010	9513385
Misc. Organics							
Phenols	mg/L	0.022	0.0015	9520436	0.0037	0.0015	9520436

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limit raised based on sample volume used and sample matrix
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B958262
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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

MERCURY BY COLD VAPOR (GROUND WATER)

BV Labs ID		WC9722	WC9722	WC9723		
Sampling Date		2019/07/16 08:15	2019/07/16 08:15	2019/07/16 09:25		
COC Number		298598	298598	298598		
	UNITS	**GIQ8-10-2-4**	**GIQ8-10-2-4 Lab-Dup**	**GIP11 09-1-4-R**	**RDL**	**QC Batch**
Elements						
Dissolved Mercury (Hg)	ug/L	0.0027	0.0028	<0.0020	0.0020	9520461

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WC9722
Sample ID: GIQ8-10-2-4
Matrix: Ground Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514401	N/A	2019/07/21	Adriana Munoz
F1-BTEX	CALC/MS	9512118	N/A	2019/07/22	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9512961	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9516753	N/A	2019/07/22	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9513919	2019/07/19	2019/07/22	Raymond Blumenschein
Hardness	CALC	9513098	N/A	2019/07/22	Automated Statchk
Mercury (Dissolved) by CV	CV	9520461	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515127	N/A	2019/07/22	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9515131	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9512972	N/A	2019/07/20	Automated Statchk
Nitrate and Nitrite	CALC	9513176	N/A	2019/07/21	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9513177	N/A	2019/07/21	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9513385	N/A	2019/07/19	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9520436	N/A	2019/07/24	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9513892	2019/07/19	2019/07/22	Amy Aston

BV Labs ID: WC9722 Dup
Sample ID: GIQ8-10-2-4
Matrix: Ground Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury (Dissolved) by CV	CV	9520461	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515127	N/A	2019/07/22	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9515131	N/A	2019/07/20	Julie Harrison

BV Labs ID: WC9723
Sample ID: GIP11 09-1-4-R
Matrix: Ground Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514401	N/A	2019/07/21	Adriana Munoz
F1-BTEX	CALC/MS	9512118	N/A	2019/07/22	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9512961	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9516753	N/A	2019/07/22	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9513919	2019/07/19	2019/07/22	Raymond Blumenschein
Hardness	CALC	9513098	N/A	2019/07/22	Automated Statchk
Mercury (Dissolved) by CV	CV	9520461	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515127	N/A	2019/07/22	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9515131	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9512972	N/A	2019/07/20	Automated Statchk

BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WC9723
Sample ID: GIP11 09-1-4-R
Matrix: Ground Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate and Nitrite	CALC	9513176	N/A	2019/07/21	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9513177	N/A	2019/07/21	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9513385	N/A	2019/07/20	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9520436	N/A	2019/07/24	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516424	2019/07/21	2019/07/23	Amy Aston

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GENERAL COMMENTS

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

Package 1	3.3°C

Sample WC9723 [GIP11 09-1-4-R] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WC9723	GIP11 09-1-4-R	Ground Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9513385	KD5	Method Blank	Dissolved Nitrite (N)	2019/07/19	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/19	<0.010		mg/L	
9513892	AAZ	Method Blank	Total Dissolved Solids	2019/07/22	<10		mg/L	
9513919	RBN	Method Blank	O-TERPHENYL (sur.)	2019/07/21		102	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/21	<0.10		mg/L	
9514401	AMJ	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/21		103	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/21		101	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/21		99	%	50 - 140
			Benzene	2019/07/21	<0.00040		mg/L	
			Toluene	2019/07/21	<0.00040		mg/L	
			Ethylbenzene	2019/07/21	<0.00040		mg/L	
			m & p-Xylene	2019/07/21	<0.00080		mg/L	
			o-Xylene	2019/07/21	<0.00040		mg/L	
			LH (C5-C10)	2019/07/21	<0.10		mg/L	
			F1 (C6-C10)	2019/07/21	<0.10		mg/L	
9515127	MSD	Method Blank	Dissolved Iron (Fe)	2019/07/22	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/22	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/22	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/22	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/22	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/22	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/22	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/22	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/22	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/22	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/22	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/22	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/22	<0.30		mg/L	
9515131	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/20	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/20	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/20	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/20	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/20	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/20	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/20	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/20	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/20	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/20	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/20	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/20	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/20	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/20	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/20	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/20	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/20	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/20	<0.0010		mg/L	
9515617	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/20	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/20	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/20	<1.0		mg/L	
			Carbonate (CO3)	2019/07/20	<1.0		mg/L	
			Hydroxide (OH)	2019/07/20	<1.0		mg/L	
9515618	MA4	Method Blank	Conductivity	2019/07/20	<2.0		uS/cm	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9516424	AAZ	Method Blank	Total Dissolved Solids	2019/07/23	<10		mg/L	
9516753	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/22	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/22	<1.0		mg/L	
9520436	FFE	Method Blank	Phenols	2019/07/24	<0.0015		mg/L	
9520461	APY	Method Blank	Dissolved Mercury (Hg)	2019/07/24	<0.0020		ug/L	
9515127	MSD	RPD [WC9722-02]	Dissolved Iron (Fe)	2019/07/22	0.42		%	20
			Dissolved Lithium (Li)	2019/07/22	2.1		%	20
			Dissolved Magnesium (Mg)	2019/07/22	0.25		%	20
			Dissolved Manganese (Mn)	2019/07/22	0.81		%	20
			Dissolved Potassium (K)	2019/07/22	0.76		%	20
			Dissolved Sodium (Na)	2019/07/22	0.24		%	20
			Dissolved Strontium (Sr)	2019/07/22	1.1		%	20
			Dissolved Sulphur (S)	2019/07/22	0.22		%	20
			Dissolved Phosphorus (P)	2019/07/22	NC		%	20
			Dissolved Barium (Ba)	2019/07/22	0.25		%	20
			Dissolved Silicon (Si)	2019/07/22	0.54		%	20
			Dissolved Boron (B)	2019/07/22	0.67		%	20
			Dissolved Calcium (Ca)	2019/07/22	0.93		%	20
9515131	JHS	RPD [WC9722-02]	Dissolved Aluminum (Al)	2019/07/20	6.9		%	20
			Dissolved Chromium (Cr)	2019/07/20	NC		%	20
			Dissolved Cobalt (Co)	2019/07/20	0.70		%	20
			Dissolved Copper (Cu)	2019/07/20	3.0		%	20
			Dissolved Lead (Pb)	2019/07/20	NC		%	20
			Dissolved Antimony (Sb)	2019/07/20	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/20	6.4		%	20
			Dissolved Nickel (Ni)	2019/07/20	1.5		%	20
			Dissolved Selenium (Se)	2019/07/20	10		%	20
			Dissolved Silver (Ag)	2019/07/20	NC		%	20
			Dissolved Arsenic (As)	2019/07/20	4.3		%	20
			Dissolved Thallium (Tl)	2019/07/20	NC		%	20
			Dissolved Tin (Sn)	2019/07/20	NC		%	20
			Dissolved Titanium (Ti)	2019/07/20	NC		%	20
			Dissolved Uranium (U)	2019/07/20	0.30		%	20
			Dissolved Vanadium (V)	2019/07/20	NC		%	20
			Dissolved Zinc (Zn)	2019/07/20	2.8		%	20
			Dissolved Beryllium (Be)	2019/07/20	NC		%	20
9520461	APY	RPD [WC9722-04]	Dissolved Mercury (Hg)	2019/07/24	4.1		%	20
9515127	MSD	Matrix Spike [WC9722-02]	Dissolved Strontium (Sr)	2019/07/22		84	%	80 - 120
			Dissolved Sulphur (S)	2019/07/22		NC	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/22		100	%	80 - 120
			Dissolved Barium (Ba)	2019/07/22		97	%	80 - 120
			Dissolved Silicon (Si)	2019/07/22		92	%	80 - 120
			Dissolved Boron (B)	2019/07/22		100	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/22		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/07/22		NC	%	80 - 120
			Dissolved Lithium (Li)	2019/07/22		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/22		89	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/22		NC	%	80 - 120
			Dissolved Potassium (K)	2019/07/22		101	%	80 - 120
			Dissolved Sodium (Na)	2019/07/22		92	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9515131	JHS	Matrix Spike [WC9722-02]	Dissolved Aluminum (Al)	2019/07/20		97	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/20		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/20		97	%	80 - 120
			Dissolved Copper (Cu)	2019/07/20		96	%	80 - 120
			Dissolved Lead (Pb)	2019/07/20		95	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/20		102	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/20		107	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/20		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/20		106	%	80 - 120
			Dissolved Silver (Ag)	2019/07/20		102	%	80 - 120
			Dissolved Arsenic (As)	2019/07/20		99	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/20		97	%	80 - 120
			Dissolved Tin (Sn)	2019/07/20		103	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/20		98	%	80 - 120
			Dissolved Uranium (U)	2019/07/20		97	%	80 - 120
			Dissolved Vanadium (V)	2019/07/20		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/20		98	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/20		101	%	80 - 120
9520461	APY	Matrix Spike [WC9723-04]	Dissolved Mercury (Hg)	2019/07/24		100	%	80 - 120
9513385	KD5	LCS	Dissolved Nitrite (N)	2019/07/19		101	%	80 - 120
			Dissolved Nitrate (N)	2019/07/19		101	%	80 - 120
9513892	AAZ	LCS	Total Dissolved Solids	2019/07/22		101	%	80 - 120
9513919	RBN	LCS	O-TERPHENYL (sur.)	2019/07/21		99	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/21		110	%	60 - 140
9514401	AMJ	LCS	1,4-Difluorobenzene (sur.)	2019/07/21		99	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/21		99	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/21		100	%	50 - 140
			Benzene	2019/07/21		111	%	60 - 130
			Toluene	2019/07/21		110	%	60 - 130
			Ethylbenzene	2019/07/21		116	%	60 - 130
			m & p-Xylene	2019/07/21		116	%	60 - 130
			o-Xylene	2019/07/21		114	%	60 - 130
			F1 (C6-C10)	2019/07/21		94	%	60 - 140
9515127	MSD	LCS	Dissolved Iron (Fe)	2019/07/22		100	%	80 - 120
			Dissolved Lithium (Li)	2019/07/22		99	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/22		97	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/22		99	%	80 - 120
			Dissolved Potassium (K)	2019/07/22		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/22		99	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/22		92	%	80 - 120
			Dissolved Sulphur (S)	2019/07/22		100	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/22		100	%	80 - 120
			Dissolved Barium (Ba)	2019/07/22		99	%	80 - 120
			Dissolved Silicon (Si)	2019/07/22		96	%	80 - 120
			Dissolved Boron (B)	2019/07/22		100	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/22		97	%	80 - 120
9515131	JHS	LCS	Dissolved Aluminum (Al)	2019/07/20		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/20		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/20		98	%	80 - 120
			Dissolved Copper (Cu)	2019/07/20		101	%	80 - 120

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lead (Pb)	2019/07/20		101	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/20		98	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/20		102	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/20		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/20		103	%	80 - 120
			Dissolved Silver (Ag)	2019/07/20		102	%	80 - 120
			Dissolved Arsenic (As)	2019/07/20		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/20		101	%	80 - 120
			Dissolved Tin (Sn)	2019/07/20		102	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/20		98	%	80 - 120
			Dissolved Uranium (U)	2019/07/20		97	%	80 - 120
			Dissolved Vanadium (V)	2019/07/20		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/20		101	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/20		99	%	80 - 120
9515617	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/20		99	%	80 - 120
9515618	MA4	LCS	Conductivity	2019/07/20		99	%	90 - 110
9516424	AAZ	LCS	Total Dissolved Solids	2019/07/23		100	%	80 - 120
9516753	MRD	LCS	Dissolved Chloride (Cl)	2019/07/22		111	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/22		109	%	80 - 120
9520436	FFE	LCS	Phenols	2019/07/24		87	%	80 - 120
9520461	APY	LCS	Dissolved Mercury (Hg)	2019/07/24		107	%	80 - 120

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.

LCS: 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).

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958262
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

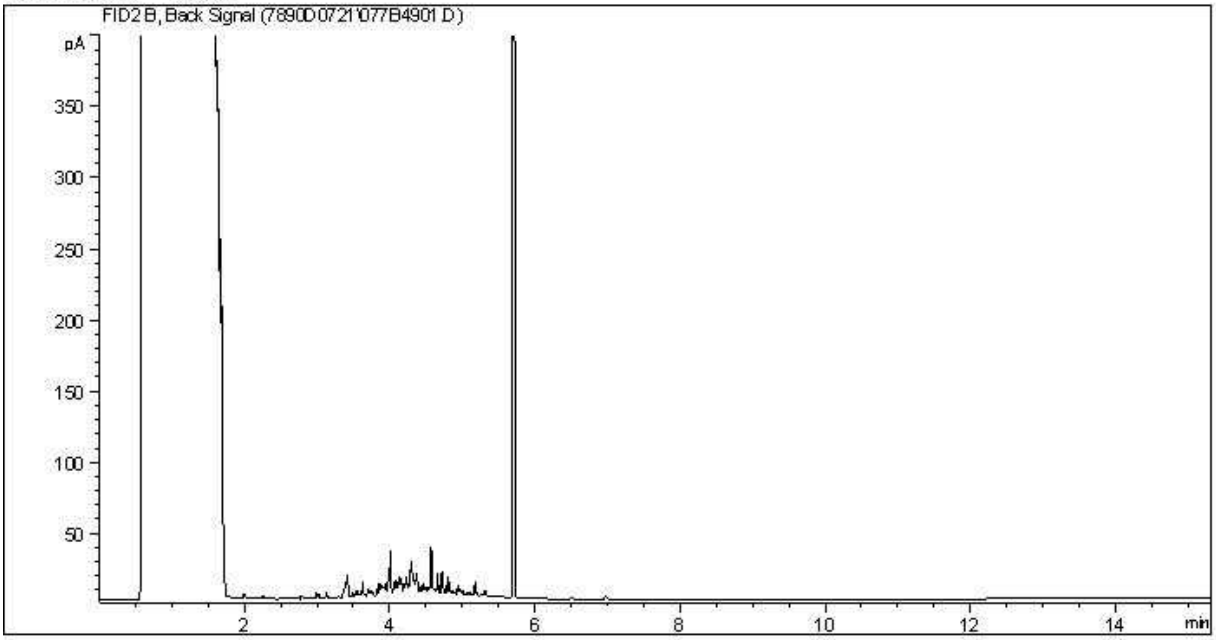
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958262
Report Date: 2019/07/25
BV Labs Sample: WC9722

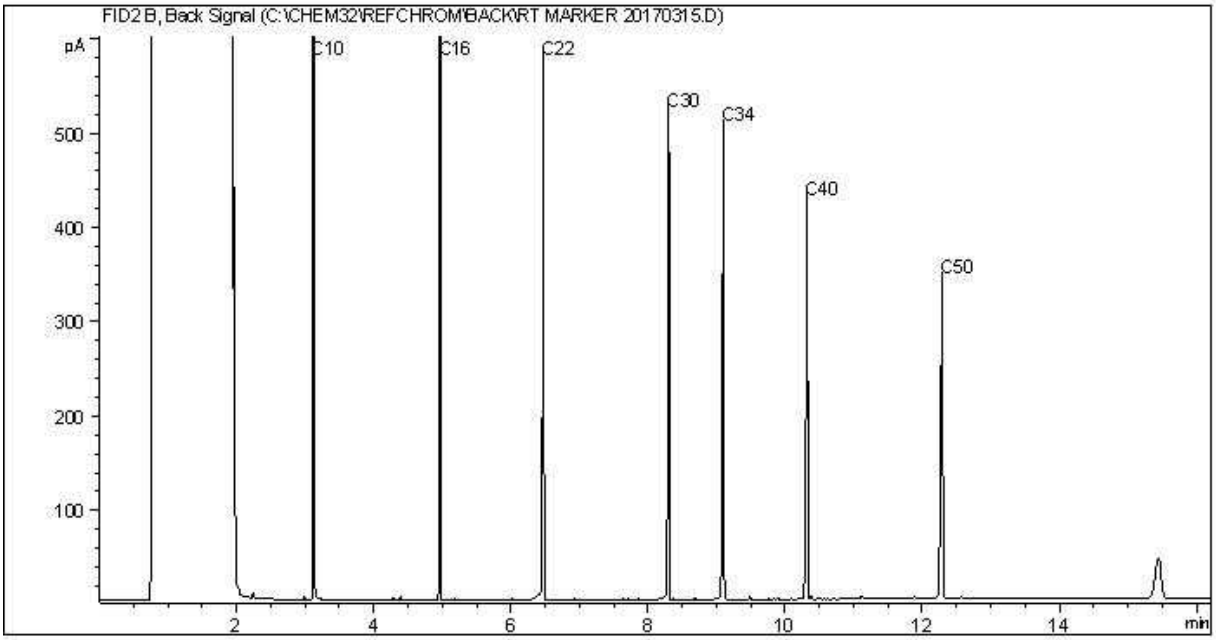
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: GIQ8-10-2-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

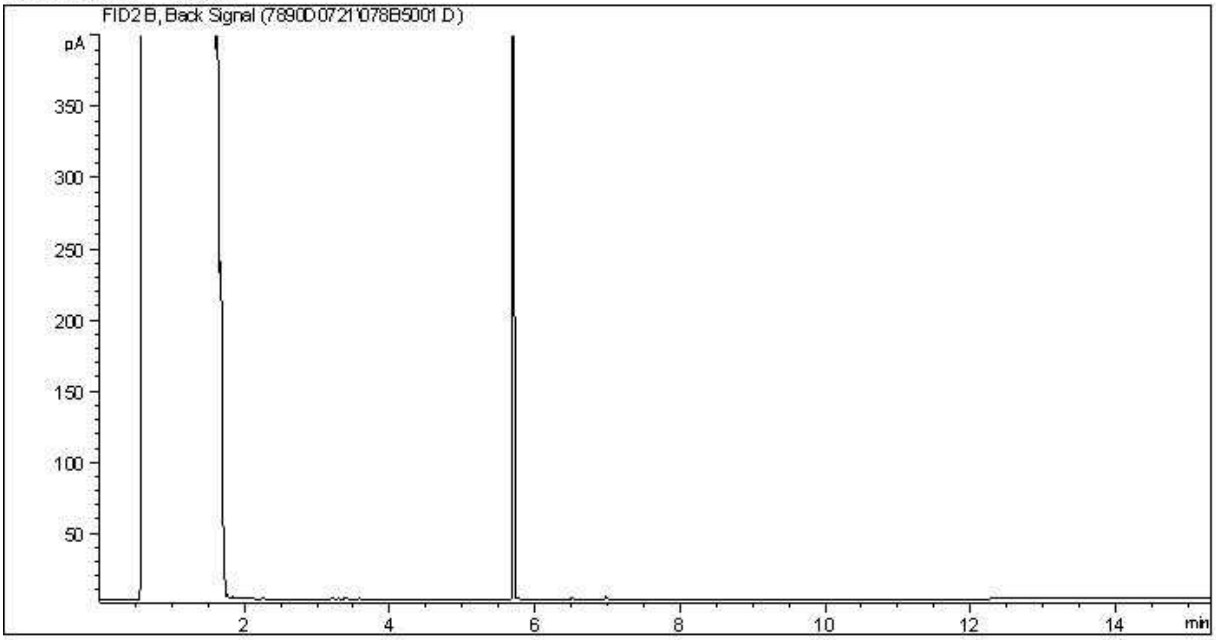
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958262
Report Date: 2019/07/25
BV Labs Sample: WC9723

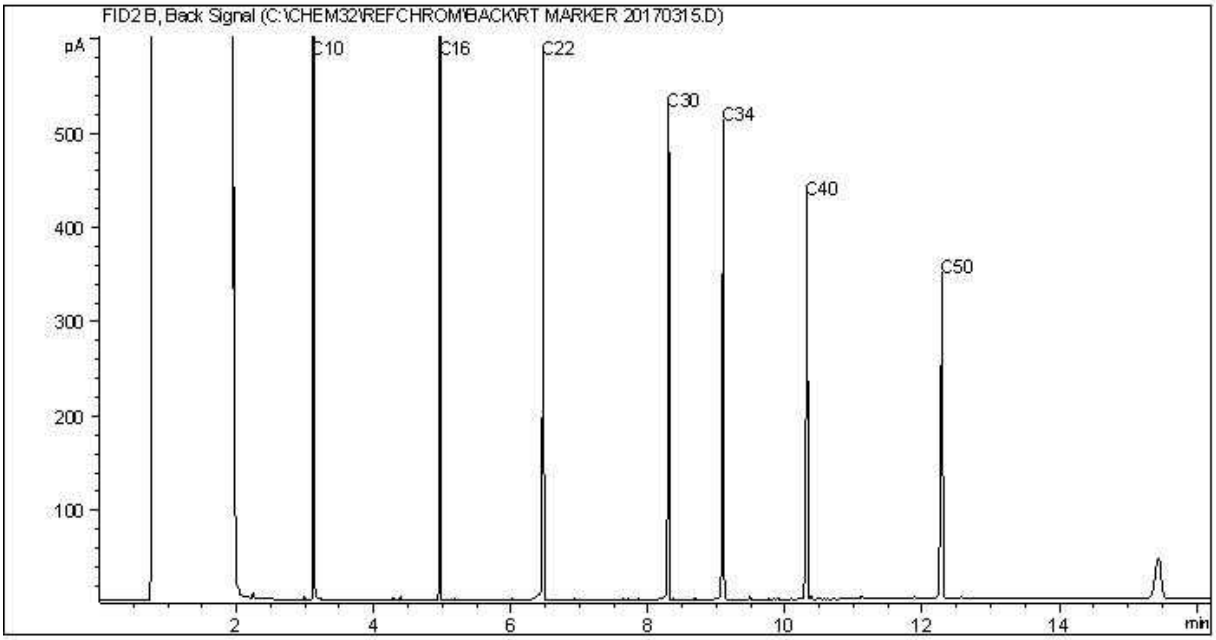
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: GIP11 09-1-4-R

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
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☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

841

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

YT

C of C # 298598

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-249-7200	Ph: 403-249-0200
Sampler Name (Print): Michelle Vokaty, Jessica Appleton	Consultant Project #: 407011-00770-400

FIELD SAMPLE ID	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	SAMPLING: TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS TOT ☐ DIS ☒	MERCURY TOTAL ☐ DISSOLVED ☒	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP	Limited sample, missing bottle(s), partial bottle(s)
1 GIQ8-10-2-4	X				10	2019/07/16	08:15	X				X							X	X					X			X	
2 GIP11 09-1-4-R	X				7	↓	09:25	X				X							X	X					X			X	X
3																														
4																														
5																														
6																														
7																														
8																														
9																														
10																														

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email: canada.chemistry@worleyparsons.com, cacal_IOR_data_trade@worleyparsons.com, melissa.lord@advisian.com
IESA2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT	✓					
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1. Michelle Vokaty	Michelle Vokaty	2019/07/17	08:00	1.	LIVLEEN RENAL	2019 07 18	09:55
2.				2.			
3.				3.			

LAB USE ONLY
MAXXAM JOB # B958262
SAMPLES
LABELED BY: GS
VERIFIED BY: WYS

COC-1010 (06/2016) IOL-AB

White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 16-Jul-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP OPS) | Sample Submission Number: B958267

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD			x	
Matrix Spike Recovery			x	
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration	x			Sample GIBG-10-2-3 and its field duplicate NWD19-38 exceeded the 50% alert limit for Dissolved Copper (Cu) (90%). All other QC samples met alert limits.
Trip Blank Concentration	x			
Equipment Blank Concentration			x	
Field Duplicate RPD		x		

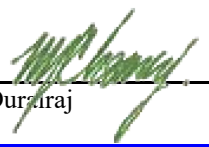
Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	Yes
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: No

Date DQO was received:

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): 

Date: 02-Aug-19 | Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)
Your C.O.C. #: 298599

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/25
Report #: R2757590
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958267
Received: 2019/07/18, 09:55

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	4	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	4		Auto Calc
Cadmium - low level CCME - Dissolved	2		Auto Calc
Chloride/Sulphate by Auto Colourimetry	2	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	2	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	4	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	2		Auto Calc
Mercury (Dissolved) by CV	2	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	2	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	2	AB SOP-00043	EPA 6020b R2 m
Ion Balance	2		Auto Calc
Nitrate and Nitrite	2		Auto Calc
Nitrate + Nitrite-N (calculated)	2		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (3)	2		Auto Calc
PAH in Water by GC/MS	2	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	2	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	2	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)
Your C.O.C. #: 298599

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/25
Report #: R2757590
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958267
Received: 2019/07/18, 09:55

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WC9735	WC9736	WC9737	WC9738		
Sampling Date		2019/07/16 08:30	2019/07/16 08:35	2019/07/16 18:00	2019/07/16 08:40		
COC Number		298599	298599	298599	298599		
	UNITS	**GIBG-10-2-3**	**NWD19-38**	**NWD19-10**	**NWD19-20**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon							
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9515034
Volatiles							
Benzene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9514419
Toluene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9514419
Ethylbenzene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9514419
m & p-Xylene	mg/L	<0.00080	<0.00080	<0.00080	<0.00080	0.00080	9514419
o-Xylene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9514419
Xylenes (Total)	mg/L	<0.00089	<0.00089	<0.00089	<0.00089	0.00089	9512118
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9512118
LH (C5-C10)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9514419
F1 (C6-C10)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9514419
Extraction Surrogate Recovery (%)							
O-TERPHENYL (sur.)	%	96	101	101	100		9515034
Instrument Surrogate Recovery (%)							
1,4-Difluorobenzene (sur.)	%	101	99	99	98		9514419
4-Bromofluorobenzene (sur.)	%	99	100	101	101		9514419
D4-1,2-Dichloroethane (sur.)	%	100	98	96	98		9514419

RDL = Reportable Detection Limit

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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC9735	WC9736		
Sampling Date		2019/07/16 08:30	2019/07/16 08:35		
COC Number		298599	298599		
	UNITS	**GIBG-10-2-3**	**NWD19-38**	**RDL**	**QC Batch**
Low Level Elements					
Dissolved Cadmium (Cd)	mg/L	0.00018	0.00017	0.000020	9512961
Elements					
Dissolved Aluminum (Al)	mg/L	0.0058	0.0054	0.0030	9515131
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	9515131
Dissolved Arsenic (As)	mg/L	0.00042	0.00034	0.00020	9515131
Dissolved Barium (Ba)	mg/L	0.11	0.11	0.010	9515127
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	9515131
Dissolved Boron (B)	mg/L	<0.020	<0.020	0.020	9515127
Dissolved Calcium (Ca)	mg/L	93	93	0.30	9515127
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	9515131
Dissolved Cobalt (Co)	mg/L	0.0014	0.0014	0.00030	9515131
Dissolved Copper (Cu)	mg/L	0.0029	0.0011	0.00020	9515131
Dissolved Iron (Fe)	mg/L	<0.060	<0.060	0.060	9515127
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	9515131
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	0.020	9515127
Dissolved Magnesium (Mg)	mg/L	18	18	0.20	9515127
Dissolved Manganese (Mn)	mg/L	0.46	0.47	0.0040	9515127
Dissolved Molybdenum (Mo)	mg/L	0.0011	0.0010	0.00020	9515131
Dissolved Nickel (Ni)	mg/L	0.0040	0.0039	0.00050	9515131
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	9515127
Dissolved Potassium (K)	mg/L	1.7	1.7	0.30	9515127
Dissolved Selenium (Se)	mg/L	<0.00020	<0.00020	0.00020	9515131
Dissolved Silicon (Si)	mg/L	3.3	3.4	0.10	9515127
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	9515131
Dissolved Sodium (Na)	mg/L	17	17	0.50	9515127
Dissolved Strontium (Sr)	mg/L	0.48	0.48	0.020	9515127
Dissolved Sulphur (S)	mg/L	18	18	0.20	9515127
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	9515131
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	9515131
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	9515131
Dissolved Uranium (U)	mg/L	0.0016	0.0016	0.00010	9515131
RDL = Reportable Detection Limit					

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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WC9735	WC9736		
Sampling Date		2019/07/16 08:30	2019/07/16 08:35		
COC Number		298599	298599		
	UNITS	**GIBG-10-2-3**	**NWD19-38**	**RDL**	**QC Batch**
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	9515131
Dissolved Zinc (Zn)	mg/L	0.0083	0.0068	0.0030	9515131
RDL = Reportable Detection Limit					

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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WC9735		WC9736		
Sampling Date		2019/07/16 08:30		2019/07/16 08:35		
COC Number		298599		298599		
	UNITS	**GIBG-10-2-3**	**RDL**	**NWD19-38**	**RDL**	**QC Batch**
Calculated Parameters						
Hardness (CaCO3)	mg/L	310	0.50	310	0.50	9513098
Ion Balance (% Difference)	%	6.4	N/A	5.4	N/A	9512972
Dissolved Nitrate (NO3)	mg/L	0.83	0.044	0.82	0.044	9513176
Nitrate plus Nitrite (N)	mg/L	0.19	0.014	0.19	0.014	9513177
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	<0.033	0.033	9513176
Misc. Inorganics						
Conductivity	uS/cm	690	2.0	690	2.0	9515618
Total Dissolved Solids	mg/L	450	10	460	10	9516424
Anions						
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	<1.0	1.0	9515617
Alkalinity (Total as CaCO3)	mg/L	320	1.0	310	1.0	9515617
Bicarbonate (HCO3)	mg/L	390	1.0	380	1.0	9515617
Carbonate (CO3)	mg/L	<1.0	1.0	<1.0	1.0	9515617
Hydroxide (OH)	mg/L	<1.0	1.0	<1.0	1.0	9515617
Dissolved Chloride (Cl)	mg/L	9.9	1.0	9.9	1.0	9516753
Dissolved Sulphate (SO4)	mg/L	61	1.0	61	1.0	9516753
Nutrients						
Dissolved Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	9513385
Dissolved Nitrate (N)	mg/L	0.19	0.010	0.19	0.010	9513385
Misc. Organics						
Phenols	mg/L	0.0057 (1)	0.0030	0.0083	0.0015	9520436

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to matrix interference.

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SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WC9735	WC9736		
Sampling Date		2019/07/16 08:30	2019/07/16 08:35		
COC Number		298599	298599		
	UNITS	**GIBG-10-2-3**	**NWD19-38**	**RDL**	**QC Batch**
Polycyclic Aromatics					
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	0.000024	0.000010	9512121
Acenaphthene	mg/L	<0.00010	<0.00010	0.00010	9515022
Acenaphthylene	mg/L	<0.00010	<0.00010	0.00010	9515022
Acridine	mg/L	<0.000040	<0.000040	0.000040	9515022
Anthracene	mg/L	<0.000010	<0.000010	0.000010	9515022
Benzo(a)anthracene	mg/L	<0.0000085	<0.0000085	0.0000085	9515022
Benzo(b&j)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9515022
Benzo(k)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9515022
Benzo(g,h,i)perylene	mg/L	<0.0000085	0.000014	0.0000085	9515022
Benzo(c)phenanthrene	mg/L	<0.000050	<0.000050	0.000050	9515022
Benzo(a)pyrene	mg/L	<0.0000075	<0.0000075	0.0000075	9515022
Benzo(e)pyrene	mg/L	<0.000050	<0.000050	0.000050	9515022
Chrysene	mg/L	<0.0000085	<0.0000085	0.0000085	9515022
Dibenz(a,h)anthracene	mg/L	<0.0000075	0.000017	0.0000075	9515022
Fluoranthene	mg/L	<0.000010	<0.000010	0.000010	9515022
Fluorene	mg/L	<0.000050	<0.000050	0.000050	9515022
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	0.000018	0.0000085	9515022
1-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9515022
2-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9515022
Naphthalene	mg/L	<0.00010	<0.00010	0.00010	9515022
Phenanthrene	mg/L	<0.000050	0.000063	0.000050	9515022
Perylene	mg/L	<0.000050	<0.000050	0.000050	9515022
Pyrene	mg/L	<0.000020	<0.000020	0.000020	9515022
Quinoline	mg/L	<0.00020	<0.00020	0.00020	9515022
Extraction Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	75	79		9515022
D8-ACENAPHTHYLENE (sur.)	%	74	80		9515022
D8-NAPHTHALENE (sur.)	%	71	77		9515022
TERPHENYL-D14 (sur.)	%	85	92		9515022
RDL = Reportable Detection Limit					

BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WC9735	WC9736		
Sampling Date		2019/07/16 08:30	2019/07/16 08:35		
COC Number		298599	298599		
	UNITS	**GIBG-10-2-3**	**NWD19-38**	**RDL**	**QC Batch**
Elements					
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	9520461
RDL = Reportable Detection Limit					

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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WC9735
Sample ID: GIBG-10-2-3
Matrix: Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514419	N/A	2019/07/21	Rebecca Chen
F1-BTEX	CALC/MS	9512118	N/A	2019/07/23	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9512961	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9516753	N/A	2019/07/22	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9515034	2019/07/19	2019/07/21	Kelsey Holt
Hardness	CALC	9513098	N/A	2019/07/22	Automated Statchk
Mercury (Dissolved) by CV	CV	9520461	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515127	N/A	2019/07/22	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9515131	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9512972	N/A	2019/07/20	Automated Statchk
Nitrate and Nitrite	CALC	9513176	N/A	2019/07/21	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9513177	N/A	2019/07/21	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9513385	N/A	2019/07/19	Krista Dawe
Benzo[a]pyrene Equivalency	GC/MSD	9512121	N/A	2019/07/22	Automated Statchk
PAH in Water by GC/MS	GC/MS	9515022	2019/07/19	2019/07/20	Harneet Gill
Phenols (4-AAP)	TECH/4AAP	9520436	N/A	2019/07/24	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516424	2019/07/21	2019/07/23	Amy Aston

BV Labs ID: WC9736
Sample ID: NWD19-38
Matrix: Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9515617	N/A	2019/07/20	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514419	N/A	2019/07/21	Rebecca Chen
F1-BTEX	CALC/MS	9512118	N/A	2019/07/23	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9512961	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9516753	N/A	2019/07/22	Marissa Richard
Conductivity @25C	COND	9515618	N/A	2019/07/20	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9515034	2019/07/19	2019/07/21	Kelsey Holt
Hardness	CALC	9513098	N/A	2019/07/22	Automated Statchk
Mercury (Dissolved) by CV	CV	9520461	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515127	N/A	2019/07/22	Mahesh Ranjan
Elements by ICPMS - Dissolved	ICPM	9515131	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9512972	N/A	2019/07/20	Automated Statchk
Nitrate and Nitrite	CALC	9513176	N/A	2019/07/21	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9513177	N/A	2019/07/21	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9513385	N/A	2019/07/19	Krista Dawe
Benzo[a]pyrene Equivalency	GC/MSD	9512121	N/A	2019/07/22	Automated Statchk
PAH in Water by GC/MS	GC/MS	9515022	2019/07/19	2019/07/20	Harneet Gill
Phenols (4-AAP)	TECH/4AAP	9520436	N/A	2019/07/24	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516424	2019/07/21	2019/07/23	Amy Aston

BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WC9737
Sample ID: NWD19-10
Matrix: Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514419	N/A	2019/07/21	Rebecca Chen
F1-BTEX	CALC/MS	9512118	N/A	2019/07/23	Automated Statchk
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9515034	2019/07/19	2019/07/21	Kelsey Holt

BV Labs ID: WC9738
Sample ID: NWD19-20
Matrix: Water

Collected: 2019/07/16
Relinquished: 2019/07/17
Received: 2019/07/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9514419	N/A	2019/07/21	Rebecca Chen
F1-BTEX	CALC/MS	9512118	N/A	2019/07/23	Automated Statchk
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9515034	2019/07/19	2019/07/21	Kelsey Holt

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BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

GENERAL COMMENTS

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

Package 1	3.7°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9513385	KD5	Method Blank	Dissolved Nitrite (N)	2019/07/19	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/19	<0.010		mg/L	
9514419	RC6	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/21		101	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/21		99	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/21		99	%	50 - 140
			Benzene	2019/07/21	<0.00040		mg/L	
			Toluene	2019/07/21	<0.00040		mg/L	
			Ethylbenzene	2019/07/21	<0.00040		mg/L	
			m & p-Xylene	2019/07/21	<0.00080		mg/L	
			o-Xylene	2019/07/21	<0.00040		mg/L	
			LH (C5-C10)	2019/07/21	<0.10		mg/L	
			F1 (C6-C10)	2019/07/21	<0.10		mg/L	
9515022	HG3	Method Blank	D10-ANTHRACENE (sur.)	2019/07/20		86	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/20		102	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/20		87	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/20		83	%	50 - 130
			Acenaphthene	2019/07/20	<0.00010		mg/L	
			Acenaphthylene	2019/07/20	<0.00010		mg/L	
			Acridine	2019/07/20	<0.000040		mg/L	
			Anthracene	2019/07/20	<0.000010		mg/L	
			Benzo(a)anthracene	2019/07/20	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/07/20	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/07/20	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/07/20	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/07/20	<0.000050		mg/L	
			Benzo(a)pyrene	2019/07/20	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/07/20	<0.000050		mg/L	
			Chrysene	2019/07/20	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/07/20	<0.0000075		mg/L	
			Fluoranthene	2019/07/20	<0.000010		mg/L	
			Fluorene	2019/07/20	<0.000050		mg/L	
			Indeno(1,2,3-cd)pyrene	2019/07/20	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/07/20	<0.00010		mg/L	
			2-Methylnaphthalene	2019/07/20	<0.00010		mg/L	
			Naphthalene	2019/07/20	<0.00010		mg/L	
			Phenanthrene	2019/07/20	<0.000050		mg/L	
			Perylene	2019/07/20	<0.000050		mg/L	
			Pyrene	2019/07/20	<0.000020		mg/L	
			Quinoline	2019/07/20	<0.00020		mg/L	
9515034	KHO	Method Blank	O-TERPHENYL (sur.)	2019/07/21		99	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/21	<0.10		mg/L	
9515127	MSD	Method Blank	Dissolved Iron (Fe)	2019/07/22	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/22	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/22	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/22	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/22	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/22	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/22	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/22	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/22	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/22	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/22	<0.10		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Boron (B)	2019/07/22	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/22	<0.30		mg/L	
9515131	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/20	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/20	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/20	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/20	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/20	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/20	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/20	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/20	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/20	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/20	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/20	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/20	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/20	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/20	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/20	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/20	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/20	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/20	<0.0010		mg/L	
9515617	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/20	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/20	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/20	<1.0		mg/L	
			Carbonate (CO3)	2019/07/20	<1.0		mg/L	
			Hydroxide (OH)	2019/07/20	<1.0		mg/L	
9515618	MA4	Method Blank	Conductivity	2019/07/20	<2.0		uS/cm	
9516424	AAZ	Method Blank	Total Dissolved Solids	2019/07/23	<10		mg/L	
9516753	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/22	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/22	<1.0		mg/L	
9520436	FFE	Method Blank	Phenols	2019/07/24	<0.0015		mg/L	
9520461	APY	Method Blank	Dissolved Mercury (Hg)	2019/07/24	<0.0020		ug/L	
9513385	KD5	LCS	Dissolved Nitrite (N)	2019/07/19		101	%	80 - 120
			Dissolved Nitrate (N)	2019/07/19		101	%	80 - 120
9514419	RC6	LCS	1,4-Difluorobenzene (sur.)	2019/07/23		101	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/23		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/23		99	%	50 - 140
			Benzene	2019/07/23		93	%	60 - 130
			Toluene	2019/07/23		90	%	60 - 130
			Ethylbenzene	2019/07/23		95	%	60 - 130
			m & p-Xylene	2019/07/23		91	%	60 - 130
			o-Xylene	2019/07/23		94	%	60 - 130
			F1 (C6-C10)	2019/07/23		80	%	60 - 140
9515022	HG3	LCS	D10-ANTHRACENE (sur.)	2019/07/20		79	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/20		81	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/20		80	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/20		75	%	50 - 130
			Acenaphthene	2019/07/20		71	%	50 - 130
			Acenaphthylene	2019/07/20		75	%	50 - 130
			Acridine	2019/07/20		79	%	50 - 130
			Anthracene	2019/07/20		79	%	50 - 130
			Benzo(a)anthracene	2019/07/20		84	%	50 - 130
			Benzo(b&j)fluoranthene	2019/07/20		85	%	50 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(k)fluoranthene	2019/07/20		81	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/20		76	%	50 - 130
			Benzo(c)phenanthrene	2019/07/20		82	%	50 - 130
			Benzo(a)pyrene	2019/07/20		96	%	50 - 130
			Benzo(e)pyrene	2019/07/20		87	%	50 - 130
			Chrysene	2019/07/20		76	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/20		76	%	50 - 130
			Fluoranthene	2019/07/20		78	%	50 - 130
			Fluorene	2019/07/20		73	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/20		86	%	50 - 130
			1-Methylnaphthalene	2019/07/20		71	%	50 - 130
			2-Methylnaphthalene	2019/07/20		72	%	50 - 130
			Naphthalene	2019/07/20		69	%	50 - 130
			Phenanthrene	2019/07/20		76	%	50 - 130
			Perylene	2019/07/20		85	%	50 - 130
			Pyrene	2019/07/20		79	%	50 - 130
			Quinoline	2019/07/20		112	%	50 - 130
9515034	KHO	LCS	O-TERPHENYL (sur.)	2019/07/21		101	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/21		106	%	60 - 140
9515127	MSD	LCS	Dissolved Iron (Fe)	2019/07/22		100	%	80 - 120
			Dissolved Lithium (Li)	2019/07/22		99	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/22		97	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/22		99	%	80 - 120
			Dissolved Potassium (K)	2019/07/22		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/22		99	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/22		92	%	80 - 120
			Dissolved Sulphur (S)	2019/07/22		100	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/22		100	%	80 - 120
			Dissolved Barium (Ba)	2019/07/22		99	%	80 - 120
			Dissolved Silicon (Si)	2019/07/22		96	%	80 - 120
			Dissolved Boron (B)	2019/07/22		100	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/22		97	%	80 - 120
9515131	JHS	LCS	Dissolved Aluminum (Al)	2019/07/20		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/20		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/20		98	%	80 - 120
			Dissolved Copper (Cu)	2019/07/20		101	%	80 - 120
			Dissolved Lead (Pb)	2019/07/20		101	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/20		98	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/20		102	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/20		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/20		103	%	80 - 120
			Dissolved Silver (Ag)	2019/07/20		102	%	80 - 120
			Dissolved Arsenic (As)	2019/07/20		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/20		101	%	80 - 120
			Dissolved Tin (Sn)	2019/07/20		102	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/20		98	%	80 - 120
			Dissolved Uranium (U)	2019/07/20		97	%	80 - 120
			Dissolved Vanadium (V)	2019/07/20		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/20		101	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/20		99	%	80 - 120
9515617	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/20		99	%	80 - 120
9515618	MA4	LCS	Conductivity	2019/07/20		99	%	90 - 110

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9516424	AAZ	LCS	Total Dissolved Solids	2019/07/23		100	%	80 - 120
9516753	MRD	LCS	Dissolved Chloride (Cl)	2019/07/22		111	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/22		109	%	80 - 120
9520436	FFE	LCS	Phenols	2019/07/24		87	%	80 - 120
9520461	APY	LCS	Dissolved Mercury (Hg)	2019/07/24		107	%	80 - 120

LCS: 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.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958267
Report Date: 2019/07/25

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

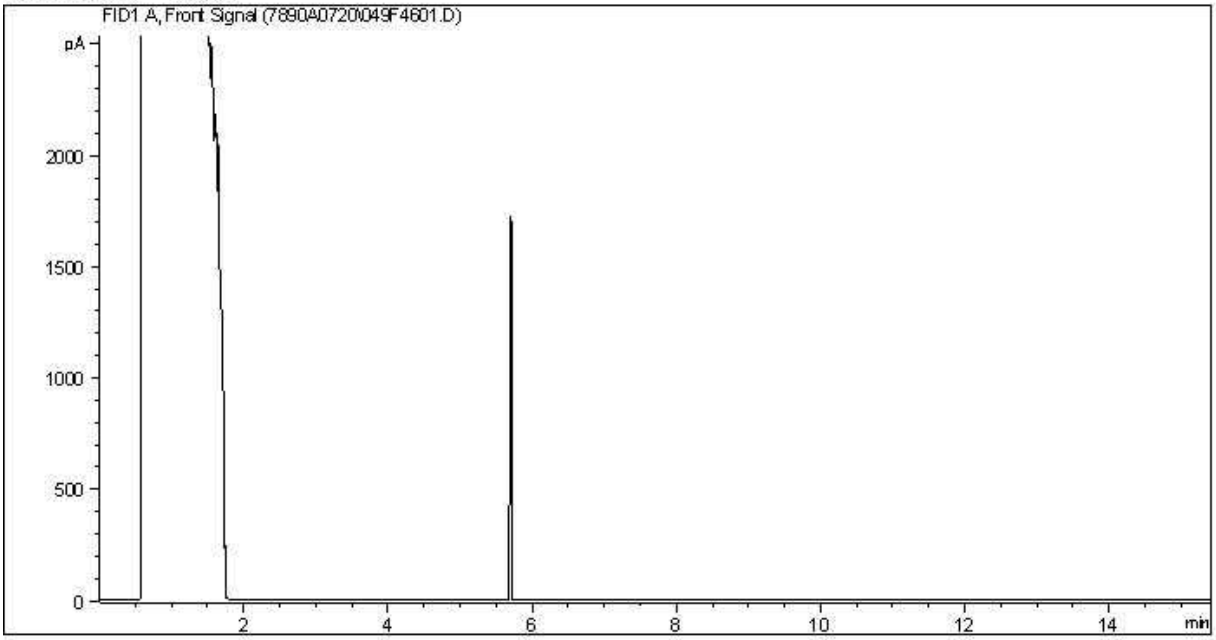
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958267
Report Date: 2019/07/25
BV Labs Sample: WC9735

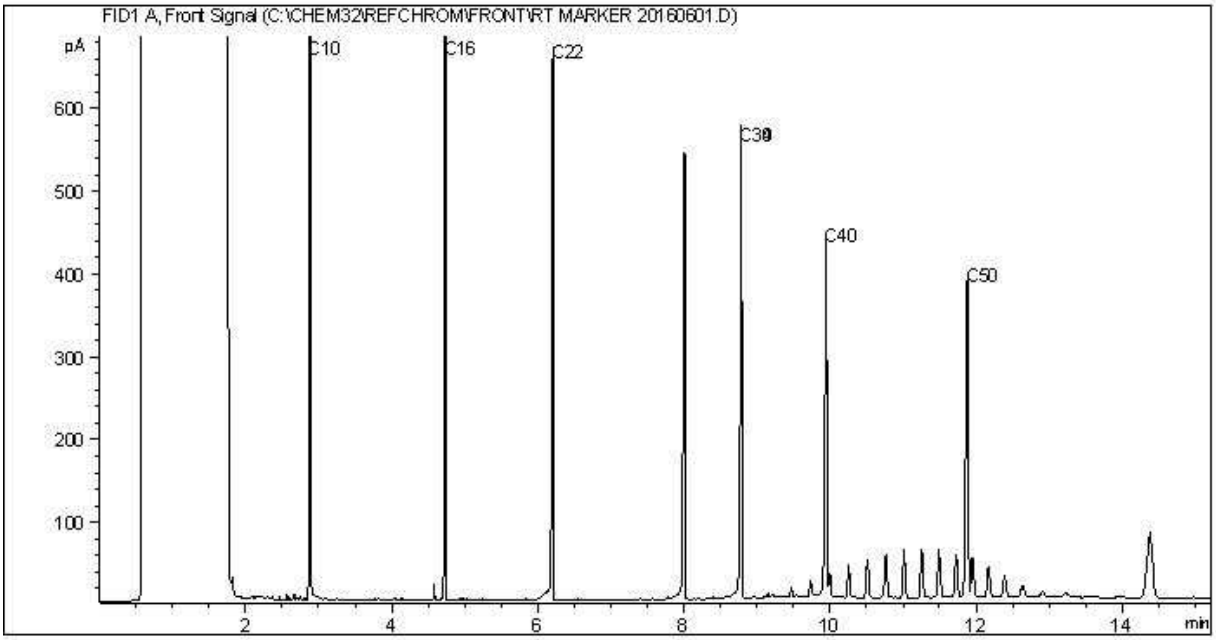
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: GIBG-10-2-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

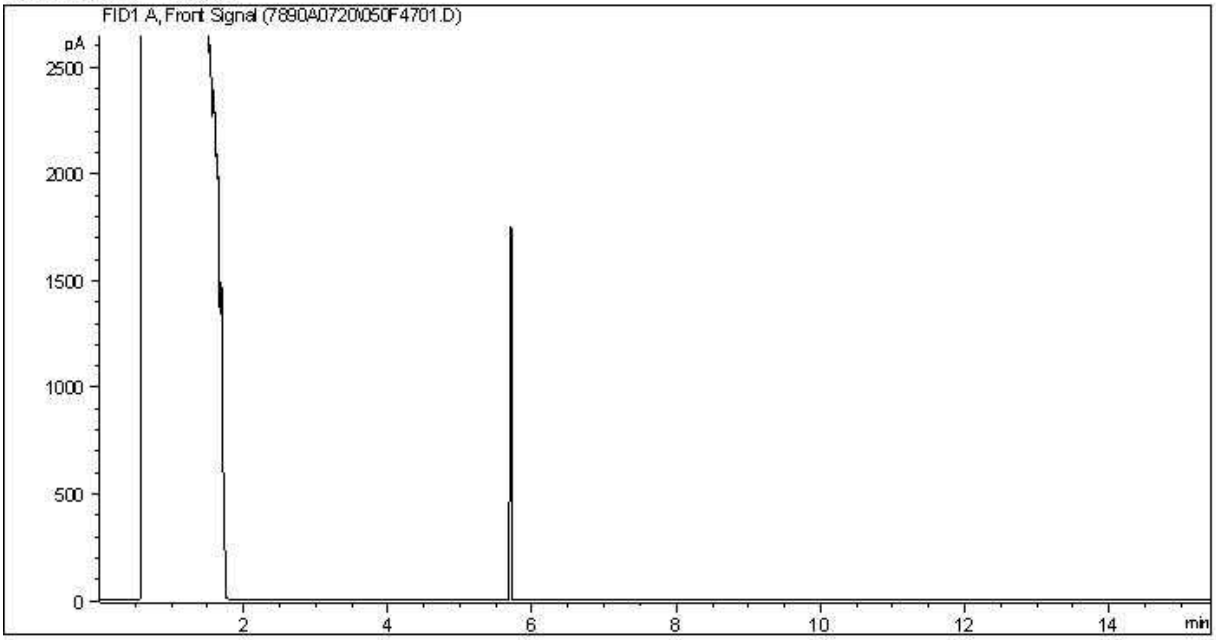
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958267
Report Date: 2019/07/25
BV Labs Sample: WC9736

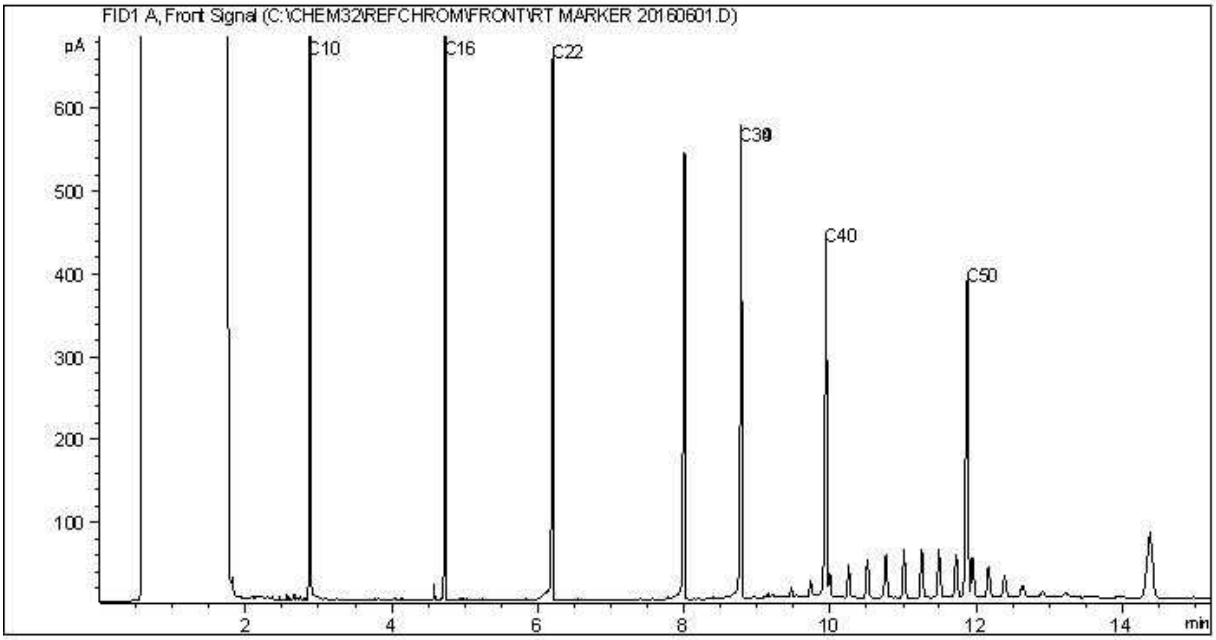
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-38

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

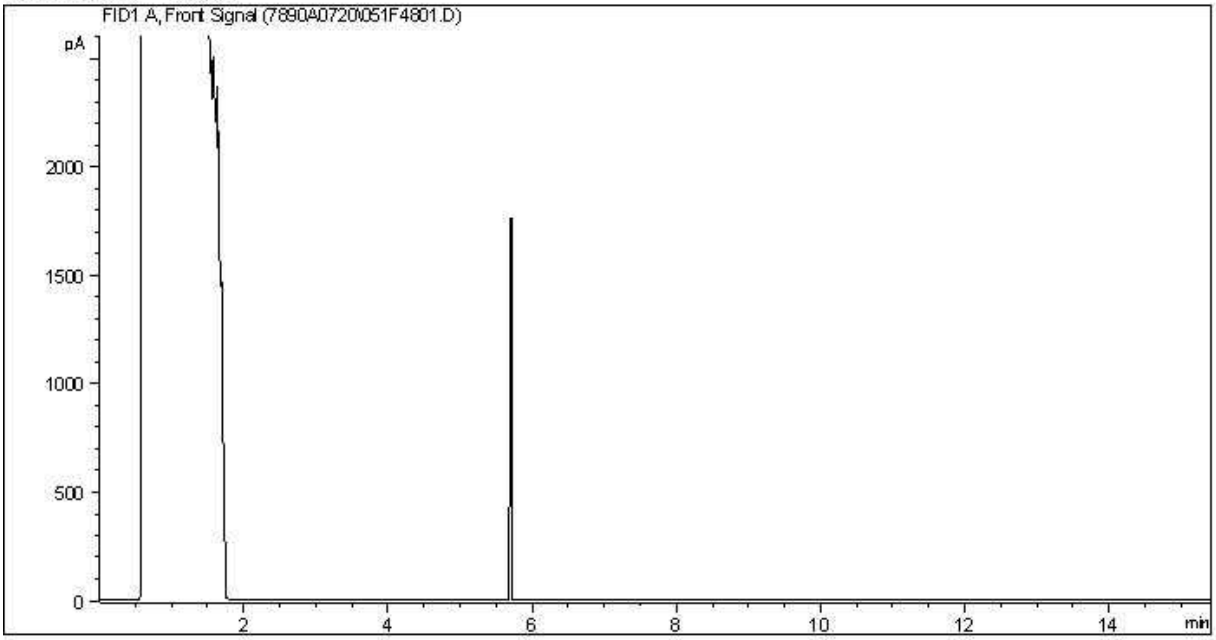
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958267
Report Date: 2019/07/25
BV Labs Sample: WC9737

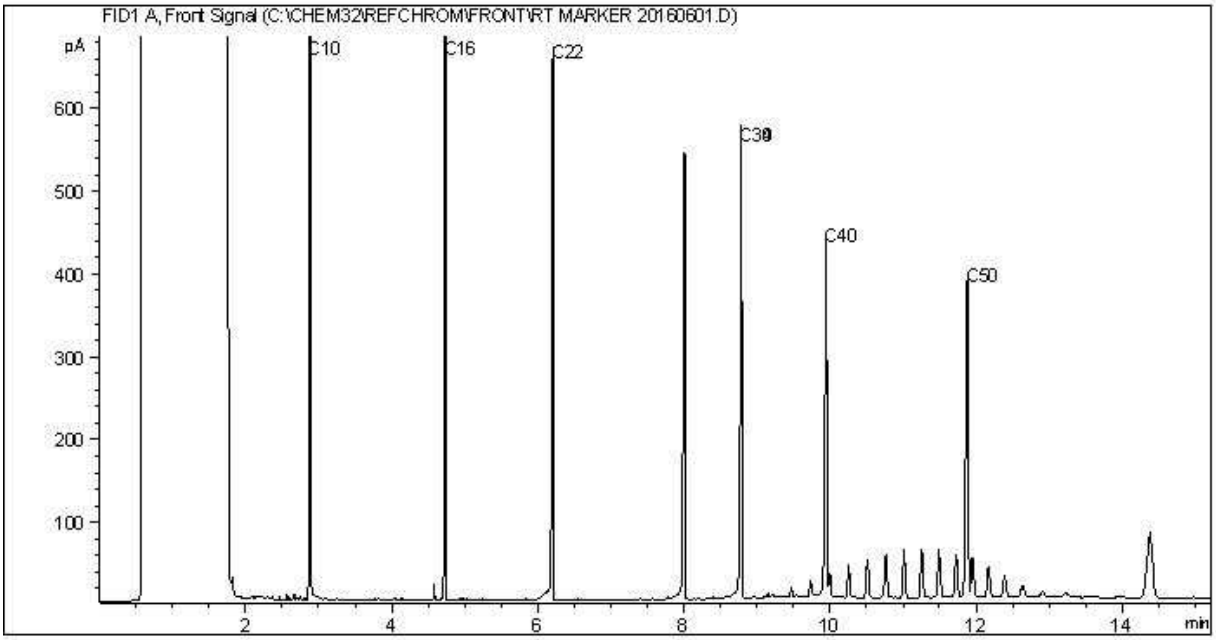
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-10

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

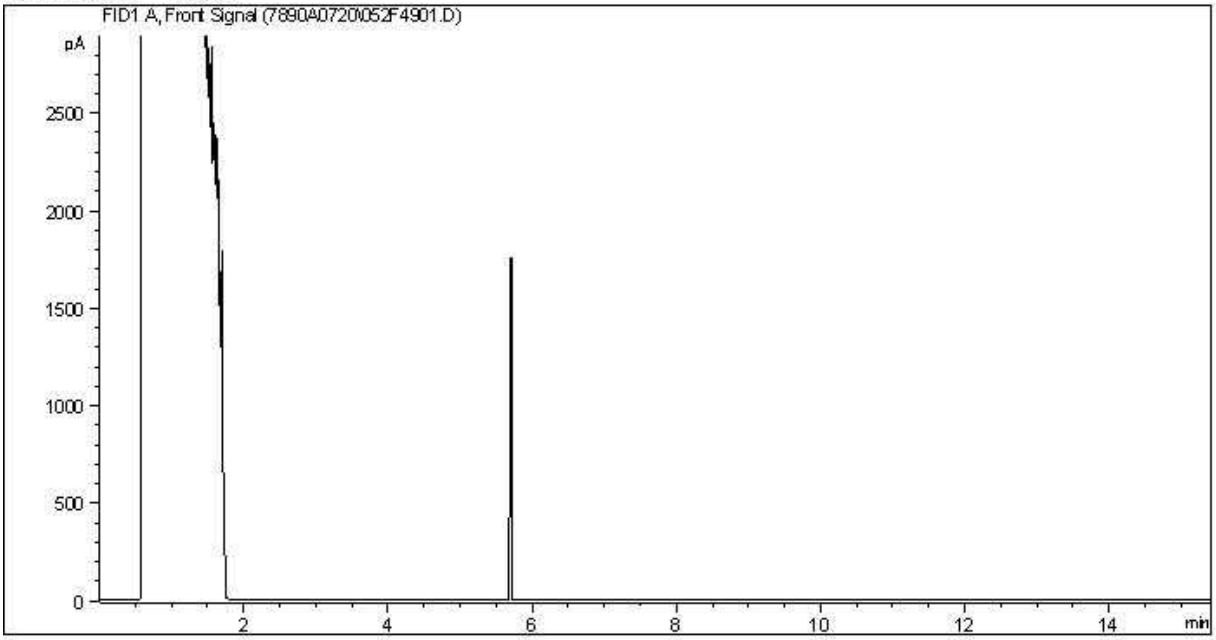
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958267
Report Date: 2019/07/25
BV Labs Sample: WC9738

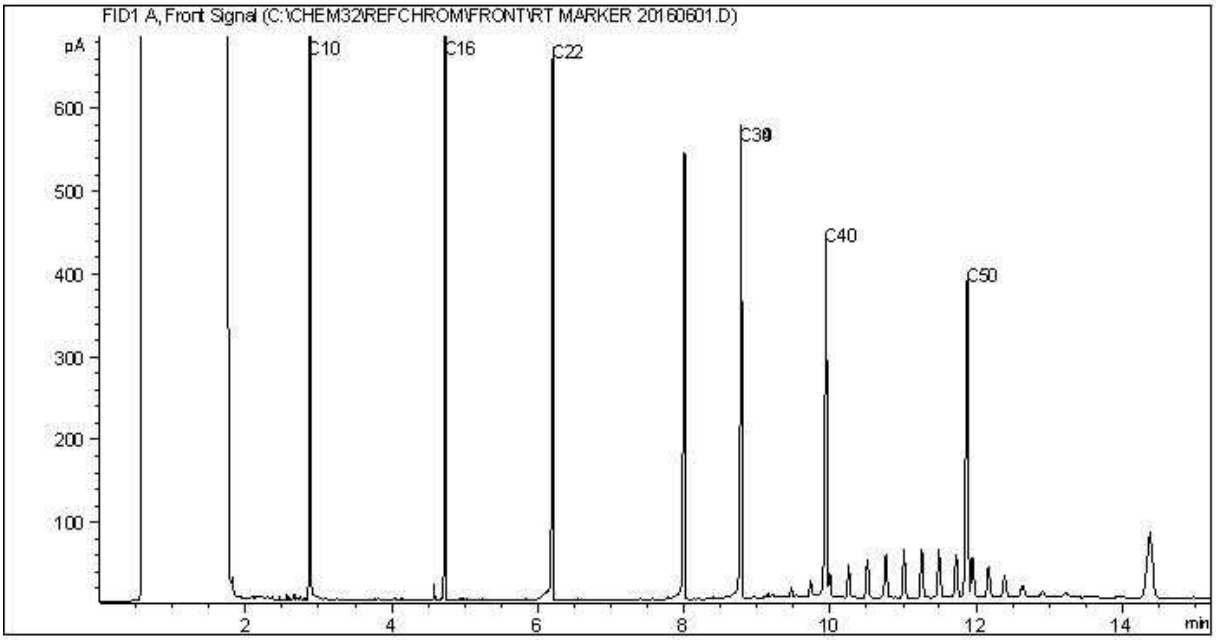
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-20

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
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☒ Edmonton
9331 - 48 Street, T6B 2R4
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Fax: (780) 450-4187
Toll Free: (800) 386-7247

YG8

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

Page 1 of 1

C of C # 298599

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Michelle Vokaty, Jessica Appleton	Consultant Project #: 407011-00770-400

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	ANALYSIS REQUESTED: VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS TOT ☐ DIS ☒	MERCURY TOTAL ☐ DISSOLVED ☒	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP	Limited sample, missing bottle(s), partial bottle(s)
1 GIBG-10-2-3	X				9	2019/07/16	08:30	X			X	X								X	X					X			X	X
2 NWD9-38	X				9		08:35	X			X	X								X	X					X			X	X
3 NWD19-10	X			X	5		18:00					X																		
4 NWD19-20	X				5		08:40					X																		
5																														
6																														
7																														
8																														
9																														
10																														

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email: canadachemistry@worleyparsons.com, czal-10a-datatrack@worleyparsons.com, melissa.lord@advisian.com

IES A2601436

JARS USED & NOT SUBMITTED (enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT	✓		3		4	4
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	TEMP °C 1	2	3
SEAL PRESENT						
SEAL INTACT						
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B958267

SAMPLES
LABELED BY: YG8
VERIFIED BY: DMX

RELINQUISHED BY:	printed name	DATE: (YYYY/MM/DD)	TIME (24 HR)	RECEIVED BY:	printed name	DATE: (YYYY/MM/DD)	TIME (24 HR)
1. Michelle Vokaty	Michelle Vokaty	2019/07/17	08:00	1.	LIVLEEN REHAL	2019 07 18	09:55
2. signature	printed name	YYYY/MM/DD	HH:MM	2. signature	printed name	YYYY/MM/DD	HH:MM
3. signature	printed name	YYYY/MM/DD	HH:MM	3. signature	printed name	YYYY/MM/DD	HH:MM

COC-1010 (06/2016) IOL-AB

White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 17-Jul-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B958871

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration	x			All field QC samples met alert limits.
Trip Blank Concentration	x			
Equipment Blank Concentration			x	
Field Duplicate RPD	x			

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 26-Jul-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): 

Date: 02-Aug-19 | Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298582

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/26
Report #: R2758317
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958871
Received: 2019/07/19, 12:53

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	5	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	5		Auto Calc
Cadmium - low level CCME - Dissolved	3		Auto Calc
Chloride/Sulphate by Auto Colourimetry	3	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	3	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	5	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	3		Auto Calc
Mercury (Dissolved) by CV	3	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	3	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	3	AB SOP-00043	EPA 6020b R2 m
Ion Balance	3		Auto Calc
Nitrate and Nitrite	3		Auto Calc
Nitrate + Nitrite-N (calculated)	3		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	3	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (3)	1		Auto Calc
PAH in Water by GC/MS	1	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	3	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	3	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

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Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298582

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/07/26
Report #: R2758317
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B958871
Received: 2019/07/19, 12:53

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WD2708		WD2709	WD2710	WD2711		
Sampling Date		2019/07/17 15:05		2019/07/17 14:25	2019/07/17 14:30	2019/07/17 14:40		
COC Number		298582		298582	298582	298582		
	UNITS	**BIBG-10-1-4**	**QC Batch**	**BIS 97-1-3**	**NWD19-45**	**NWD19-19**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	9516121	<0.10	<0.10	<0.10	0.10	9516122
Volatiles								
Benzene	mg/L	<0.00040	9516532	<0.00040	<0.00040	<0.00040	0.00040	9516532
Toluene	mg/L	<0.00040	9516532	<0.00040	<0.00040	<0.00040	0.00040	9516532
Ethylbenzene	mg/L	<0.00040	9516532	<0.00040	<0.00040	<0.00040	0.00040	9516532
m & p-Xylene	mg/L	<0.00080	9516532	<0.00080	<0.00080	<0.00080	0.00080	9516532
o-Xylene	mg/L	<0.00040	9516532	<0.00040	<0.00040	<0.00040	0.00040	9516532
Xylenes (Total)	mg/L	<0.00089	9514959	<0.00089	<0.00089	<0.00089	0.00089	9514959
F1 (C6-C10) - BTEX	mg/L	<0.10	9514959	<0.10	<0.10	<0.10	0.10	9514959
LH (C5-C10)	mg/L	<0.10	9516532	<0.10	<0.10	<0.10	0.10	9516532
F1 (C6-C10)	mg/L	<0.10	9516532	<0.10	<0.10	<0.10	0.10	9516532
Extraction Surrogate Recovery (%)								
O-TERPHENYL (sur.)	%	105	9516121	96	101	93		9516122
Instrument Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	104	9516532	103	104	108		9516532
4-Bromofluorobenzene (sur.)	%	98	9516532	97	99	99		9516532
D4-1,2-Dichloroethane (sur.)	%	102	9516532	104	104	101		9516532

RDL = Reportable Detection Limit

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WD2712		
Sampling Date		2019/07/17 18:00		
COC Number		298582		
	UNITS	**NWD19-09**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9516122
Volatiles				
Benzene	mg/L	<0.00040	0.00040	9516532
Toluene	mg/L	<0.00040	0.00040	9516532
Ethylbenzene	mg/L	<0.00040	0.00040	9516532
m & p-Xylene	mg/L	<0.00080	0.00080	9516532
o-Xylene	mg/L	<0.00040	0.00040	9516532
Xylenes (Total)	mg/L	<0.00089	0.00089	9515278
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9515278
LH (C5-C10)	mg/L	<0.10	0.10	9516532
F1 (C6-C10)	mg/L	<0.10	0.10	9516532
Extraction Surrogate Recovery (%)				
O-TERPHENYL (sur.)	%	101		9516122
Instrument Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	102		9516532
4-Bromofluorobenzene (sur.)	%	98		9516532
D4-1,2-Dichloroethane (sur.)	%	101		9516532
RDL = Reportable Detection Limit				

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REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WD2708	WD2709	WD2710		
Sampling Date		2019/07/17 15:05	2019/07/17 14:25	2019/07/17 14:30		
COC Number		298582	298582	298582		
	UNITS	**BIBG-10-1-4**	**BIS 97-1-3**	**NWD19-45**	**RDL**	**QC Batch**
Low Level Elements						
Dissolved Cadmium (Cd)	mg/L	0.000038	<0.000020	<0.000020	0.000020	9514829
Elements						
Dissolved Aluminum (Al)	mg/L	0.0076	0.0064	0.0066	0.0030	9515991
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00060	9515991
Dissolved Arsenic (As)	mg/L	0.00052	0.0010	0.00095	0.00020	9515991
Dissolved Barium (Ba)	mg/L	0.038	0.045	0.046	0.010	9515872
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9515991
Dissolved Boron (B)	mg/L	<0.020	<0.020	<0.020	0.020	9515872
Dissolved Calcium (Ca)	mg/L	220	210	210	0.30	9515872
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9515991
Dissolved Cobalt (Co)	mg/L	0.0013	0.0016	0.0016	0.00030	9515991
Dissolved Copper (Cu)	mg/L	0.0015	0.0025	0.0041	0.00020	9515991
Dissolved Iron (Fe)	mg/L	0.13	5.7	5.7	0.060	9515872
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9515991
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.020	9515872
Dissolved Magnesium (Mg)	mg/L	50	93	93	0.20	9515872
Dissolved Manganese (Mn)	mg/L	0.73	0.65	0.65	0.0040	9515872
Dissolved Molybdenum (Mo)	mg/L	0.026	0.0046	0.0046	0.00020	9515991
Dissolved Nickel (Ni)	mg/L	0.0053	0.0065	0.0067	0.00050	9515991
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	9515872
Dissolved Potassium (K)	mg/L	1.7	3.5	3.5	0.30	9515872
Dissolved Selenium (Se)	mg/L	<0.00020	0.00046	0.00049	0.00020	9515991
Dissolved Silicon (Si)	mg/L	3.6	5.6	5.6	0.10	9515872
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9515991
Dissolved Sodium (Na)	mg/L	6.7	20	20	0.50	9515872
Dissolved Strontium (Sr)	mg/L	0.61	0.76	0.76	0.020	9515872
Dissolved Sulphur (S)	mg/L	120	68	68	0.20	9515872
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9515991
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9515991
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9515991
Dissolved Uranium (U)	mg/L	0.0052	0.0014	0.0014	0.00010	9515991
RDL = Reportable Detection Limit						

BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		WD2708	WD2709	WD2710		
Sampling Date		2019/07/17 15:05	2019/07/17 14:25	2019/07/17 14:30		
COC Number		298582	298582	298582		
	UNITS	**BIBG-10-1-4**	**BIS 97-1-3**	**NWD19-45**	**RDL**	**QC Batch**
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9515991
Dissolved Zinc (Zn)	mg/L	0.015	0.0042	0.0063	0.0030	9515991
RDL = Reportable Detection Limit						

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WD2708			WD2709		WD2710		
Sampling Date		2019/07/17 15:05			2019/07/17 14:25		2019/07/17 14:30		
COC Number		298582			298582		298582		
	UNITS	**BIBG-10-1-4**	**RDL**	**QC Batch**	**BIS 97-1-3**	**RDL**	**NWD19-45**	**RDL**	**QC Batch**
Calculated Parameters									
Hardness (CaCO3)	mg/L	750	0.50	9514856	910	0.50	910	0.50	9514856
Ion Balance (% Difference)	%	0.93	N/A	9514859	4.6	N/A	3.2	N/A	9514859
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	9514808	2.4	0.044	2.4	0.044	9514808
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9514810	0.55	0.014	0.56	0.014	9514810
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9514808	0.037	0.033	0.043	0.033	9514808
Misc. Inorganics									
Conductivity	uS/cm	1300	2.0	9519235	1500	2.0	1500	2.0	9519235
Total Dissolved Solids	mg/L	950	10	9516424	1000	10	1000	10	9516544
Anions									
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9519234	<1.0	1.0	<1.0	1.0	9519234
Alkalinity (Total as CaCO3)	mg/L	390	1.0	9519234	670	1.0	690	1.0	9519234
Bicarbonate (HCO3)	mg/L	480	1.0	9519234	820	1.0	840	1.0	9519234
Carbonate (CO3)	mg/L	<1.0	1.0	9519234	<1.0	1.0	<1.0	1.0	9519234
Hydroxide (OH)	mg/L	<1.0	1.0	9519234	<1.0	1.0	<1.0	1.0	9519234
Dissolved Chloride (Cl)	mg/L	23	1.0	9518619	19	1.0	19	1.0	9518619
Dissolved Sulphate (SO4)	mg/L	320 (1)	5.0	9518619	180	1.0	180	1.0	9518619
Nutrients									
Dissolved Nitrite (N)	mg/L	<0.010 (2)	0.010	9515861	0.011	0.010	0.013	0.010	9515861
Dissolved Nitrate (N)	mg/L	<0.010 (2)	0.010	9515861	0.53	0.010	0.54	0.010	9515861
Misc. Organics									
Phenols	mg/L	0.0020	0.0015	9520899	0.0061	0.0015	0.011 (3)	0.0030	9520899

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.
(2) Sample was originally processed within hold time. Data quality required investigation. Re-analysis was completed past recommended hold time.
(3) Detection limits raised due to matrix interference.

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WD2708		
Sampling Date		2019/07/17 15:05		
COC Number		298582		
	UNITS	**BIBG-10-1-4**	**RDL**	**QC Batch**
Polycyclic Aromatics				
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	0.000010	9514935
Acenaphthene	mg/L	<0.00010	0.00010	9516119
Acenaphthylene	mg/L	<0.00010	0.00010	9516119
Acridine	mg/L	<0.000040	0.000040	9516119
Anthracene	mg/L	<0.000010	0.000010	9516119
Benzo(a)anthracene	mg/L	<0.0000085	0.0000085	9516119
Benzo(b&j)fluoranthene	mg/L	<0.0000085	0.0000085	9516119
Benzo(k)fluoranthene	mg/L	<0.0000085	0.0000085	9516119
Benzo(g,h,i)perylene	mg/L	<0.0000085	0.0000085	9516119
Benzo(c)phenanthrene	mg/L	<0.000050	0.000050	9516119
Benzo(a)pyrene	mg/L	<0.0000075	0.0000075	9516119
Benzo(e)pyrene	mg/L	<0.000050	0.000050	9516119
Chrysene	mg/L	<0.0000085	0.0000085	9516119
Dibenz(a,h)anthracene	mg/L	<0.0000075	0.0000075	9516119
Fluoranthene	mg/L	<0.000010	0.000010	9516119
Fluorene	mg/L	<0.000050	0.000050	9516119
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	0.0000085	9516119
1-Methylnaphthalene	mg/L	<0.00010	0.00010	9516119
2-Methylnaphthalene	mg/L	<0.00010	0.00010	9516119
Naphthalene	mg/L	<0.00010	0.00010	9516119
Phenanthrene	mg/L	<0.000050	0.000050	9516119
Perylene	mg/L	<0.000050	0.000050	9516119
Pyrene	mg/L	<0.000020	0.000020	9516119
Quinoline	mg/L	<0.00020	0.00020	9516119
Extraction Surrogate Recovery (%)				
D10-ANTHRACENE (sur.)	%	94		9516119
D8-ACENAPHTHYLENE (sur.)	%	95		9516119
D8-NAPHTHALENE (sur.)	%	90		9516119
TERPHENYL-D14 (sur.)	%	100		9516119
RDL = Reportable Detection Limit				

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WD2708	WD2708	WD2709	WD2710		
Sampling Date		2019/07/17 15:05	2019/07/17 15:05	2019/07/17 14:25	2019/07/17 14:30		
COC Number		298582	298582	298582	298582		
	UNITS	**BIBG-10-1-4**	**BIBG-10-1-4 Lab-Dup**	**BIS 97-1-3**	**NWD19-45**	**RDL**	**QC Batch**
Elements							
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0027	0.0031	0.0020	9520469

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WD2708
Sample ID: BIBG-10-1-4
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9519234	N/A	2019/07/23	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9516532	N/A	2019/07/22	Michael Fernandez
F1-BTEX	CALC/MS	9514959	N/A	2019/07/23	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9514829	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9518619	N/A	2019/07/23	Chelsea Harmatys
Conductivity @25C	COND	9519235	N/A	2019/07/23	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9516121	2019/07/21	2019/07/23	Grace Guo
Hardness	CALC	9514856	N/A	2019/07/24	Automated Statchk
Mercury (Dissolved) by CV	CV	9520469	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515872	N/A	2019/07/23	Andrew Payne
Elements by ICPMS - Dissolved	ICPM	9515991	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9514859	N/A	2019/07/22	Automated Statchk
Nitrate and Nitrite	CALC	9514808	N/A	2019/07/23	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9514810	N/A	2019/07/23	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9515861	N/A	2019/07/22	Krista Dawe
Benzo[a]pyrene Equivalency	GC/MSD	9514935	N/A	2019/07/23	Automated Statchk
PAH in Water by GC/MS	GC/MS	9516119	2019/07/20	2019/07/23	Sandra Wilson
Phenols (4-AAP)	TECH/4AAP	9520899	N/A	2019/07/25	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516424	2019/07/21	2019/07/23	Amy Aston

BV Labs ID: WD2708 Dup
Sample ID: BIBG-10-1-4
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury (Dissolved) by CV	CV	9520469	2019/07/24	2019/07/24	Andrew Payne

BV Labs ID: WD2709
Sample ID: BIS 97-1-3
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9519234	N/A	2019/07/23	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9516532	N/A	2019/07/22	Michael Fernandez
F1-BTEX	CALC/MS	9514959	N/A	2019/07/23	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9514829	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9518619	N/A	2019/07/23	Chelsea Harmatys
Conductivity @25C	COND	9519235	N/A	2019/07/23	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9516122	2019/07/20	2019/07/23	Raymond Blumenschein
Hardness	CALC	9514856	N/A	2019/07/24	Automated Statchk
Mercury (Dissolved) by CV	CV	9520469	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515872	N/A	2019/07/23	Andrew Payne
Elements by ICPMS - Dissolved	ICPM	9515991	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9514859	N/A	2019/07/22	Automated Statchk

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WD2709
Sample ID: BIS 97-1-3
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate and Nitrite	CALC	9514808	N/A	2019/07/23	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9514810	N/A	2019/07/23	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9515861	N/A	2019/07/20	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9520899	N/A	2019/07/25	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516544	2019/07/21	2019/07/23	Luminita Chiosa

BV Labs ID: WD2710
Sample ID: NWD19-45
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9519234	N/A	2019/07/23	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9516532	N/A	2019/07/22	Michael Fernandez
F1-BTEX	CALC/MS	9514959	N/A	2019/07/23	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9514829	N/A	2019/07/22	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9518619	N/A	2019/07/23	Chelsea Harmatys
Conductivity @25C	COND	9519235	N/A	2019/07/23	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9516122	2019/07/20	2019/07/23	Raymond Blumenschein
Hardness	CALC	9514856	N/A	2019/07/24	Automated Statchk
Mercury (Dissolved) by CV	CV	9520469	2019/07/24	2019/07/24	Andrew Payne
Elements by ICP - Dissolved	ICPA	9515872	N/A	2019/07/23	Andrew Payne
Elements by ICPMS - Dissolved	ICPM	9515991	N/A	2019/07/20	Julie Harrison
Ion Balance	CALC	9514859	N/A	2019/07/22	Automated Statchk
Nitrate and Nitrite	CALC	9514808	N/A	2019/07/23	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9514810	N/A	2019/07/23	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9515861	N/A	2019/07/20	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9520899	N/A	2019/07/25	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9516544	2019/07/21	2019/07/23	Luminita Chiosa

BV Labs ID: WD2711
Sample ID: NWD19-19
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9516532	N/A	2019/07/22	Michael Fernandez
F1-BTEX	CALC/MS	9514959	N/A	2019/07/23	Automated Statchk
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9516122	2019/07/20	2019/07/23	Raymond Blumenschein

BV Labs ID: WD2712
Sample ID: NWD19-09
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9516532	N/A	2019/07/22	Michael Fernandez
F1-BTEX	CALC/MS	9515278	N/A	2019/07/23	Automated Statchk

BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WD2712
Sample ID: NWD19-09
Matrix: Water

Collected: 2019/07/17
Relinquished: 2019/07/18
Received: 2019/07/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9516122	2019/07/20	2019/07/23	Raymond Blumenschein

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

GENERAL COMMENTS

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

Package 1	4.3°C

Sample WD2708 [BIBG-10-1-4] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WD2708	BIBG-10-1-4	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9515861	KD5	Method Blank	Dissolved Nitrite (N)	2019/07/20	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/20	<0.010		mg/L	
9515872	APY	Method Blank	Dissolved Iron (Fe)	2019/07/23	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/23	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/23	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/23	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/23	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/23	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/23	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/23	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/23	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/23	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/23	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/23	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/23	<0.30		mg/L	
9515991	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/20	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/20	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/20	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/20	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/20	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/20	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/20	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/20	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/20	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/20	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/20	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/20	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/20	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/20	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/20	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/20	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/20	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/20	<0.0010		mg/L	
9516119	SB8	Method Blank	D10-ANTHRACENE (sur.)	2019/07/22		96	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/22		100	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/22		98	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/22		93	%	50 - 130
			Acenaphthene	2019/07/22	<0.00010		mg/L	
			Acenaphthylene	2019/07/22	<0.00010		mg/L	
			Acridine	2019/07/22	<0.000040		mg/L	
			Anthracene	2019/07/22	<0.000010		mg/L	
			Benzo(a)anthracene	2019/07/22	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/07/22	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/07/22	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/07/22	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/07/22	<0.000050		mg/L	
			Benzo(a)pyrene	2019/07/22	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/07/22	<0.000050		mg/L	
			Chrysene	2019/07/22	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/07/22	<0.0000075		mg/L	
			Fluoranthene	2019/07/22	<0.000010		mg/L	
			Fluorene	2019/07/22	<0.000050		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Indeno(1,2,3-cd)pyrene	2019/07/22	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/07/22	<0.00010		mg/L	
			2-Methylnaphthalene	2019/07/22	<0.00010		mg/L	
			Naphthalene	2019/07/22	<0.00010		mg/L	
			Phenanthrene	2019/07/22	<0.000050		mg/L	
			Perylene	2019/07/22	<0.000050		mg/L	
			Pyrene	2019/07/22	<0.000020		mg/L	
			Quinoline	2019/07/22	<0.00020		mg/L	
9516121	GG3	Method Blank	O-TERPHENYL (sur.)	2019/07/22		108	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/22	<0.10		mg/L	
9516122	RBN	Method Blank	O-TERPHENYL (sur.)	2019/07/23		102	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/23	<0.10		mg/L	
9516424	AAZ	Method Blank	Total Dissolved Solids	2019/07/23	<10		mg/L	
9516532	MF3	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/21		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/21		97	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/21		99	%	50 - 140
			Benzene	2019/07/21	<0.00040		mg/L	
			Toluene	2019/07/21	<0.00040		mg/L	
			Ethylbenzene	2019/07/21	<0.00040		mg/L	
			m & p-Xylene	2019/07/21	<0.00080		mg/L	
			o-Xylene	2019/07/21	<0.00040		mg/L	
			LH (C5-C10)	2019/07/21	<0.10		mg/L	
			F1 (C6-C10)	2019/07/21	<0.10		mg/L	
9516544	LCA	Method Blank	Total Dissolved Solids	2019/07/23	<10		mg/L	
9518619	CH7	Method Blank	Dissolved Chloride (Cl)	2019/07/23	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/23	<1.0		mg/L	
9519234	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/23	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/23	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/23	<1.0		mg/L	
			Carbonate (CO3)	2019/07/23	<1.0		mg/L	
			Hydroxide (OH)	2019/07/23	<1.0		mg/L	
9519235	MA4	Method Blank	Conductivity	2019/07/23	<2.0		uS/cm	
9520469	APY	Method Blank	Dissolved Mercury (Hg)	2019/07/24	<0.0020		ug/L	
9520899	FFE	Method Blank	Phenols	2019/07/25	<0.0015		mg/L	
9520469	APY	RPD [WD2708-05]	Dissolved Mercury (Hg)	2019/07/24	NC		%	20
9520469	APY	Matrix Spike [WD2709-05]	Dissolved Mercury (Hg)	2019/07/24		108	%	80 - 120
9515861	KD5	LCS	Dissolved Nitrite (N)	2019/07/20		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/20		102	%	80 - 120
9515872	APY	LCS	Dissolved Iron (Fe)	2019/07/23		102	%	80 - 120
			Dissolved Lithium (Li)	2019/07/23		106	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/23		103	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/23		99	%	80 - 120
			Dissolved Potassium (K)	2019/07/23		106	%	80 - 120
			Dissolved Sodium (Na)	2019/07/23		110	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/23		102	%	80 - 120
			Dissolved Sulphur (S)	2019/07/23		102	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/23		100	%	80 - 120
			Dissolved Barium (Ba)	2019/07/23		102	%	80 - 120
			Dissolved Silicon (Si)	2019/07/23		95	%	80 - 120
			Dissolved Boron (B)	2019/07/23		102	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/23		97	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9515991	JHS	LCS	Dissolved Aluminum (Al)	2019/07/20		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/20		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/20		98	%	80 - 120
			Dissolved Copper (Cu)	2019/07/20		99	%	80 - 120
			Dissolved Lead (Pb)	2019/07/20		101	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/20		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/20		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/20		98	%	80 - 120
			Dissolved Selenium (Se)	2019/07/20		104	%	80 - 120
			Dissolved Silver (Ag)	2019/07/20		102	%	80 - 120
			Dissolved Arsenic (As)	2019/07/20		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/20		101	%	80 - 120
			Dissolved Tin (Sn)	2019/07/20		101	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/20		95	%	80 - 120
			Dissolved Uranium (U)	2019/07/20		98	%	80 - 120
			Dissolved Vanadium (V)	2019/07/20		100	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/20		99	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/20		95	%	80 - 120
9516119	SB8	LCS	D10-ANTHRACENE (sur.)	2019/07/23		88	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/07/23		91	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/07/23		89	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/07/23		85	%	50 - 130
			Acenaphthene	2019/07/23		85	%	50 - 130
			Acenaphthylene	2019/07/23		91	%	50 - 130
			Acridine	2019/07/23		92	%	50 - 130
			Anthracene	2019/07/23		91	%	50 - 130
			Benzo(a)anthracene	2019/07/23		89	%	50 - 130
			Benzo(b&j)fluoranthene	2019/07/23		94	%	50 - 130
			Benzo(k)fluoranthene	2019/07/23		87	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/23		93	%	50 - 130
			Benzo(c)phenanthrene	2019/07/23		92	%	50 - 130
			Benzo(a)pyrene	2019/07/23		97	%	50 - 130
			Benzo(e)pyrene	2019/07/23		98	%	50 - 130
			Chrysene	2019/07/23		84	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/23		93	%	50 - 130
			Fluoranthene	2019/07/23		94	%	50 - 130
			Fluorene	2019/07/23		91	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/23		103	%	50 - 130
			1-Methylnaphthalene	2019/07/23		92	%	50 - 130
			2-Methylnaphthalene	2019/07/23		95	%	50 - 130
			Naphthalene	2019/07/23		90	%	50 - 130
			Phenanthrene	2019/07/23		88	%	50 - 130
			Perylene	2019/07/23		99	%	50 - 130
			Pyrene	2019/07/23		94	%	50 - 130
			Quinoline	2019/07/23		117	%	50 - 130
9516121	GG3	LCS	O-TERPHENYL (sur.)	2019/07/22		109	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/22		124	%	60 - 140
9516122	RBN	LCS	O-TERPHENYL (sur.)	2019/07/23		105	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/23		124	%	60 - 140
9516424	AAZ	LCS	Total Dissolved Solids	2019/07/23		100	%	80 - 120
9516532	MF3	LCS	1,4-Difluorobenzene (sur.)	2019/07/23		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/23		101	%	50 - 140

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			D4-1,2-Dichloroethane (sur.)	2019/07/23		96	%	50 - 140
			Benzene	2019/07/23		98	%	60 - 130
			Toluene	2019/07/23		101	%	60 - 130
			Ethylbenzene	2019/07/23		108	%	60 - 130
			m & p-Xylene	2019/07/23		111	%	60 - 130
			o-Xylene	2019/07/23		107	%	60 - 130
			LH (C5-C10)	2019/07/23		121	%	60 - 140
			F1 (C6-C10)	2019/07/23		121	%	60 - 140
9516544	LCA	LCS	Total Dissolved Solids	2019/07/23		102	%	80 - 120
9518619	CH7	LCS	Dissolved Chloride (Cl)	2019/07/23		106	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/23		103	%	80 - 120
9519234	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/23		99	%	80 - 120
9519235	MA4	LCS	Conductivity	2019/07/23		100	%	90 - 110
9520469	APY	LCS	Dissolved Mercury (Hg)	2019/07/24		97	%	80 - 120
9520899	FFE	LCS	Phenols	2019/07/25		91	%	80 - 120

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.

LCS: 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 (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).

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BV Labs Job #: B958871
Report Date: 2019/07/26

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Winnie Au, B.Sc., QP, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

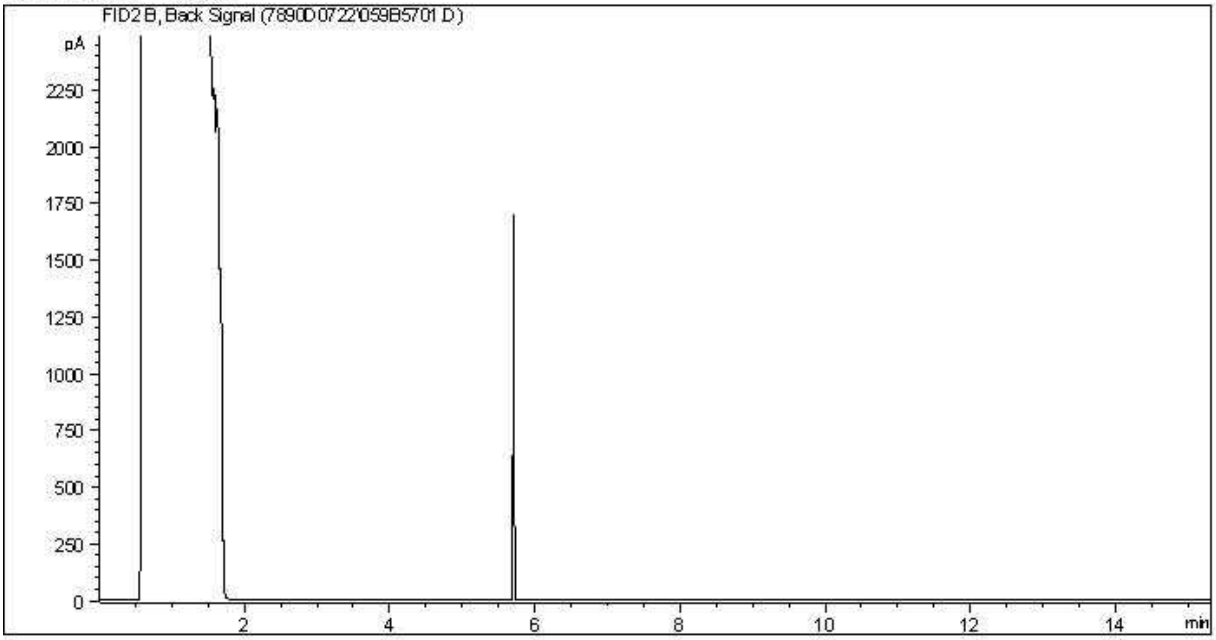
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B958871
Report Date: 2019/07/26
BV Labs Sample: WD2708

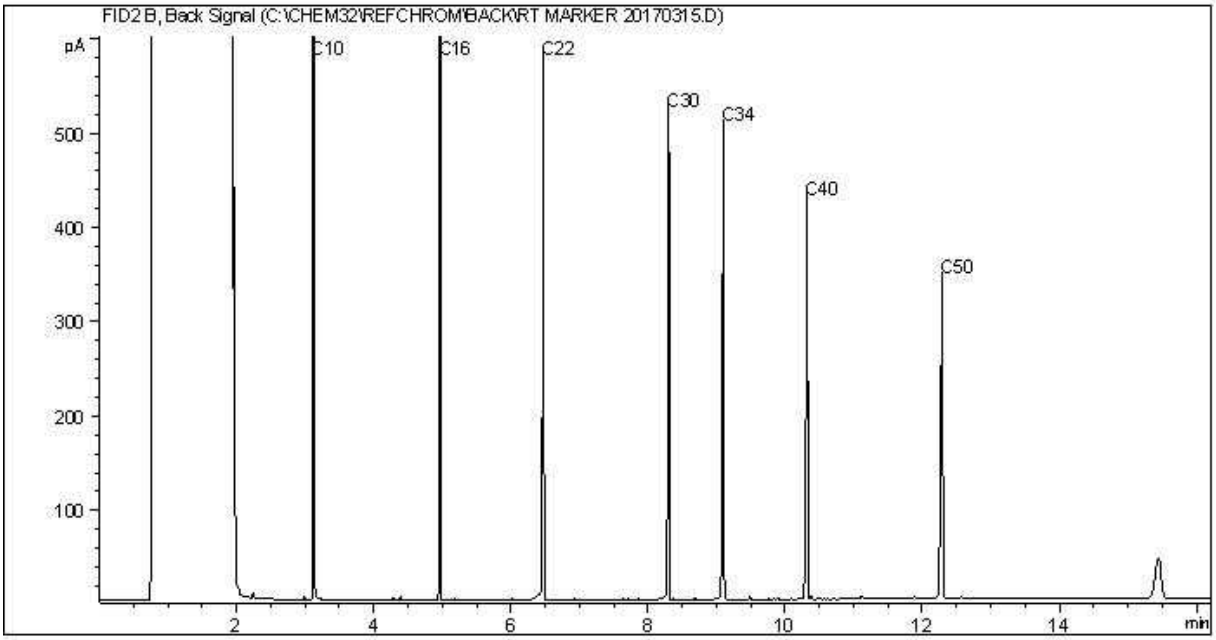
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BIBG-10-1-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

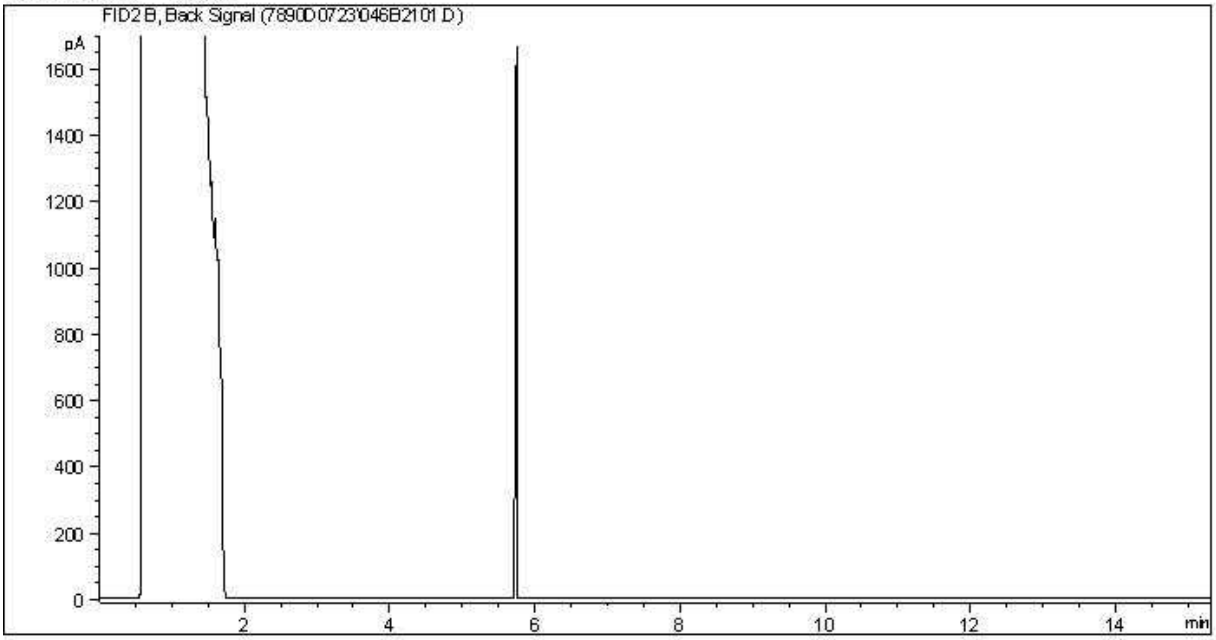
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958871
Report Date: 2019/07/26
BV Labs Sample: WD2709

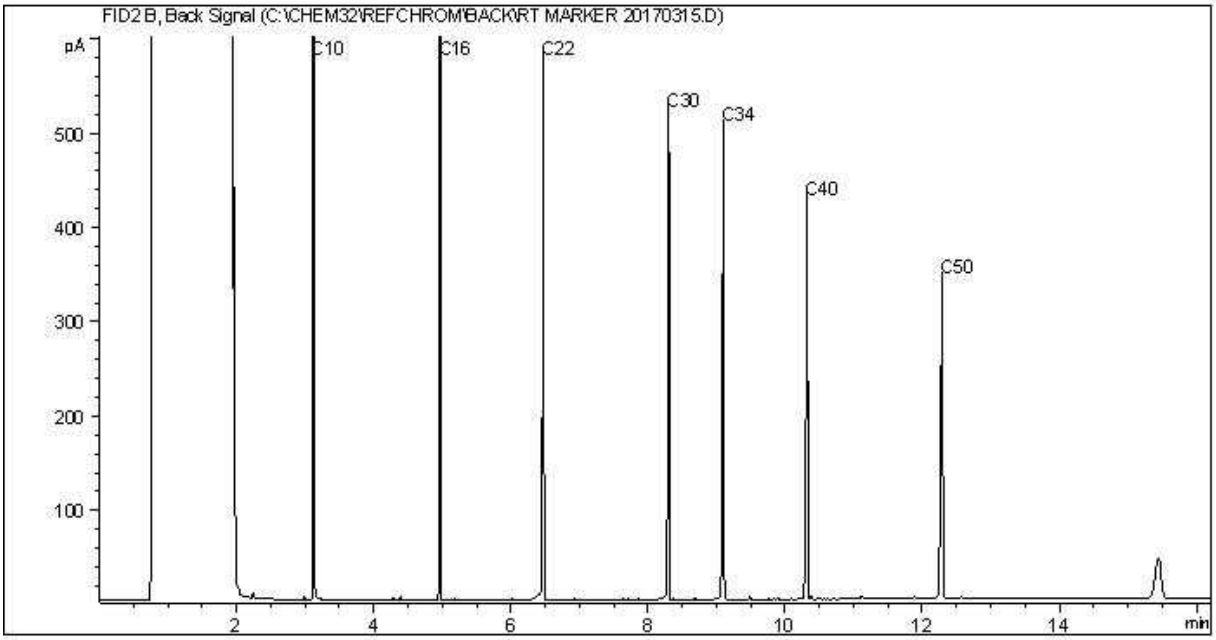
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BIS 97-1-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

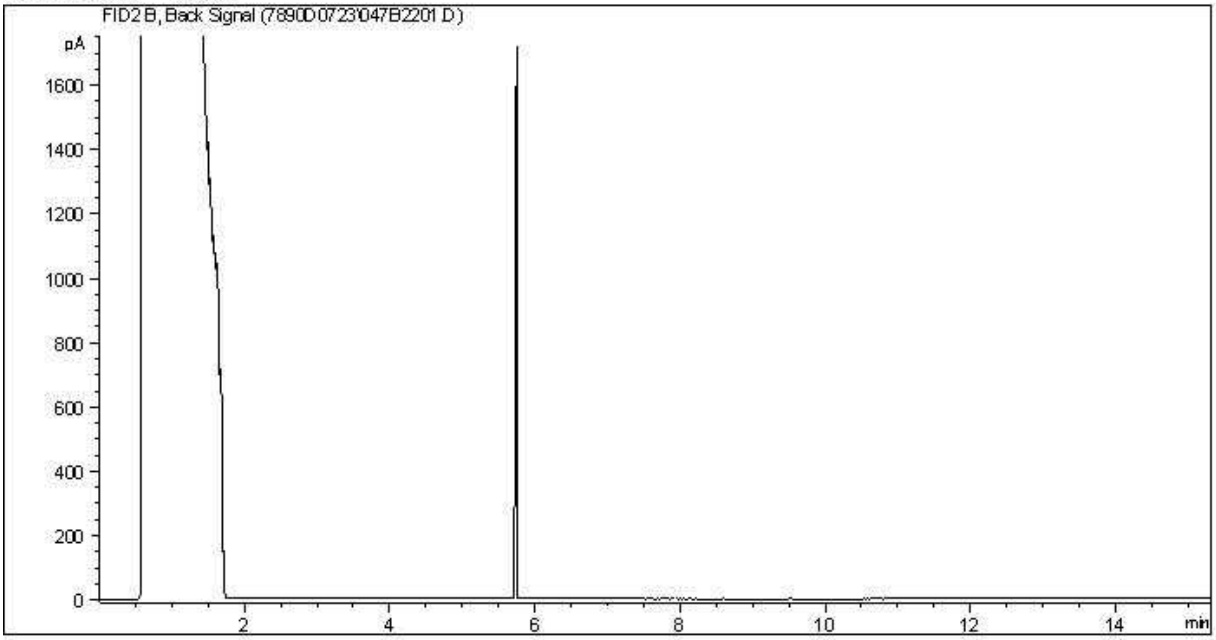
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958871
Report Date: 2019/07/26
BV Labs Sample: WD2710

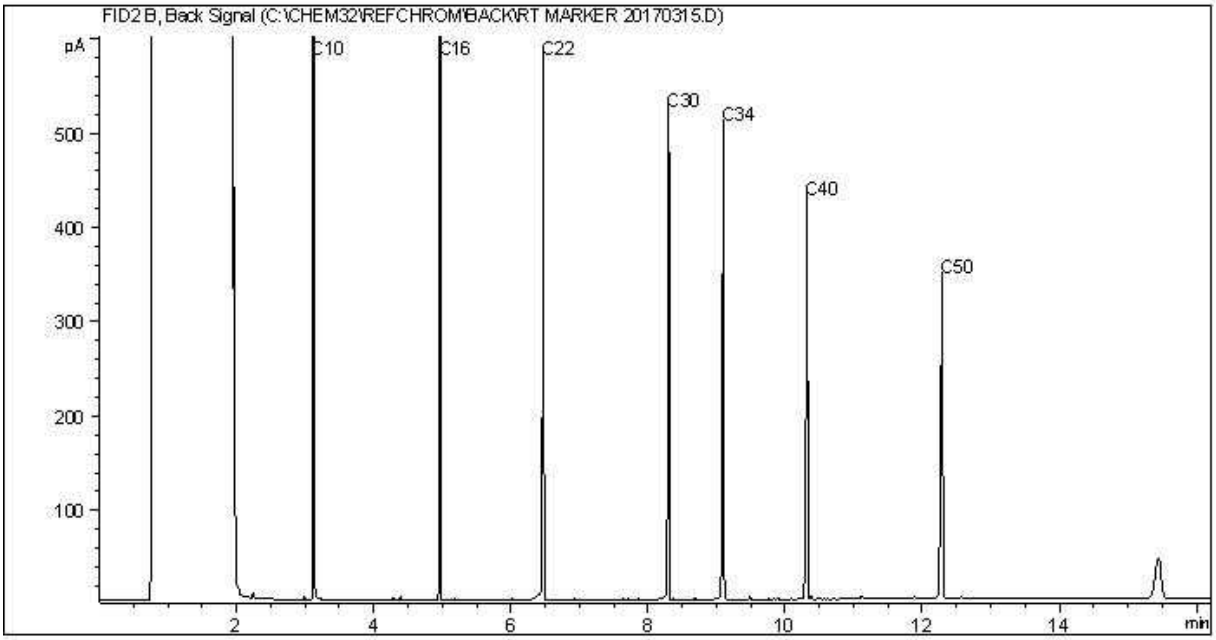
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-45

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

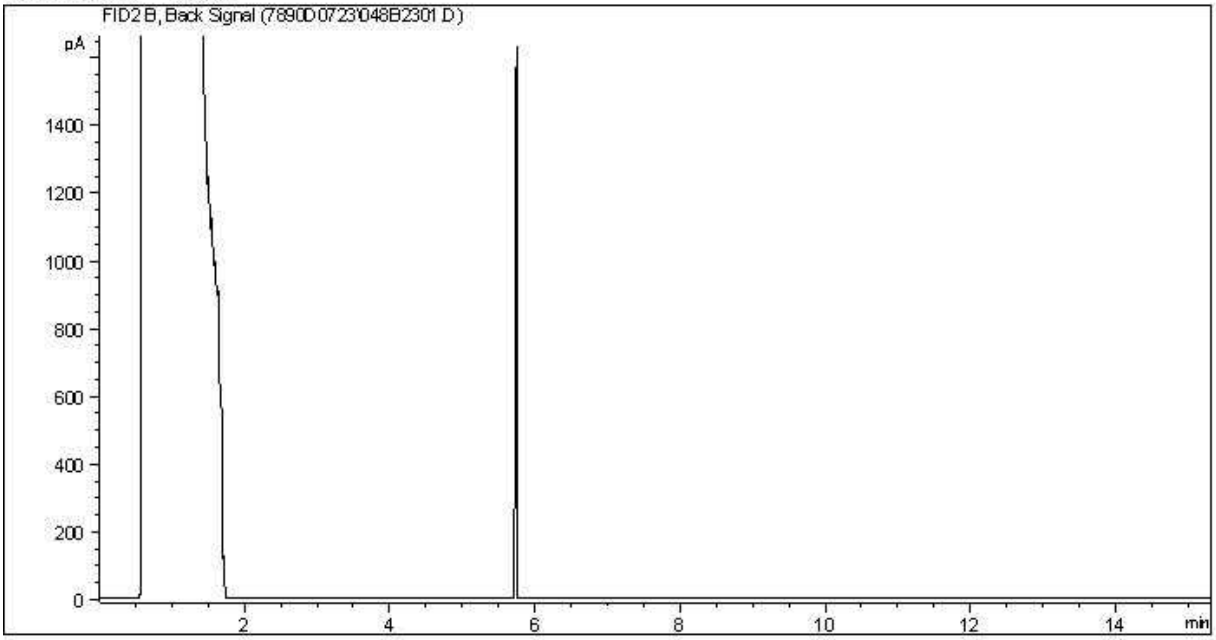
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958871
Report Date: 2019/07/26
BV Labs Sample: WD2711

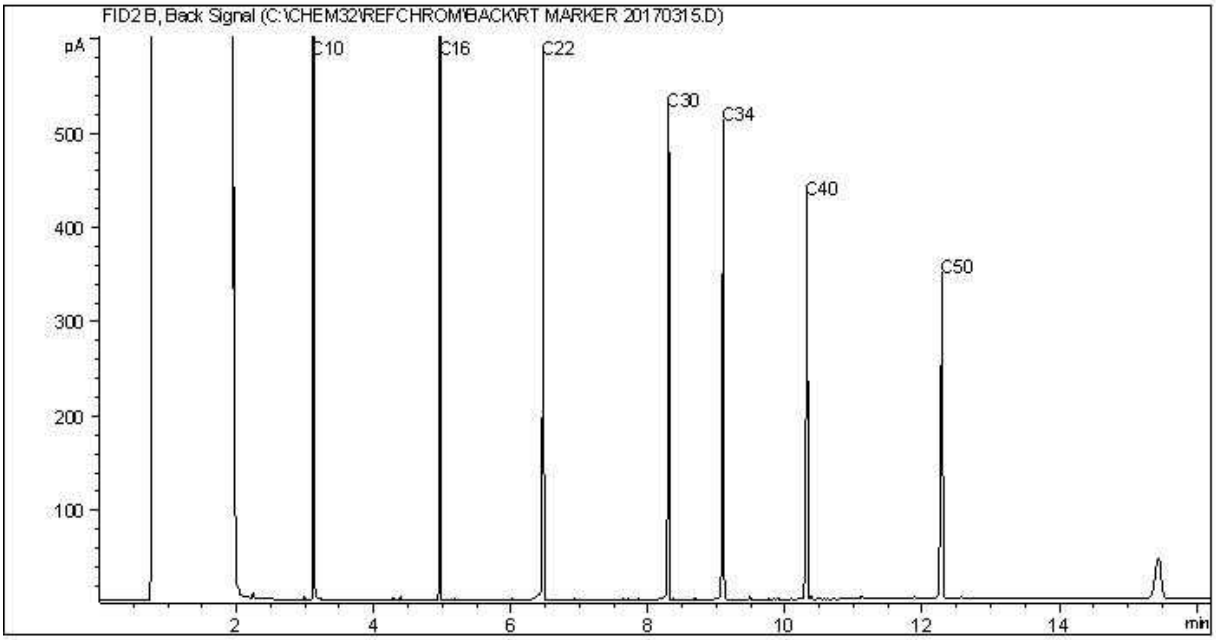
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-19

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

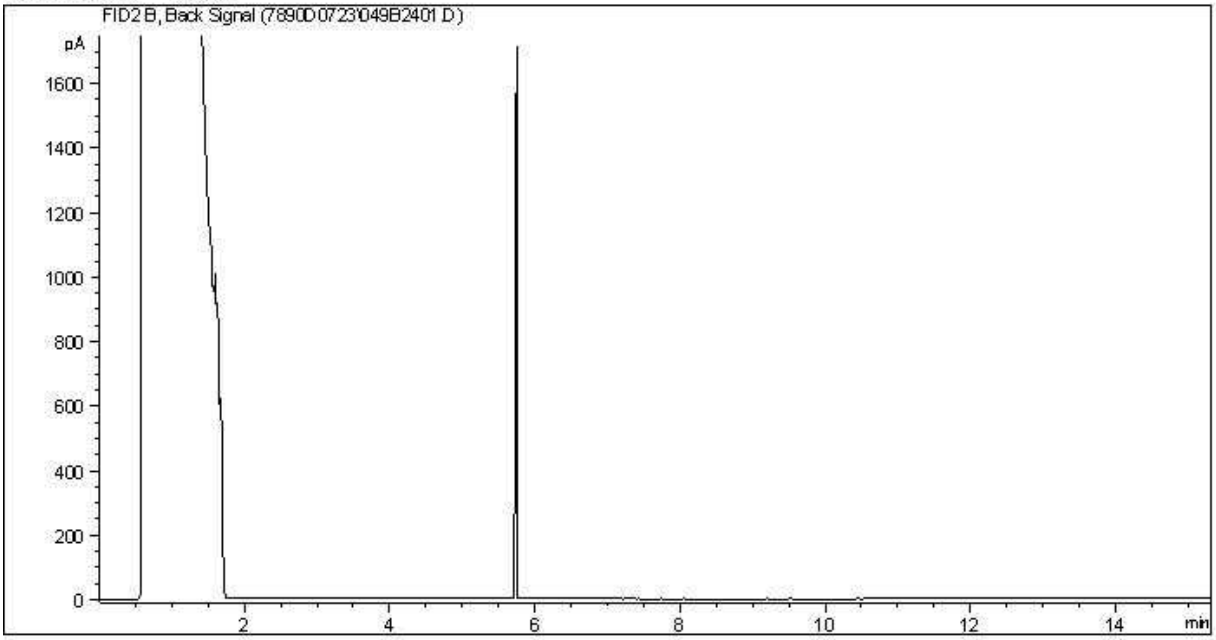
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B958871
Report Date: 2019/07/26
BV Labs Sample: WD2712

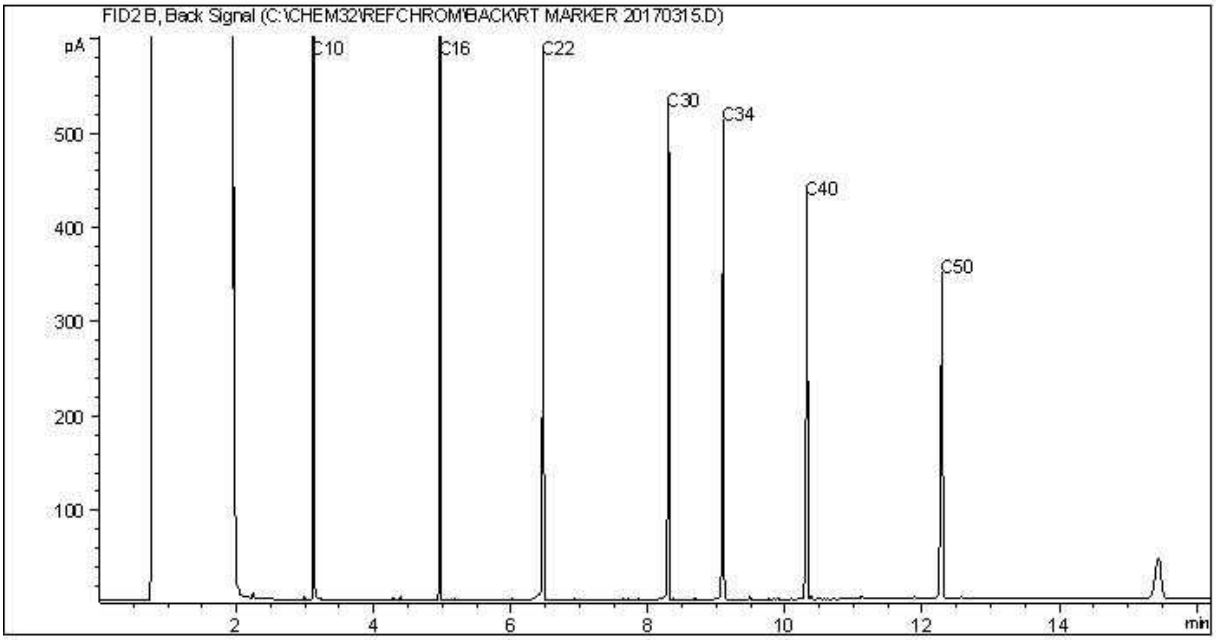
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD19-09

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

GY

C of C # 298582

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500-151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Michelle Vokaty, Jessica Appleton	Consultant Project #: 407011-00770-400

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED
1 BIBG-10-1-4	X				12	2019/07/17	15:05	X	
2 BIS 97-1-3	X				9		14:25	X	
3 NWD19-45	X				9		14:30	X	
4 NWD19-19	X				5		14:40		
5 NWD19-09				X	5	↓	18:00		
6									
7									
8									
9									
10									

ANALYSIS REQUESTED

VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☒ DIS ☐ TOT	MERCURY ☒ DISSOLVED ☐ TOTAL	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP	Limited sample, missing bottle(s), partial bottle(s)	Headspace present in BTEX vial(s)
	X	X							X	X					X			X		
		X							X	X					X			X	X	X
		X							X	X					X			X	X	
		X																		
		X																		

IOL SITE LOCATION: Norman Wells, NT
IOL PROJECT # (if applicable): N/A
MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS also email: canada.chemistry@worleyparsons.com cacal_lokdatatrack@worleyparsons.com melissa.lord@advisian.com
1ES 9260/1436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	4	5	4
SEAL INTACT	✓			1	2	3
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B958871

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1 Michelle Vokaty	Michelle Vokaty	2019/07/18	08:00	1.	Tesh'Ali	2019/07/19	1253
2.				2.			
3.				3.			

SAMPLES
LABELED BY: WYS.
VERIFIED BY: KVT

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 27-Jul-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops) | Sample Submission Number: B961957

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

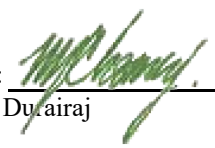
Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 07-Aug-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): nandhini durairaj | Data Reviewed by (Signature): 

Date: 12-Aug-19 | Myrna Chorney for Nandhini Durairaj

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299042

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/08/07
Report #: R2763330
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B961957
Received: 2019/07/30, 12:26

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	AB SOP-00005	SM 23 2320 B m
Send Part to Archive	1		
BTEX/F1 in Water by HS GC/MS/FID	1	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	1		Auto Calc
Cadmium - low level CCME - Dissolved	1		Auto Calc
Chloride/Sulphate by Auto Colourimetry	1	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	1	AB SOP-00005	SM 23 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	1	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Filtration (Metals)	1		
Hardness	1		Auto Calc
Mercury (Dissolved) by CV-Lab Filtered	1	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP-Dissolved-Lab Filtered (3)	1	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS-Dissolved-Lab Filtered (4)	1	AB SOP-00043	EPA 6020b R2 m
Ion Balance	1		Auto Calc
Nitrate and Nitrite (1)	1		Auto Calc
Nitrate + Nitrite-N (calculated) (1)	1		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC (1)	1	AB SOP-00023	SM 23 4110 B m
Phenols (4-AAP)	1	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	1	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 299042

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/08/07
Report #: R2763330
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B961957
Received: 2019/07/30, 12:26

BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 BV Labs Calgary Environmental
(2) Silica gel clean up employed.
(3) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(4) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: RPhayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WE7663		
Sampling Date		2019/07/27 16:00		
COC Number		299042		
	UNITS	**CPF 97-7-5**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9528363
Volatiles				
Benzene	mg/L	<0.00040	0.00040	9528255
Toluene	mg/L	<0.00040	0.00040	9528255
Ethylbenzene	mg/L	<0.00040	0.00040	9528255
m & p-Xylene	mg/L	<0.00080	0.00080	9528255
o-Xylene	mg/L	<0.00040	0.00040	9528255
Xylenes (Total)	mg/L	<0.00089	0.00089	9527721
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9527721
LH (C5-C10)	mg/L	<0.10	0.10	9528255
F1 (C6-C10)	mg/L	<0.10	0.10	9528255
Extraction Surrogate Recovery (%)				
O-TERPHENYL (sur.)	%	97		9528363
Instrument Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	101		9528255
4-Bromofluorobenzene (sur.)	%	100		9528255
D4-1,2-Dichloroethane (sur.)	%	100		9528255
RDL = Reportable Detection Limit				

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS INCL. HG –FILTERED (WATER)

BV Labs ID		WE7663			WE7663		
Sampling Date		2019/07/27 16:00			2019/07/27 16:00		
COC Number		299042			299042		
	UNITS	**CPF 97-7-5**	**RDL**	**QC Batch**	**CPF 97-7-5 Lab-Dup**	**RDL**	**QC Batch**
Low Level Elements							
Dissolved Cadmium (Cd)	mg/L	0.0017	0.000020	9527416			
Lab Filtered Elements							
Dissolved Mercury (Hg)	ug/L	<0.0020	0.0020	9529459	<0.0020	0.0020	9529459
Dissolved Aluminum (Al)	mg/L	0.024	0.0030	9528338			
Dissolved Antimony (Sb)	mg/L	0.0012	0.00060	9528338			
Dissolved Arsenic (As)	mg/L	0.00030	0.00020	9528338			
Dissolved Barium (Ba)	mg/L	0.065	0.010	9529262			
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9528338			
Dissolved Boron (B)	mg/L	0.064	0.020	9529262			
Dissolved Calcium (Ca)	mg/L	380	0.30	9529262			
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9528338			
Dissolved Cobalt (Co)	mg/L	0.00070	0.00030	9528338			
Dissolved Copper (Cu)	mg/L	0.0039	0.00020	9528338			
Dissolved Iron (Fe)	mg/L	<0.060	0.060	9529262			
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9528338			
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9529262			
Dissolved Magnesium (Mg)	mg/L	83	0.20	9529262			
Dissolved Manganese (Mn)	mg/L	0.79	0.0040	9529262			
Dissolved Molybdenum (Mo)	mg/L	0.0016	0.00020	9528338			
Dissolved Nickel (Ni)	mg/L	0.0075	0.00050	9528338			
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9529262			
Dissolved Potassium (K)	mg/L	4.7	0.30	9529262			
Dissolved Selenium (Se)	mg/L	0.00026	0.00020	9528338			
Dissolved Silicon (Si)	mg/L	4.2	0.10	9529262			
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9528338			
Dissolved Sodium (Na)	mg/L	9.2	0.50	9529262			
Dissolved Strontium (Sr)	mg/L	1.8	0.020	9529262			
Dissolved Sulphur (S)	mg/L	300	0.20	9529262			
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9528338			

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

REGULATED METALS INCL. HG –FILTERED (WATER)

BV Labs ID		WE7663			WE7663		
Sampling Date		2019/07/27 16:00			2019/07/27 16:00		
COC Number		299042			299042		
	UNITS	**CPF 97-7-5**	**RDL**	**QC Batch**	**CPF 97-7-5 Lab-Dup**	**RDL**	**QC Batch**
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9528338			
Dissolved Titanium (Ti)	mg/L	0.0010	0.0010	9528338			
Dissolved Uranium (U)	mg/L	0.0028	0.00010	9528338			
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9528338			
Dissolved Zinc (Zn)	mg/L	0.018	0.0030	9528338			

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WE7663		
Sampling Date		2019/07/27 16:00		
COC Number		299042		
	UNITS	**CPF 97-7-5**	**RDL**	**QC Batch**
Calculated Parameters				
Hardness (CaCO3)	mg/L	1300	0.50	9527636
Ion Balance (% Difference)	%	0.66	N/A	9527638
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	9527009
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9527010
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9527009
Misc. Inorganics				
Conductivity	uS/cm	2000	2.0	9529547
Total Dissolved Solids	mg/L	1800	10	9528731
Anions				
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9529546
Alkalinity (Total as CaCO3)	mg/L	300	1.0	9529546
Bicarbonate (HCO3)	mg/L	370	1.0	9529546
Carbonate (CO3)	mg/L	<1.0	1.0	9529546
Hydroxide (OH)	mg/L	<1.0	1.0	9529546
Dissolved Chloride (Cl)	mg/L	16	1.0	9529550
Dissolved Sulphate (SO4)	mg/L	980 (1)	5.0	9529550
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9529604
Dissolved Nitrate (N)	mg/L	<0.010	0.010	9529604
Misc. Organics				
Phenols	mg/L	0.0040	0.0015	9529317

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WE7663
Sample ID: CPF 97-7-5
Matrix: Water

Collected: 2019/07/27
Relinquished: 2019/07/29
Received: 2019/07/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9529546	N/A	2019/07/31	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9528255	N/A	2019/07/31	Hetul Patel
F1-BTEX	CALC/MS	9527721	N/A	2019/07/31	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9527416	N/A	2019/07/31	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9529550	N/A	2019/07/31	Marissa Richard
Conductivity @25C	COND	9529547	N/A	2019/07/31	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9528363	2019/07/30	2019/07/31	Jake Manegre
Hardness	CALC	9527636	N/A	2019/07/31	Automated Statchk
Mercury (Dissolved) by CV-Lab Filtered	CV	9529459	2019/07/31	2019/07/31	Michelle Rivest
Elements by ICP-Dissolved-Lab Filtered	ICPA	9529262	N/A	2019/07/31	Mahesh Ranjan
Elements by ICPMS-Dissolved-Lab Filtered	ICPM	9528338	N/A	2019/07/30	Julie Harrison
Ion Balance	CALC	9527638	N/A	2019/07/31	Automated Statchk
Nitrate and Nitrite	CALC	9527009	N/A	2019/08/01	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9527010	N/A	2019/08/01	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9529604	N/A	2019/07/31	Parniyan Roosta
Phenols (4-AAP)	TECH/4AAP	9529317	N/A	2019/07/31	Fengling Feng
Total Dissolved Solids (Filt. Residue)	BAL	9528731	2019/07/31	2019/08/01	May Al-Jarah

BV Labs ID: WE7663 Dup
Sample ID: CPF 97-7-5
Matrix: Water

Collected: 2019/07/27
Relinquished: 2019/07/29
Received: 2019/07/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury (Dissolved) by CV-Lab Filtered	CV	9529459	2019/07/31	2019/07/31	Michelle Rivest

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

GENERAL COMMENTS

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

Package 1	3.0°C

Note: Labelling issue (label missing and /or incorrect);The Chain of Custody lists sample CPF 97-7-5, but one of the containers was received without a sample ID written on the label. The unlabelled container was a 250mL unpreserved container.

Sample WE7663 [CPF 97-7-5] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WE7663	CPF 97-7-5	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9528255	HP5	Method Blank	1,4-Difluorobenzene (sur.)	2019/07/31		97	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/31		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/31		99	%	50 - 140
			Benzene	2019/07/31	<0.00040		mg/L	
			Toluene	2019/07/31	<0.00040		mg/L	
			Ethylbenzene	2019/07/31	<0.00040		mg/L	
			m & p-Xylene	2019/07/31	<0.00080		mg/L	
			o-Xylene	2019/07/31	<0.00040		mg/L	
			LH (C5-C10)	2019/07/31	<0.10		mg/L	
			F1 (C6-C10)	2019/07/31	<0.10		mg/L	
9528338	JHS	Method Blank	Dissolved Aluminum (Al)	2019/07/31	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/07/31	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/31	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/31	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/31	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/07/31	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/31	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/31	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/31	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/31	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/07/31	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/07/31	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/31	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/31	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/31	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/31	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/31	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/07/31	<0.0010		mg/L	
9528363	JMN	Method Blank	O-TERPHENYL (sur.)	2019/07/31		99	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/31	<0.10		mg/L	
9528731	MJA	Method Blank	Total Dissolved Solids	2019/08/01	<10		mg/L	
9529262	MSD	Method Blank	Dissolved Iron (Fe)	2019/07/31	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/31	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/31	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/31	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/31	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/31	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/31	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/31	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/07/31	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/07/31	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/07/31	<0.10		mg/L	
			Dissolved Boron (B)	2019/07/31	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/31	<0.30		mg/L	
9529317	FFE	Method Blank	Phenols	2019/07/31	<0.0015		mg/L	
9529459	MHD	Method Blank	Dissolved Mercury (Hg)	2019/07/31	<0.0020		ug/L	
9529546	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/07/31	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/07/31	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/31	<1.0		mg/L	
			Carbonate (CO3)	2019/07/31	<1.0		mg/L	
			Hydroxide (OH)	2019/07/31	<1.0		mg/L	
9529547	MA4	Method Blank	Conductivity	2019/07/31	<2.0		uS/cm	

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9529550	MRD	Method Blank	Dissolved Chloride (Cl)	2019/07/31	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/31	<1.0		mg/L	
9529604	PR6	Method Blank	Dissolved Nitrite (N)	2019/07/31	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/31	<0.010		mg/L	
9529459	MHD	RPD [WE7663-07]	Dissolved Mercury (Hg)	2019/07/31	NC		%	20
9529459	MHD	Matrix Spike [WE7663-07]	Dissolved Mercury (Hg)	2019/07/31		99	%	80 - 120
9528255	HP5	LCS	1,4-Difluorobenzene (sur.)	2019/07/31		98	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/07/31		101	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/07/31		103	%	50 - 140
			Benzene	2019/07/31		94	%	60 - 130
			Toluene	2019/07/31		94	%	60 - 130
			Ethylbenzene	2019/07/31		105	%	60 - 130
			m & p-Xylene	2019/07/31		105	%	60 - 130
			o-Xylene	2019/07/31		103	%	60 - 130
			LH (C5-C10)	2019/07/31		127	%	60 - 140
			F1 (C6-C10)	2019/07/31		127	%	60 - 140
9528338	JHS	LCS	Dissolved Aluminum (Al)	2019/07/30		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/30		101	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/30		101	%	80 - 120
			Dissolved Copper (Cu)	2019/07/30		101	%	80 - 120
			Dissolved Lead (Pb)	2019/07/30		100	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/30		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/30		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/30		100	%	80 - 120
			Dissolved Selenium (Se)	2019/07/30		102	%	80 - 120
			Dissolved Silver (Ag)	2019/07/30		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/30		98	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/30		99	%	80 - 120
			Dissolved Tin (Sn)	2019/07/30		99	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/30		97	%	80 - 120
			Dissolved Uranium (U)	2019/07/30		98	%	80 - 120
			Dissolved Vanadium (V)	2019/07/30		102	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/30		103	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/30		99	%	80 - 120
9528363	JMN	LCS	O-TERPHENYL (sur.)	2019/07/31		99	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/07/31		117	%	60 - 140
9528731	MJA	LCS	Total Dissolved Solids	2019/08/01		101	%	80 - 120
9529262	MSD	LCS	Dissolved Iron (Fe)	2019/07/31		95	%	80 - 120
			Dissolved Lithium (Li)	2019/07/31		94	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/31		99	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/31		96	%	80 - 120
			Dissolved Potassium (K)	2019/07/31		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/31		97	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/31		94	%	80 - 120
			Dissolved Sulphur (S)	2019/07/31		98	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/31		95	%	80 - 120
			Dissolved Barium (Ba)	2019/07/31		96	%	80 - 120
			Dissolved Silicon (Si)	2019/07/31		92	%	80 - 120
			Dissolved Boron (B)	2019/07/31		97	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/31		96	%	80 - 120
9529317	FFE	LCS	Phenols	2019/07/31		97	%	80 - 120

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9529459	MHD	LCS	Dissolved Mercury (Hg)	2019/07/31		99	%	80 - 120
9529546	MA4	LCS	Alkalinity (Total as CaCO3)	2019/07/31		100	%	80 - 120
9529547	MA4	LCS	Conductivity	2019/07/31		100	%	90 - 110
9529550	MRD	LCS	Dissolved Chloride (Cl)	2019/07/31		110	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/31		106	%	80 - 120
9529604	PR6	LCS	Dissolved Nitrite (N)	2019/07/31		101	%	80 - 120
			Dissolved Nitrate (N)	2019/07/31		102	%	80 - 120

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.

LCS: 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 (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).

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BV Labs Job #: B961957
Report Date: 2019/08/07

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

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

Justin Geisel, B.Sc., Organics Supervisor

Roland Menard, Analyst II

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

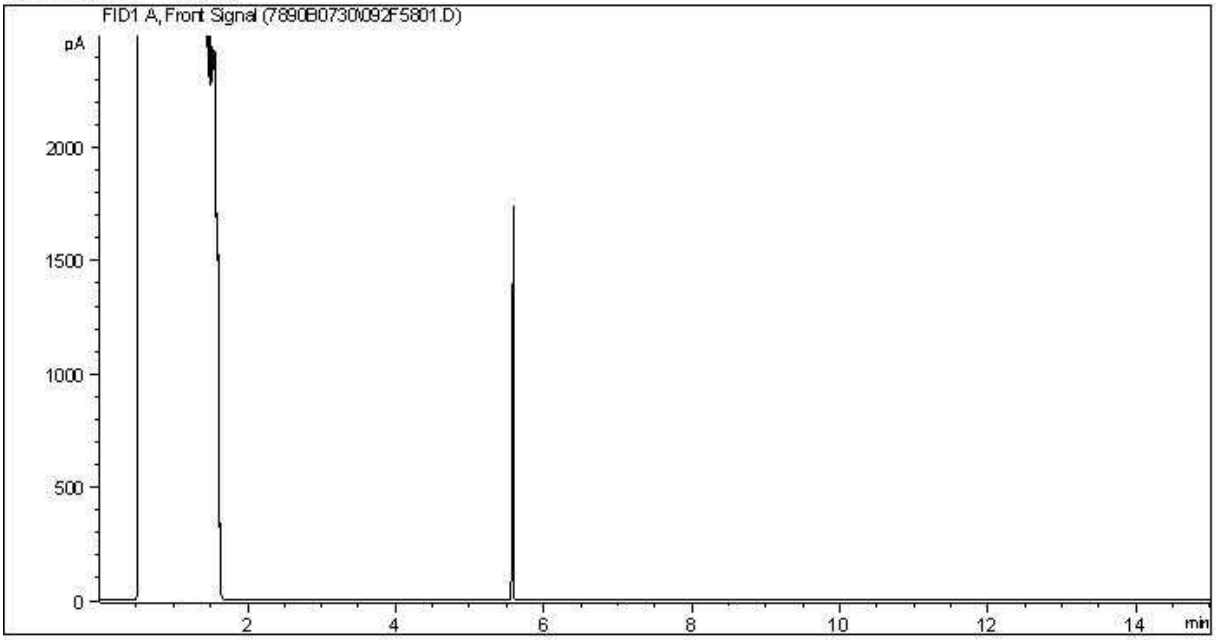
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B961957
Report Date: 2019/08/07
BV Labs Sample: WE7663

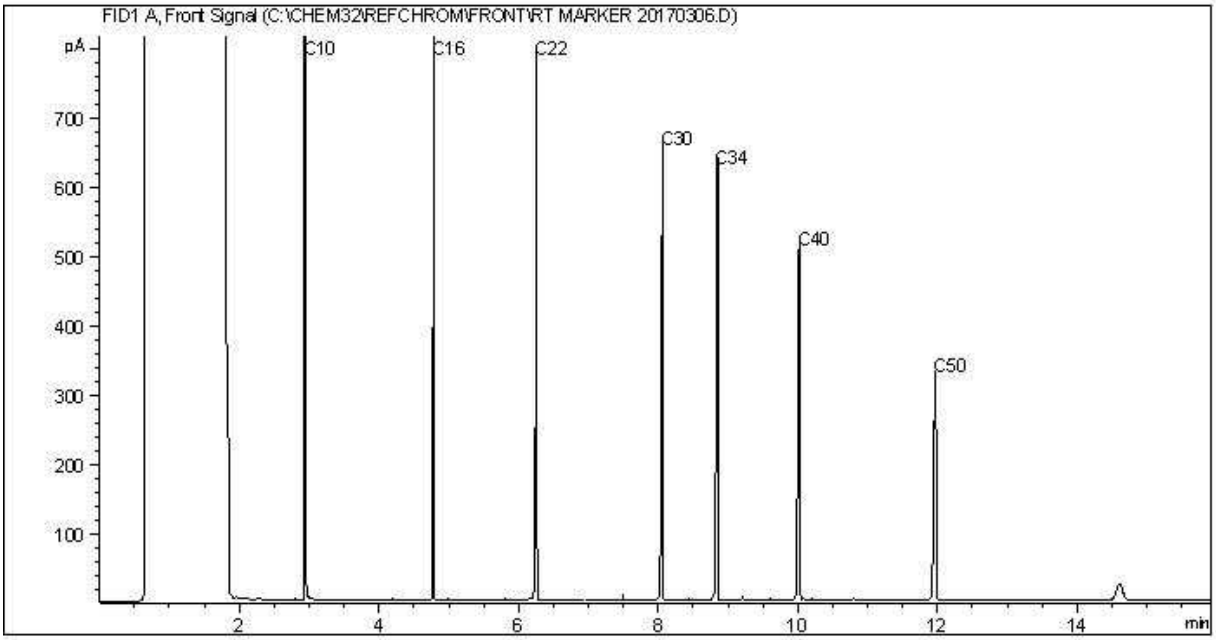
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: CPF 97-7-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890B



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

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1471 KVT

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

Page 1 of 1

C of C # 299042

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500, 151 Canada Olympic Rd SW Calgary, AB, T3B 6B7	Address: 500, 151 Canada Olympic Rd SW, Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403 247 0200	Ph: 403 247 0200
Sampler Name (Print): Alex Haigh	Consultant Project #: 407011-00770.400

FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☒ DIS ☐ TOT	MERCURY ☐ TOTAL ☒ DISSOLVED	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP						
1 CPF 97-7-5	X				10	2019/07/29	16:00		X			X							X	X					X			X						
2																																		
3																																		
4																																		
5																																		
6																																		
7																																		
8																																		
9																																		
10																																		

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770.400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email: Canada.chemistry@worleyparsons.com cacal_TOR_data_trade@ " alex.haigh@advisian.com

JARS USED & NOT SUBMITTED Enter N/A for Water: N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	5	2	2
SEAL INTACT	✓			1	2	3
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B961457

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1.	Alex Haigh	2019/07/29	09:35	1.	Testi Ali	2019/07/30	1220
2.				2.			
3.				3.			

SAMPLES
LABELED BY: LR2
VERIFIED BY: YB

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian | Sampling Date: 28-Sep-19

Location: Norman Wells | Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP OPS) | Sample Submission Number: B983537

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration	x			All field QC samples met alert limits.
Trip Blank Concentration	x			
Equipment Blank Concentration			x	
Field Duplicate RPD	x			

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 30-Oct-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): dheenarama kr | Data Reviewed by (Signature):

Date: 14-Nov-19

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)
Your C.O.C. #: 299052

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/10/30
Report #: R2803652
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B983537
Received: 2019/09/30, 10:32

Sample Matrix: Water
Samples Received: 10

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	8	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	10	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	10		Auto Calc
Cadmium - low level CCME - Dissolved	8		Auto Calc
Chloride/Sulphate by Auto Colourimetry	8	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	8	AB SOP-00005	SM 23 2510 B m
Fluoride	8	AB SOP-00005	SM 23 4500-F C m
CCME Hydrocarbons in Water (F2; C10-C16) (1)	10	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	8		Auto Calc
Mercury (Dissolved) by CV	8	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (2)	8	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	8	AB SOP-00043	EPA 6020b R2 m
Ion Balance	8		Auto Calc
Nitrate and Nitrite	8		Auto Calc
Nitrate + Nitrite-N (calculated)	8		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	8	AB SOP-00023	SM 23 4110 B m
Phenols (4-AAP)	8	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	8	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)
Your C.O.C. #: 299052

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/10/30
Report #: R2803652
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B983537
Received: 2019/09/30, 10:32

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. When sampling is not conducted by BV Labs, results relate to the supplied 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) Silica gel clean up employed.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: Rhecie.Phayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WP5367			WP5367			WP5368		
Sampling Date		2019/09/28 11:10			2019/09/28 11:10			2019/09/28 11:40		
COC Number		299052			299052			299052		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**	**MTF 97-1-5 Lab-Dup**	**RDL**	**QC Batch**	**TF 03-12-3**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9610915	<0.10	0.10	9610915	<0.10	0.10	9610915
Volatiles										
Benzene	mg/L	<0.00040	0.00040	9612424				<0.00040	0.00040	9612424
Toluene	mg/L	<0.00040	0.00040	9612424				<0.00040	0.00040	9612424
Ethylbenzene	mg/L	<0.00040	0.00040	9612424				<0.00040	0.00040	9612424
m & p-Xylene	mg/L	<0.00080	0.00080	9612424				<0.00080	0.00080	9612424
o-Xylene	mg/L	<0.00040	0.00040	9612424				<0.00040	0.00040	9612424
Xylenes (Total)	mg/L	<0.00089	0.00089	9610480				<0.00089	0.00089	9610480
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9610480				<0.10	0.10	9610480
LH (C5-C10)	mg/L	<0.10	0.10	9612424				<0.10	0.10	9612424
F1 (C6-C10)	mg/L	<0.10	0.10	9612424				<0.10	0.10	9612424
Extraction Surrogate Recovery (%)										
O-TERPHENYL (sur.)	%	93		9610915	87		9610915	94		9610915
Instrument Surrogate Recovery (%)										
1,4-Difluorobenzene (sur.)	%	96		9612424				96		9612424
4-Bromofluorobenzene (sur.)	%	100		9612424				101		9612424
D4-1,2-Dichloroethane (sur.)	%	92		9612424				96		9612424

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WP5369	WP5370	WP5371	WP5372	WP5373	WP5374		
Sampling Date		2019/09/28 11:45	2019/09/28 13:20	2019/09/28 13:50	2019/09/28 14:25	2019/09/28 14:50	2019/09/28 15:15		
COC Number		299052	299052	299052	299052	299052	299052		
	UNITS	**NWD 19-01**	**C38 08-1-4**	**ARB-12-3-3**	**WSY 97-1-5**	**CPF 97-7-5**	**CPF 98-8-3**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon									
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	9610915
Volatiles									
Benzene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9612424
Toluene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9612424
Ethylbenzene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9612424
m & p-Xylene	mg/L	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	0.00080	9612424
o-Xylene	mg/L	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9612424
Xylenes (Total)	mg/L	<0.00089	<0.00089	<0.00089	<0.00089	<0.00089	<0.00089	0.00089	9610480
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	9610480
LH (C5-C10)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	9612424
F1 (C6-C10)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	9612424
Extraction Surrogate Recovery (%)									
O-TERPHENYL (sur.)	%	96	94	91	96	94	87		9610915
Instrument Surrogate Recovery (%)									
1,4-Difluorobenzene (sur.)	%	96	96	96	98	98	95		9612424
4-Bromofluorobenzene (sur.)	%	100	100	99	101	100	99		9612424
D4-1,2-Dichloroethane (sur.)	%	96	95	97	95	95	95		9612424

RDL = Reportable Detection Limit

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WP5375	WP5376		
Sampling Date		2019/09/28 16:00	2019/09/28 16:05		
COC Number		299052	299052		
	UNITS	**NWD 19-03**	**NWD 19-04**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	9610915
Volatiles					
Benzene	mg/L	<0.00040	<0.00040	0.00040	9612424
Toluene	mg/L	<0.00040	<0.00040	0.00040	9612424
Ethylbenzene	mg/L	<0.00040	<0.00040	0.00040	9612424
m & p-Xylene	mg/L	<0.00080	<0.00080	0.00080	9612424
o-Xylene	mg/L	<0.00040	<0.00040	0.00040	9612424
Xylenes (Total)	mg/L	<0.00089	<0.00089	0.00089	9610480
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	0.10	9610480
LH (C5-C10)	mg/L	<0.10	<0.10	0.10	9612424
F1 (C6-C10)	mg/L	<0.10	<0.10	0.10	9612424
Extraction Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	88	100		9610915
Instrument Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	98	98		9612424
4-Bromofluorobenzene (sur.)	%	100	99		9612424
D4-1,2-Dichloroethane (sur.)	%	95	94		9612424
RDL = Reportable Detection Limit					

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP5367			WP5367			WP5368		
Sampling Date		2019/09/28 11:10			2019/09/28 11:10			2019/09/28 11:40		
COC Number		299052			299052			299052		
	UNITS	**MTF 97-1-5**	**RDL**	**QC Batch**	**MTF 97-1-5 Lab-Dup**	**RDL**	**QC Batch**	**TF 03-12-3**	**RDL**	**QC Batch**
Calculated Parameters										
Hardness (CaCO3)	mg/L	970	0.50	9609911				940	0.50	9609911
Ion Balance (% Difference)	%	4.8	N/A	9609912				2.1	N/A	9609912
Dissolved Nitrate (NO3)	mg/L	13	0.044	9609914				0.057	0.044	9609914
Nitrate plus Nitrite (N)	mg/L	3.0	0.014	9609915				<0.014	0.014	9609915
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9609914				<0.033	0.033	9609914
Misc. Inorganics										
Conductivity	uS/cm	1700	2.0	9613350				1700	2.0	9613350
Total Dissolved Solids	mg/L	1400	10	9611301				1300 (1)	25	9611301
Low Level Elements										
Dissolved Cadmium (Cd)	mg/L	0.00014	0.000020	9609909				0.000076	0.000020	9609909
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9613347				<1.0	1.0	9613347
Alkalinity (Total as CaCO3)	mg/L	390	1.0	9613347				690	1.0	9613347
Bicarbonate (HCO3)	mg/L	470	1.0	9613347				840	1.0	9613347
Carbonate (CO3)	mg/L	<1.0	1.0	9613347				<1.0	1.0	9613347
Dissolved Fluoride (F)	mg/L	0.12	0.050	9642884				0.35	0.050	9642884
Hydroxide (OH)	mg/L	<1.0	1.0	9613347				<1.0	1.0	9613347
Dissolved Chloride (Cl)	mg/L	1.7	1.0	9614182				80	1.0	9614182
Dissolved Sulphate (SO4)	mg/L	660 (2)	5.0	9614182				280 (2)	5.0	9614182
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9610590				<0.010	0.010	9610590
Dissolved Nitrate (N)	mg/L	3.0	0.010	9610590				0.013	0.010	9610590
Misc. Organics										
Phenols	mg/L	<0.0015	0.0015	9614221	<0.0015	0.0015	9614221	0.012 (3)	0.0075	9614221

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limit raised based on sample volume used and sample matrix
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.
(3) Detection limits raised due to matrix interference.

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP5368			WP5369			WP5370		
Sampling Date		2019/09/28 11:40			2019/09/28 11:45			2019/09/28 13:20		
COC Number		299052			299052			299052		
	UNITS	**TF 03-12-3 Lab-Dup**	**RDL**	**QC Batch**	**NWD 19-01**	**RDL**	**QC Batch**	**C38 08-1-4**	**RDL**	**QC Batch**
Calculated Parameters										
Hardness (CaCO3)	mg/L				940	0.50	9609911	610	0.50	9609911
Ion Balance (% Difference)	%				1.4	N/A	9609912	3.5	N/A	9609912
Dissolved Nitrate (NO3)	mg/L				0.13	0.044	9609914	<0.044	0.044	9609914
Nitrate plus Nitrite (N)	mg/L				0.028	0.014	9609915	<0.014	0.014	9609915
Dissolved Nitrite (NO2)	mg/L				<0.033	0.033	9609914	<0.033	0.033	9609914
Misc. Inorganics										
Conductivity	uS/cm				1700	2.0	9613350	1300	2.0	9613350
Total Dissolved Solids	mg/L				1300 (1)	25	9611301	890 (1)	25	9611301
Low Level Elements										
Dissolved Cadmium (Cd)	mg/L				0.000076	0.000020	9609909	<0.000020	0.000020	9609909
Anions										
Alkalinity (PP as CaCO3)	mg/L				<1.0	1.0	9613347	<1.0	1.0	9613347
Alkalinity (Total as CaCO3)	mg/L				680	1.0	9613347	680	1.0	9613347
Bicarbonate (HCO3)	mg/L				820	1.0	9613347	830	1.0	9613347
Carbonate (CO3)	mg/L				<1.0	1.0	9613347	<1.0	1.0	9613347
Dissolved Fluoride (F)	mg/L	0.36	0.050	9642884	0.35	0.050	9642884	0.096	0.050	9642884
Hydroxide (OH)	mg/L				<1.0	1.0	9613347	<1.0	1.0	9613347
Dissolved Chloride (Cl)	mg/L	80	1.0	9614182	78	1.0	9614182	19	1.0	9614182
Dissolved Sulphate (SO4)	mg/L	300	5.0	9614182	280 (2)	5.0	9614182	73	1.0	9614182
Nutrients										
Dissolved Nitrite (N)	mg/L				<0.010	0.010	9610590	<0.010	0.010	9610590
Dissolved Nitrate (N)	mg/L				0.028	0.010	9610590	<0.010	0.010	9610590
Misc. Organics										
Phenols	mg/L				0.0099 (3)	0.0075	9614221	0.021 (3)	0.0075	9614933

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limit raised based on sample volume used and sample matrix
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.
(3) Detection limits raised due to matrix interference.

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP5371			WP5372		WP5373		
Sampling Date		2019/09/28 13:50			2019/09/28 14:25		2019/09/28 14:50		
COC Number		299052			299052		299052		
	UNITS	**ARB-12-3-3**	**RDL**	**QC Batch**	**WSY 97-1-5**	**QC Batch**	**CPF 97-7-5**	**RDL**	**QC Batch**
Calculated Parameters									
Hardness (CaCO3)	mg/L	530	0.50	9609911	880	9610614	1200	0.50	9610614
Ion Balance (% Difference)	%	2.3	N/A	9609912	1.3	9609912	5.4	N/A	9610617
Dissolved Nitrate (NO3)	mg/L	0.51	0.044	9609914	<0.044	9609914	0.083	0.044	9609914
Nitrate plus Nitrite (N)	mg/L	0.13	0.014	9609915	<0.014	9609915	0.019	0.014	9609915
Dissolved Nitrite (NO2)	mg/L	0.048	0.033	9609914	<0.033	9609914	<0.033	0.033	9609914
Misc. Inorganics									
Conductivity	uS/cm	1000	2.0	9613350	1500	9613350	1900	2.0	9613350
Total Dissolved Solids	mg/L	780	10	9611301	1400	9612870	1700	10	9612870
Low Level Elements									
Dissolved Cadmium (Cd)	mg/L	0.000085	0.000020	9609909	0.000059	9609909	0.000078	0.000020	9609909
Anions									
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9613347	<1.0	9613347	<1.0	1.0	9613347
Alkalinity (Total as CaCO3)	mg/L	410	1.0	9613347	400	9613347	300	1.0	9613347
Bicarbonate (HCO3)	mg/L	500	1.0	9613347	490	9613347	370	1.0	9613347
Carbonate (CO3)	mg/L	<1.0	1.0	9613347	<1.0	9613347	<1.0	1.0	9613347
Dissolved Fluoride (F)	mg/L	0.088	0.050	9642884	0.097	9642884	0.12	0.050	9642884
Hydroxide (OH)	mg/L	<1.0	1.0	9613347	<1.0	9613347	<1.0	1.0	9613347
Dissolved Chloride (Cl)	mg/L	17	1.0	9614182	24	9614182	74	1.0	9614182
Dissolved Sulphate (SO4)	mg/L	180	1.0	9614182	480 (1)	9614182	880 (1)	5.0	9614182
Nutrients									
Dissolved Nitrite (N)	mg/L	0.015	0.010	9610590	<0.010	9610590	<0.010	0.010	9610590
Dissolved Nitrate (N)	mg/L	0.12	0.010	9610590	<0.010	9610590	0.019	0.010	9610590
Misc. Organics									
Phenols	mg/L	0.0059	0.0015	9614933	0.0044	9614933	0.0024	0.0015	9614933

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP5373			WP5374		
Sampling Date		2019/09/28 14:50			2019/09/28 15:15		
COC Number		299052			299052		
	UNITS	**CPF 97-7-5 Lab-Dup**	**RDL**	**QC Batch**	**CPF 98-8-3**	**RDL**	**QC Batch**
Calculated Parameters							
Hardness (CaCO3)	mg/L				630	0.50	9610614
Ion Balance (% Difference)	%				1.4	N/A	9610617
Dissolved Nitrate (NO3)	mg/L				0.071	0.044	9609914
Nitrate plus Nitrite (N)	mg/L				0.016	0.014	9609915
Dissolved Nitrite (NO2)	mg/L				<0.033	0.033	9609914
Misc. Inorganics							
Conductivity	uS/cm	1800	2.0	9613350	1200	2.0	9613350
Total Dissolved Solids	mg/L				880	10	9612870
Low Level Elements							
Dissolved Cadmium (Cd)	mg/L				<0.000020	0.000020	9609909
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9613347	<1.0	1.0	9613347
Alkalinity (Total as CaCO3)	mg/L	300	1.0	9613347	430	1.0	9613347
Bicarbonate (HCO3)	mg/L	370	1.0	9613347	520	1.0	9613347
Carbonate (CO3)	mg/L	<1.0	1.0	9613347	<1.0	1.0	9613347
Dissolved Fluoride (F)	mg/L				0.064	0.050	9642884
Hydroxide (OH)	mg/L	<1.0	1.0	9613347	<1.0	1.0	9613347
Dissolved Chloride (Cl)	mg/L				9.7	1.0	9614182
Dissolved Sulphate (SO4)	mg/L				250 (1)	5.0	9614182
Nutrients							
Dissolved Nitrite (N)	mg/L				<0.010	0.010	9610590
Dissolved Nitrate (N)	mg/L				0.016	0.010	9610590
Misc. Organics							
Phenols	mg/L				0.0084	0.0015	9614933

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WP5367	WP5368	WP5369	WP5370	WP5371	WP5372		
Sampling Date		2019/09/28 11:10	2019/09/28 11:40	2019/09/28 11:45	2019/09/28 13:20	2019/09/28 13:50	2019/09/28 14:25		
COC Number		299052	299052	299052	299052	299052	299052		
	UNITS	**MTF 97-1-5**	**TF 03-12-3**	**NWD 19-01**	**C38 08-1-4**	**ARB-12-3-3**	**WSY 97-1-5**	**RDL**	**QC Batch**
Elements									
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	0.0020	9611031
RDL = Reportable Detection Limit									

BV Labs ID		WP5373	WP5374		
Sampling Date		2019/09/28 14:50	2019/09/28 15:15		
COC Number		299052	299052		
	UNITS	**CPF 97-7-5**	**CPF 98-8-3**	**RDL**	**QC Batch**
Elements					
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	0.0020	9611031
RDL = Reportable Detection Limit					

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP5367	WP5368	WP5369	WP5370	WP5371	WP5372		
Sampling Date		2019/09/28 11:10	2019/09/28 11:40	2019/09/28 11:45	2019/09/28 13:20	2019/09/28 13:50	2019/09/28 14:25		
COC Number		299052	299052	299052	299052	299052	299052		
	UNITS	**MTF 97-1-5**	**TF 03-12-3**	**NWD 19-01**	**C38 08-1-4**	**ARB-12-3-3**	**WSY 97-1-5**	**RDL**	**QC Batch**
Elements									
Dissolved Aluminum (Al)	mg/L	0.0085	0.014	0.014	0.065	0.012	0.015	0.0030	9611146
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	0.00060	9611146
Dissolved Arsenic (As)	mg/L	<0.00020	0.0066	0.0067	0.0050	0.0011	0.0013	0.00020	9611146
Dissolved Barium (Ba)	mg/L	0.027	0.081	0.081	0.32	0.11	0.049	0.010	9611144
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9611146
Dissolved Boron (B)	mg/L	0.038	0.023	0.023	<0.020	0.022	0.16	0.020	9611144
Dissolved Calcium (Ca)	mg/L	270	230	240	160	140	250	0.30	9611144
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9611146
Dissolved Cobalt (Co)	mg/L	<0.00030	0.0043	0.0043	0.0027	0.00059	0.0018	0.00030	9611146
Dissolved Copper (Cu)	mg/L	0.0021	0.0022	0.00033	0.00031	0.0026	0.0027	0.00020	9611146
Dissolved Iron (Fe)	mg/L	<0.060	4.5	4.5	12	0.36	1.3	0.060	9611144
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00072	0.00020	9611146
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.024	<0.020	0.021	0.020	9611144
Dissolved Magnesium (Mg)	mg/L	74	87	86	53	43	59	0.20	9611144
Dissolved Manganese (Mn)	mg/L	<0.0040	0.50	0.50	1.0	0.26	1.0	0.0040	9611144
Dissolved Molybdenum (Mo)	mg/L	0.012	0.17	0.17	0.00099	0.0050	0.0098	0.00020	9611146
Dissolved Nickel (Ni)	mg/L	0.0038	0.030	0.030	0.0044	0.0037	0.0037	0.00050	9611146
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.54	0.20	<0.10	0.10	9611144
Dissolved Potassium (K)	mg/L	1.8	4.8	4.8	3.3	2.5	2.8	0.30	9611144
Dissolved Selenium (Se)	mg/L	0.12	0.0012	0.0013	0.00051	0.00079	0.00071	0.00020	9611146
Dissolved Silicon (Si)	mg/L	4.3	13	12	9.5	4.9	4.4	0.10	9611144
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	9611146
Dissolved Sodium (Na)	mg/L	4.3	41	41	41	27	15	0.50	9611144
Dissolved Strontium (Sr)	mg/L	0.51	0.80	0.79	0.44	0.44	0.67	0.020	9611144
Dissolved Sulphur (S)	mg/L	190	85	83	26	50	150	0.20	9611144
Dissolved Thallium (Tl)	mg/L	<0.00020	0.0015	0.0015	<0.00020	<0.00020	<0.00020	0.00020	9611146
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9611146
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	0.0015	0.0017	<0.0010	<0.0010	0.0010	9611146
Dissolved Uranium (U)	mg/L	0.021	0.018	0.019	0.00039	0.0077	0.0053	0.00010	9611146
Dissolved Vanadium (V)	mg/L	<0.0010	0.0039	0.0041	<0.0010	<0.0010	<0.0010	0.0010	9611146
Dissolved Zinc (Zn)	mg/L	0.0049	0.0083	0.0068	0.0033	0.0064	0.010	0.0030	9611146

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP5373	WP5374		
Sampling Date		2019/09/28 14:50	2019/09/28 15:15		
COC Number		299052	299052		
	UNITS	**CPF 97-7-5**	**CPF 98-8-3**	**RDL**	**QC Batch**
Elements					
Dissolved Aluminum (Al)	mg/L	0.025	0.029	0.0030	9611146
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	9611146
Dissolved Arsenic (As)	mg/L	0.00033	0.0015	0.00020	9611146
Dissolved Barium (Ba)	mg/L	0.057	0.18	0.010	9611144
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	9611146
Dissolved Boron (B)	mg/L	0.026	<0.020	0.020	9611144
Dissolved Calcium (Ca)	mg/L	350	190	0.30	9611144
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	9611146
Dissolved Cobalt (Co)	mg/L	0.0033	0.0026	0.00030	9611146
Dissolved Copper (Cu)	mg/L	0.0011	0.00050	0.00020	9611146
Dissolved Iron (Fe)	mg/L	0.90	2.6	0.060	9611144
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	9611146
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	0.020	9611144
Dissolved Magnesium (Mg)	mg/L	70	40	0.20	9611144
Dissolved Manganese (Mn)	mg/L	1.7	1.3	0.0040	9611144
Dissolved Molybdenum (Mo)	mg/L	0.0058	0.00040	0.00020	9611146
Dissolved Nickel (Ni)	mg/L	0.0087	0.0042	0.00050	9611146
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	9611144
Dissolved Potassium (K)	mg/L	4.3	2.7	0.30	9611144
Dissolved Selenium (Se)	mg/L	0.00026	0.00037	0.00020	9611146
Dissolved Silicon (Si)	mg/L	4.3	5.1	0.10	9611144
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	9611146
Dissolved Sodium (Na)	mg/L	9.7	23	0.50	9611144
Dissolved Strontium (Sr)	mg/L	1.2	0.77	0.020	9611144
Dissolved Sulphur (S)	mg/L	260	79	0.20	9611144
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	9611146
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	9611146
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	9611146
Dissolved Uranium (U)	mg/L	0.0054	0.00068	0.00010	9611146
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	9611146
Dissolved Zinc (Zn)	mg/L	0.012	0.0071	0.0030	9611146
RDL = Reportable Detection Limit					

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WP5367
Sample ID: MTF 97-1-5
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/02	Grace Guo
Hardness	CALC	9609911	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/05	Julie Harrison
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614221	N/A	2019/10/03	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9611301	2019/10/02	2019/10/03	Luminita Chiosa

BV Labs ID: WP5367 Dup
Sample ID: MTF 97-1-5
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/02	Grace Guo
Phenols (4-AAP)	TECH/4AAP	9614221	N/A	2019/10/03	Ying Yang

BV Labs ID: WP5368
Sample ID: TF 03-12-3
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9609911	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WP5368
Sample ID: TF 03-12-3
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614221	N/A	2019/10/03	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9611301	2019/10/02	2019/10/03	Luminita Chiosa

BV Labs ID: WP5368 Dup
Sample ID: TF 03-12-3
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar

BV Labs ID: WP5369
Sample ID: NWD 19-01
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9609911	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614221	N/A	2019/10/03	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9611301	2019/10/02	2019/10/03	Luminita Chiosa

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WP5370
Sample ID: C38 08-1-4
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9609911	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614933	N/A	2019/10/04	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9611301	2019/10/02	2019/10/03	Luminita Chiosa

BV Labs ID: WP5371
Sample ID: ARB-12-3-3
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9609911	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614933	N/A	2019/10/04	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9611301	2019/10/02	2019/10/03	Luminita Chiosa

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WP5372
Sample ID: WSY 97-1-5
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9610614	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9609912	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614933	N/A	2019/10/04	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9612870	2019/10/03	2019/10/04	Luminita Chiosa

BV Labs ID: WP5373
Sample ID: CPF 97-7-5
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/03	Grace Guo
Hardness	CALC	9610614	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9610617	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614933	N/A	2019/10/04	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9612870	2019/10/03	2019/10/04	Luminita Chiosa

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

TEST SUMMARY

BV Labs ID: WP5373 Dup
Sample ID: CPF 97-7-5
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar

BV Labs ID: WP5374
Sample ID: CPF 98-8-3
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9613347	N/A	2019/10/03	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9609909	N/A	2019/10/05	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9614182	N/A	2019/10/06	Marissa Richard
Conductivity @25C	COND	9613350	N/A	2019/10/03	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/02	Grace Guo
Hardness	CALC	9610614	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9611031	2019/10/03	2019/10/03	Andrew Payne
Elements by ICP - Dissolved	ICPA	9611144	N/A	2019/10/04	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9611146	N/A	2019/10/04	Julie Harrison
Ion Balance	CALC	9610617	N/A	2019/10/02	Suwan Fock
Nitrate and Nitrite	CALC	9609914	N/A	2019/10/02	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9609915	N/A	2019/10/02	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9610590	N/A	2019/10/02	Christine Albrecht
Phenols (4-AAP)	TECH/4AAP	9614933	N/A	2019/10/04	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9612870	2019/10/03	2019/10/04	Luminita Chiosa

BV Labs ID: WP5375
Sample ID: NWD 19-03
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/02	Grace Guo

BV Labs ID: WP5376
Sample ID: NWD 19-04
Matrix: Water

Collected: 2019/09/28
Relinquished: 2019/09/29
Received: 2019/09/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9612424	N/A	2019/10/04	Adriana Munoz
F1-BTEX	CALC/MS	9610480	N/A	2019/10/07	Automated Statchk
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9610915	2019/10/02	2019/10/02	Grace Guo

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BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

GENERAL COMMENTS

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

Package 1	4.3°C

Version 2: Report reissued to include results for Fluoride as per AARF on 2019/10/23.

Sample WP5367 [MTF 97-1-5] : 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.

Sample WP5368 [TF 03-12-3] : 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.

Sample WP5369 [NWD 19-01] : 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.

Sample WP5370 [C38 08-1-4] : 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.

Sample WP5371 [ARB-12-3-3] : 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.

Sample WP5372 [WSY 97-1-5] : 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.

Sample WP5373 [CPF 97-7-5] : 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.

Sample WP5374 [CPF 98-8-3] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WP5367	MTF 97-1-5	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5368	TF 03-12-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5369	NWD 19-01	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5370	C38 08-1-4	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

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DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WP5371	ARB-12-3-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5372	WSY 97-1-5	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5373	CPF 97-7-5	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP5374	CPF 98-8-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9610590	CAR	Method Blank	Dissolved Nitrite (N)	2019/10/01	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/10/01	<0.010		mg/L	
9610915	GG3	Method Blank	O-TERPHENYL (sur.)	2019/10/02		107	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/02	<0.10		mg/L	
9611031	APY	Method Blank	Dissolved Mercury (Hg)	2019/10/03	<0.0020		ug/L	
9611144	ACY	Method Blank	Dissolved Iron (Fe)	2019/10/04	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/04	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/04	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/04	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/10/04	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/10/04	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/04	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/04	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/10/04	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/10/04	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/10/04	<0.10		mg/L	
			Dissolved Boron (B)	2019/10/04	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/04	<0.30		mg/L	
9611146	JHS	Method Blank	Dissolved Aluminum (Al)	2019/10/04	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/10/04	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/10/04	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/10/04	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/10/04	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/10/04	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/10/04	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/10/04	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/10/04	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/10/04	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/10/04	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/10/04	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/10/04	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/10/04	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/10/04	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/10/04	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/10/04	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/10/04	<0.0010		mg/L	
9611301	LCA	Method Blank	Total Dissolved Solids	2019/10/03	<10		mg/L	
9612424	AMJ	Method Blank	1,4-Difluorobenzene (sur.)	2019/10/04		95	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/04		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/04		89	%	50 - 140
			Benzene	2019/10/04	<0.00040		mg/L	
			Toluene	2019/10/04	<0.00040		mg/L	
			Ethylbenzene	2019/10/04	<0.00040		mg/L	
			m & p-Xylene	2019/10/04	<0.00080		mg/L	
			o-Xylene	2019/10/04	<0.00040		mg/L	
			LH (C5-C10)	2019/10/04	<0.10		mg/L	
			F1 (C6-C10)	2019/10/04	<0.10		mg/L	
9612870	LCA	Method Blank	Total Dissolved Solids	2019/10/04	<10		mg/L	
9613347	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/10/03	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/10/03	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/03	<1.0		mg/L	
			Carbonate (CO3)	2019/10/03	<1.0		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Hydroxide (OH)	2019/10/03	<1.0		mg/L	
9613350	MA4	Method Blank	Conductivity	2019/10/03	<2.0		uS/cm	
9614182	MRD	Method Blank	Dissolved Chloride (Cl)	2019/10/06	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/10/06	<1.0		mg/L	
9614221	YY	Method Blank	Phenols	2019/10/03	<0.0015		mg/L	
9614933	YY	Method Blank	Phenols	2019/10/04	<0.0015		mg/L	
9642884	MA4	Method Blank	Dissolved Fluoride (F)	2019/10/25	<0.050		mg/L	
9610915	GG3	RPD [WP5367-06]	F2 (C10-C16 Hydrocarbons)	2019/10/02	NC		%	30
9614221	YY	RPD [WP5367-03]	Phenols	2019/10/03	NC		%	20
9614182	MRD	RPD [WP5368-01]	Dissolved Chloride (Cl)	2019/10/06	0.56		%	20
			Dissolved Sulphate (SO4)	2019/10/06	8.0		%	20
9642884	MA4	RPD [WP5368-01]	Dissolved Fluoride (F)	2019/10/25	1.6		%	20
9613347	MA4	RPD [WP5373-01]	Alkalinity (Total as CaCO3)	2019/10/03	0.92		%	20
			Alkalinity (PP as CaCO3)	2019/10/03	NC		%	20
			Bicarbonate (HCO3)	2019/10/03	0.92		%	20
			Carbonate (CO3)	2019/10/03	NC		%	20
			Hydroxide (OH)	2019/10/03	NC		%	20
9613350	MA4	RPD [WP5373-01]	Conductivity	2019/10/03	2.4		%	10
9610915	GG3	Matrix Spike [WP5368-06]	O-TERPHENYL (sur.)	2019/10/03		99	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/03		102	%	60 - 140
9614182	MRD	Matrix Spike [WP5368-01]	Dissolved Chloride (Cl)	2019/10/06		NC	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/06		NC	%	80 - 120
9614221	YY	Matrix Spike [WP5367-03]	Phenols	2019/10/03		104	%	80 - 120
9642884	MA4	Matrix Spike [WP5368-01]	Dissolved Fluoride (F)	2019/10/25		100	%	80 - 120
9610590	CAR	LCS	Dissolved Nitrite (N)	2019/10/01		99	%	80 - 120
			Dissolved Nitrate (N)	2019/10/01		99	%	80 - 120
9610915	GG3	LCS	O-TERPHENYL (sur.)	2019/10/02		104	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/02		107	%	60 - 140
9611031	APY	LCS	Dissolved Mercury (Hg)	2019/10/03		96	%	80 - 120
9611144	ACY	LCS	Dissolved Iron (Fe)	2019/10/04		107	%	80 - 120
			Dissolved Lithium (Li)	2019/10/04		103	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/04		102	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/04		105	%	80 - 120
			Dissolved Potassium (K)	2019/10/04		103	%	80 - 120
			Dissolved Sodium (Na)	2019/10/04		106	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/04		99	%	80 - 120
			Dissolved Sulphur (S)	2019/10/04		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/04		104	%	80 - 120
			Dissolved Barium (Ba)	2019/10/04		108	%	80 - 120
			Dissolved Silicon (Si)	2019/10/04		102	%	80 - 120
			Dissolved Boron (B)	2019/10/04		107	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/04		105	%	80 - 120
9611146	JHS	LCS	Dissolved Aluminum (Al)	2019/10/05		103	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/05		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/05		96	%	80 - 120
			Dissolved Copper (Cu)	2019/10/05		99	%	80 - 120
			Dissolved Lead (Pb)	2019/10/05		97	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/05		96	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Molybdenum (Mo)	2019/10/05		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/05		97	%	80 - 120
			Dissolved Selenium (Se)	2019/10/05		99	%	80 - 120
			Dissolved Silver (Ag)	2019/10/05		97	%	80 - 120
			Dissolved Arsenic (As)	2019/10/05		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/05		92	%	80 - 120
			Dissolved Tin (Sn)	2019/10/05		101	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/05		93	%	80 - 120
			Dissolved Uranium (U)	2019/10/05		94	%	80 - 120
			Dissolved Vanadium (V)	2019/10/05		98	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/05		101	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/05		93	%	80 - 120
9611301	LCA	LCS	Total Dissolved Solids	2019/10/03		102	%	80 - 120
9612424	AMJ	LCS	1,4-Difluorobenzene (sur.)	2019/10/04		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/04		101	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/04		96	%	50 - 140
			Benzene	2019/10/04		76	%	60 - 130
			Toluene	2019/10/04		74	%	60 - 130
			Ethylbenzene	2019/10/04		79	%	60 - 130
			m & p-Xylene	2019/10/04		78	%	60 - 130
			o-Xylene	2019/10/04		76	%	60 - 130
			LH (C5-C10)	2019/10/04		79	%	60 - 140
			F1 (C6-C10)	2019/10/04		79	%	60 - 140
9612870	LCA	LCS	Total Dissolved Solids	2019/10/04		102	%	80 - 120
9613347	MA4	LCS	Alkalinity (Total as CaCO3)	2019/10/03		98	%	80 - 120
9613350	MA4	LCS	Conductivity	2019/10/03		101	%	90 - 110
9614182	MRD	LCS	Dissolved Chloride (Cl)	2019/10/06		107	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/06		100	%	80 - 120
9614221	YY	LCS	Phenols	2019/10/03		101	%	80 - 120
9614933	YY	LCS	Phenols	2019/10/04		97	%	80 - 120
9642884	MA4	LCS	Dissolved Fluoride (F)	2019/10/25		100	%	80 - 120

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.

LCS: 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).

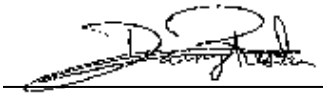
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B983537
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP OPS)

VALIDATION SIGNATURE PAGE

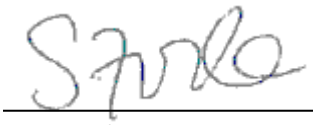
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Daniel Reslan, cCT, QP, Organics Manager



Justin Geisel, B.Sc., Organics Supervisor



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

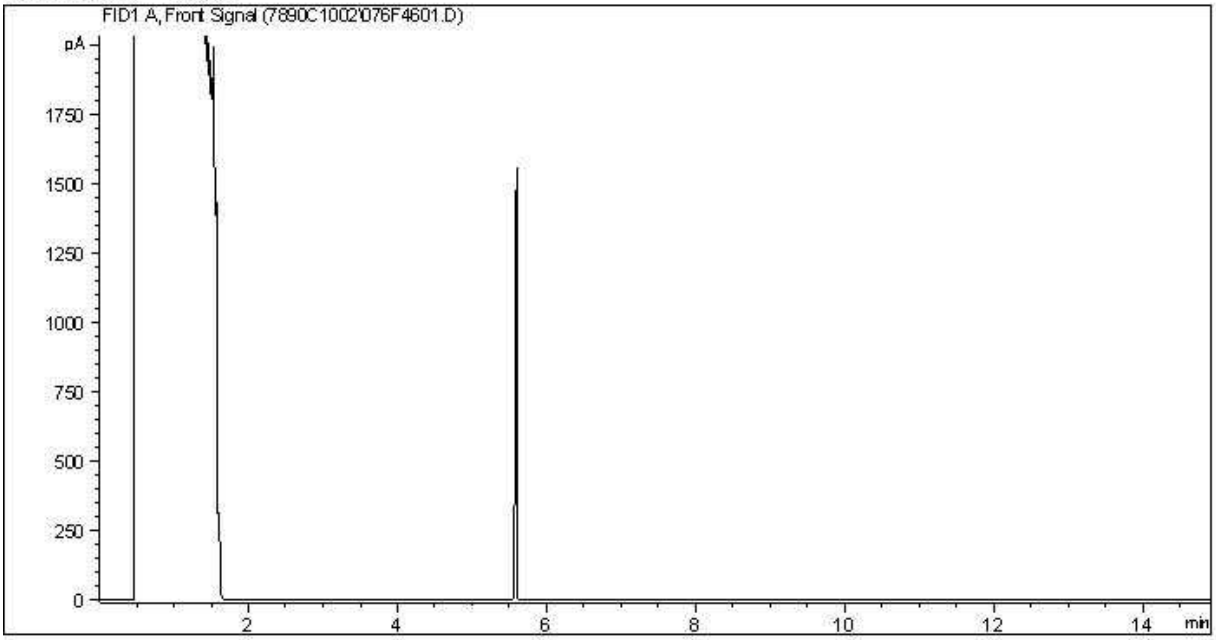
Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5367

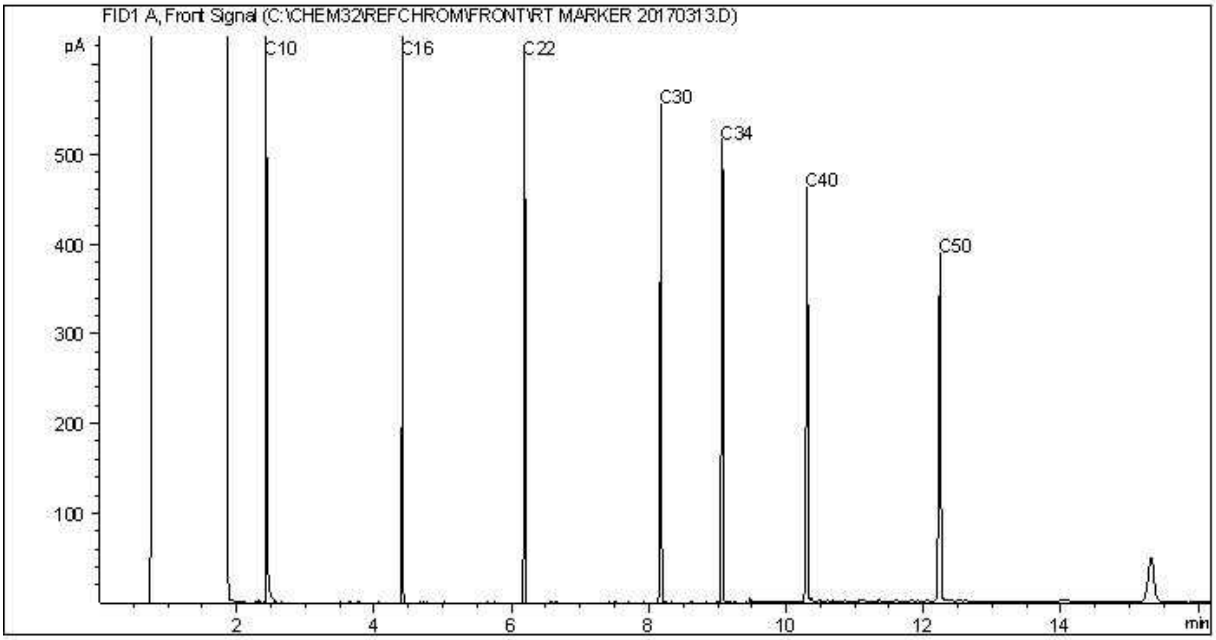
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: MTF 97-1-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

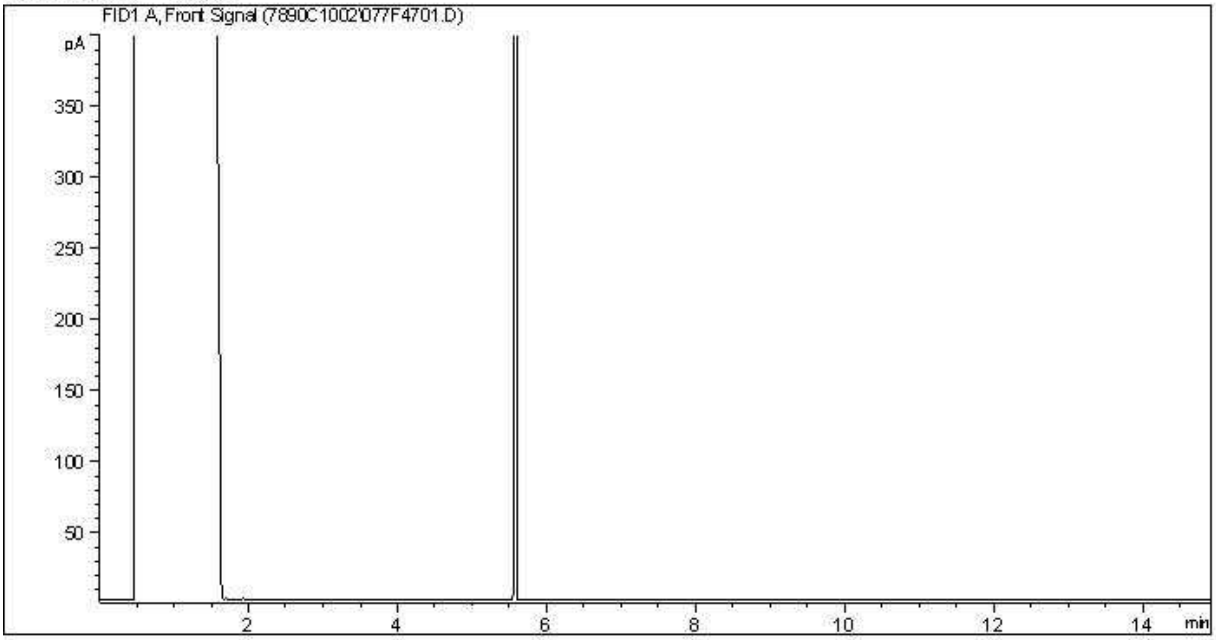
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5367 Lab-Dup

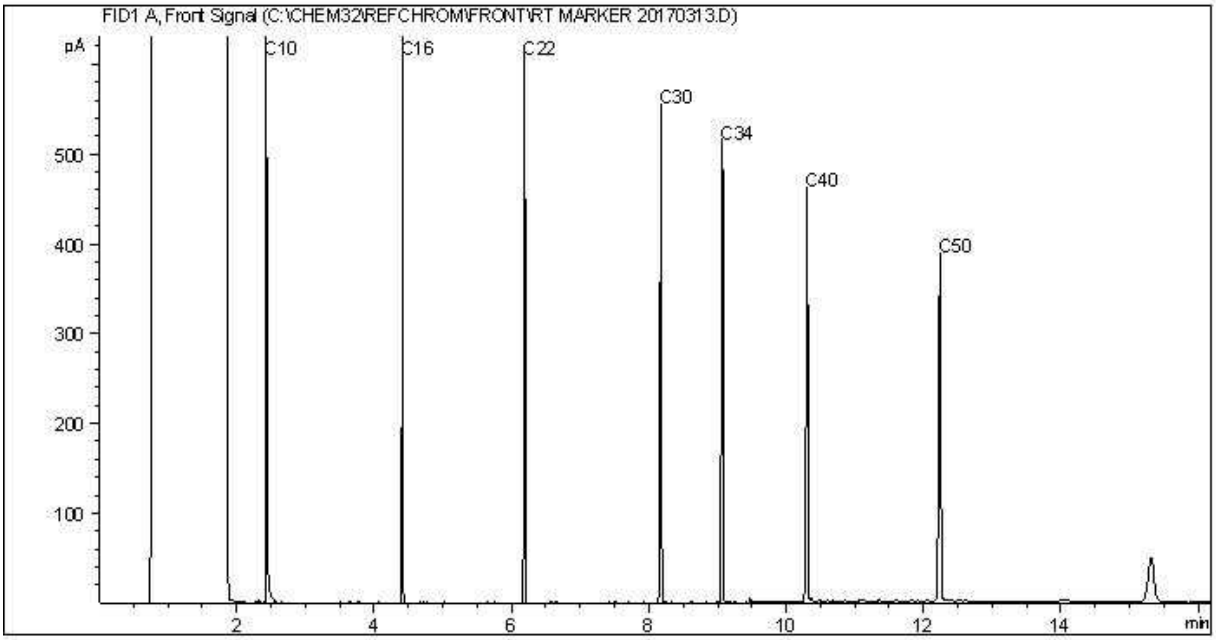
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: MTF 97-1-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

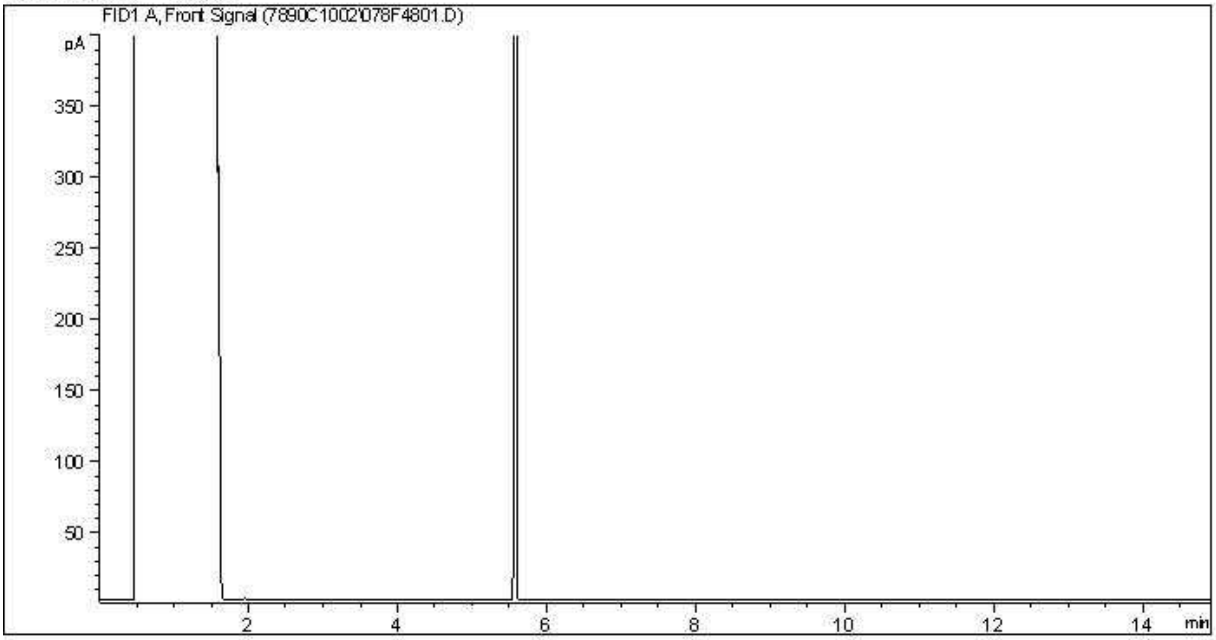
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5368

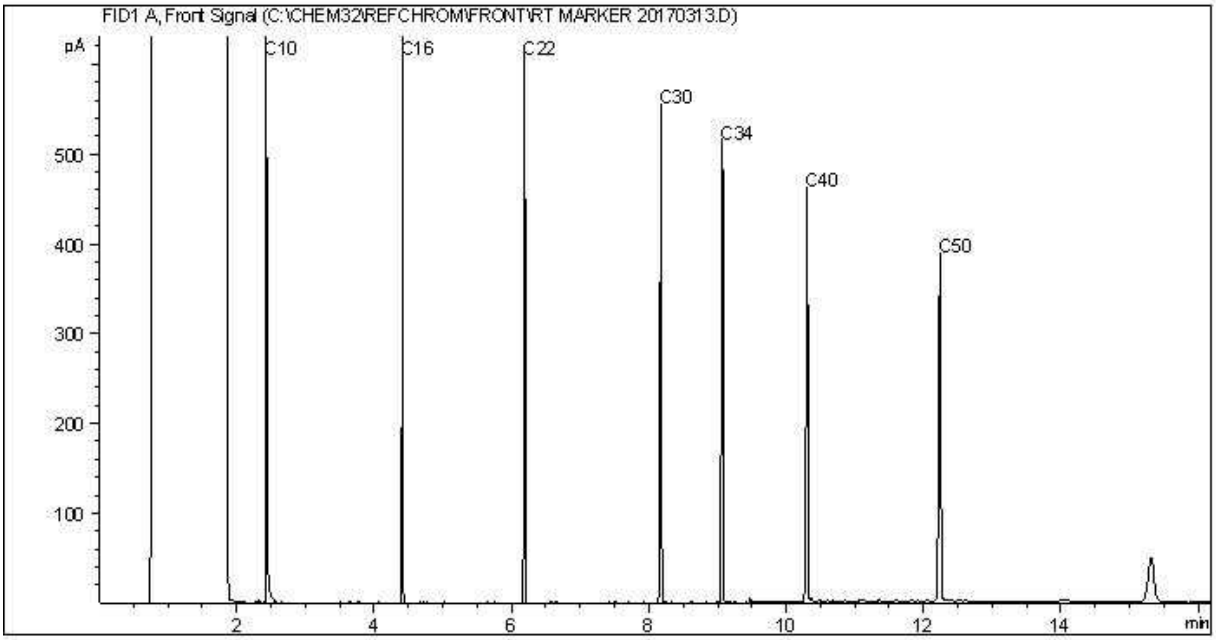
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: TF 03-12-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

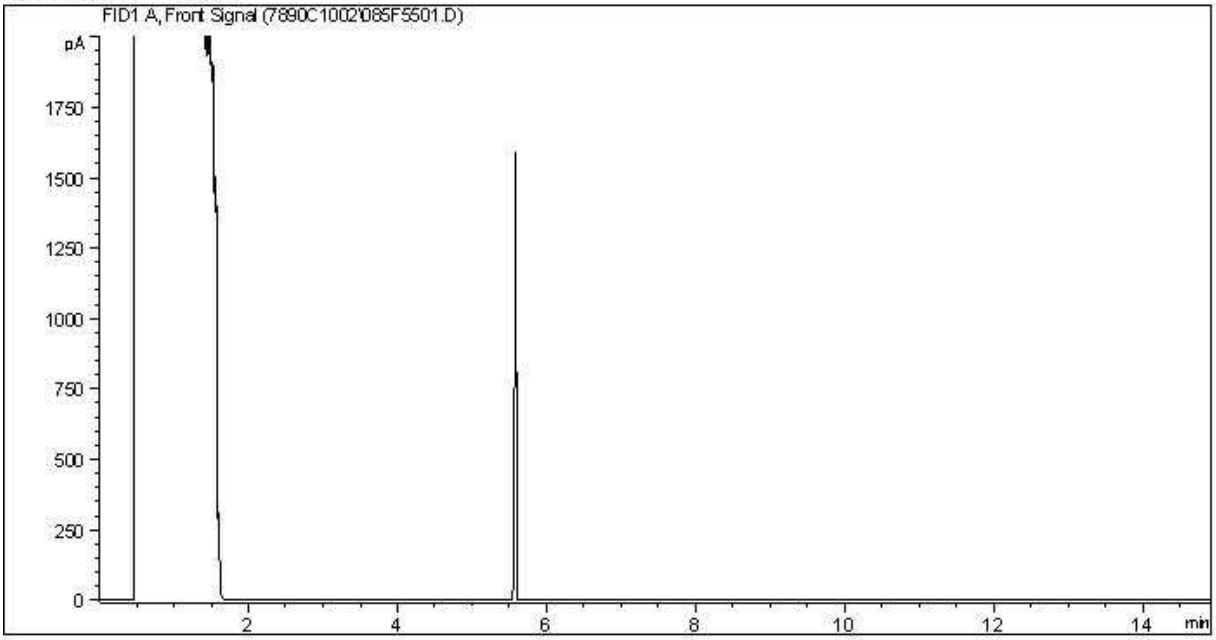
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5369

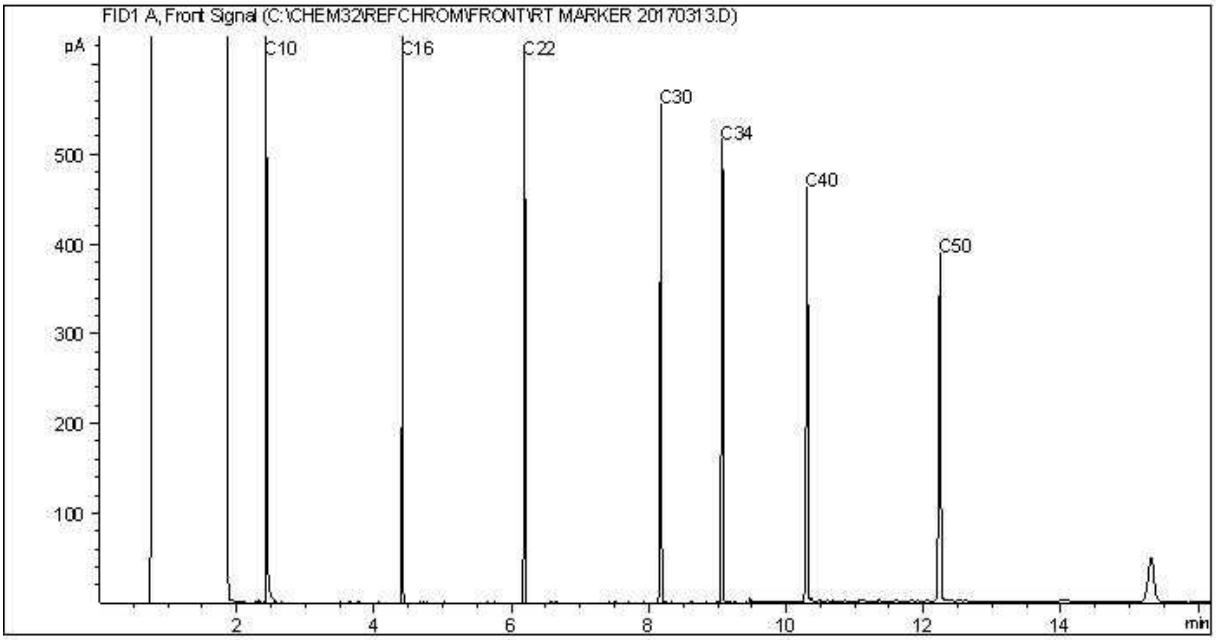
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD 19-01

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

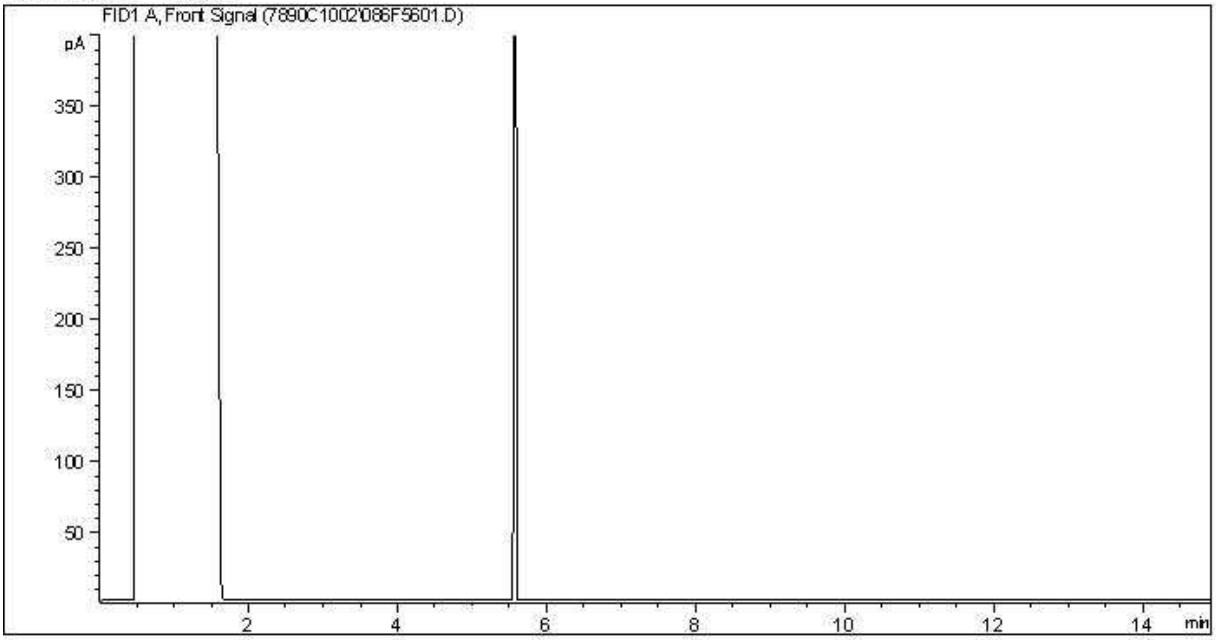
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5370

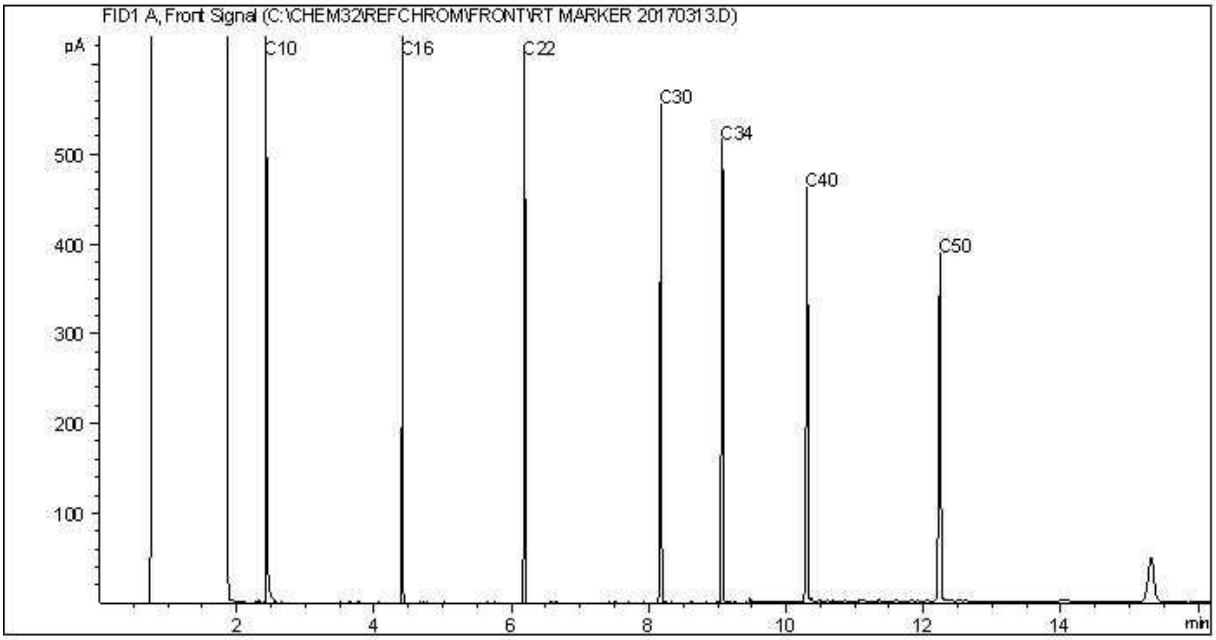
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: C38 08-1-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

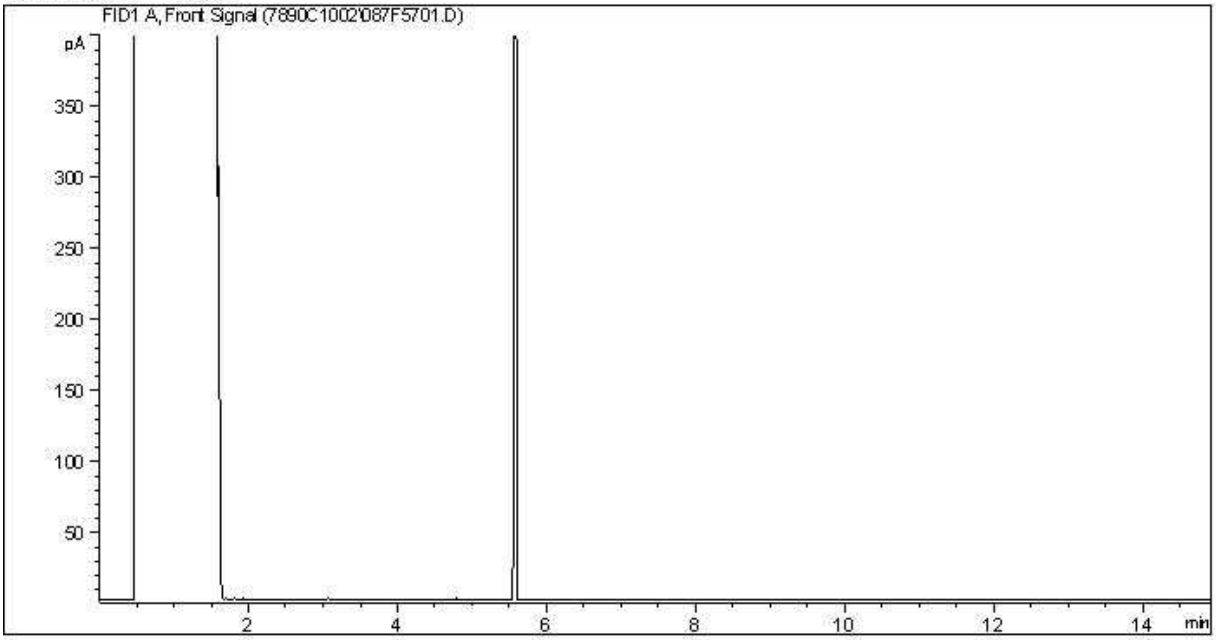
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5371

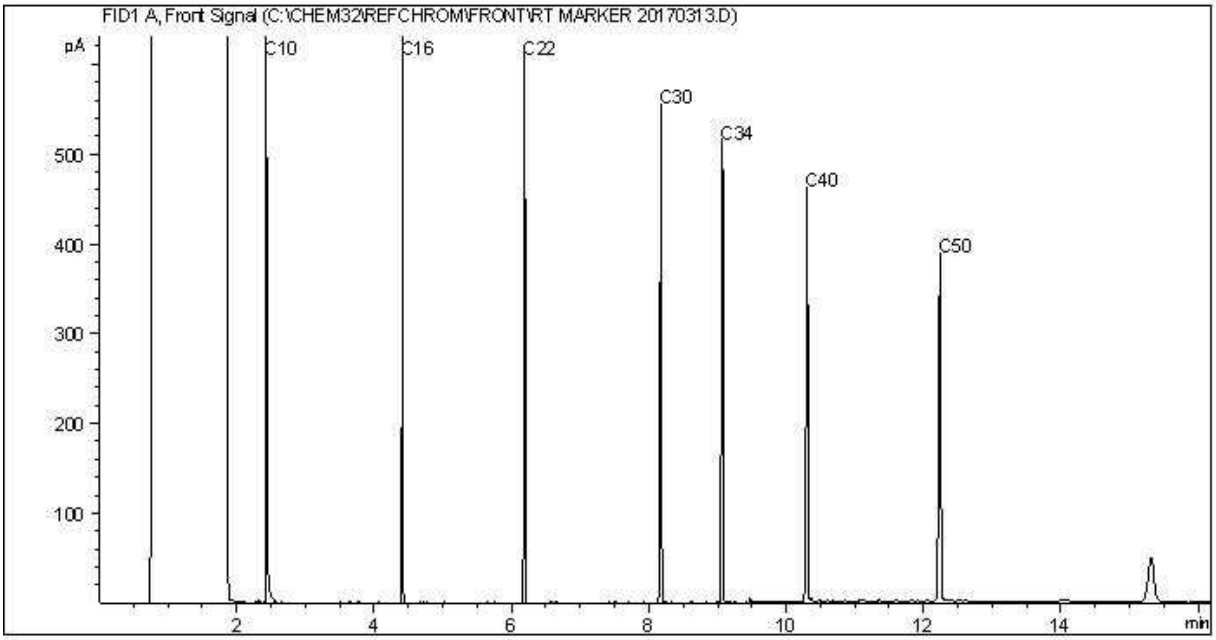
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: ARB-12-3-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

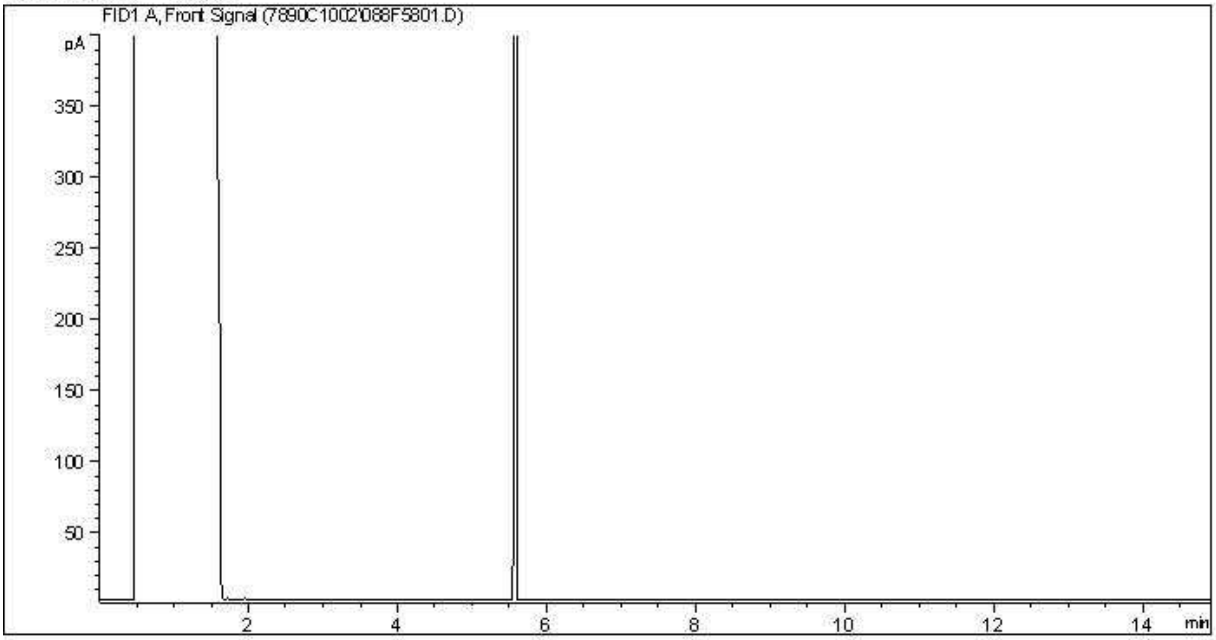
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5372

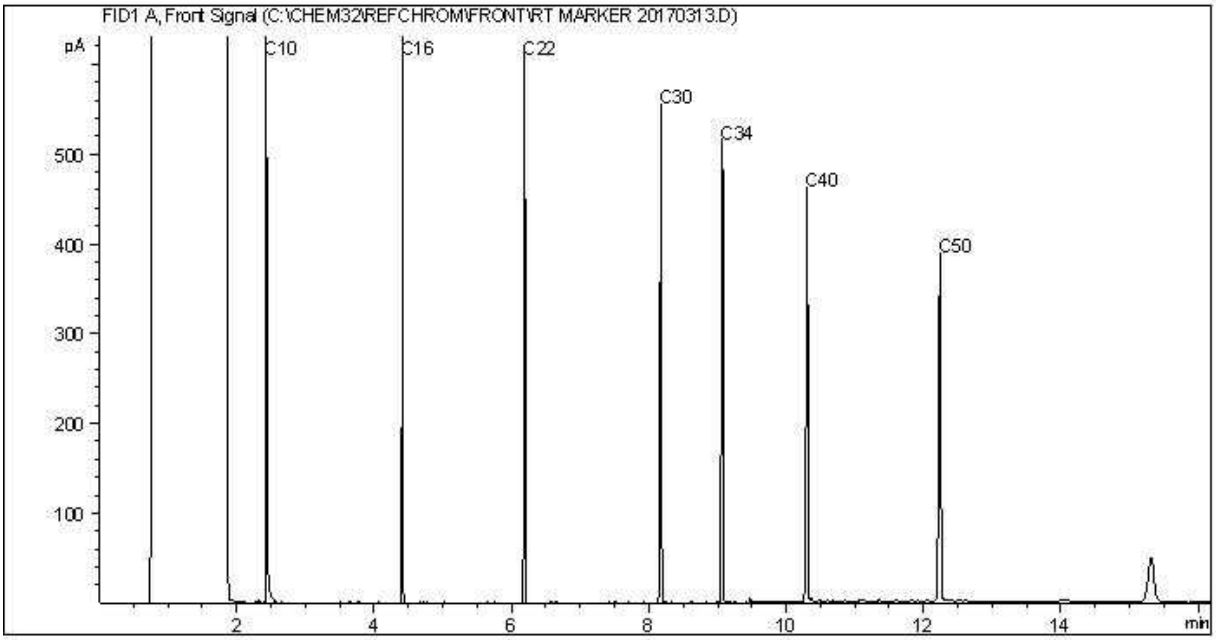
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: WSY 97-1-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

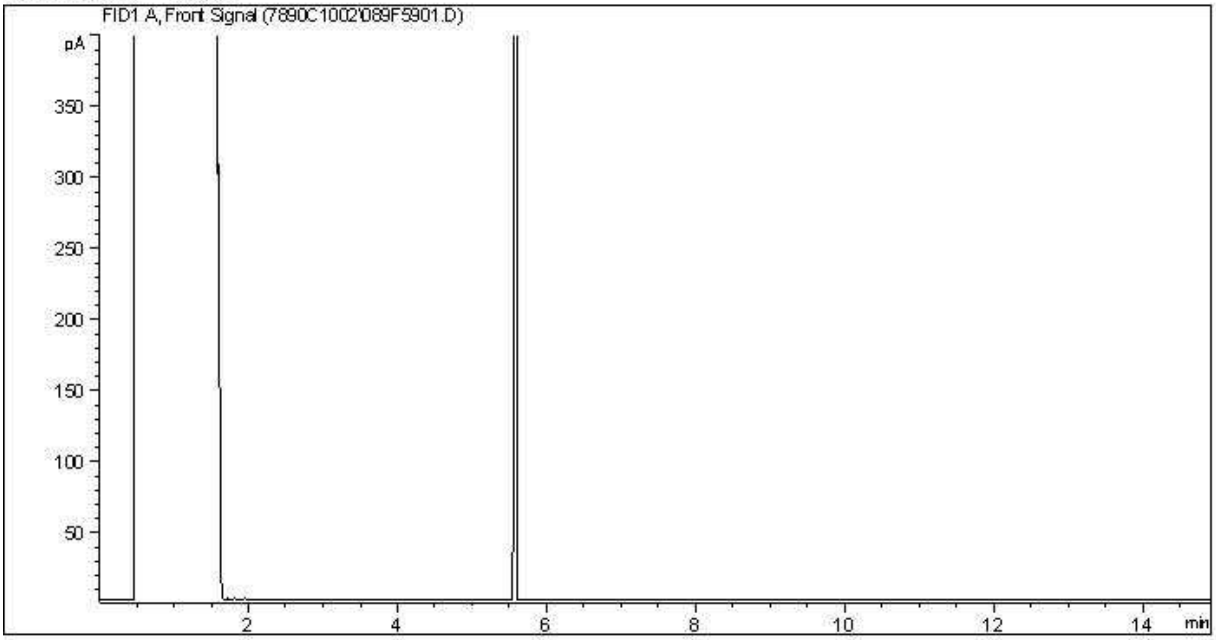
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5373

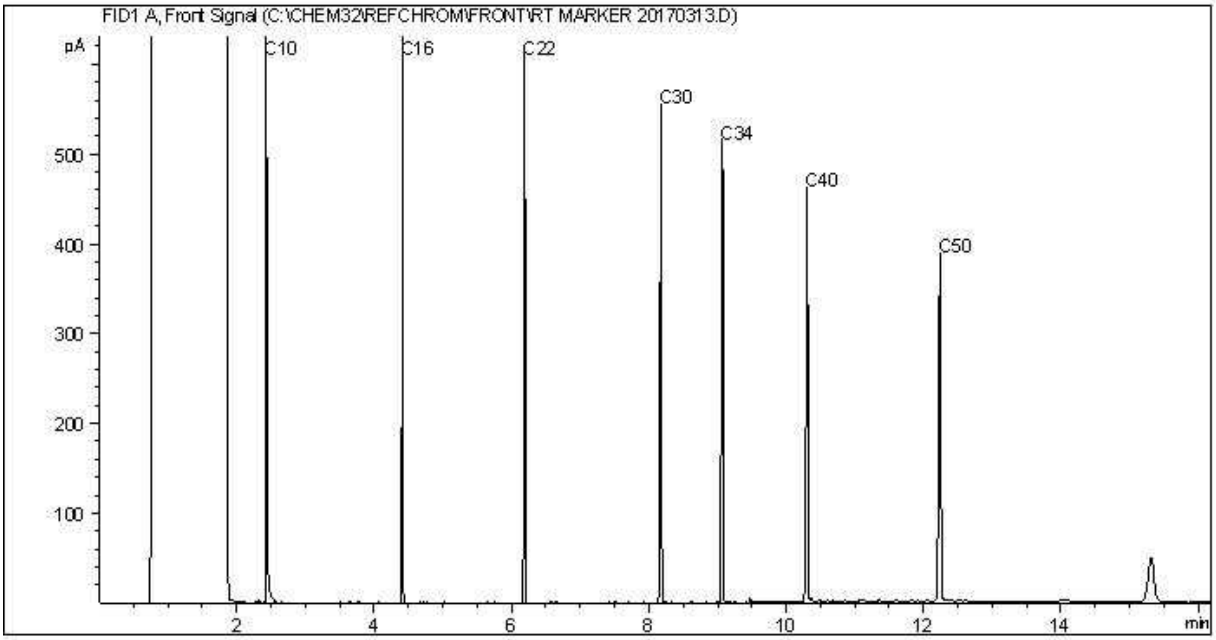
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: CPF 97-7-5

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



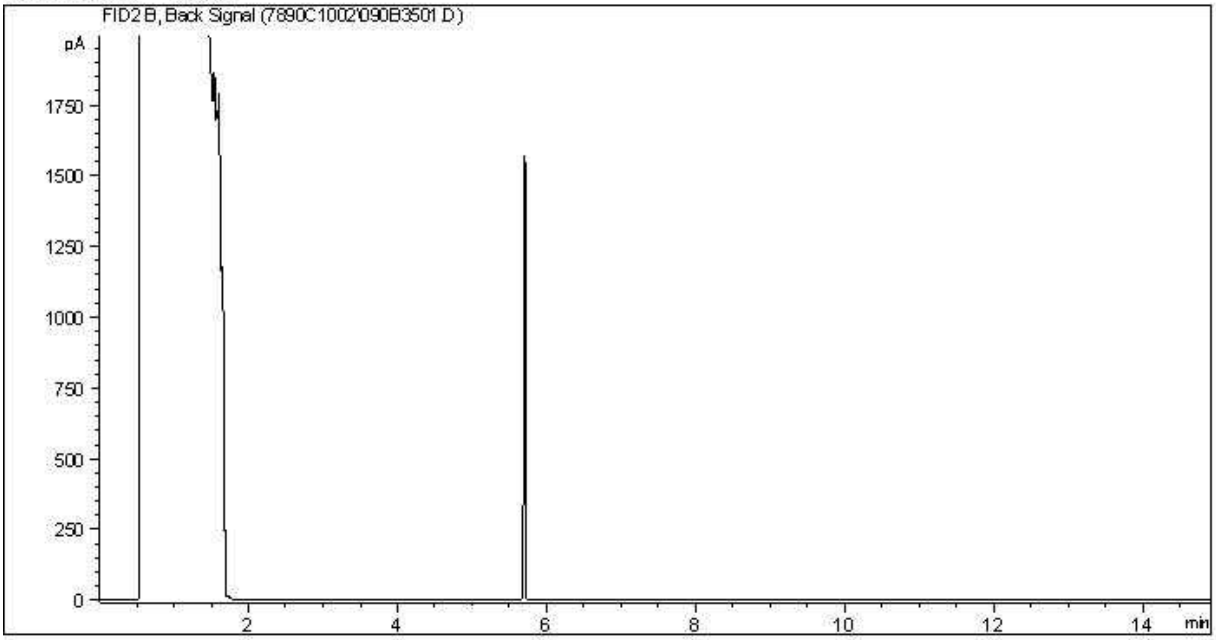
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

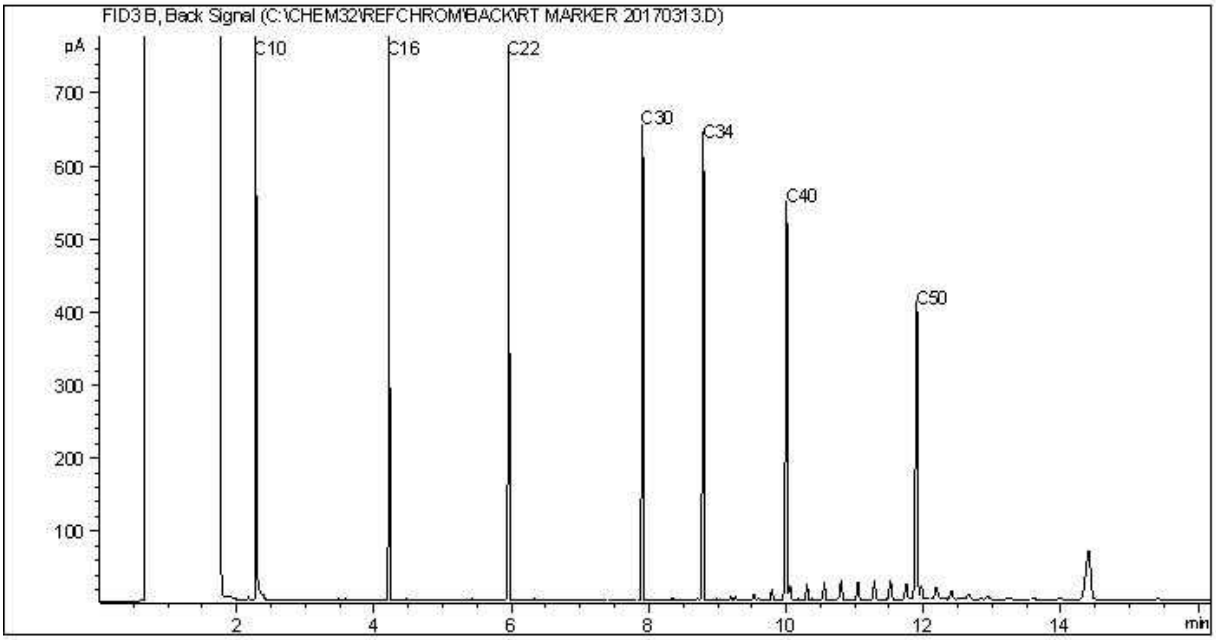
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



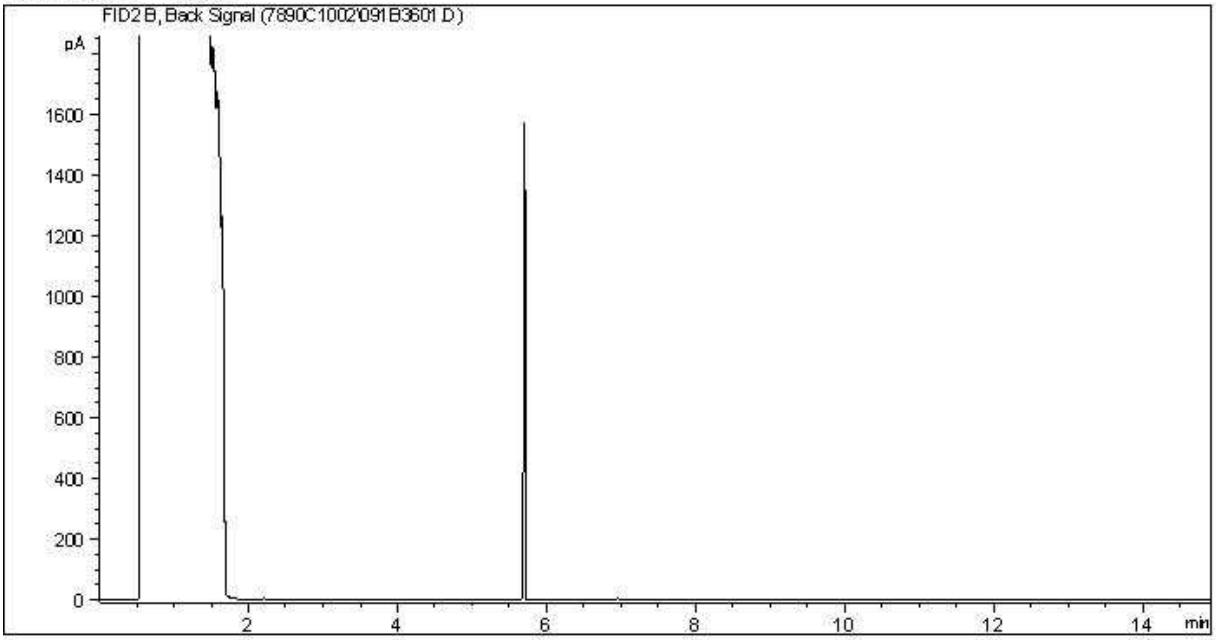
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

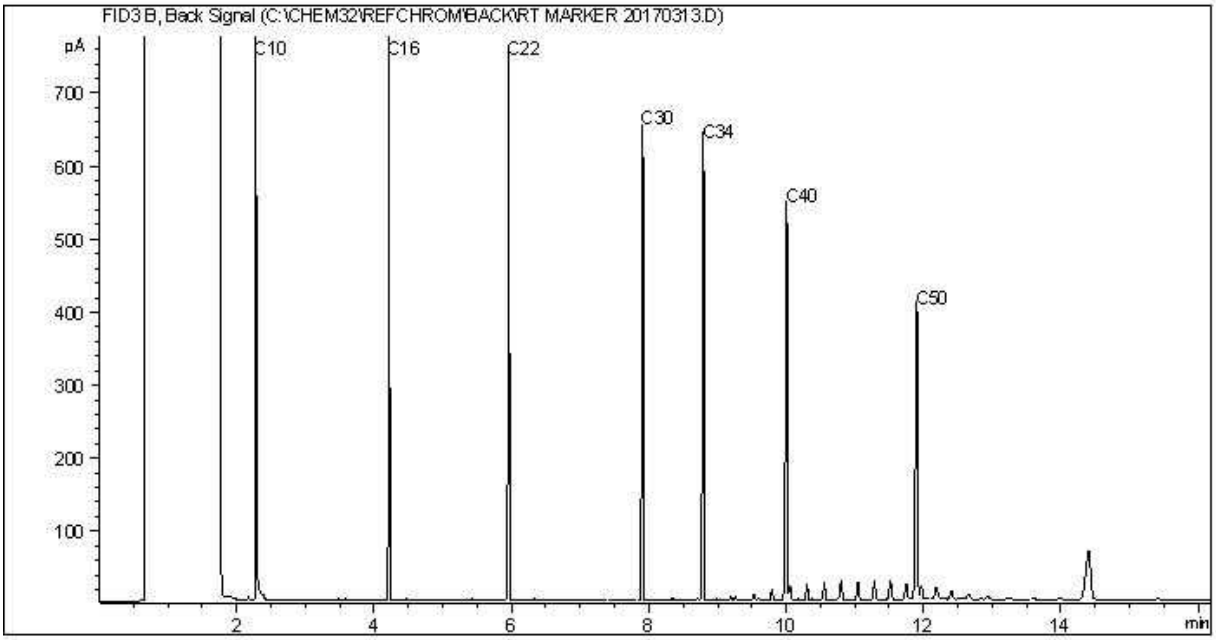
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

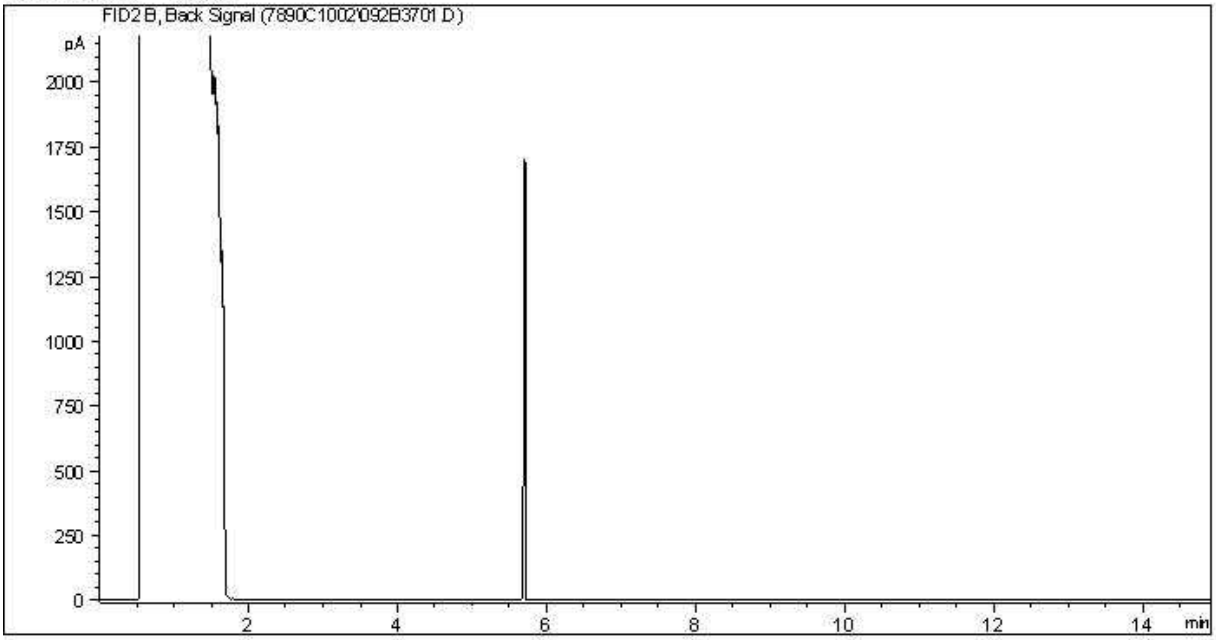
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B983537
Report Date: 2019/10/30
BV Labs Sample: WP5376

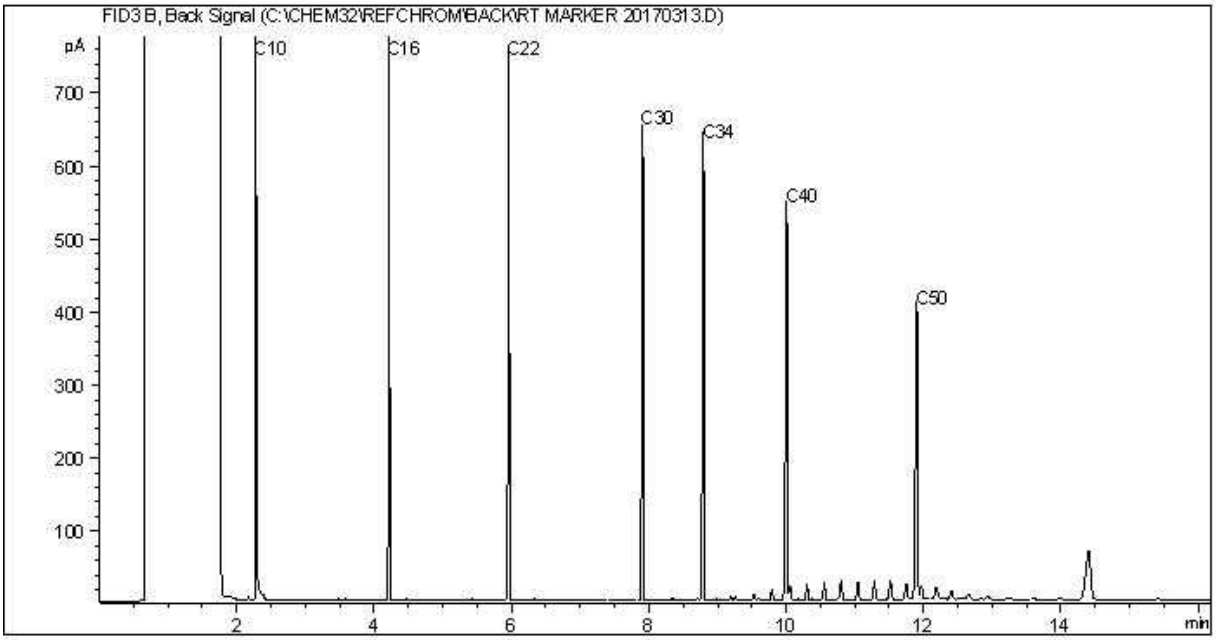
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: NWD 19-04

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

1660

Page 1 of 1

C of C # 299052

INVOICE INFORMATION

Company Name: ☒ Imperial Oil ☐ ExxonMobil
Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW, Calgary, AB, T3B 6B7
Email: stacy.gibb@advisian.com
Ph: 403 247 0200
Sampler Name (Print): Alex Haigh

REPORT INFORMATION

Company Name: ~~Stacy~~ WorleyParsons
Contact Name: Stacy Gibb
Address: 500-151 Canada Olympic Rd SW, Calgary, AB, T3B 6B7
Email: stacy.gibb@advisian.com
Ph: 403 247 0200
Consultant Project #: 407011-00770.400

ANALYSIS REQUESTED

#	FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS TOT ☐ DIS ☒	MERCURY TOTAL ☐ DISSOLVED ☒	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Plants by 4AAP
1	MTF 97-1-5	X				10	2019/09/28	11:10	X				X							X	X					X			X
2	TF 03-12-3	X				10		11:40	X				X							X	X					X			X
3	NWD 19-01	X				10		11:45	X				X							X	X					X			X
4	C38 08-1-4	X				10		13:20	X				X							X	X					X			X
5	ARB-12-3-3	X				10		13:50	X				X							X	X					X			X
6	WSY 97-1-5	X				10		14:25	X				X							X	X					X			X
7	CPF 97-7-5	X				10		14:50	X				X							X	X					X			X
8	CPF 98-8-3	X				10		15:15	X				X							X	X					X			X
9	NWD 19-03				X	5		16:00					X																
10	NWD 19-04				X	5		16:05					X																

IOL SITE LOCATION: Norman Wells, NT
IOL PROJECT # (if applicable): N/A
MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770.400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email Canada.chemistry@worleyparsons.com cacal_IOL2data.trunk@...
IESA 2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	3 (1)	5 (2)	5 (3)
SEAL INTACT	✓					
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C	(1)	(2)	(3)
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C	(1)	(2)	(3)
SEAL INTACT						
COOLING MEDIA PRESENT						

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1.	Alex Haigh	2019/09/29	09:00	1.	Test Air	2019/09/30	1032
2.				2.			
3.				3.			

LAB USE ONLY
MAXXAM JOB # B983537
SAMPLES
LABELED BY: GG
VERIFIED BY: DMX

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian

Sampling Date: 30-Sep-19, 29-Sep-19

Location: Norman Wells

Laboratory : Maxxam

Consultant Project Number: 407011-00770-400 (SNP Ops)

Sample Submission Number: B984438

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	All field QC samples met alert limits.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD	x			

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	No
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: Yes

Date DQO was received: 31-Oct-19

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): dheenarama kr

Data Reviewed by (Signature):

Date: 14-Nov-19

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)
Your C.O.C. #: 298945

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/10/30
Report #: R2804159
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B984438
Received: 2019/10/03, 09:25

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	6	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	6	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	6		Auto Calc
Cadmium - low level CCME - Dissolved	6		Auto Calc
Chloride/Sulphate by Auto Colourimetry	6	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	6	AB SOP-00005	SM 23 2510 B m
Fluoride	6	AB SOP-00005	SM 23 4500-F C m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	6	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Filtration (Metals)	1		
Hardness	6		Auto Calc
Mercury (Dissolved) by CV	6	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (3)	5	AB SOP-00042	EPA 6010d R5 m
Elements by ICP-Dissolved-Lab Filtered (3)	1	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (3)	5	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS-Dissolved-Lab Filtered (4)	1	AB SOP-00043	EPA 6020b R2 m
Ion Balance	6		Auto Calc
Nitrate and Nitrite	6		Auto Calc
Nitrate + Nitrite-N (calculated)	6		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	6	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (1, 5)	2		Auto Calc
PAH in Water by GC/MS (1)	2	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	6	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	6	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
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BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 BV Labs Calgary Environmental
(2) Silica gel clean up employed.
(3) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(4) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: Rhecie.Phayouphone@bvlabs.com
Phone# (403)735-2283

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BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WP9740		WP9741	WP9742		WP9743		
Sampling Date		2019/09/30 09:35		2019/09/30 09:10	2019/09/30 09:10		2019/09/29 15:45		
COC Number		298945		298945	298945		298945		
	UNITS	**GIBG-10-2-3**	**QC Batch**	**GIQ8-10-2-4**	**MWD19-02**	**QC Batch**	**BIBG-10-1-4**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon									
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	9616530	0.14	0.12	9614336	<0.10	0.10	9616530
Volatiles									
Benzene	mg/L	<0.00040	9614465	<0.00040	<0.00040	9614465	<0.00040	0.00040	9614465
Toluene	mg/L	<0.00040	9614465	<0.00040	<0.00040	9614465	<0.00040	0.00040	9614465
Ethylbenzene	mg/L	<0.00040	9614465	<0.00040	<0.00040	9614465	<0.00040	0.00040	9614465
m & p-Xylene	mg/L	<0.00080	9614465	<0.00080	<0.00080	9614465	<0.00080	0.00080	9614465
o-Xylene	mg/L	<0.00040	9614465	<0.00040	<0.00040	9614465	<0.00040	0.00040	9614465
Xylenes (Total)	mg/L	<0.00089	9613289	<0.00089	<0.00089	9613289	<0.00089	0.00089	9613289
F1 (C6-C10) - BTEX	mg/L	<0.10	9613289	<0.10	<0.10	9613289	<0.10	0.10	9613289
LH (C5-C10)	mg/L	<0.10	9614465	<0.10	<0.10	9614465	<0.10	0.10	9614465
F1 (C6-C10)	mg/L	<0.10	9614465	<0.10	<0.10	9614465	<0.10	0.10	9614465
Extraction Surrogate Recovery (%)									
O-TERPHENYL (sur.)	%	94	9616530	88	95	9614336	94		9616530
Instrument Surrogate Recovery (%)									
1,4-Difluorobenzene (sur.)	%	98	9614465	96	98	9614465	97		9614465
4-Bromofluorobenzene (sur.)	%	100	9614465	101	101	9614465	101		9614465
D4-1,2-Dichloroethane (sur.)	%	89	9614465	90	93	9614465	90		9614465

RDL = Reportable Detection Limit

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BV Labs Job #: B984438
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Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WP9744	WP9745		
Sampling Date		2019/09/29 16:15	2019/09/29 16:45		
COC Number		298945	298945		
	UNITS	**BIS 97-1-3**	**BI-13-1-4**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	9614336
Volatiles					
Benzene	mg/L	<0.00040	<0.00040	0.00040	9614465
Toluene	mg/L	<0.00040	<0.00040	0.00040	9614465
Ethylbenzene	mg/L	<0.00040	<0.00040	0.00040	9614465
m & p-Xylene	mg/L	<0.00080	<0.00080	0.00080	9614465
o-Xylene	mg/L	<0.00040	<0.00040	0.00040	9614465
Xylenes (Total)	mg/L	<0.00089	<0.00089	0.00089	9613289
F1 (C6-C10) - BTEX	mg/L	<0.10	<0.10	0.10	9613289
LH (C5-C10)	mg/L	<0.10	<0.10	0.10	9614465
F1 (C6-C10)	mg/L	<0.10	<0.10	0.10	9614465
Extraction Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	94	78		9614336
Instrument Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	96	97		9614465
4-Bromofluorobenzene (sur.)	%	102	102		9614465
D4-1,2-Dichloroethane (sur.)	%	91	91		9614465
RDL = Reportable Detection Limit					

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP9740			WP9740			WP9741	WP9742		
Sampling Date		2019/09/30 09:35			2019/09/30 09:35			2019/09/30 09:10	2019/09/30 09:10		
COC Number		298945			298945			298945	298945		
	UNITS	**GIBG-10-2-3**	**RDL**	**QC Batch**	**GIBG-10-2-3 Lab-Dup**	**RDL**	**QC Batch**	**GIQ8-10-2-4**	**MWD19-02**	**RDL**	**QC Batch**
Calculated Parameters											
Hardness (CaCO3)	mg/L	360	0.50	9613613				1400	1400	0.50	9613613
Ion Balance (% Difference)	%	2.7	N/A	9612921				1.5	2.3	N/A	9612921
Dissolved Nitrate (NO3)	mg/L	0.38	0.044	9613619				<0.044	0.18	0.044	9613619
Nitrate plus Nitrite (N)	mg/L	0.086	0.014	9613621				<0.014	0.040	0.014	9613621
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9613619				<0.033	<0.033	0.033	9613619
Misc. Inorganics											
Conductivity	uS/cm	730	2.0	9615098				2200	2200	2.0	9615098
Total Dissolved Solids	mg/L	470	10	9614823				1800	1800	10	9614823
Low Level Elements											
Dissolved Cadmium (Cd)	mg/L	0.00019	0.000020	9612918				0.00031	0.00032	0.000020	9612918
Anions											
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9615097				<1.0	<1.0	1.0	9615097
Alkalinity (Total as CaCO3)	mg/L	340	1.0	9615097				610	600	1.0	9615097
Bicarbonate (HCO3)	mg/L	410	1.0	9615097				750	730	1.0	9615097
Carbonate (CO3)	mg/L	<1.0	1.0	9615097				<1.0	<1.0	1.0	9615097
Dissolved Fluoride (F)	mg/L	0.051	0.050	9642884				<0.050	<0.050	0.050	9642884
Hydroxide (OH)	mg/L	<1.0	1.0	9615097				<1.0	<1.0	1.0	9615097
Dissolved Chloride (Cl)	mg/L	11	1.0	9618138	10	1.0	9618138	20	20	1.0	9619264
Dissolved Sulphate (SO4)	mg/L	65	1.0	9618138	58	1.0	9618138	740 (1)	740 (1)	5.0	9619264
Nutrients											
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9614177				<0.010	<0.010 (2)	0.010	9613860
Dissolved Nitrate (N)	mg/L	0.086	0.010	9614177				<0.010	0.040 (2)	0.010	9613860
Misc. Organics											
Phenols	mg/L	0.0037	0.0015	9617494				0.013	0.012	0.0015	9617494

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.
(2) Sample was originally processed within hold time. Data quality required investigation. Re-analysis was completed past recommended hold time.

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Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WP9743			WP9744			WP9745		
Sampling Date		2019/09/29 15:45			2019/09/29 16:15			2019/09/29 16:45		
COC Number		298945			298945			298945		
	UNITS	**BIBG-10-1-4**	**RDL**	**QC Batch**	**BIS 97-1-3**	**RDL**	**QC Batch**	**BI-13-1-4**	**RDL**	**QC Batch**
Calculated Parameters										
Hardness (CaCO3)	mg/L	870	0.50	9613613	1100	0.50	9613613	1100	0.50	9613613
Ion Balance (% Difference)	%	1.6	N/A	9612921	5.6	N/A	9612921	4.2	N/A	9612921
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	9613619	0.26	0.044	9613619	0.092	0.044	9613619
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9613621	0.072	0.014	9613621	0.021	0.014	9613621
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9613619	0.045	0.033	9613619	<0.033	0.033	9613619
Misc. Inorganics										
Conductivity	uS/cm	1500	2.0	9617148	1700	2.0	9615098	1800	2.0	9615389
Total Dissolved Solids	mg/L	1100	10	9614823	1100	10	9614823	1300	10	9614823
Low Level Elements										
Dissolved Cadmium (Cd)	mg/L	<0.000020	0.000020	9612918	0.000046	0.000020	9612918	<0.000020	0.000020	9612918
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9617087	<1.0	1.0	9615097	<1.0	1.0	9615388
Alkalinity (Total as CaCO3)	mg/L	500	1.0	9617087	830	1.0	9615097	810	1.0	9615388
Bicarbonate (HCO3)	mg/L	610	1.0	9617087	1000	1.0	9615097	980	1.0	9615388
Carbonate (CO3)	mg/L	<1.0	1.0	9617087	<1.0	1.0	9615097	<1.0	1.0	9615388
Dissolved Fluoride (F)	mg/L	0.21	0.050	9642884	0.21	0.050	9642884	0.23	0.050	9642884
Hydroxide (OH)	mg/L	<1.0	1.0	9617087	<1.0	1.0	9615097	<1.0	1.0	9615388
Dissolved Chloride (Cl)	mg/L	20	1.0	9619264	22	1.0	9619264	8.7	1.0	9619264
Dissolved Sulphate (SO4)	mg/L	320 (1)	5.0	9619264	200	1.0	9619264	290 (1)	5.0	9619264
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9613860	0.014	0.010	9613860	<0.010	0.010	9613860
Dissolved Nitrate (N)	mg/L	<0.010	0.010	9613860	0.059	0.010	9613860	0.021	0.010	9613860
Misc. Organics										
Phenols	mg/L	0.0045	0.0015	9617494	0.011	0.0015	9617494	0.013	0.0015	9617494

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: B984438
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Task Order#: 407011-00770-400
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Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WP9740	WP9743		
Sampling Date		2019/09/30 09:35	2019/09/29 15:45		
COC Number		298945	298945		
	UNITS	**GIBG-10-2-3**	**BIBG-10-1-4**	**RDL**	**QC Batch**
Polycyclic Aromatics					
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	<0.000010	0.000010	9612986
Acenaphthene	mg/L	<0.00010	<0.00010	0.00010	9616528
Acenaphthylene	mg/L	<0.00010	<0.00010	0.00010	9616528
Acridine	mg/L	<0.000040	<0.000040	0.000040	9616528
Anthracene	mg/L	<0.000010	<0.000010	0.000010	9616528
Benzo(a)anthracene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
Benzo(b&j)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
Benzo(k)fluoranthene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
Benzo(g,h,i)perylene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
Benzo(c)phenanthrene	mg/L	<0.000050	<0.000050	0.000050	9616528
Benzo(a)pyrene	mg/L	<0.0000075	<0.0000075	0.0000075	9616528
Benzo(e)pyrene	mg/L	<0.000050	<0.000050	0.000050	9616528
Chrysene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
Dibenz(a,h)anthracene	mg/L	<0.0000075	<0.0000075	0.0000075	9616528
Fluoranthene	mg/L	<0.000010	<0.000010	0.000010	9616528
Fluorene	mg/L	<0.000050	<0.000050	0.000050	9616528
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	<0.0000085	0.0000085	9616528
1-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9616528
2-Methylnaphthalene	mg/L	<0.00010	<0.00010	0.00010	9616528
Naphthalene	mg/L	<0.00010	<0.00010	0.00010	9616528
Phenanthrene	mg/L	<0.000050	<0.000050	0.000050	9616528
Perylene	mg/L	<0.000050	<0.000050	0.000050	9616528
Pyrene	mg/L	<0.000020	<0.000020	0.000020	9616528
Quinoline	mg/L	<0.00020	<0.00020	0.00020	9616528
Extraction Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	86	88		9616528
D8-ACENAPHTHYLENE (sur.)	%	91	86		9616528
D8-NAPHTHALENE (sur.)	%	90	91		9616528
TERPHENYL-D14 (sur.)	%	97	99		9616528
RDL = Reportable Detection Limit					

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MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WP9740	WP9741	WP9742	WP9743	WP9744	WP9745		
Sampling Date		2019/09/30 09:35	2019/09/30 09:10	2019/09/30 09:10	2019/09/29 15:45	2019/09/29 16:15	2019/09/29 16:45		
COC Number		298945	298945	298945	298945	298945	298945		
	UNITS	**GIBG-10-2-3**	**GIQ8-10-2-4**	**MWD19-02**	**BIBG-10-1-4**	**BIS 97-1-3**	**BI-13-1-4**	**RDL**	**QC Batch**
Elements									
Dissolved Mercury (Hg)	ug/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	9619312
RDL = Reportable Detection Limit									

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP9740			WP9741			WP9741		
Sampling Date		2019/09/30 09:35			2019/09/30 09:10			2019/09/30 09:10		
COC Number		298945			298945			298945		
	UNITS	**GIBG-10-2-3**	**RDL**	**QC Batch**	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIQ8-10-2-4 Lab-Dup**	**RDL**	**QC Batch**
Elements										
Dissolved Aluminum (Al)	mg/L				0.0076	0.0030	9614366	0.0076	0.0030	9614366
Dissolved Antimony (Sb)	mg/L				<0.00060	0.00060	9614366	<0.00060	0.00060	9614366
Dissolved Arsenic (As)	mg/L				0.0026	0.00020	9614366	0.0027	0.00020	9614366
Dissolved Barium (Ba)	mg/L				0.15	0.010	9616667			
Dissolved Beryllium (Be)	mg/L				<0.0010	0.0010	9614366	<0.0010	0.0010	9614366
Dissolved Boron (B)	mg/L				0.030	0.020	9616667			
Dissolved Calcium (Ca)	mg/L				380	0.30	9616667			
Dissolved Chromium (Cr)	mg/L				<0.0010	0.0010	9614366	<0.0010	0.0010	9614366
Dissolved Cobalt (Co)	mg/L				0.017	0.00030	9614366	0.017	0.00030	9614366
Dissolved Copper (Cu)	mg/L				0.00089	0.00020	9614366	0.0010	0.00020	9614366
Dissolved Iron (Fe)	mg/L				8.3	0.060	9616667			
Dissolved Lead (Pb)	mg/L				<0.00020	0.00020	9614366	<0.00020	0.00020	9614366
Dissolved Lithium (Li)	mg/L				0.022	0.020	9616667			
Dissolved Magnesium (Mg)	mg/L				100	0.20	9616667			
Dissolved Manganese (Mn)	mg/L				6.7	0.0040	9616667			
Dissolved Molybdenum (Mo)	mg/L				0.00071	0.00020	9614366	0.00068	0.00020	9614366
Dissolved Nickel (Ni)	mg/L				0.024	0.00050	9614366	0.025	0.00050	9614366
Dissolved Phosphorus (P)	mg/L				<0.10	0.10	9616667			
Dissolved Potassium (K)	mg/L				3.5	0.30	9616667			
Dissolved Selenium (Se)	mg/L				0.00029	0.00020	9614366	0.00030	0.00020	9614366
Dissolved Silicon (Si)	mg/L				6.3	0.10	9616667			
Dissolved Silver (Ag)	mg/L				<0.00010	0.00010	9614366	<0.00010	0.00010	9614366
Dissolved Sodium (Na)	mg/L				29	0.50	9616667			
Dissolved Strontium (Sr)	mg/L				1.6	0.020	9616667			
Dissolved Sulphur (S)	mg/L				260	0.20	9616667			
Dissolved Thallium (Tl)	mg/L				<0.00020	0.00020	9614366	<0.00020	0.00020	9614366
Dissolved Tin (Sn)	mg/L				<0.0010	0.0010	9614366	<0.0010	0.0010	9614366
Dissolved Titanium (Ti)	mg/L				<0.0010	0.0010	9614366	<0.0010	0.0010	9614366
Dissolved Uranium (U)	mg/L				0.0072	0.00010	9614366	0.0074	0.00010	9614366
Dissolved Vanadium (V)	mg/L				<0.0010	0.0010	9614366	<0.0010	0.0010	9614366

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP9740			WP9741			WP9741		
Sampling Date		2019/09/30 09:35			2019/09/30 09:10			2019/09/30 09:10		
COC Number		298945			298945			298945		
	UNITS	**GIBG-10-2-3**	**RDL**	**QC Batch**	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIQ8-10-2-4 Lab-Dup**	**RDL**	**QC Batch**
Dissolved Zinc (Zn)	mg/L				0.016	0.0030	9614366	0.017	0.0030	9614366
Lab Filtered Elements										
Dissolved Aluminum (Al)	mg/L	0.0055	0.0030	9615400						
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9615400						
Dissolved Arsenic (As)	mg/L	0.00085	0.00020	9615400						
Dissolved Barium (Ba)	mg/L	0.13	0.010	9615423						
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9615400						
Dissolved Boron (B)	mg/L	0.026	0.020	9615423						
Dissolved Calcium (Ca)	mg/L	110	0.30	9615423						
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9615400						
Dissolved Cobalt (Co)	mg/L	0.0035	0.00030	9615400						
Dissolved Copper (Cu)	mg/L	0.0015	0.00020	9615400						
Dissolved Iron (Fe)	mg/L	0.29	0.060	9615423						
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9615400						
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9615423						
Dissolved Magnesium (Mg)	mg/L	21	0.20	9615423						
Dissolved Manganese (Mn)	mg/L	0.96	0.0040	9615423						
Dissolved Molybdenum (Mo)	mg/L	0.0010	0.00020	9615400						
Dissolved Nickel (Ni)	mg/L	0.0063	0.00050	9615400						
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9615423						
Dissolved Potassium (K)	mg/L	2.1	0.30	9615423						
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	9615400						
Dissolved Silicon (Si)	mg/L	4.4	0.10	9615423						
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9615400						
Dissolved Sodium (Na)	mg/L	15	0.50	9615423						
Dissolved Strontium (Sr)	mg/L	0.56	0.020	9615423						
Dissolved Sulphur (S)	mg/L	17	0.20	9615423						
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9615400						
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9615400						
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9615400						
Dissolved Uranium (U)	mg/L	0.0019	0.00010	9615400						

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP9740			WP9741			WP9741		
Sampling Date		2019/09/30 09:35			2019/09/30 09:10			2019/09/30 09:10		
COC Number		298945			298945			298945		
	UNITS	**GIBG-10-2-3**	**RDL**	**QC Batch**	**GIQ8-10-2-4**	**RDL**	**QC Batch**	**GIQ8-10-2-4 Lab-Dup**	**RDL**	**QC Batch**
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9615400						
Dissolved Zinc (Zn)	mg/L	0.016	0.0030	9615400						

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WP9742	WP9743	WP9744	WP9745		
Sampling Date		2019/09/30 09:10	2019/09/29 15:45	2019/09/29 16:15	2019/09/29 16:45		
COC Number		298945	298945	298945	298945		
	UNITS	**MWD19-02**	**BIBG-10-1-4**	**BIS 97-1-3**	**BI-13-1-4**	**RDL**	**QC Batch**
Elements							
Dissolved Aluminum (Al)	mg/L	0.0073	0.0056	0.0085	0.011	0.0030	9614366
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	<0.00060	0.00060	9614366
Dissolved Arsenic (As)	mg/L	0.0027	0.00089	0.0017	0.0058	0.00020	9614366
Dissolved Barium (Ba)	mg/L	0.15	0.036	0.055	0.046	0.010	9616667
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9614366
Dissolved Boron (B)	mg/L	0.030	0.021	<0.020	<0.020	0.020	9616667
Dissolved Calcium (Ca)	mg/L	380	260	270	280	0.30	9616667
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9614366
Dissolved Cobalt (Co)	mg/L	0.017	0.0024	0.0031	0.0081	0.00030	9614366
Dissolved Copper (Cu)	mg/L	0.00087	0.0014	0.0021	0.0016	0.00020	9614366
Dissolved Iron (Fe)	mg/L	8.5	3.0	21	49	0.060	9616667
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9614366
Dissolved Lithium (Li)	mg/L	0.022	<0.020	<0.020	<0.020	0.020	9616667
Dissolved Magnesium (Mg)	mg/L	100	55	100	95	0.20	9616667
Dissolved Manganese (Mn)	mg/L	6.7	1.3	1.2	2.5	0.0040	9616667
Dissolved Molybdenum (Mo)	mg/L	0.00070	0.011	0.0039	0.0017	0.00020	9614366
Dissolved Nickel (Ni)	mg/L	0.025	0.0059	0.0085	0.010	0.00050	9614366
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9616667
Dissolved Potassium (K)	mg/L	3.5	1.8	3.7	1.5	0.30	9616667
Dissolved Selenium (Se)	mg/L	0.00034	0.00027	0.00060	0.00056	0.00020	9614366
Dissolved Silicon (Si)	mg/L	6.4	4.2	7.1	5.7	0.10	9616667
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	9614366
Dissolved Sodium (Na)	mg/L	30	6.4	19	16	0.50	9616667
Dissolved Strontium (Sr)	mg/L	1.6	0.66	0.92	1.8	0.020	9616667
Dissolved Sulphur (S)	mg/L	260	110	78	97	0.20	9616667
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9614366
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9614366
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9614366
Dissolved Uranium (U)	mg/L	0.0072	0.0050	0.0011	0.0039	0.00010	9614366
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0012	0.0017	0.0010	9614366
Dissolved Zinc (Zn)	mg/L	0.017	0.0042	0.0037	0.0037	0.0030	9614366
RDL = Reportable Detection Limit							

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WP9740
Sample ID: GIBG-10-2-3
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9615097	N/A	2019/10/04	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/07	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9618138	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9615098	N/A	2019/10/04	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9616530	2019/10/07	2019/10/08	Jana Rychlikova
Hardness	CALC	9613613	N/A	2019/10/05	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP-Dissolved-Lab Filtered	ICPA	9615423	N/A	2019/10/04	Andrew Payne
Elements by ICPMS-Dissolved-Lab Filtered	ICPM	9615400	N/A	2019/10/05	Julie Harrison
Ion Balance	CALC	9612921	N/A	2019/10/05	Suwan Fock
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/05	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/05	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9614177	N/A	2019/10/04	Christine Albrecht
Benzo[a]pyrene Equivalency	GC/MSD	9612986	N/A	2019/10/08	Automated Statchk
PAH in Water by GC/MS	GC/MS	9616528	2019/10/04	2019/10/08	Nora Kazemian
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

BV Labs ID: WP9740 Dup
Sample ID: GIBG-10-2-3
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride/Sulphate by Auto Colourimetry	KONE	9618138	N/A	2019/10/08	Marissa Richard

BV Labs ID: WP9741
Sample ID: GIQ8-10-2-4
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9615097	N/A	2019/10/04	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/08	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9619264	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9615098	N/A	2019/10/04	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9614336	2019/10/04	2019/10/04	Grace Guo
Hardness	CALC	9613613	N/A	2019/10/09	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP - Dissolved	ICPA	9616667	N/A	2019/10/09	Queen Acharya

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WP9741
Sample ID: GIQ8-10-2-4
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne
Ion Balance	CALC	9612921	N/A	2019/10/05	Automated Statchk
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/07	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/07	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9613860	N/A	2019/10/03	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

BV Labs ID: WP9741 Dup
Sample ID: GIQ8-10-2-4
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne

BV Labs ID: WP9742
Sample ID: MWD19-02
Matrix: Water

Collected: 2019/09/30
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9615097	N/A	2019/10/04	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/08	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9619264	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9615098	N/A	2019/10/04	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9614336	2019/10/04	2019/10/04	Grace Guo
Hardness	CALC	9613613	N/A	2019/10/09	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP - Dissolved	ICPA	9616667	N/A	2019/10/09	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne
Ion Balance	CALC	9612921	N/A	2019/10/05	Automated Statchk
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/07	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/07	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9613860	N/A	2019/10/04	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WP9743
Sample ID: BIBG-10-1-4
Matrix: Water

Collected: 2019/09/29
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9617087	N/A	2019/10/07	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/08	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9619264	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9617148	N/A	2019/10/07	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9616530	2019/10/07	2019/10/08	Jana Rychlikova
Hardness	CALC	9613613	N/A	2019/10/09	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP - Dissolved	ICPA	9616667	N/A	2019/10/09	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne
Ion Balance	CALC	9612921	N/A	2019/10/06	Suwan Fock
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/07	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/07	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9613860	N/A	2019/10/04	Krista Dawe
Benzo[a]pyrene Equivalency	GC/MSD	9612986	N/A	2019/10/09	Automated Statchk
PAH in Water by GC/MS	GC/MS	9616528	2019/10/04	2019/10/08	Nora Kazemian
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

BV Labs ID: WP9744
Sample ID: BIS 97-1-3
Matrix: Water

Collected: 2019/09/29
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9615097	N/A	2019/10/04	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/08	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9619264	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9615098	N/A	2019/10/04	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9614336	2019/10/04	2019/10/04	Grace Guo
Hardness	CALC	9613613	N/A	2019/10/09	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP - Dissolved	ICPA	9616667	N/A	2019/10/09	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne
Ion Balance	CALC	9612921	N/A	2019/10/05	Suwan Fock
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/07	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/07	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9613860	N/A	2019/10/03	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

TEST SUMMARY

BV Labs ID: WP9745
Sample ID: BI-13-1-4
Matrix: Water

Collected: 2019/09/29
Relinquished: 2019/10/02
Received: 2019/10/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9615388	N/A	2019/10/04	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9614465	N/A	2019/10/07	Adriana Munoz
F1-BTEX	CALC/MS	9613289	N/A	2019/10/08	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9612918	N/A	2019/10/08	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9619264	N/A	2019/10/08	Marissa Richard
Conductivity @25C	COND	9615389	N/A	2019/10/04	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9614336	2019/10/04	2019/10/04	Grace Guo
Hardness	CALC	9613613	N/A	2019/10/09	Automated Statchk
Mercury (Dissolved) by CV	CV	9619312	2019/10/08	2019/10/08	Andrew Payne
Elements by ICP - Dissolved	ICPA	9616667	N/A	2019/10/09	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9614366	N/A	2019/10/07	Andrew Payne
Ion Balance	CALC	9612921	N/A	2019/10/04	Suwan Fock
Nitrate and Nitrite	CALC	9613619	N/A	2019/10/07	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9613621	N/A	2019/10/07	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9613860	N/A	2019/10/04	Krista Dawe
Phenols (4-AAP)	TECH/4AAP	9617494	N/A	2019/10/07	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9614823	2019/10/04	2019/10/06	Amy Aston

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

GENERAL COMMENTS

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

Package 1	5.0°C

Note: Samples received after hold time;The samples BIBG-10-1-4, BIS 97-1-3, and BI-13-1-4 were received past hold time for Nitrate/Nitrite analysis. Informed client and proceeded with analysis.
Temperatures upon receipt at Bureau Veritas Labs Calgary
Package 1: 4.3 degrees C
Each temperature is the average of up to three cooler temperatures taken at receipt.

Version 2: Report reissued to include results for Fluoride as per AARF on 2019/10/23.

Sample WP9740 [GIBG-10-2-3] : 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.

Sample WP9742 [MWD19-02] : 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.

Sample WP9743 [BIBG-10-1-4] : 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.

Sample WP9744 [BIS 97-1-3] : 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.

Sample WP9745 [BI-13-1-4] : 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.

Results relate only to the items tested.

DATA QUALITY OVERVIEW

Lab ID	Client Sample ID	Matrix	Test Code	Analysis Type	Parameters	Deviation	Root Cause	Potential Impact
WP9740	GIBG-10-2-3	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#10 Lab Error	This may increase the uncertainty associated with these results.
WP9742	MWD19-02	Water	NOIC	NUTS	Sample	#11 Past Hold Time	#4 Re-Analysis Required	This may increase the uncertainty associated with these results.

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BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9613860	KD5	Method Blank	Dissolved Nitrite (N)	2019/10/03	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/10/03	<0.010		mg/L	
9614177	CAR	Method Blank	Dissolved Nitrite (N)	2019/10/04	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/10/04	<0.010		mg/L	
9614336	GG3	Method Blank	O-TERPHENYL (sur.)	2019/10/03		87	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/03	<0.10		mg/L	
9614366	APY	Method Blank	Dissolved Aluminum (Al)	2019/10/07	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/10/07	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/10/07	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/10/07	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/10/07	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/10/07	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/10/07	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/10/07	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/10/07	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/10/07	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/10/07	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/10/07	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/10/07	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/10/07	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/10/07	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/10/07	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/10/07	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/10/07	<0.0010		mg/L	
9614465	AMJ	Method Blank	1,4-Difluorobenzene (sur.)	2019/10/07		95	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/07		101	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/07		89	%	50 - 140
			Benzene	2019/10/07	<0.00040		mg/L	
			Toluene	2019/10/07	<0.00040		mg/L	
			Ethylbenzene	2019/10/07	<0.00040		mg/L	
			m & p-Xylene	2019/10/07	<0.00080		mg/L	
			o-Xylene	2019/10/07	<0.00040		mg/L	
			LH (C5-C10)	2019/10/07	<0.10		mg/L	
			F1 (C6-C10)	2019/10/07	<0.10		mg/L	
9614823	AAZ	Method Blank	Total Dissolved Solids	2019/10/06	<10		mg/L	
9615097	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/10/04	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/10/04	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/04	<1.0		mg/L	
			Carbonate (CO3)	2019/10/04	<1.0		mg/L	
			Hydroxide (OH)	2019/10/04	<1.0		mg/L	
9615098	MA4	Method Blank	Conductivity	2019/10/04	<2.0		uS/cm	
9615388	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/10/04	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/10/04	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/04	<1.0		mg/L	
			Carbonate (CO3)	2019/10/04	<1.0		mg/L	
			Hydroxide (OH)	2019/10/04	<1.0		mg/L	
9615389	MA4	Method Blank	Conductivity	2019/10/04	<2.0		uS/cm	
9615400	JHS	Method Blank	Dissolved Aluminum (Al)	2019/10/05	<0.0030		mg/L	
			Dissolved Chromium (Cr)	2019/10/05	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/10/05	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/10/05	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/10/05	<0.00020		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Antimony (Sb)	2019/10/05	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/10/05	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/10/05	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/10/05	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/10/05	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/10/05	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/10/05	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/10/05	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/10/05	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/10/05	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/10/05	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/10/05	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/10/05	<0.0010		mg/L	
9615423	APY	Method Blank	Dissolved Iron (Fe)	2019/10/04	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/04	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/04	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/04	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/10/04	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/10/04	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/04	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/04	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/10/04	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/10/04	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/10/04	<0.10		mg/L	
			Dissolved Boron (B)	2019/10/04	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/04	<0.30		mg/L	
9616528	NK3	Method Blank	D10-ANTHRACENE (sur.)	2019/10/08		86	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/10/08		94	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/10/08		92	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/10/08		90	%	50 - 130
			Acenaphthene	2019/10/08	<0.00010		mg/L	
			Acenaphthylene	2019/10/08	<0.00010		mg/L	
			Acridine	2019/10/08	<0.000040		mg/L	
			Anthracene	2019/10/08	<0.000010		mg/L	
			Benzo(a)anthracene	2019/10/08	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/10/08	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/10/08	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/10/08	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/10/08	<0.000050		mg/L	
			Benzo(a)pyrene	2019/10/08	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/10/08	<0.000050		mg/L	
			Chrysene	2019/10/08	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/10/08	<0.0000075		mg/L	
			Fluoranthene	2019/10/08	<0.000010		mg/L	
			Fluorene	2019/10/08	<0.000050		mg/L	
			Indeno(1,2,3-cd)pyrene	2019/10/08	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/10/08	<0.00010		mg/L	
			2-Methylnaphthalene	2019/10/08	<0.00010		mg/L	
			Naphthalene	2019/10/08	<0.00010		mg/L	
			Phenanthrene	2019/10/08	<0.000050		mg/L	
			Perylene	2019/10/08	<0.000050		mg/L	
			Pyrene	2019/10/08	<0.000020		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Quinoline	2019/10/08	<0.00020		mg/L	
9616530	JR1	Method Blank	O-TERPHENYL (sur.)	2019/10/07		87	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/07	<0.10		mg/L	
9616667	ACY	Method Blank	Dissolved Iron (Fe)	2019/10/09	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/09	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/09	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/09	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/10/09	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/10/09	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/09	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/09	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/10/09	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/10/09	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/10/09	<0.10		mg/L	
			Dissolved Boron (B)	2019/10/09	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/09	<0.30		mg/L	
9617087	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/10/07	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/10/07	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/07	<1.0		mg/L	
			Carbonate (CO3)	2019/10/07	<1.0		mg/L	
			Hydroxide (OH)	2019/10/07	<1.0		mg/L	
9617148	MA4	Method Blank	Conductivity	2019/10/07	<2.0		uS/cm	
9617494	YY	Method Blank	Phenols	2019/10/07	<0.0015		mg/L	
9618138	MRD	Method Blank	Dissolved Chloride (Cl)	2019/10/08	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/10/08	<1.0		mg/L	
9619264	MRD	Method Blank	Dissolved Chloride (Cl)	2019/10/08	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/10/08	<1.0		mg/L	
9619312	APY	Method Blank	Dissolved Mercury (Hg)	2019/10/08	<0.0020		ug/L	
9642884	MA4	Method Blank	Dissolved Fluoride (F)	2019/10/25	<0.050		mg/L	
9618138	MRD	RPD [WP9740-01]	Dissolved Chloride (Cl)	2019/10/08	0.65		%	20
			Dissolved Sulphate (SO4)	2019/10/08	11		%	20
9614366	APY	RPD [WP9741-04]	Dissolved Aluminum (Al)	2019/10/07	0.079		%	20
			Dissolved Chromium (Cr)	2019/10/07	NC		%	20
			Dissolved Cobalt (Co)	2019/10/07	0.12		%	20
			Dissolved Copper (Cu)	2019/10/07	12		%	20
			Dissolved Lead (Pb)	2019/10/07	NC		%	20
			Dissolved Antimony (Sb)	2019/10/07	NC		%	20
			Dissolved Molybdenum (Mo)	2019/10/07	4.1		%	20
			Dissolved Nickel (Ni)	2019/10/07	0.81		%	20
			Dissolved Selenium (Se)	2019/10/07	2.0		%	20
			Dissolved Silver (Ag)	2019/10/07	NC		%	20
			Dissolved Arsenic (As)	2019/10/07	4.1		%	20
			Dissolved Thallium (Tl)	2019/10/07	NC		%	20
			Dissolved Tin (Sn)	2019/10/07	NC		%	20
			Dissolved Titanium (Ti)	2019/10/07	NC		%	20
			Dissolved Uranium (U)	2019/10/07	1.9		%	20
			Dissolved Vanadium (V)	2019/10/07	NC		%	20
			Dissolved Zinc (Zn)	2019/10/07	1.3		%	20
			Dissolved Beryllium (Be)	2019/10/07	NC		%	20
9614366	APY	Matrix Spike [WP9741-04]	Dissolved Aluminum (Al)	2019/10/07		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/07		93	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Cobalt (Co)	2019/10/07		89	%	80 - 120
			Dissolved Copper (Cu)	2019/10/07		90	%	80 - 120
			Dissolved Lead (Pb)	2019/10/07		92	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/07		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/07		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/07		89	%	80 - 120
			Dissolved Selenium (Se)	2019/10/07		99	%	80 - 120
			Dissolved Silver (Ag)	2019/10/07		93	%	80 - 120
			Dissolved Arsenic (As)	2019/10/07		95	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/07		93	%	80 - 120
			Dissolved Tin (Sn)	2019/10/07		101	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/07		94	%	80 - 120
			Dissolved Uranium (U)	2019/10/07		93	%	80 - 120
			Dissolved Vanadium (V)	2019/10/07		95	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/07		94	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/07		92	%	80 - 120
9616528	NK3	Matrix Spike [WP9740-06]	D10-ANTHRACENE (sur.)	2019/10/08		87	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/10/08		102	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/10/08		93	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/10/08		91	%	50 - 130
			Acenaphthene	2019/10/08		96	%	50 - 130
			Acenaphthylene	2019/10/08		92	%	50 - 130
			Acridine	2019/10/08		68	%	50 - 130
			Anthracene	2019/10/08		86	%	50 - 130
			Benzo(a)anthracene	2019/10/08		104	%	50 - 130
			Benzo(b&j)fluoranthene	2019/10/08		96	%	50 - 130
			Benzo(k)fluoranthene	2019/10/08		92	%	50 - 130
			Benzo(g,h,i)perylene	2019/10/08		99	%	50 - 130
			Benzo(c)phenanthrene	2019/10/08		106	%	50 - 130
			Benzo(a)pyrene	2019/10/08		103	%	50 - 130
			Benzo(e)pyrene	2019/10/08		101	%	50 - 130
			Chrysene	2019/10/08		100	%	50 - 130
			Dibenz(a,h)anthracene	2019/10/08		99	%	50 - 130
			Fluoranthene	2019/10/08		96	%	50 - 130
			Fluorene	2019/10/08		97	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/10/08		98	%	50 - 130
			1-Methylnaphthalene	2019/10/08		97	%	50 - 130
			2-Methylnaphthalene	2019/10/08		93	%	50 - 130
			Naphthalene	2019/10/08		87	%	50 - 130
			Phenanthrene	2019/10/08		87	%	50 - 130
			Perylene	2019/10/08		97	%	50 - 130
			Pyrene	2019/10/08		95	%	50 - 130
			Quinoline	2019/10/08		108	%	50 - 130
9616530	JR1	Matrix Spike [WP9743-06]	O-TERPHENYL (sur.)	2019/10/08		97	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/08		102	%	60 - 140
9618138	MRD	Matrix Spike [WP9740-01]	Dissolved Chloride (Cl)	2019/10/08		116	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/08		NC	%	80 - 120
9613860	KD5	LCS	Dissolved Nitrite (N)	2019/10/03		101	%	80 - 120
			Dissolved Nitrate (N)	2019/10/03		101	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9614177	CAR	LCS	Dissolved Nitrite (N)	2019/10/04		101	%	80 - 120
			Dissolved Nitrate (N)	2019/10/04		102	%	80 - 120
9614336	GG3	LCS	O-TERPHENYL (sur.)	2019/10/03		104	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/03		110	%	60 - 140
9614366	APY	LCS	Dissolved Aluminum (Al)	2019/10/07		104	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/07		92	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/07		92	%	80 - 120
			Dissolved Copper (Cu)	2019/10/07		94	%	80 - 120
			Dissolved Lead (Pb)	2019/10/07		95	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/07		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/07		93	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/07		92	%	80 - 120
			Dissolved Selenium (Se)	2019/10/07		97	%	80 - 120
			Dissolved Silver (Ag)	2019/10/07		95	%	80 - 120
			Dissolved Arsenic (As)	2019/10/07		93	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/07		94	%	80 - 120
			Dissolved Tin (Sn)	2019/10/07		97	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/07		92	%	80 - 120
			Dissolved Uranium (U)	2019/10/07		92	%	80 - 120
			Dissolved Vanadium (V)	2019/10/07		93	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/07		98	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/07		90	%	80 - 120
9614465	AMJ	LCS	1,4-Difluorobenzene (sur.)	2019/10/07		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/07		101	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/07		96	%	50 - 140
			Benzene	2019/10/07		82	%	60 - 130
			Toluene	2019/10/07		80	%	60 - 130
			Ethylbenzene	2019/10/07		88	%	60 - 130
			m & p-Xylene	2019/10/07		87	%	60 - 130
			o-Xylene	2019/10/07		83	%	60 - 130
			LH (C5-C10)	2019/10/07		83	%	60 - 140
			F1 (C6-C10)	2019/10/07		84	%	60 - 140
9614823	AAZ	LCS	Total Dissolved Solids	2019/10/06		102	%	80 - 120
9615097	MA4	LCS	Alkalinity (Total as CaCO3)	2019/10/04		97	%	80 - 120
9615098	MA4	LCS	Conductivity	2019/10/04		100	%	90 - 110
9615388	MA4	LCS	Alkalinity (Total as CaCO3)	2019/10/04		98	%	80 - 120
9615389	MA4	LCS	Conductivity	2019/10/04		98	%	90 - 110
9615400	JHS	LCS	Dissolved Aluminum (Al)	2019/10/05		97	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/05		96	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/05		95	%	80 - 120
			Dissolved Copper (Cu)	2019/10/05		99	%	80 - 120
			Dissolved Lead (Pb)	2019/10/05		100	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/05		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/05		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/05		96	%	80 - 120
			Dissolved Selenium (Se)	2019/10/05		99	%	80 - 120
			Dissolved Silver (Ag)	2019/10/05		96	%	80 - 120
			Dissolved Arsenic (As)	2019/10/05		95	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/05		94	%	80 - 120
			Dissolved Tin (Sn)	2019/10/05		99	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/05		100	%	80 - 120
			Dissolved Uranium (U)	2019/10/05		97	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Vanadium (V)	2019/10/05		95	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/05		99	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/05		96	%	80 - 120
9615423	APY	LCS	Dissolved Iron (Fe)	2019/10/04		102	%	80 - 120
			Dissolved Lithium (Li)	2019/10/04		97	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/04		102	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/04		100	%	80 - 120
			Dissolved Potassium (K)	2019/10/04		103	%	80 - 120
			Dissolved Sodium (Na)	2019/10/04		100	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/04		93	%	80 - 120
			Dissolved Sulphur (S)	2019/10/04		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/04		102	%	80 - 120
			Dissolved Barium (Ba)	2019/10/04		99	%	80 - 120
			Dissolved Silicon (Si)	2019/10/04		100	%	80 - 120
			Dissolved Boron (B)	2019/10/04		103	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/04		100	%	80 - 120
9616528	NK3	LCS	D10-ANTHRACENE (sur.)	2019/10/08		83	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/10/08		91	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/10/08		89	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/10/08		87	%	50 - 130
			Acenaphthene	2019/10/08		87	%	50 - 130
			Acenaphthylene	2019/10/08		85	%	50 - 130
			Acridine	2019/10/08		83	%	50 - 130
			Anthracene	2019/10/08		82	%	50 - 130
			Benzo(a)anthracene	2019/10/08		93	%	50 - 130
			Benzo(b&j)fluoranthene	2019/10/08		86	%	50 - 130
			Benzo(k)fluoranthene	2019/10/08		85	%	50 - 130
			Benzo(g,h,i)perylene	2019/10/08		88	%	50 - 130
			Benzo(c)phenanthrene	2019/10/08		95	%	50 - 130
			Benzo(a)pyrene	2019/10/08		92	%	50 - 130
			Benzo(e)pyrene	2019/10/08		90	%	50 - 130
			Chrysene	2019/10/08		89	%	50 - 130
			Dibenz(a,h)anthracene	2019/10/08		88	%	50 - 130
			Fluoranthene	2019/10/08		91	%	50 - 130
			Fluorene	2019/10/08		91	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/10/08		86	%	50 - 130
			1-Methylnaphthalene	2019/10/08		85	%	50 - 130
			2-Methylnaphthalene	2019/10/08		81	%	50 - 130
			Naphthalene	2019/10/08		77	%	50 - 130
			Phenanthrene	2019/10/08		82	%	50 - 130
			Perylene	2019/10/08		86	%	50 - 130
			Pyrene	2019/10/08		90	%	50 - 130
			Quinoline	2019/10/08		105	%	50 - 130
9616530	JR1	LCS	O-TERPHENYL (sur.)	2019/10/07		94	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/07		100	%	60 - 140
9616667	ACY	LCS	Dissolved Iron (Fe)	2019/10/09		103	%	80 - 120
			Dissolved Lithium (Li)	2019/10/09		102	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/09		102	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/09		101	%	80 - 120
			Dissolved Potassium (K)	2019/10/09		104	%	80 - 120
			Dissolved Sodium (Na)	2019/10/09		102	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/09		98	%	80 - 120

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B984438
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sulphur (S)	2019/10/09		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/09		99	%	80 - 120
			Dissolved Barium (Ba)	2019/10/09		101	%	80 - 120
			Dissolved Silicon (Si)	2019/10/09		100	%	80 - 120
			Dissolved Boron (B)	2019/10/09		102	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/09		100	%	80 - 120
9617087	MA4	LCS	Alkalinity (Total as CaCO3)	2019/10/07		98	%	80 - 120
9617148	MA4	LCS	Conductivity	2019/10/07		102	%	90 - 110
9617494	YY	LCS	Phenols	2019/10/07		99	%	80 - 120
9618138	MRD	LCS	Dissolved Chloride (Cl)	2019/10/08		108	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/08		115	%	80 - 120
9619264	MRD	LCS	Dissolved Chloride (Cl)	2019/10/08		102	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/08		116	%	80 - 120
9619312	APY	LCS	Dissolved Mercury (Hg)	2019/10/08		104	%	80 - 120
9642884	MA4	LCS	Dissolved Fluoride (F)	2019/10/25		100	%	80 - 120

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.

LCS: 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)

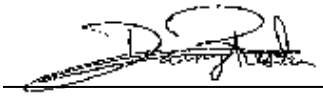
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400 (SNP Ops)

VALIDATION SIGNATURE PAGE

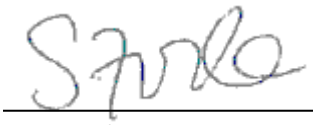
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



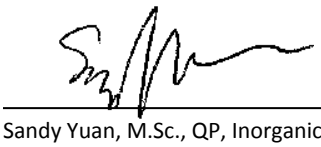
Daniel Reslan, cCT, QP, Organics Manager



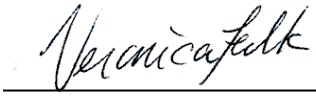
Justin Geisel, B.Sc., Organics Supervisor



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst



Sandy Yuan, M.Sc., QP, Inorganics Supervisor



Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

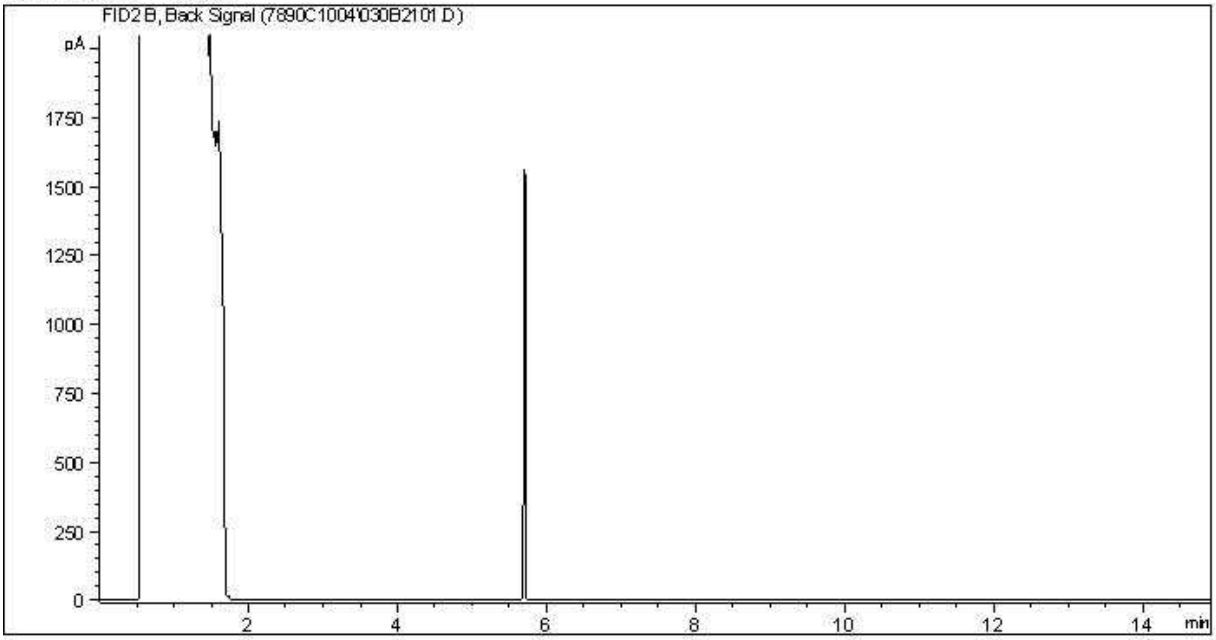
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BV Labs Job #: B984438
Report Date: 2019/10/30
BV Labs Sample: WP9741

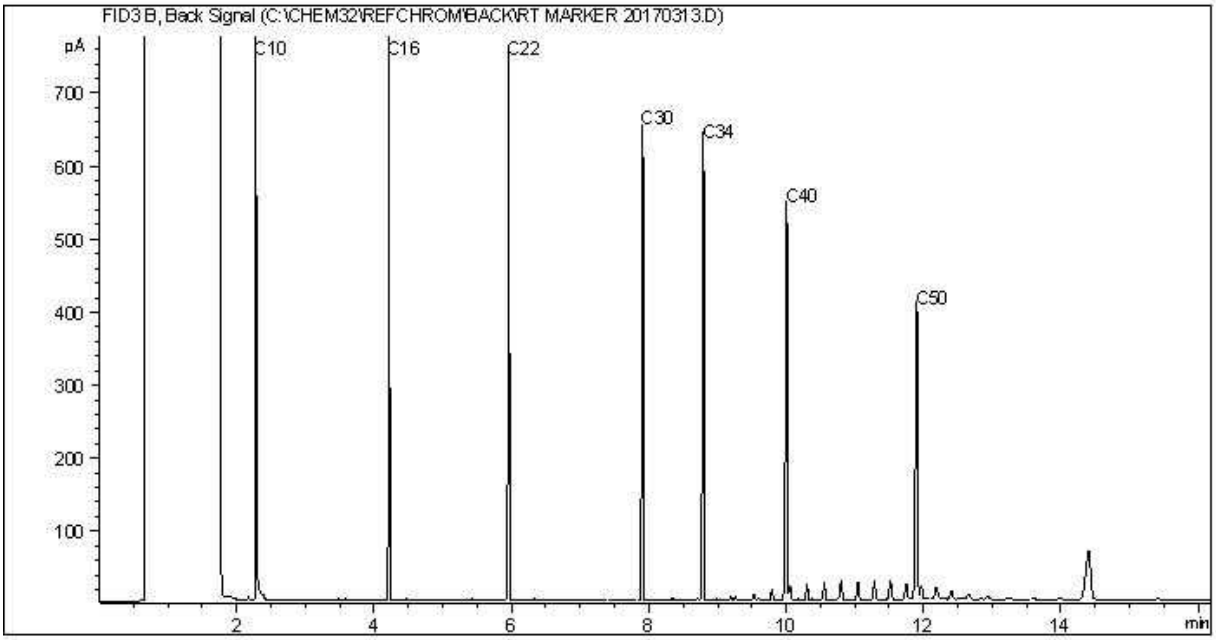
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: GIQ8-10-2-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

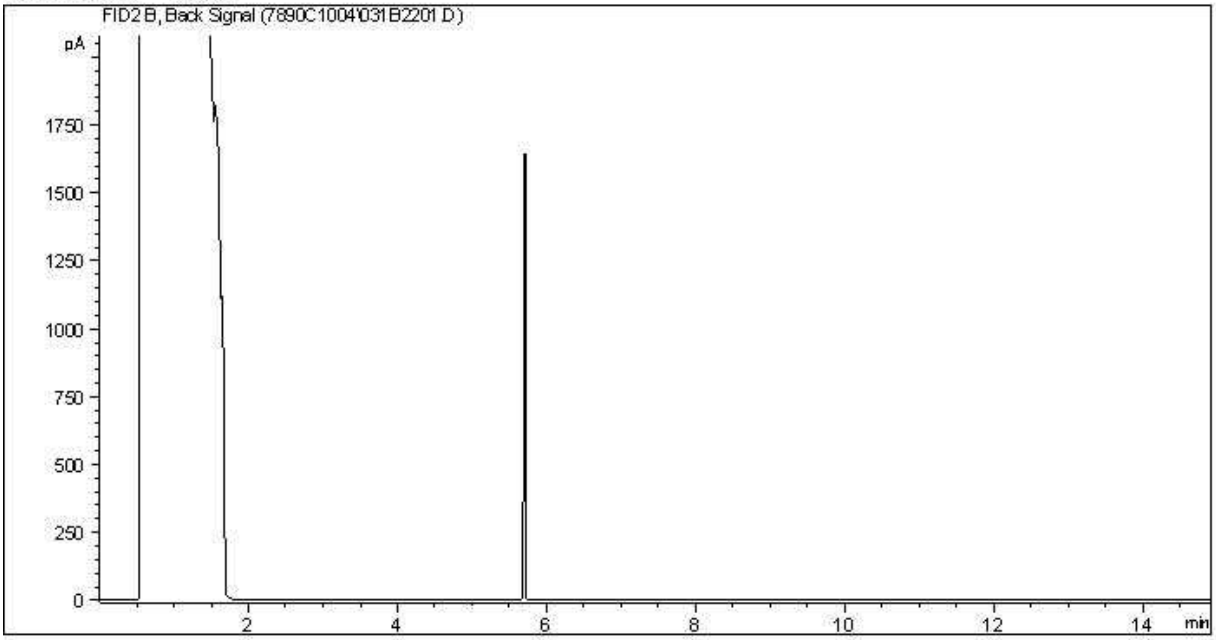
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B984438
Report Date: 2019/10/30
BV Labs Sample: WP9742

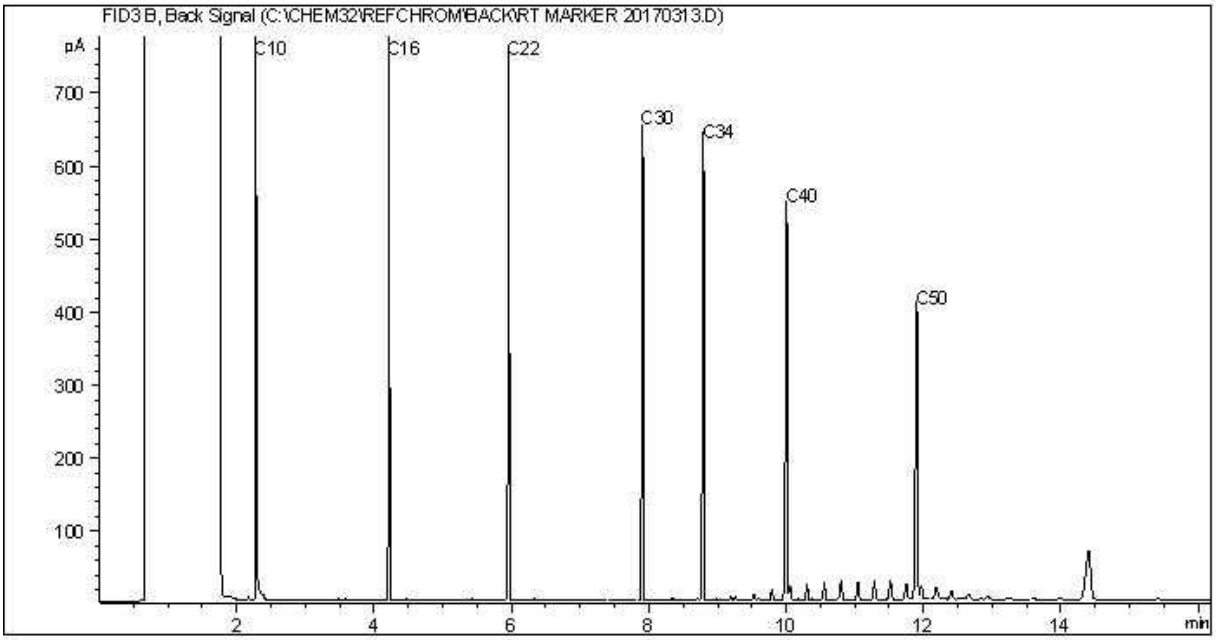
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: MWD19-02

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

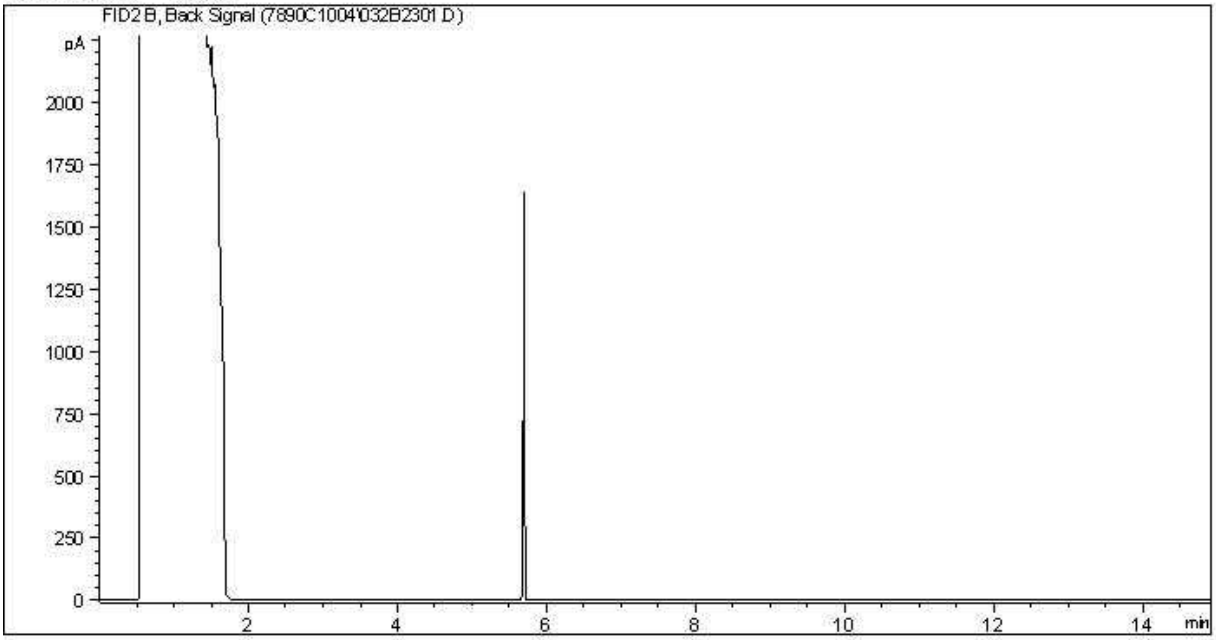
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B984438
Report Date: 2019/10/30
BV Labs Sample: WP9744

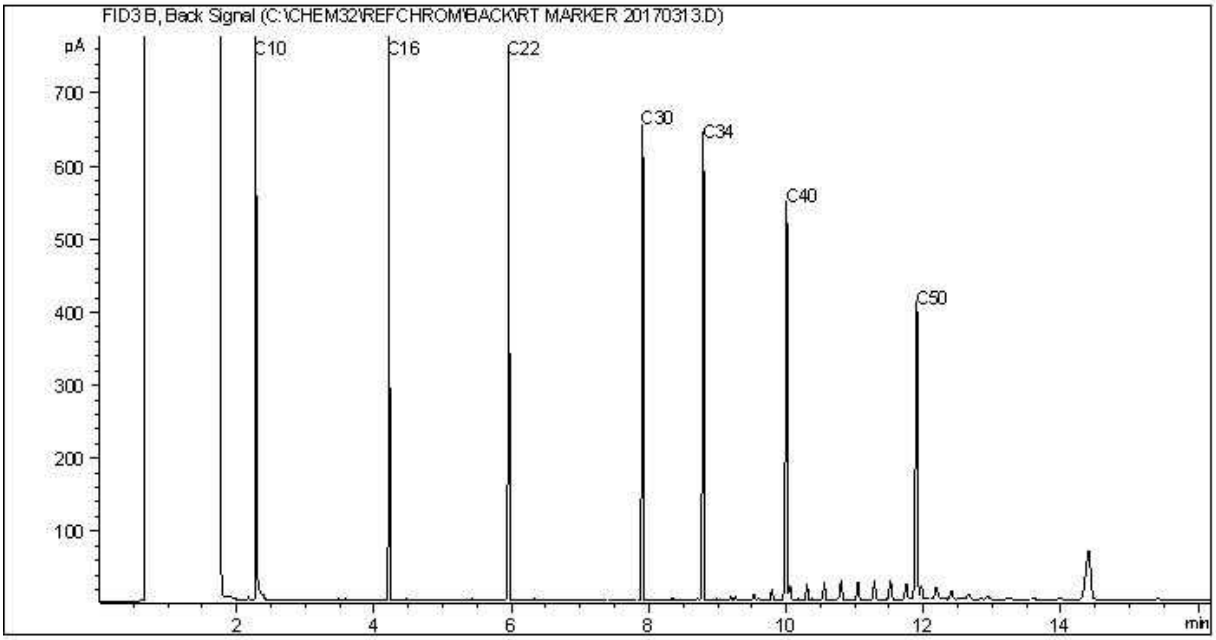
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BIS 97-1-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

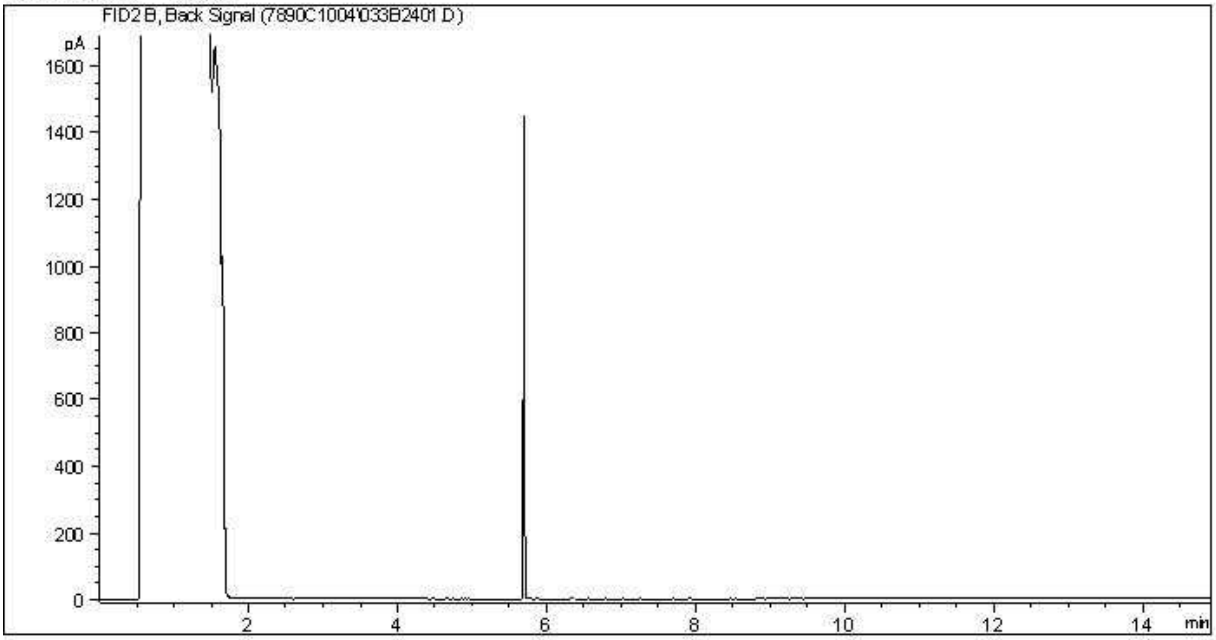
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B984438
Report Date: 2019/10/30
BV Labs Sample: WP9745

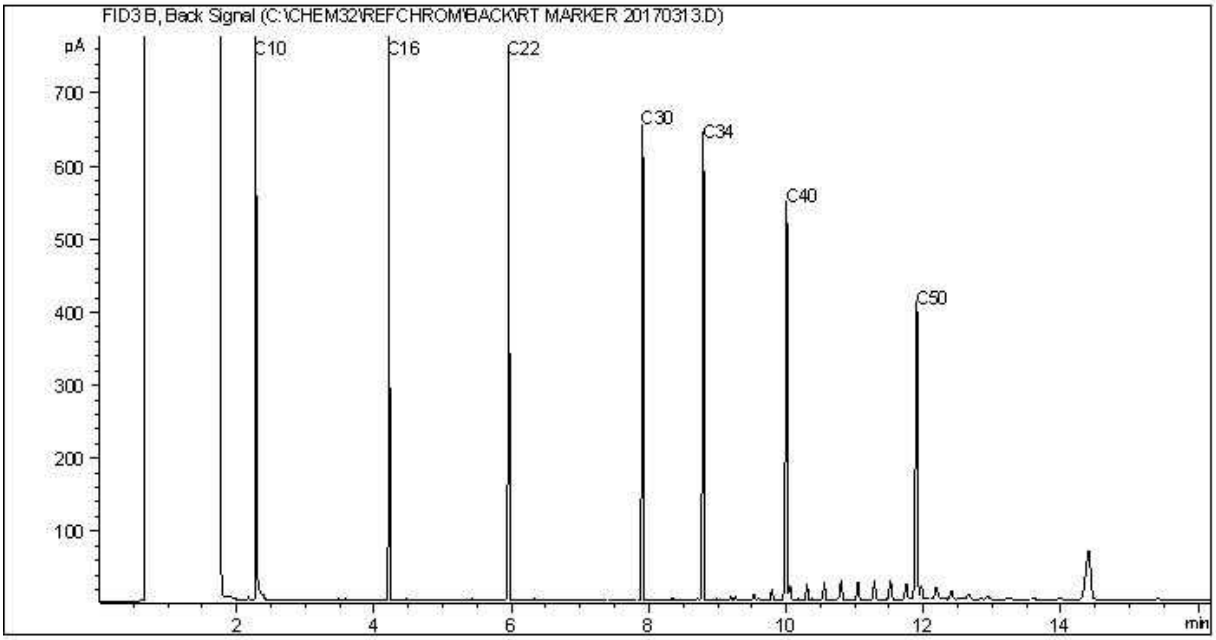
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: BI-13-1-4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
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☒ Edmonton
9331 - 48 Street, T6B 2R4
Phone: (780) 577-7100
Fax: (780) 450-4187
Toll Free: (800) 386-7247

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EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

C of C # 298945

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: WorleyParsons
Contact Name: Stacy Gibb	Contact Name: ~~Stacy~~ Stacy Gibb
Address: 500-151 Canada Olympic Rd SW, Calgary, AB T3B 6B7	Address: 500 - 151 Canada Olympic Rd SW, Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy.gibb@advisian.com
Ph: 403 247 0200	Ph: 403 247 0200
Sampler Name (Print): Alex Haigh / Dave Skillicorn	Consultant Project #: 407011-00770.400

ANALYSIS REQUESTED

	FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS: TOT ☐ DISS ☑	MERCURY: TOTAL ☐ DISSOLVED ☑	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP
1	GIBG-10-2-3	X				12	2019/09/30	09:35	X			X	X							X	X					X			X
2	GIQ8-10-2-4	X				10	↓	09:10	X				X							X	X					X			X
3	NWD19-02	X				10	↓	09:10	X				X							X	X					X			X
4	BIBG-10-1-4	X				12	2019/09/29	15:45	X			X	X							X	X					X			X
5	BIS 97-1-3	X				10	↓	16:15	X				X							X	X					X			X
6	BI-13-1-4	X				10	↓	16:45	X				X							X	X					X			X
7																													
8																													
9																													
10																													

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770.400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) PWAL ☐ Other

SPECIAL INSTRUCTIONS: also email: canada.chemistry@worleyparsons.com cacal-IORdatahandle@ IESA 2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #			
SEAL PRESENT	✓		TEMP °C	4	5	6
SEAL INTACT	✓			1	2	3
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #			
SEAL PRESENT			TEMP °C			
SEAL INTACT				1	2	3
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B984438

SAMPLES
LABELED BY: GA
VERIFIED BY: YLS

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1.	Alex Haigh	2019/10/02	10:00	1.	RAISE MATHEW	2019/10/03	09:25
2.				2.			
3.				3.			

COC-1010 (06/2016) IOL-AB White: Maxxam Yellow: Client

Sent to: **BV Labs Calgary**
4000 - 19 St.
Calgary, AB, T2E 6P8
Tel: (403) 291-3077

BV LABS INTERLAB CHAIN OF CUSTODY RECORD

pmx

COC # B984438-MCAL-01-01

REPORT INFORMATION	
Company:	Bureau Veritas Laboratories
Address:	9331 - 48th Street, Edmonton, Alberta, T6B 2R4
Contact Name:	Rhecie Phayouphone
Email:	Rhecie.Phayouphone@bvlabs.com, customerservice@bvlabs.com
Phone:	(403) 735-2283
BV Labs Project #:	B984438
Client Invoice To:	Imperial Oil Ltd - Worley Parsons (12794)
Client Report To:	Advisian (38038) **Incl. on Report? Yes / No**

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	ANALYSIS REQUESTED: PAH - Water	ADDITIONAL SAMPLE INFORMATION
1	WP9740-GIBG-10-2-3	GW	2019/09/30	09:35	AH	4	X	(P: 06)
2	WP9743-BIBG-10-1-4	GW	2019/09/29	15:45	AH	4	X	(P: 06)
3								
4								
5								
6								
7								
8								
9								
10								

Job Barcode Label

B984438

SITE LOCATION:	REGULATORY CRITERIA	SPECIAL INSTRUCTIONS	REQUIRED EDDs	TURNAROUND TIME
Norman Wells, NT	CCME: FWAL	Please inform BV Labs immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**	National Excel (N001) Worley Parsons Komex Equis (N026) Standard DBF (Old DBase Names) (A002)	☐ Rush Required **2019/10/09** Date Required *Please inform us if rush charges will be incurred.*
SITE #: N/A				
PROJECT #: 407011-00770-400 (SNP Ops)				
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM: A2601436, 407011-00770-400				

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present	✓					
Custody Seal Intact	✓					
Cooling Media Present	✓					
				4	7	2

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RECEIVING LAB USE ONLY

BV Labs Job #

B984438

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	Samples Labelled By:	Labels Verified By:
1. ARINJAY SARMA	2019/10/07	18:10	1. CLEMENTINE UWITIJE	2019/10/08	07:00	CT9	JKY
2.			2.				

DATA QUALITY REVIEW CHECKLIST - IMPERIAL OIL PROJECTS

Consultant: Advisian

Sampling Date: 04-Oct-19

Location: Norman Wells

Laboratory : Maxxam

Consultant Project Number: 407011-00770-400

Sample Submission Number: B985436

Are All Laboratory QC Within Acceptance Criteria (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Instrument Surrogate Recovery	x			All laboratory QC met acceptance criteria.
Extraction Surrogate Recovery	x			
Method Blank Concentration	x			
Matrix Duplicate RPD	x			
Matrix Spike Recovery	x			
Lab Control Sample Recovery	x			

Are All Field QC Samples Within Alert Limits (Yes, No, Not Applicable)?

	Yes	No	NA	Comments
Field Blank Concentration			x	No field QC samples submitted.
Trip Blank Concentration			x	
Equipment Blank Concentration			x	
Field Duplicate RPD			x	

Has CoA been signed off (Yes/No)?:	Yes
Has lab warranted all tests were analyzed following SOP's in CoA (Yes/No)?:	Yes
Were all samples analyzed within hold times (Yes/No)?:	Yes
All volatiles samples methanol extracted (if required) within 48 hours (Yes/No)?:	n/a
Is Chain of Custody completed and signed (Yes/No)?:	Yes
Were sample temperatures acceptable when they reached lab (Yes/No)?:	Yes

Was a Data Quality Overview (DQO) issued (Yes/No)?: No

Date DQO was received: NA

Is data considered to be reliable (Yes/No)?: Yes

If answer is "No", describe and provide rationale:

Data Reviewed by (Print): dheenarama kr

Data Reviewed by (Signature):

Date: 31-Oct-19

Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298954

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/10/30
Report #: R2803653
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B985436
Received: 2019/10/06, 10:30

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Laboratory Method	Primary Reference
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	AB SOP-00005	SM 23 2320 B m
BTEX/F1 in Water by HS GC/MS/FID	2	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	2		Auto Calc
Cadmium - low level CCME - Dissolved	1		Auto Calc
Chloride/Sulphate by Auto Colourimetry	2	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	2	AB SOP-00005	SM 23 2510 B m
Fluoride	2	AB SOP-00005	SM 23 4500-F C m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	2	AB SOP-00037 / AB SOP-00040	CCME PHC-CWS m
Hardness	1		Auto Calc
Mercury (Dissolved) by CV	1	EENVSOP-00031	EPA 245.7 R2 m
Elements by ICP - Dissolved (3)	1	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (3)	1	AB SOP-00043	EPA 6020b R2 m
Ion Balance	1		Auto Calc
Nitrate and Nitrite (1)	1		Auto Calc
Nitrate + Nitrite-N (calculated) (1)	1		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC (1)	1	AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency (4)	1		Auto Calc
PAH in Water by GC/MS	1	AB SOP-00037 / AB SOP-00003	EPA 3510C/8270E m
Phenols (4-AAP)	1	EENVSOP-00061	MMCW 154 1996 m
Total Dissolved Solids (Filt. Residue)	1	AB SOP-00065	SM 23 2540 C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard. All samples were analyzed within hold time unless otherwise flagged.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and

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Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400
Your C.O.C. #: 298954

Attention: Stacy Gibb

Advisian
Suite 500, 151 Canada Olympic
Calgary, AB
Canada T3B 6B7

Report Date: 2019/10/30
Report #: R2803653
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B985436
Received: 2019/10/06, 10:30

use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 BV Labs Calgary Environmental
(2) Silica gel clean up employed.
(3) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(4) B[a]P TPE is calculated using 1/2 of the RDL for non detect results as per Alberta Environment instructions. This protocol may not apply in other jurisdictions.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Rhecie Phayouphone, Key Account Specialist
Email: Rhecie.Phayouphone@bvlabs.com
Phone# (403)735-2283
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

AT1 BTEX AND F1-F2 IN WATER (WATER)

BV Labs ID		WQ5023			WQ5023			WQ5024		
Sampling Date		2019/10/04 14:37			2019/10/04 14:37			2019/10/04 15:40		
COC Number		298954			298954			298954		
	UNITS	**GIP11 09-1-4-R**	**RDL**	**QC Batch**	**GIP11 09-1-4-R Lab-Dup**	**RDL**	**QC Batch**	**MEBG-10-1-3**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	9617011				<0.10	0.10	9616044
Volatiles										
Benzene	mg/L	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288
Toluene	mg/L	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288
Ethylbenzene	mg/L	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288
m & p-Xylene	mg/L	<0.00080	0.00080	9618288	<0.00080	0.00080	9618288	<0.00080	0.00080	9618288
o-Xylene	mg/L	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288	<0.00040	0.00040	9618288
Xylenes (Total)	mg/L	<0.00089	0.00089	9616687				<0.00089	0.00089	9616687
F1 (C6-C10) - BTEX	mg/L	<0.10	0.10	9616687				<0.10	0.10	9616687
LH (C5-C10)	mg/L	<0.10	0.10	9618288	<0.10	0.10	9618288	<0.10	0.10	9618288
F1 (C6-C10)	mg/L	<0.10	0.10	9618288	<0.10	0.10	9618288	<0.10	0.10	9618288
Extraction Surrogate Recovery (%)										
O-TERPHENYL (sur.)	%	95		9617011				86		9616044
Instrument Surrogate Recovery (%)										
1,4-Difluorobenzene (sur.)	%	97		9618288	98		9618288	98		9618288
4-Bromofluorobenzene (sur.)	%	102		9618288	102		9618288	101		9618288
D4-1,2-Dichloroethane (sur.)	%	92		9618288	94		9618288	94		9618288

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WQ5023			WQ5024		
Sampling Date		2019/10/04 14:37			2019/10/04 15:40		
COC Number		298954			298954		
	UNITS	**GIP11 09-1-4-R**	**RDL**	**QC Batch**	**MEBG-10-1-3**	**RDL**	**QC Batch**
Calculated Parameters							
Hardness (CaCO3)	mg/L				810	0.50	9616690
Ion Balance (% Difference)	%				4.1	N/A	9616691
Dissolved Nitrate (NO3)	mg/L				<0.044	0.044	9616693
Nitrate plus Nitrite (N)	mg/L				<0.014	0.014	9616694
Dissolved Nitrite (NO2)	mg/L				<0.033	0.033	9616693
Misc. Inorganics							
Conductivity	uS/cm	1100	2.0	9618593	1500	2.0	9618593
Total Dissolved Solids	mg/L				980	10	9620224
Low Level Elements							
Dissolved Cadmium (Cd)	mg/L				0.000030	0.000020	9616688
Anions							
Alkalinity (PP as CaCO3)	mg/L				<1.0	1.0	9618590
Alkalinity (Total as CaCO3)	mg/L				680	1.0	9618590
Bicarbonate (HCO3)	mg/L				830	1.0	9618590
Carbonate (CO3)	mg/L				<1.0	1.0	9618590
Dissolved Fluoride (F)	mg/L	0.061	0.050	9642884	0.11	0.050	9642884
Hydroxide (OH)	mg/L				<1.0	1.0	9618590
Dissolved Chloride (Cl)	mg/L	17	1.0	9623207	1.9	1.0	9623207
Dissolved Sulphate (SO4)	mg/L				260 (1)	5.0	9623207
Nutrients							
Dissolved Nitrite (N)	mg/L				<0.010	0.010	9618195
Dissolved Nitrate (N)	mg/L				<0.010	0.010	9618195
Misc. Organics							
Phenols	mg/L				0.0022	0.0015	9622877

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

SEMIVOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID		WQ5024		
Sampling Date		2019/10/04 15:40		
COC Number		298954		
	UNITS	**MEBG-10-1-3**	**RDL**	**QC Batch**
Polycyclic Aromatics				
B[a]P TPE Total Potency Equivalents	mg/L	<0.000010	0.000010	9616811
Acenaphthene	mg/L	<0.00010	0.00010	9616053
Acenaphthylene	mg/L	<0.00010	0.00010	9616053
Acridine	mg/L	<0.000040	0.000040	9616053
Anthracene	mg/L	<0.000010	0.000010	9616053
Benzo(a)anthracene	mg/L	<0.0000085	0.0000085	9616053
Benzo(b&j)fluoranthene	mg/L	<0.0000085	0.0000085	9616053
Benzo(k)fluoranthene	mg/L	<0.0000085	0.0000085	9616053
Benzo(g,h,i)perylene	mg/L	<0.0000085	0.0000085	9616053
Benzo(c)phenanthrene	mg/L	<0.000050	0.000050	9616053
Benzo(a)pyrene	mg/L	<0.0000075	0.0000075	9616053
Benzo(e)pyrene	mg/L	<0.000050	0.000050	9616053
Chrysene	mg/L	<0.0000085	0.0000085	9616053
Dibenz(a,h)anthracene	mg/L	<0.0000075	0.0000075	9616053
Fluoranthene	mg/L	<0.000010	0.000010	9616053
Fluorene	mg/L	<0.000050	0.000050	9616053
Indeno(1,2,3-cd)pyrene	mg/L	<0.0000085	0.0000085	9616053
1-Methylnaphthalene	mg/L	<0.00010	0.00010	9616053
2-Methylnaphthalene	mg/L	<0.00010	0.00010	9616053
Naphthalene	mg/L	<0.00010	0.00010	9616053
Phenanthrene	mg/L	<0.000050	0.000050	9616053
Perylene	mg/L	<0.000050	0.000050	9616053
Pyrene	mg/L	<0.000020	0.000020	9616053
Quinoline	mg/L	<0.00020	0.00020	9616053
Extraction Surrogate Recovery (%)				
D10-ANTHRACENE (sur.)	%	72		9616053
D8-ACENAPHTHYLENE (sur.)	%	80		9616053
D8-NAPHTHALENE (sur.)	%	74		9616053
TERPHENYL-D14 (sur.)	%	71		9616053
RDL = Reportable Detection Limit				

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WQ5024		
Sampling Date		2019/10/04 15:40		
COC Number		298954		
	UNITS	**MEBG-10-1-3**	**RDL**	**QC Batch**
Elements				
Dissolved Mercury (Hg)	ug/L	<0.0020	0.0020	9619325
RDL = Reportable Detection Limit				

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WQ5024		
Sampling Date		2019/10/04 15:40		
COC Number		298954		
	UNITS	**MEBG-10-1-3**	**RDL**	**QC Batch**
Elements				
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0030	9621860
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9621860
Dissolved Arsenic (As)	mg/L	0.0016	0.00020	9621860
Dissolved Barium (Ba)	mg/L	0.24	0.010	9621862
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9621860
Dissolved Boron (B)	mg/L	0.022	0.020	9621862
Dissolved Calcium (Ca)	mg/L	240	0.30	9621862
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9621860
Dissolved Cobalt (Co)	mg/L	0.0033	0.00030	9621860
Dissolved Copper (Cu)	mg/L	0.00039	0.00020	9621860
Dissolved Iron (Fe)	mg/L	4.5	0.060	9621862
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9621860
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9621862
Dissolved Magnesium (Mg)	mg/L	51	0.20	9621862
Dissolved Manganese (Mn)	mg/L	2.3	0.0040	9621862
Dissolved Molybdenum (Mo)	mg/L	0.0023	0.00020	9621860
Dissolved Nickel (Ni)	mg/L	0.0071	0.00050	9621860
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9621862
Dissolved Potassium (K)	mg/L	1.3	0.30	9621862
Dissolved Selenium (Se)	mg/L	0.00024	0.00020	9621860
Dissolved Silicon (Si)	mg/L	4.5	0.10	9621862
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9621860
Dissolved Sodium (Na)	mg/L	25	0.50	9621862
Dissolved Strontium (Sr)	mg/L	0.74	0.020	9621862
Dissolved Sulphur (S)	mg/L	73	0.20	9621862
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9621860
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9621860
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9621860
Dissolved Uranium (U)	mg/L	0.0082	0.00010	9621860
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9621860
Dissolved Zinc (Zn)	mg/L	0.0060	0.0030	9621860
RDL = Reportable Detection Limit				

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

TEST SUMMARY

BV Labs ID: WQ5023
Sample ID: GIP11 09-1-4-R
Matrix: Water

Collected: 2019/10/04
Relinquished: 2019/10/05
Received: 2019/10/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9618288	N/A	2019/10/10	Adriana Munoz
F1-BTEX	CALC/MS	9616687	N/A	2019/10/11	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9623207	N/A	2019/10/11	Ashley Fedoriuk
Conductivity @25C	COND	9618593	N/A	2019/10/08	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9617011	2019/10/07	2019/10/08	Jana Rychlikova

BV Labs ID: WQ5023 Dup
Sample ID: GIP11 09-1-4-R
Matrix: Water

Collected: 2019/10/04
Relinquished: 2019/10/05
Received: 2019/10/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9618288	N/A	2019/10/10	Adriana Munoz

BV Labs ID: WQ5024
Sample ID: MEBG-10-1-3
Matrix: Water

Collected: 2019/10/04
Relinquished: 2019/10/05
Received: 2019/10/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity @25C (pp, total), CO3,HCO3,OH	AT/ALK	9618590	N/A	2019/10/08	Malina Alamyar
BTEX/F1 in Water by HS GC/MS/FID	HSGC/MS	9618288	N/A	2019/10/10	Adriana Munoz
F1-BTEX	CALC/MS	9616687	N/A	2019/10/11	Automated Statchk
Cadmium - low level CCME - Dissolved	CALC/MS	9616688	N/A	2019/10/12	Automated Statchk
Chloride/Sulphate by Auto Colourimetry	KONE	9623207	N/A	2019/10/11	Ashley Fedoriuk
Conductivity @25C	COND	9618593	N/A	2019/10/08	Malina Alamyar
Fluoride	AT	9642884	N/A	2019/10/25	Malina Alamyar
CCME Hydrocarbons in Water (F2; C10-C16)	GC/FID	9616044	2019/10/08	2019/10/10	Grace Guo
Hardness	CALC	9616690	N/A	2019/10/11	Automated Statchk
Mercury (Dissolved) by CV	CV	9619325	2019/10/10	2019/10/10	Andrew Payne
Elements by ICP - Dissolved	ICPA	9621862	N/A	2019/10/10	Queen Acharya
Elements by ICPMS - Dissolved	ICPM	9621860	N/A	2019/10/11	Julie Harrison
Ion Balance	CALC	9616691	N/A	2019/10/08	Suwan Fock
Nitrate and Nitrite	CALC	9616693	N/A	2019/10/10	Automated Statchk
Nitrate + Nitrite-N (calculated)	CALC	9616694	N/A	2019/10/10	Automated Statchk
Nitrogen (Nitrite - Nitrate) by IC	IC/UV	9618195	N/A	2019/10/07	Parniyan Roosta
Benzo[a]pyrene Equivalency	GC/MSD	9616811	N/A	2019/10/11	Automated Statchk
PAH in Water by GC/MS	GC/MS	9616053	2019/10/07	2019/10/11	Sandra Wilson
Phenols (4-AAP)	TECH/4AAP	9622877	N/A	2019/10/10	Ying Yang
Total Dissolved Solids (Filt. Residue)	BAL	9620224	2019/10/09	2019/10/10	Amy Aston

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

GENERAL COMMENTS

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

Package 1	3.0°C

Temperatures upon receipt at Maxxam Calgary
Package 1: 2.7 degrees C
Each temperature is the average of up to three cooler temperatures taken at receipt

Version 2: Report reissued to include results for Fluoride as per AARF on 2019/10/23.

Results relate only to the items tested.

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BV Labs Job #: B985436
Report Date: 2019/10/30

Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9616044	GG3	Method Blank	O-TERPHENYL (sur.)	2019/10/09		89	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/09	<0.10		mg/L	
9616053	SB8	Method Blank	D10-ANTHRACENE (sur.)	2019/10/10		72	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/10/10		73	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/10/10		78	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/10/10		74	%	50 - 130
			Acenaphthene	2019/10/10	<0.00010		mg/L	
			Acenaphthylene	2019/10/10	<0.00010		mg/L	
			Acridine	2019/10/10	<0.000040		mg/L	
			Anthracene	2019/10/10	<0.000010		mg/L	
			Benzo(a)anthracene	2019/10/10	<0.0000085		mg/L	
			Benzo(b&j)fluoranthene	2019/10/10	<0.0000085		mg/L	
			Benzo(k)fluoranthene	2019/10/10	<0.0000085		mg/L	
			Benzo(g,h,i)perylene	2019/10/10	<0.0000085		mg/L	
			Benzo(c)phenanthrene	2019/10/10	<0.000050		mg/L	
			Benzo(a)pyrene	2019/10/10	<0.0000075		mg/L	
			Benzo(e)pyrene	2019/10/10	<0.000050		mg/L	
			Chrysene	2019/10/10	<0.0000085		mg/L	
			Dibenz(a,h)anthracene	2019/10/10	<0.0000075		mg/L	
			Fluoranthene	2019/10/10	<0.000010		mg/L	
			Fluorene	2019/10/10	<0.000050		mg/L	
			Indeno(1,2,3-cd)pyrene	2019/10/10	<0.0000085		mg/L	
			1-Methylnaphthalene	2019/10/10	<0.00010		mg/L	
			2-Methylnaphthalene	2019/10/10	<0.00010		mg/L	
			Naphthalene	2019/10/10	<0.00010		mg/L	
			Phenanthrene	2019/10/10	<0.000050		mg/L	
			Perylene	2019/10/10	<0.000050		mg/L	
			Pyrene	2019/10/10	<0.000020		mg/L	
			Quinoline	2019/10/10	<0.00020		mg/L	
9617011	JR1	Method Blank	O-TERPHENYL (sur.)	2019/10/07		93	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/07	<0.10		mg/L	
9618195	PR6	Method Blank	Dissolved Nitrite (N)	2019/10/07	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/10/07	<0.010		mg/L	
9618288	AMJ	Method Blank	1,4-Difluorobenzene (sur.)	2019/10/10		96	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/10		102	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/10		92	%	50 - 140
			Benzene	2019/10/10	<0.00040		mg/L	
			Toluene	2019/10/10	<0.00040		mg/L	
			Ethylbenzene	2019/10/10	<0.00040		mg/L	
			m & p-Xylene	2019/10/10	<0.00080		mg/L	
			o-Xylene	2019/10/10	<0.00040		mg/L	
			LH (C5-C10)	2019/10/10	<0.10		mg/L	
			F1 (C6-C10)	2019/10/10	<0.10		mg/L	
9618590	MA4	Method Blank	Alkalinity (Total as CaCO3)	2019/10/08	<1.0		mg/L	
			Alkalinity (PP as CaCO3)	2019/10/08	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/08	<1.0		mg/L	
			Carbonate (CO3)	2019/10/08	<1.0		mg/L	
			Hydroxide (OH)	2019/10/08	<1.0		mg/L	
9618593	MA4	Method Blank	Conductivity	2019/10/08	<2.0		uS/cm	
9619325	APY	Method Blank	Dissolved Mercury (Hg)	2019/10/10	<0.0020		ug/L	
9620224	AAZ	Method Blank	Total Dissolved Solids	2019/10/10	<10		mg/L	
9621860	JHS	Method Blank	Dissolved Aluminum (Al)	2019/10/11	<0.0030		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Chromium (Cr)	2019/10/11	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/10/11	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/10/11	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/10/11	<0.00020		mg/L	
			Dissolved Antimony (Sb)	2019/10/11	<0.00060		mg/L	
			Dissolved Molybdenum (Mo)	2019/10/11	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/10/11	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/10/11	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/10/11	<0.00010		mg/L	
			Dissolved Arsenic (As)	2019/10/11	<0.00020		mg/L	
			Dissolved Thallium (Tl)	2019/10/11	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/10/11	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/10/11	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/10/11	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/10/11	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/10/11	<0.0030		mg/L	
			Dissolved Beryllium (Be)	2019/10/11	<0.0010		mg/L	
9621862	ACY	Method Blank	Dissolved Iron (Fe)	2019/10/10	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/10	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/10	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/10	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/10/10	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/10/10	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/10	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/10	<0.20		mg/L	
			Dissolved Phosphorus (P)	2019/10/10	<0.10		mg/L	
			Dissolved Barium (Ba)	2019/10/10	<0.010		mg/L	
			Dissolved Silicon (Si)	2019/10/10	<0.10		mg/L	
			Dissolved Boron (B)	2019/10/10	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/10	<0.30		mg/L	
9622877	YY	Method Blank	Phenols	2019/10/10	<0.0015		mg/L	
9623207	AF6	Method Blank	Dissolved Chloride (Cl)	2019/10/11	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/10/11	<1.0		mg/L	
9642884	MA4	Method Blank	Dissolved Fluoride (F)	2019/10/25	<0.050		mg/L	
9618288	AMJ	RPD [WQ5023-02]	Benzene	2019/10/10	NC		%	30
			Toluene	2019/10/10	NC		%	30
			Ethylbenzene	2019/10/10	NC		%	30
			m & p-Xylene	2019/10/10	NC		%	30
			o-Xylene	2019/10/10	NC		%	30
			LH (C5-C10)	2019/10/10	NC		%	30
			F1 (C6-C10)	2019/10/10	NC		%	30
9618288	AMJ	Matrix Spike [WQ5024-02]	1,4-Difluorobenzene (sur.)	2019/10/10		98	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/10		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/10		100	%	50 - 140
			Benzene	2019/10/10		79	%	50 - 140
			Toluene	2019/10/10		76	%	50 - 140
			Ethylbenzene	2019/10/10		83	%	50 - 140
			m & p-Xylene	2019/10/10		80	%	50 - 140
			o-Xylene	2019/10/10		79	%	50 - 140
			LH (C5-C10)	2019/10/10		74	%	60 - 140
			F1 (C6-C10)	2019/10/10		74	%	60 - 140

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9616044	GG3	LCS	O-TERPHENYL (sur.)	2019/10/09		91	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/09		98	%	60 - 140
9616053	SB8	LCS	D10-ANTHRACENE (sur.)	2019/10/10		74	%	50 - 130
			TERPHENYL-D14 (sur.)	2019/10/10		75	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2019/10/10		83	%	50 - 130
			D8-NAPHTHALENE (sur.)	2019/10/10		78	%	50 - 130
			Acenaphthene	2019/10/10		75	%	50 - 130
			Acenaphthylene	2019/10/10		84	%	50 - 130
			Acridine	2019/10/10		69	%	50 - 130
			Anthracene	2019/10/10		79	%	50 - 130
			Benzo(a)anthracene	2019/10/10		85	%	50 - 130
			Benzo(b&j)fluoranthene	2019/10/10		85	%	50 - 130
			Benzo(k)fluoranthene	2019/10/10		82	%	50 - 130
			Benzo(g,h,i)perylene	2019/10/10		73	%	50 - 130
			Benzo(c)phenanthrene	2019/10/10		83	%	50 - 130
			Benzo(a)pyrene	2019/10/10		80	%	50 - 130
			Benzo(e)pyrene	2019/10/10		85	%	50 - 130
			Chrysene	2019/10/10		81	%	50 - 130
			Dibenz(a,h)anthracene	2019/10/10		71	%	50 - 130
			Fluoranthene	2019/10/10		73	%	50 - 130
			Fluorene	2019/10/10		81	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/10/10		73	%	50 - 130
			1-Methylnaphthalene	2019/10/10		82	%	50 - 130
			2-Methylnaphthalene	2019/10/10		81	%	50 - 130
			Naphthalene	2019/10/10		77	%	50 - 130
			Phenanthrene	2019/10/10		73	%	50 - 130
			Perylene	2019/10/10		83	%	50 - 130
			Pyrene	2019/10/10		73	%	50 - 130
			Quinoline	2019/10/10		116	%	50 - 130
9617011	JR1	LCS	O-TERPHENYL (sur.)	2019/10/07		92	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2019/10/07		95	%	60 - 140
9618195	PR6	LCS	Dissolved Nitrite (N)	2019/10/07		100	%	80 - 120
			Dissolved Nitrate (N)	2019/10/07		102	%	80 - 120
9618288	AMJ	LCS	1,4-Difluorobenzene (sur.)	2019/10/10		100	%	50 - 140
			4-Bromofluorobenzene (sur.)	2019/10/10		100	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2019/10/10		98	%	50 - 140
			Benzene	2019/10/10		81	%	60 - 130
			Toluene	2019/10/10		78	%	60 - 130
			Ethylbenzene	2019/10/10		85	%	60 - 130
			m & p-Xylene	2019/10/10		83	%	60 - 130
			o-Xylene	2019/10/10		81	%	60 - 130
			LH (C5-C10)	2019/10/10		76	%	60 - 140
			F1 (C6-C10)	2019/10/10		76	%	60 - 140
9618590	MA4	LCS	Alkalinity (Total as CaCO3)	2019/10/08		97	%	80 - 120
9618593	MA4	LCS	Conductivity	2019/10/08		97	%	90 - 110
9619325	APY	LCS	Dissolved Mercury (Hg)	2019/10/10		105	%	80 - 120
9620224	AAZ	LCS	Total Dissolved Solids	2019/10/10		99	%	80 - 120
9621860	JHS	LCS	Dissolved Aluminum (Al)	2019/10/11		103	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/11		96	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/11		96	%	80 - 120
			Dissolved Copper (Cu)	2019/10/11		96	%	80 - 120
			Dissolved Lead (Pb)	2019/10/11		96	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Antimony (Sb)	2019/10/11		93	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/11		95	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/11		94	%	80 - 120
			Dissolved Selenium (Se)	2019/10/11		98	%	80 - 120
			Dissolved Silver (Ag)	2019/10/11		94	%	80 - 120
			Dissolved Arsenic (As)	2019/10/11		96	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/11		95	%	80 - 120
			Dissolved Tin (Sn)	2019/10/11		98	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/11		94	%	80 - 120
			Dissolved Uranium (U)	2019/10/11		90	%	80 - 120
			Dissolved Vanadium (V)	2019/10/11		96	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/11		94	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/11		93	%	80 - 120
9621862	ACY	LCS	Dissolved Iron (Fe)	2019/10/10		100	%	80 - 120
			Dissolved Lithium (Li)	2019/10/10		101	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/10		100	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/10		99	%	80 - 120
			Dissolved Potassium (K)	2019/10/10		102	%	80 - 120
			Dissolved Sodium (Na)	2019/10/10		101	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/10		98	%	80 - 120
			Dissolved Sulphur (S)	2019/10/10		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/10		102	%	80 - 120
			Dissolved Barium (Ba)	2019/10/10		101	%	80 - 120
			Dissolved Silicon (Si)	2019/10/10		96	%	80 - 120
			Dissolved Boron (B)	2019/10/10		101	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/10		99	%	80 - 120
9622877	YY	LCS	Phenols	2019/10/10		97	%	80 - 120
9623207	AF6	LCS	Dissolved Chloride (Cl)	2019/10/11		111	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/11		108	%	80 - 120
9642884	MA4	LCS	Dissolved Fluoride (F)	2019/10/25		100	%	80 - 120

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.

LCS: 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 (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).

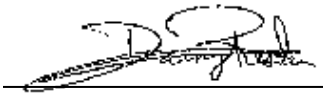
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BV Labs Job #: B985436
Report Date: 2019/10/30

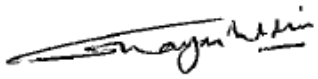
Advisian
Task Order#: 407011-00770-400
Site#: N/A
Site Location: Norman Wells, NT
Project #: 407011-00770-400

VALIDATION SIGNATURE PAGE

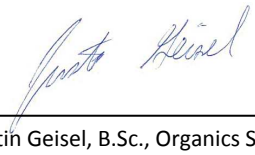
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



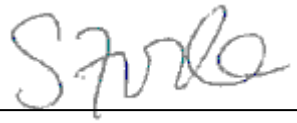
Daniel Reslan, cCT, QP, Organics Manager



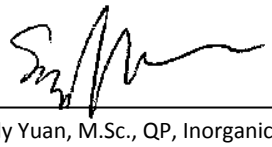
Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics



Justin Geisel, B.Sc., Organics Supervisor



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst



Sandy Yuan, M.Sc., QP, Inorganics Supervisor

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

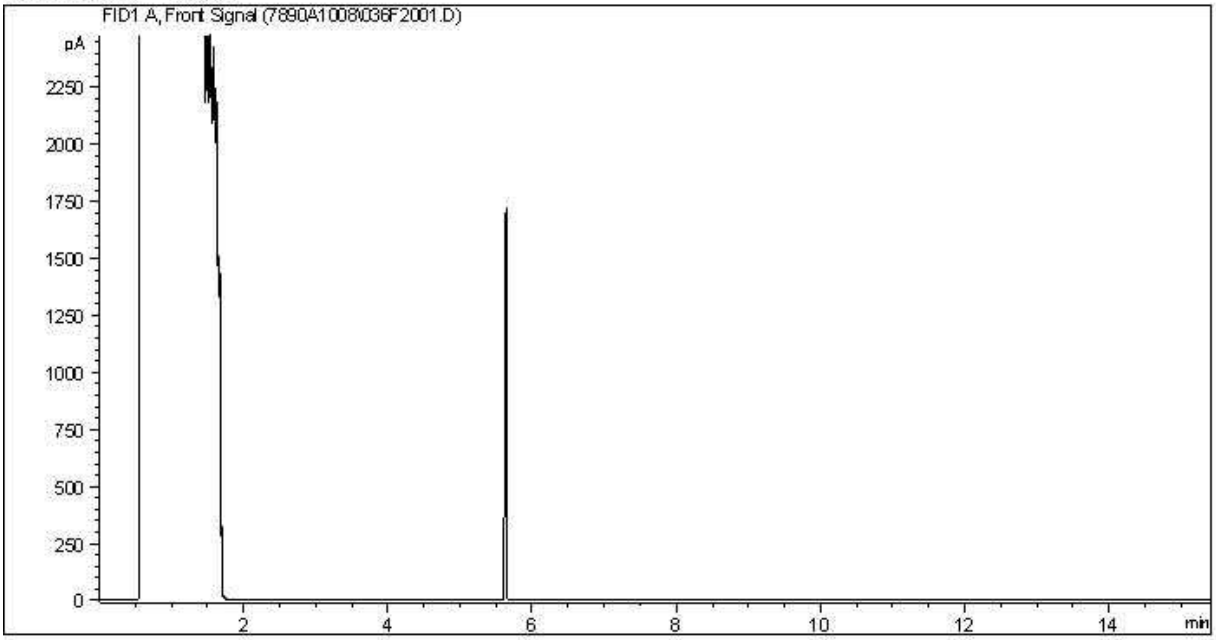
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BV Labs Job #: B985436
Report Date: 2019/10/30
BV Labs Sample: WQ5023

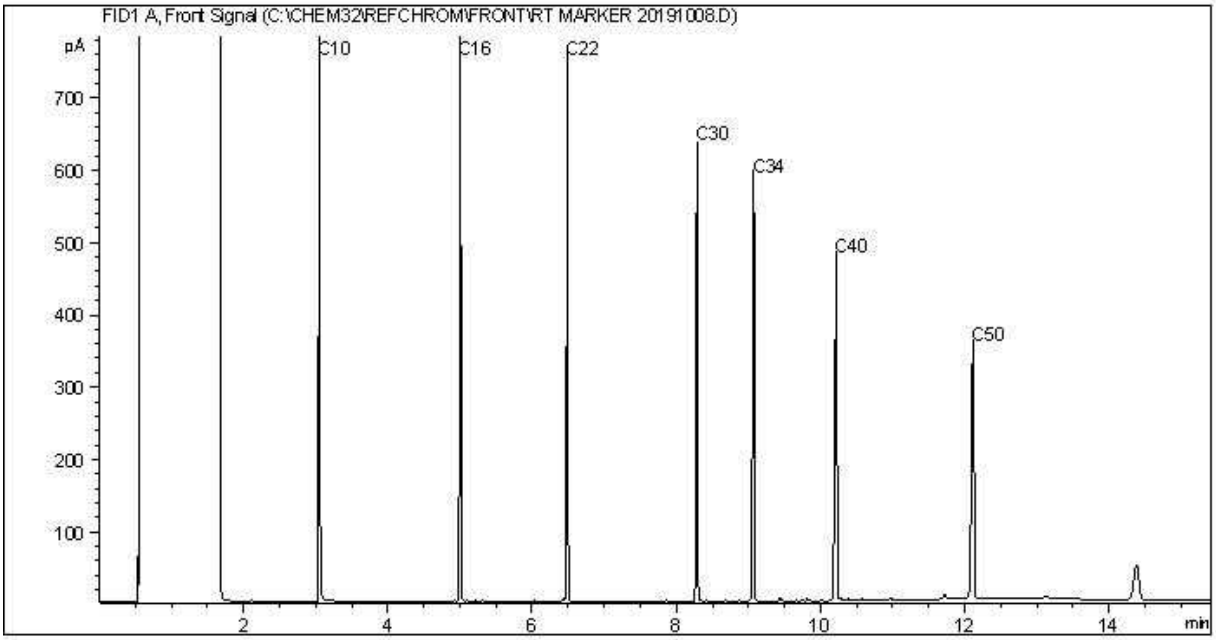
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: GIP11 09-1-4-R

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890A



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

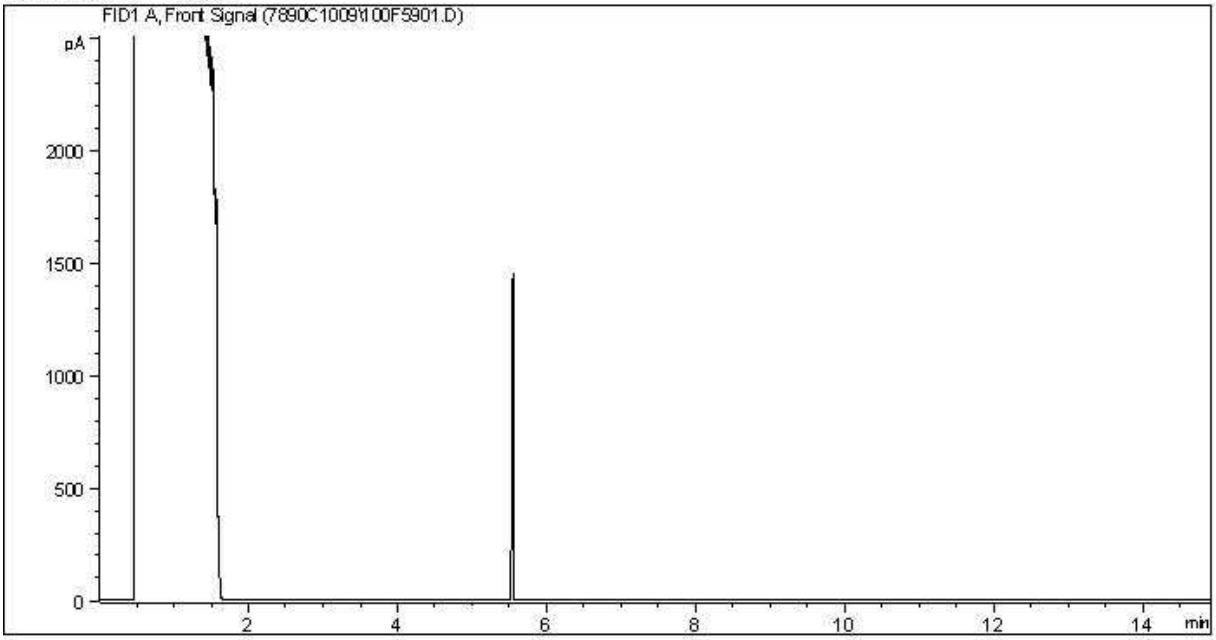
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: B985436
Report Date: 2019/10/30
BV Labs Sample: WQ5024

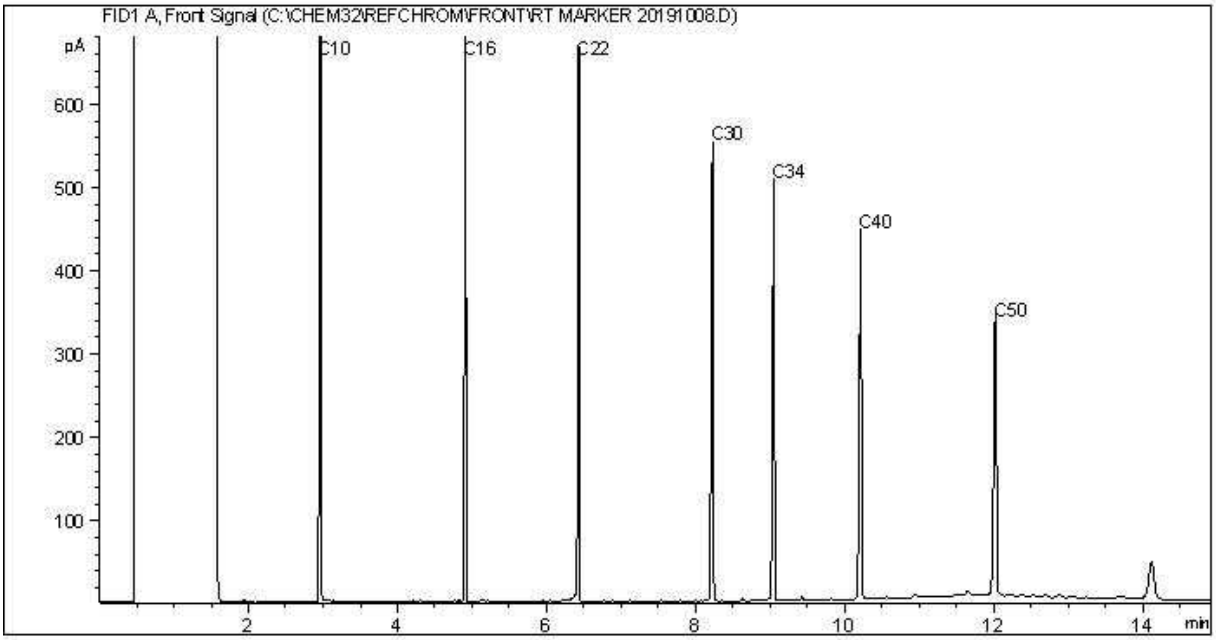
Advisian
Task Order#:407011-00770-400Line Item:
Site#: N/A
Site Location: Norman Wells, NT
Client ID: MEBG-10-1-3

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890C



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam — A Bureau Veritas Group Company

☐ Calgary
4000 19th St. NE, T2E 6P8
Phone: (403) 291-3077
Fax: (403) 735-2240
Toll Free: (800) 386-7247

☒ Edmonton
9331 - 48 Street, T6B 2R4
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Fax: (780) 450-4187
Toll Free: (800) 386-7247

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EXXON MOBIL/IMPERIAL OIL - MAXXAM CHAIN-OF-CUSTODY RECORD

Page 1 of 1

C of C # 298954

INVOICE INFORMATION	REPORT INFORMATION
Company Name: ☒ Imperial Oil ☐ ExxonMobil	Company Name: Advisian
Contact Name: Stacy Gibb	Contact Name: Stacy Gibb
Address: 500, 151 Caxada Olympic Rd SW Calgary, AB T3B 6B7	Address: 500, 151 Canada Olympic Rd SW Calgary, AB T3B 6B7
Email: stacy.gibb@advisian.com	Email: stacy-gibb@advisian.com
Ph: 403-247-0200	Ph: 403-247-0200
Sampler Name (Print): Michelle Vokaty, Stacy Gibb	Consultant Project #: 407011-00770-400

#	FIELD SAMPLE ID	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE (YYYY/MM/DD)	TIME (24 HR)	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	VOC	PAH	PHCs (FRACTIONS 1-2 PLUS BTEX)	PHCs (FRACTIONS 1-4 PLUS BTEX)	PHCs (FRACTIONS 2-4)	PHCs (FRACTION 1 PLUS BTEX)	GRAIN SIZE (75 MICRON)	TEXTURE (% SAND, SILT, CLAY)	PARTICLE SIZE DISTRIBUTION WITH GRAPH	REGULATED METALS ☐ TOT ☒ DIS.	MERCURY ☐ TOTAL ☒ DISSOLVED	SALINITY SOIL	FERTILIZER SOIL	FERTILIZER WATER	NUTRIENTS SOIL	ROUTINE POTABILITY	pH ☐ EC ☐ ALKALINITY ☐	BASIC CLASS II LANDFILL PKG	Phenols by 4AAP	EC, Cl, SO4, NO2+NO3	Limited sample
1	GIP11 09-1-4-R	X				6	2019/10/04	14:37					X																	X	X
2	MEB6-10-1-3	X				12	2019/10/04	15:40	X			X	X							X	X					X			X		
3																															
4																															
5																															
6																															
7																															
8																															
9																															
10																															

IOL SITE LOCATION: Norman Wells, NT

IOL PROJECT # (if applicable): N/A

MAXXAM TASK ORDER # OR SERVICE ORDER # + LINE ITEM: 407011-00770-400

REGULATORY CRITERIA / DETECTION LIMITS:
☐ Alberta Tier 1 ☐ CDWG
☐ SEQG (SK) ☐ NoSC (SK)
☒ CCME (incl. level) FWAL ☐ Other

SPECIAL INSTRUCTIONS: also email - canada.chemistry@advisian.com melissa.lord@advisian.com
IES A 2601436

JARS USED & NOT SUBMITTED (Enter N/A for Water): N/A

TURNAROUND TIME
Standard (5 days) ☒
Rush (3 days) ☐
(2 days) ☐
(1 day) ☐
(same day) ☐
Date Required

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT	✓		TEMP °C	3	3	3
SEAL INTACT	✓					
COOLING MEDIA PRESENT	✓					

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT			TEMP °C			
SEAL INTACT						
COOLING MEDIA PRESENT						

	YES	NO	COOLER ID #	1	2	3
SEAL PRESENT			TEMP °C			
SEAL INTACT						
COOLING MEDIA PRESENT						

LAB USE ONLY
MAXXAM JOB # B985436

SAMPLES
LABELED BY: DW
VERIFIED BY: MC

RELINQUISHED BY:		DATE:	TIME (24 HR)	RECEIVED BY:		DATE:	TIME (24 HR)
1. Michelle Vokaty	Michelle Vokaty	2019/10/05	13:00	1.	DEJIWU	2019/10/06	10:30
2.				2.			
3.				3.			

G9

BUREAU VERITAS

Sent to: **BV Labs Calgary**
4000 - 19 St.
Calgary, AB, T2E 6P8
Tel: (403) 291-3077

BV LABS INTERLAB CHAIN OF CUSTODY RECORD

COC # B985436-MCAL-01-01

REPORT INFORMATION	
Company:	Bureau Veritas Laboratories
Address:	9331 - 48th Street, Edmonton, Alberta, T6B 2R4
Contact Name:	Rhecie Phayouphone
Email:	Rhecie.Phayouphone@bvlabs.com, customerservice@bvlabs.com
Phone:	(403) 735-2283
BV Labs Project #:	B985436
Client Invoice To:	Imperial Oil Ltd - Worley Parsons (12794)
Client Report To:	Advisian (38038) **Incl. on Report? Yes / No**

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Nitrate and Nitrite	Nitrate + Nitrite-N (calculated)	Nitrogen (Nitrite - Nitrate) by IC								ADDITIONAL SAMPLE INFORMATION
1	WQ5024-MEBG-10-1-3	GW	2019/10/04	15:40	MV	1	X	X	X								(P: 03)
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

ANALYSIS REQUESTED

Job Barcode Label

B985436

SITE LOCATION:	REGULATORY CRITERIA	SPECIAL INSTRUCTIONS	REQUIRED EDDs	TURNAROUND TIME
Norman Wells, NT	CCME FWAL	Please inform BV Labs immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**	National Excel (N001) Worley Parsons Komex Equis (N026) Standard DBF (Old DBase Names) (A002)	☐ Rush Required 2019/10/11 Date Required *Please inform us if rush charges will be incurred.*
SITE #: N/A				
PROJECT #: 407011-00770-400				
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM: A2601436, 407011-00770-400				

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present	✓					
Custody Seal Intact	✓					
Cooling Media Present	✓					

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RECEIVING LAB USE ONLY

BV Labs Job #

B985436

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	Samples Labelled By:	Labels Verified By:
1. Jessica Lee	2019/10/07	09:34	1. Josh Kingsbury	2019/10/07	1551	DW2	JKy
2.			2.				

Appendix E
Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC)

Field QA/QC Program

The groundwater field QA/QC program for the SNP consisted of five field duplicate samples for the analysis of dissolved chloride and BTEX parameters. Four trip blank samples and four field blank samples were also submitted for analysis of petroleum hydrocarbons as part of the 2019 field program.

For the field duplicate samples, the QA/QC results were evaluated by calculating the relative percent difference (RPD) between the parent and duplicate sample results and comparison of the RPD to designated alert limits.

The RPD is calculated using the following formula:

$$\text{RPD \%} = \left(\frac{|x1 - x2|}{(x1 + x2)/2} \right) * 100$$

Where x_1 = original field sample
x_2 = blind field duplicate sample

Consistent with laboratory practices and to permit reliable calculations, an RPD is only considered to be statistically relevant when the original and duplicate sample concentrations are at least five times the reportable detection limit. These limits vary parameter to parameter and sample to sample and are indicated by the laboratory alongside the analytical results in the Certificates of Analysis (Appendix D).

The designated field duplicate RPD alert limits are presented in the analytical tables. All field duplicate RPDs were within the designated alert limits (<50% for dissolved chloride and <80% for BTE).

The designated trip and field blank alert limits are >5X the reportable detection limit (RDL) for BTE and >2X RDL for PHC fractions F1 through F4. The trip blanks and field blanks collected during the E&PS sampling program, which was completed concurrently with parts of the SNP program, were compared to the alert limits and are presented in Table D-1. All of the results were below the RDLs.

Laboratory QA/QC Program

The laboratory QA/QC program consisted of one or more of the following analyses:

- instrument and extraction surrogate recoveries for samples that were analyzed; and
- the analysis of method blank, laboratory duplicate, matrix spike and/or laboratory control samples for the sample analytical batches that were analyzed.

The laboratory QA/QC results are presented in the certificates of analysis (Appendix D). There were no QA/QC laboratory issues identified that impact the primary SNP parameters (dissolved chloride and BTE).

No field or laboratory QA/QC issues were identified that would affect the overall conclusions presented in this report. Overall, the results reported are considered to be reliable.

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Table E-1

Field and Trip Blanks: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770-400

Monitoring Station	Date (dd-mmm-yyyy)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	m&p-Xylene (mg/L)	o-Xylene (mg/L)	Xylenes (Total) (mg/L)	PHC F1 (C_6-C_{10}) (mg/L)	PHC F1 (C_6-C_{10}) - BTEX (mg/L)	PHC F2 (C_{10}-C_{16}) (mg/L)
CCME CEQG Freshwater Aquatic Life		**0.37**	**0.002**	**0.09**	**---**	**---**	**---**	**---**	**---**	**---**
Groundwater Field Blanks										
NWD19-18	11-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-20	16-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-19	17-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-03	28-Sep-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
Groundwater Trip Blanks										
NWD19-08	11-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-10	16-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-09	17-Jul-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
NWD19-04	28-Sep-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10

NOTES:

1. --- in guideline row(s) denotes no criteria for that parameter.
2. --- in detail data row(s) denotes parameter not analyzed.

Bold 3. Denotes values exceeding applied background concentrations and CCME guidelines
(CCME 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1).

Bold 4. Denotes values exceeding applied background concentrations only.

Bold 5. Denotes non-detect values where reportable detection limit exceeds applied background concentrations and CCME guidelines
(CCME 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1).

Appendix F
Mann–Kendall Statistical Analyses

Table F-1
Mann-Kendall Statistical Analysis (1997-2019) - Chloride

Filtered Trend Results, two-sided p-value < 0.05 And Normalized Slope > ± 10%/Year

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)
MEBG-10-1-3	15	-71	0.00	-0.2529	-11	1.9	2.4	5
BIBG-10-1-4	12	31	0.03	2.1693	15	3.0	14.0	25

Full Mann-Kendall Analysis, Sorted by two-sided p-value

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)
TF 03-12-3	22	-130	0.00	-7.3527	-4	80	165.0	280
MEBG-10-1-3	15	-71	0.00	-0.2529	-11	1.9	2.4	5
CPF 98-8-3	26	-134	0.00	-0.3487	-3	6.8	12.5	22
C38 08-1-4	17	-67	0.00	-0.5133	-2	14	21.0	25
BIS 97-1-3	21	-83	0.01	-0.2961	-1	16	22.0	35
CPF 97-7-5	27	104	0.03	0.2894	2	7.7	15.0	190
BIBG-10-1-4	12	31	0.03	2.1693	15	3.0	14.0	25
MTF 97-1-5	21	-67	0.04	-0.0475	-4	< 1.0	1.3	3.4
GIQ8-10-2-4	12	26	0.08	1.2106	7	5.8	18.5	21
BI-13-3-4.5	9	-17	0.09	-0.6982	-8	6.5	8.7	13
GIP11 09-1-4	7	-9	0.23	-4.5933	-66	3.6	7.0	110
BI-13-1-4	9	-12	0.25	-0.7103	-9	2.5	7.9	9.5
GIBG-10-2-3	15	22	0.29	0.3049	8	< 1.0	3.9	11
BIBG-12-1-7	4	-4	0.30	-0.5959	-7	7.5	8.65	11
WSY 97-1-5	26	-11	0.82	-0.0430	0	6.5	18.95	64
ARB-12-3-3	13	1	1.00	0.0000	0	8.7	18.0	32
GIP11 09-1-4-R	4	-1	1.00	-13.4824	-87	14	15.5	50

Table F-2
Mann-Kendall Statistical Analysis (1998-2019) - Benzene

Filtered Trend Results, two-sided p-value < 0.05 And Normalized Slope > ± 10%/Year

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)

Full Mann-Kendall Analysis, Sorted by two-sided p-value

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)
CPF 98-8-3	26	-159	0.00	0.0000	-1	< 0.0004	0.0002	< 0.0050
CPF 97-7-5	25	-144	0.00	0.0000	0	< 0.0004	0.0002	< 0.0050
WSY 97-1-5	23	-102	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
BIS 97-1-3	17	-66	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
TF 03-12-3	22	-81	0.00	0.0000	0	< 0.0004	0.0002	0.0017
MTF 97-1-5	17	-42	0.01	0.0000	0	< 0.0004	0.0002	< 0.0005
C38 08-1-4	17	14	0.18	0.0000	0	< 0.0004	0.0002	0.00093
BI-13-3-4.5	9	-2	0.84	0.0000	0	< 0.00040	0.0002	0.00042
MEBG-10-1-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIBG-10-2-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
ARB-12-3-3	13	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIQ8-10-2-4	12	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-10-1-4	12	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
BI-13-1-4	8	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIP11 09-1-4	7	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIP11 09-1-4-R	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-12-1-7	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040

Table F-3
Mann-Kendall Statistical Analysis (1998-2019) - Toluene

Filtered Trend Results, two-sided p-value < 0.05 And Normalized Slope > ± 10%/Year

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)

Full Mann-Kendall Analysis, Sorted by two-sided p-value

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)
CPF 98-8-3	26	-165	0.00	0.0000	-1	< 0.0004	0.0002	< 0.0050
CPF 97-7-5	25	-149	0.00	0.0000	-1	< 0.0004	0.0002	< 0.0050
WSY 97-1-5	23	-102	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
BIS 97-1-3	17	-66	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
TF 03-12-3	22	-72	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
MTF 97-1-5	17	-42	0.01	0.0000	0	< 0.0004	0.0002	< 0.0005
C38 08-1-4	17	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
MEBG-10-1-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIBG-10-2-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
ARB-12-3-3	13	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIQ8-10-2-4	12	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-10-1-4	12	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
BI-13-3-4.5	9	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BI-13-1-4	8	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIP11 09-1-4	7	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIP11 09-1-4-R	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-12-1-7	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040

Table F-4
Mann-Kendall Statistical Analysis (1998-2019) - Ethylbenzene

Filtered Trend Results, two-sided p-value < 0.05 And Normalized Slope > ± 10%/Year

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)

Full Mann-Kendall Analysis, Sorted by two-sided p-value

Location	Count	Mann-Kendall S	Two-sided p-value (for MK test)	Slope (mg/L/year)	Normalized Slope (%/year)	Min (mg/L)	Median (mg/L)	Max (mg/L)
CPF 98-8-3	26	-159	0.00	0.0000	-1	< 0.0004	0.0002	< 0.0050
CPF 97-7-5	25	-144	0.00	0.0000	0	< 0.0004	0.0002	< 0.0050
WSY 97-1-5	23	-102	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
BIS 97-1-3	17	-66	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
TF 03-12-3	22	-72	0.00	0.0000	0	< 0.0004	0.0002	< 0.0005
MTF 97-1-5	17	-42	0.01	0.0000	0	< 0.0004	0.0002	< 0.0005
C38 08-1-4	17	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
MEBG-10-1-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIBG-10-2-3	15	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
ARB-12-3-3	13	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIQ8-10-2-4	12	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-10-1-4	12	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
BI-13-3-4.5	9	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BI-13-1-4	8	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
GIP11 09-1-4	7	0	1.00	0.0000	0	< 0.0004	0.0002	< 0.0004
GIP11 09-1-4-R	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040
BIBG-12-1-7	4	0	1.00	0.0000	0	< 0.00040	0.0002	< 0.00040

Advisian
Worley Group

Table F-5
Statistical Summary

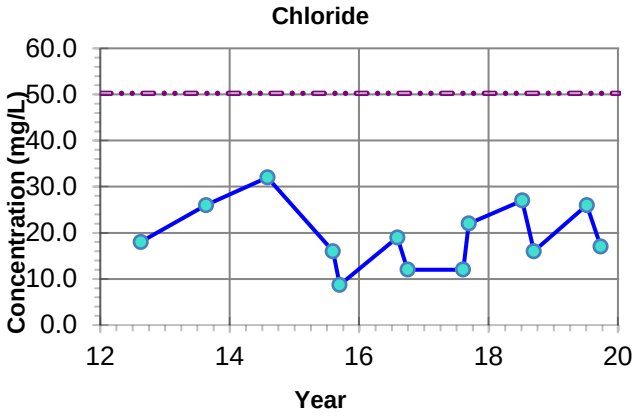
Project No.: 407011-00770-400				Trend Analysis							Upper Control Limit Analysis			Lower Control Limit Analysis			Basic Analysis									Guideline Analysis	
																	Historical								Reporting Period			
Location	Monitoring Station	Hydrostatigraphic Unit	Parameter	P Value of Two Tailed Test (-)	Inferred Confidence Level (of Trend Present in Data Set) %	Slope (mg/L/yr)	Normalized Slope (%/yr)	Meets Trend Assumptions? [7]	Statistically Significant Mann-Kendall Trend [5]	Visual Trend Assessment [9]	UCL [6] (mg/L)	2019 Values Greater than UCL	Meets UCL Assumptions [7]	LCL [6] (mg/L)	2019 Values Less than LCL	Meets LCL Assumptions [7]	Count	Min (mg/L)	Median (mg/L)	Max (mg/L)	Range	Variability [4]	Avg. (mg/L)	Std. Dev. (mg/L)	Count	Max	Guideline Value [8]	2019 Guideline Exceedances
ARB-12-3-3	ARB-12-3-3	Surficial Sediments	Chloride	NC	NC	NC	NC	N (ins. trend data)	---	---	50.25	0	Y	NC	NA	N (LCL <0)	13	8.7	18.0	32	23.30	1.29	19.3615	6.8641	2	26	120	0
ARB-12-3-3			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	13	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.37	0
ARB-12-3-3			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	13	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.002	0
ARB-12-3-3			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	13	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.09	0
C38 08-1-4	C38 08-1-4	Surficial Sediments	Chloride	0.006	0.994	-0.5133	-2.4441	Y	---	---	33.322	0	Y	7.854	0	Y	17	14	21.0	25	11	0.52	20.5882	2.8297	2	19	120	1
C38 08-1-4			Benzene	0.185	0.815	NC	NC	N (ins. >DL data)	---	---	0.001	NA	N (ins. >DL data)	NC	NA	N (LCL <0)	17	< 0.0004	NC	0.00093	NC	NC	NC	NC	2	0.00093	0.37	0
C38 08-1-4			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.002	0
C38 08-1-4			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.09	0
CPF 97-7-5	CPF 97-7-5	Surficial Sediments	Chloride	0.031	0.969	0.2894	1.9295	Y	---	---	182.747	0	Y	NC	NA	N (LCL <0)	27	7.7	15.0	190	182.3	12.15	23.1667	35.4623	2	74	120	0
CPF 97-7-5			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	25	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.37	0
CPF 97-7-5			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	25	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.002	0
CPF 97-7-5			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	25	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.09	0
CPF 98-8-3	CPF 98-8-3	Surficial Sediments	Chloride	0.003	0.997	-0.3487	-2.7899	Y	---	---	30.905	0	Y	NC	NA	N (LCL <0)	26	6.8	12.5	22	15.2	1.22	12.4885	4.0925	2	9.7	120	0
CPF 98-8-3			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	26	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.37	0
CPF 98-8-3			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	26	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.002	0
CPF 98-8-3			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	0.003	0	Y	NC	NA	N (LCL <0)	26	< 0.0004	NC	< 0.0050	NC	NC	NC	NC	2	< 0.00040	0.09	0
MEBG-10-1-3	MEBG-10-1-3	Surficial Sediments	Chloride	NC	NC	-0.2529	-10.5393	Y	---	---	6.789	0	Y	NC	NA	N (LCL <0)	15	1.9	2.4	5	3.1	1.29	2.7333	0.9013	2	2.0	120	---
MEBG-10-1-3			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.37	---
MEBG-10-1-3			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.002	---
MEBG-10-1-3			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.09	---
MTF 97-1-5	MTF 97-1-5	Surficial Sediments	Chloride	0.044	0.956	-0.0475	-3.6513	Y	---	---	4.836	0	Y	NC	NA	N (LCL <0)	21	< 1.0	1.3	3.4	2.90	2.23	1.381	0.7679	2	1.7	120	0
MTF 97-1-5			Benzene	0.01	0.990	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.37	0
MTF 97-1-5			Toluene	0.01	0.990	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.002	0
MTF 97-1-5			Ethylbenzene	0.01	0.990	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.09	0
TF 03-12-3	TF 03-12-3	Surficial Sediments	Chloride	NC	NC	-7.3527	-4.4562	Y	---	---	393.66	0	Y	NC	NA	N (LCL <0)	22	80	165.0	280	200	1.21	169.7727	49.7527	2	110	120	0
TF 03-12-3			Benzene	0.002	0.998	NC	NC	N (ins. trend data)	---	---	0.002	0	Y	NC	NA	N (LCL <0)	22	< 0.0004	NC	0.0017	NC	NC	NC	NC	2	< 0.00040	0.37	0
TF 03-12-3			Toluene	0.003	0.997	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	22	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.002	0
TF 03-12-3			Ethylbenzene	0.003	0.997	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	22	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.09	0
WSY 97-1-5	WSY 97-1-5	Surficial Sediments	Chloride	0.825	0.175	-0.043	-0.2269	Y	---	---	68.229	0	Y	NC	NA	N (LCL <0)	26	6.5	18.95	64	57.5	3.03	19.6731	10.7902	2	24	120	0
WSY 97-1-5			Benzene	0.001	0.999	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	23	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.37	0
WSY 97-1-5			Toluene	0.001	0.999	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	23	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.002	0
WSY 97-1-5			Ethylbenzene	0.001	0.999	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	23	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.09	0
BI-13-1-4	BI-13-1-4	Surficial Sediments	Chloride	0.251	0.749	-0.7103	-8.9915	Y	---	---	17.235	0	Y	NC	NA	N (LCL <0)	9	2.5	7.9	9.5	7	0.89	7.0889	2.2547	2	8.7	120	0
BI-13-1-4			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	8	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.37	0
BI-13-1-4			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	8	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.002	0
BI-13-1-4			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	8	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.09	0
BI-13-3-4.5	BI-13-3-4.5	Surficial Sediments	Chloride	0.093	0.907	-0.6982	-8.0249	Y	---	---	18.641	0	Y	0.092	0	Y	9	6.5	8.7	13	6.5	0.75	9.3667	2.0609	1	8.4	120	0
BI-13-3-4.5			Benzene	0.846	0.154	NC	NC	N (ins. >DL data)	---	---	0.001	0	Y	NC	NA	N (LCL <0)	9	< 0.00040	NC	0.00042	NC	NC	NC	NC	1	< 0.00040	0.37	0
BI-13-3-4.5			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	9	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	1	< 0.00040	0.002	0
BI-13-3-4.5			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	9	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	1	< 0.00040	0.09	0
BIBG-10-1-4	BIBG-10-1-4	Surficial Sediments	Chloride	0.039	0.961	2.1693	15.4953	Y	U	---	51.053	0	Y	NC	NA	N (LCL <0)	12	3	14.0	25	22	1.57	13.5083	8.3433	2	23	120	0
BIBG-10-1-4			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.37	0
BIBG-10-1-4			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.002	0
BIBG-10-1-4			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.09	0
BIBG-12-1-7	BIBG-12-1-7	Surficial Sediments	Chloride	0.308	0.692	-0.5959	-6.8886	Y	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	7.5	8.65	11	3.5	0.40	8.95	1.5373	0	---	120	0
BIBG-12-1-7			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	0	---	0.37	0
BIBG-12-1-7			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	0	---	0.002	0
BIBG-12-1-7			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	0	---	0.09	0
BIS 97-1-3	BIS 97-1-3	Surficial Sediments	Chloride	0.012	0.988	-0.2961	-1.3457	Y	---	---	42.867	0	Y	3.466	0	Y	21	16	22.0	35	19	0.86	23.1667	4.3779	2	22	120	0
BIS 97-1-3			Benzene	0.002	0.998	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.37	0
BIS 97-1-3			Toluene	0.002	0.998	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.002	0
BIS 97-1-3			Ethylbenzene	0.002	0.998	NC	NC	N (ins. trend data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	17	< 0.0004	NC	< 0.0005	NC	NC	NC	NC	2	< 0.00040	0.09	0

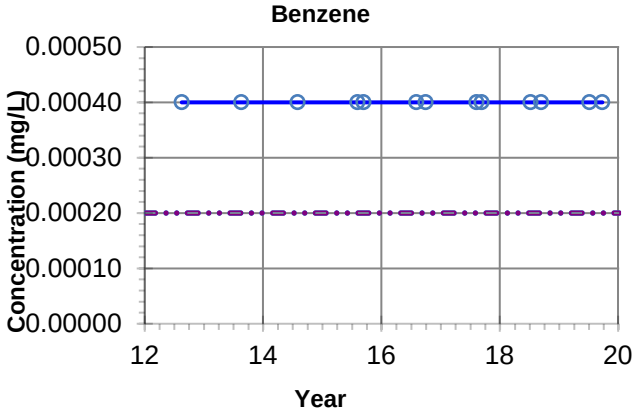
Advisian
Worley Group

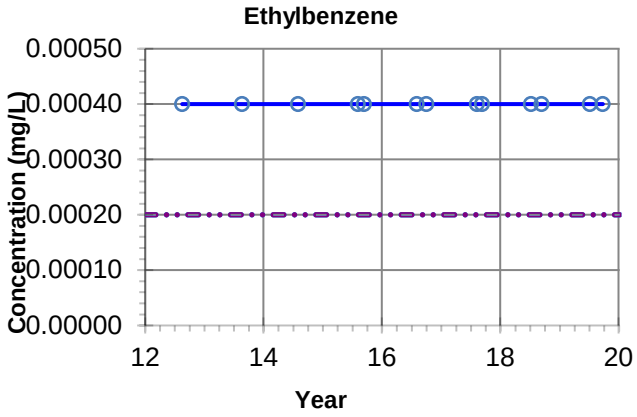
Table F-5
Statistical Summary

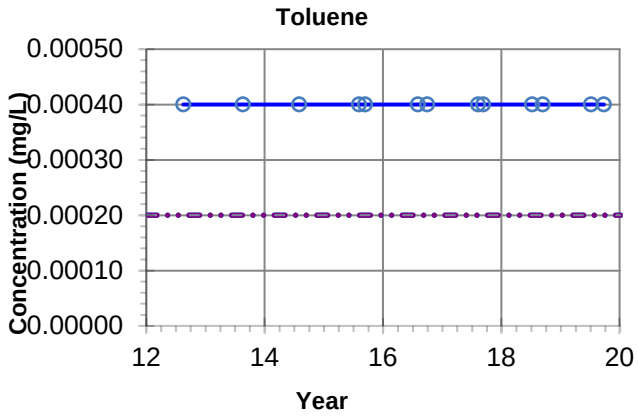
Project No.: 407011-00770-400				Trend Analysis								Upper Control Limit Analysis			Lower Control Limit Analysis			Basic Analysis										Guideline Analysis	
																		Historical								Reporting Period			
Location	Monitoring Station	Hydrostatigraphic Unit	Parameter	P Value of Two Tailed Test (-)	Inferred Confidence Level (of Trend Present in Data Set) %	Slope (mg/L/yr)	Normalized Slope (%/yr)	Meets Trend Assumptions? [7]	Statistically Significant Mann-Kendall Trend [5]	Visual Trend Assessment [9]	UCL [6] (mg/L)	2019 Values Greater than UCL	Meets UCL Assumptions [7]	LCL [6] (mg/L)	2019 Values Less than LCL	Meets LCL Assumptions [7]	Count	Min (mg/L)	Median (mg/L)	Max (mg/L)	Range	Variability [4]	Avg. (mg/L)	Std. Dev. (mg/L)	Count	Max	Guideline Value [8]	2019 Guideline Exceedances
GIP11 09-1-4	GIP11 09-1-4	Surficial Sediments	Chloride	0.23	0.770	-4.5933	-65.618	Y	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	7	3.6	7.0	110	106.4	15.20	24.2	38.5496	0	---	120	0
GIP11 09-1-4			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	7	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	0	---	0.37	0
GIP11 09-1-4			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	7	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	0	---	0.002	0
GIP11 09-1-4			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	7	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	0	---	0.09	0
GIP11 09-1-4-R	GIP11 09-1-4-R	Surficial Sediments	Chloride	NC	NC	-13.4824	-86.9831	N (ins. trend data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	14	15.5	50	36	2.32	23.75	17.557	2	17	120	---
GIP11 09-1-4-R			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.37	---
GIP11 09-1-4-R			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.002	---
GIP11 09-1-4-R			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. data)	NC	NA	N (ins. data)	4	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.09	---
GIQ8-10-2-4	GIQ8-10-2-4	Surficial Sediments	Chloride	0.084	0.916	1.2106	6.544	Y	---	---	42.737	0	Y	NC	NA	N (LCL <0)	12	5.8	18.5	21	15.2	0.82	15.225	6.1138	2	20	120	0
GIQ8-10-2-4			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.37	0
GIQ8-10-2-4			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.002	0
GIQ8-10-2-4			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	12	< 0.00040	NC	< 0.00040	NC	NC	NC	NC	2	< 0.00040	0.09	0
GIBG-10-2-3	GIBG-10-2-3	Surficial Sediments	Chloride	0.298	0.702	0.3049	7.819	Y	---	---	19.291	0	Y	NC	NA	N (LCL <0)	15	< 1.0	3.9	11	10.5	2.69	4.96	3.1847	2	11	120	0
GIBG-10-2-3			Benzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.37	0
GIBG-10-2-3			Toluene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.002	0
GIBG-10-2-3			Ethylbenzene	NC	NC	NC	NC	N (ins. >DL data)	---	---	NC	NA	N (ins. >DL data)	NC	NA	N (ins. >DL data)	15	< 0.0004	NC	< 0.0004	NC	NC	NC	NC	2	< 0.00040	0.09	0

1. *Bold formatting indicates a value is above the applied guideline*
   - *The following results have been checked against the guideline: minimum, median, maximum, average, LCL, UCL*
2. *Shading in the parameter column indicates one or more analyses returned notable results (analysis-specific shading is further specified below)*
3. *Basic analysis performed with the following conditions:*
   - *Historical: all data before 01-Jan-2019*
   - *Reporting period is defined as 01-Jan-2019 to 12-Nov-2019 (inclusive)*
   - *Non-detect multiplier of 0.5 applied to <DL sample data*
4. *Variability calculated as range / median*
5. *Trend Analysis:*
   - *Analyses performed on all sample data before 12-Nov-2019 (inclusive)*
   - *Non-detect multiplier of 0.5 applied to <DL sample data*
   - *Statistically signficant trend defined as:*
     - *Inferred confidence level greater than 95%*
       (in other words, P-value of two-tailed test is less than or equal to 0.05)
     - *Absolute value of Sen's normalized slope is greater than 10%*
   - *U: Denotes statistically significant upward trend*
   - *D: Denotes statistically significant downward trend*
   - *"---": Denotes no trend*
   - *Shading of trend analysis cells indicates a Mann-Kendall trend has been detected*
6. *Upper Control Limit (UCL) and Lower Control Limit (LCL) calculated as follows:*
   - *Calculated on all data before 12-Nov-2019 (inclusive)*
   - *Minimum 8 data points; no maximum number of data points*
   - *Non-detect multiplier of 0.5 applied to <DL sample data*
   - *Control limit exceedances reported on sample data between 01-Jan-2019 and 12-Nov-2019 (inclusive)*
   - *Shading of control limit cells indicates one or more control limit exceedances were detected*
7. *Legend for control limit/trend assumptions:*
   - *Y: All conditions are met*
   - *N: Not all conditions are met, specified as follows:*
     - *No new data: No sample data present for years reported*
     - *LCL < 0: calculated LCL was less than 0*
     - *ins. CL data: insufficient data to calculate a control limit*
     - *ins. trend data: insufficient data to calculate a trend*
     - *ins. >DL data: Less than 50% of control limit data was above detection limit*
     - *ins. >DL data: Less than 50% of trend data was above detection limit*
     - *UCL <2x/<5x RDL: The UCL is less than twice/less than 5 times the reporting detection limit*
     - *U Trend: An upward Mann-Kendall trend is present*
     - *D Trend: A downward Mann-Kendall trend is present*
8. *Guideline: Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1*
   - *Chloride guideline based on chronic exposure*
9. *Visual Trend Assessment includes: trend reversals, trend stabilizations, possible developing trends, and probable (monotonic) trends*









NOTES: - Filled symbols denote Sample Values
- Unfilled symbols denote Values < Detection Limit(s)

GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit ng/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

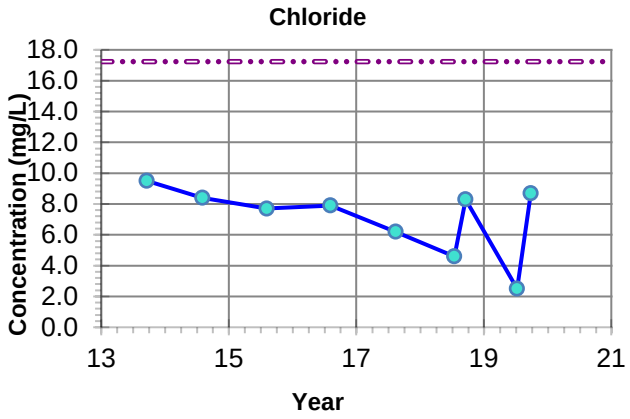
Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: ARB-12-3-3

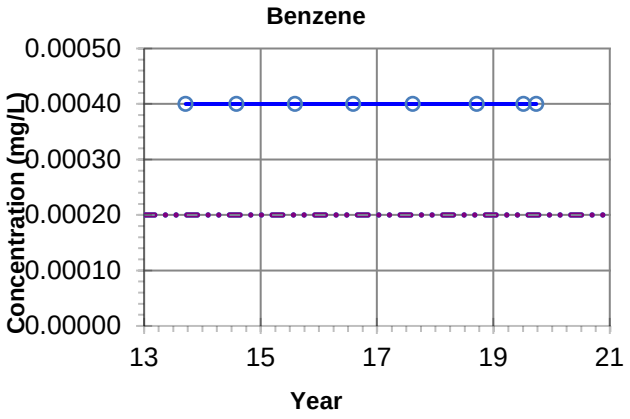
Advisian
Worley Group

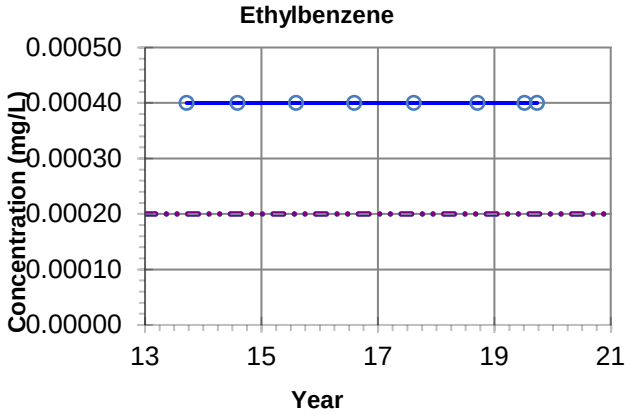
12-Nov-2019 date	NA edited by	JC drawn by	NA app by	PROJECT NUMBER: 407011-00770-400	Figure F-1

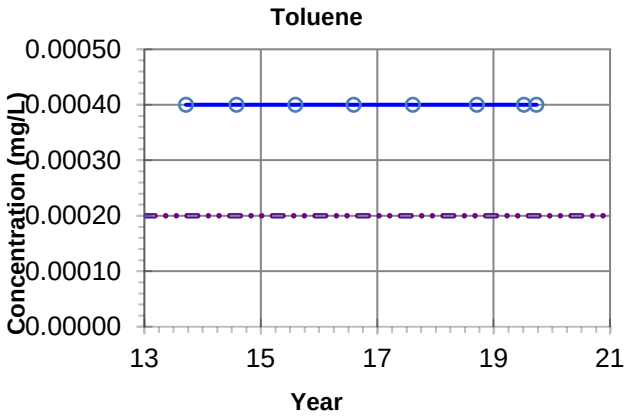
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: BI-13-1-4

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

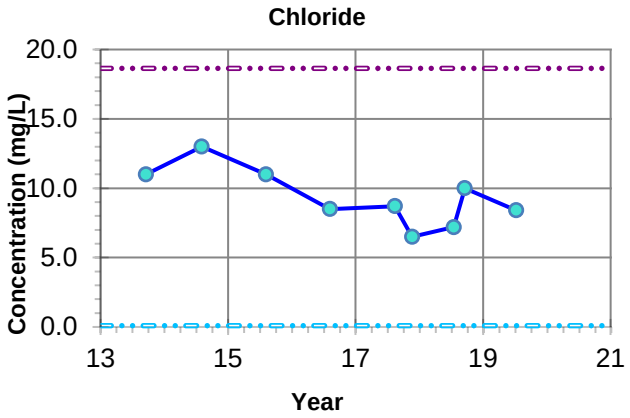
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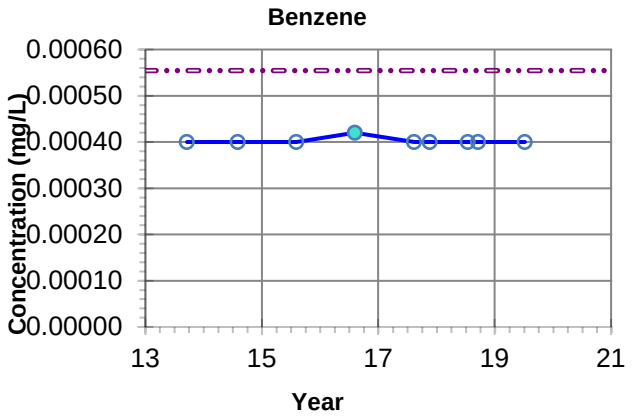
Advisian
Worley Group

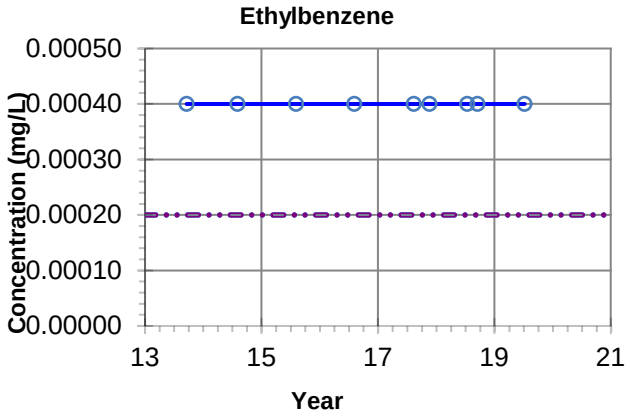
PROJECT NUMBER: 407011-00770-400

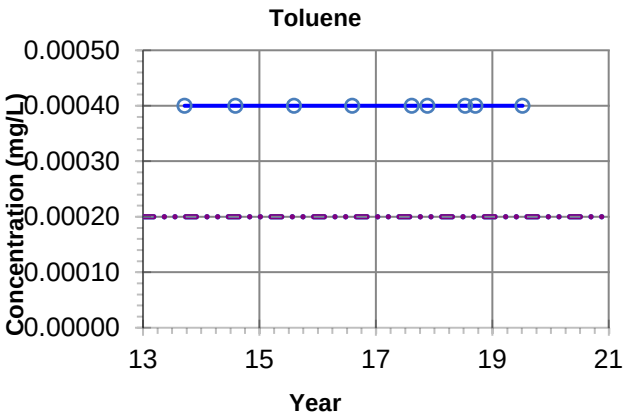
Figure F-2

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NOTES: - Filled symbols denote Sample Values
- Unfilled symbols denote Values < Detection Limit(s)

GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: BI-13-3-4.5

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

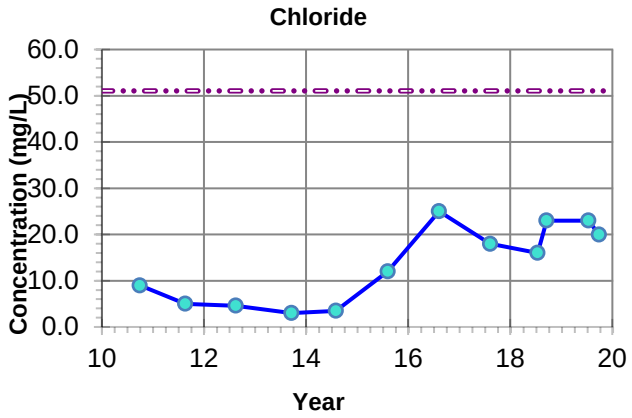
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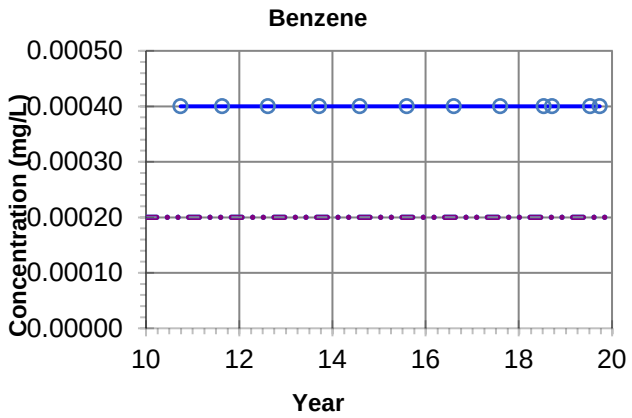
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Worley Group

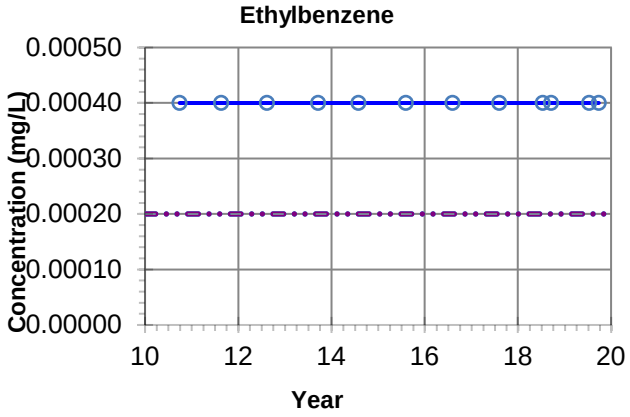
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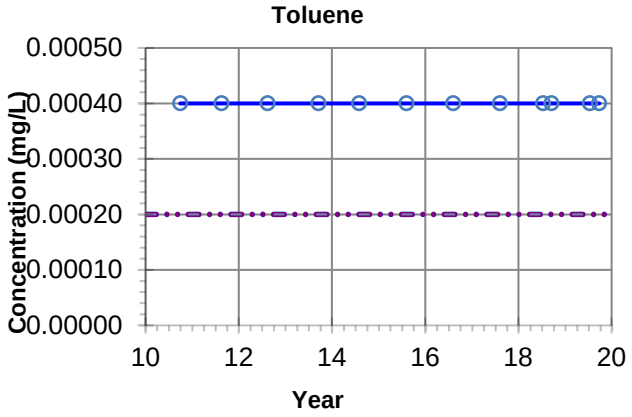
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NOTES: - Filled symbols denote Sample Values
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: BIBG-10-1-4

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

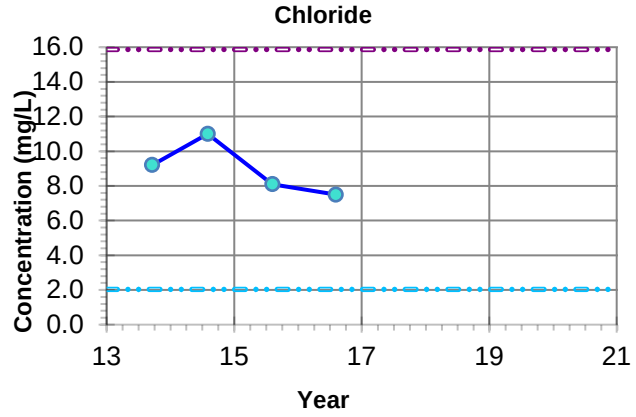
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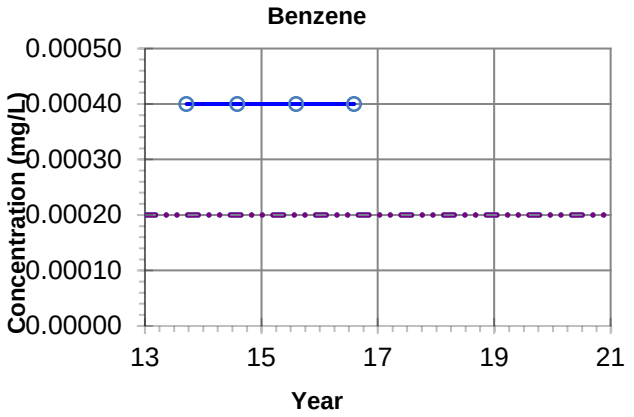
Advisian
Worley Group

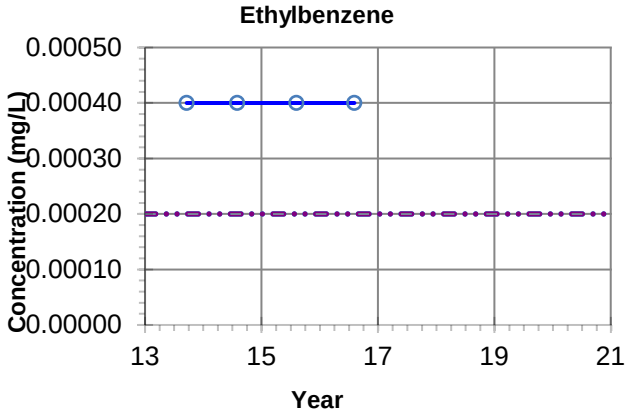
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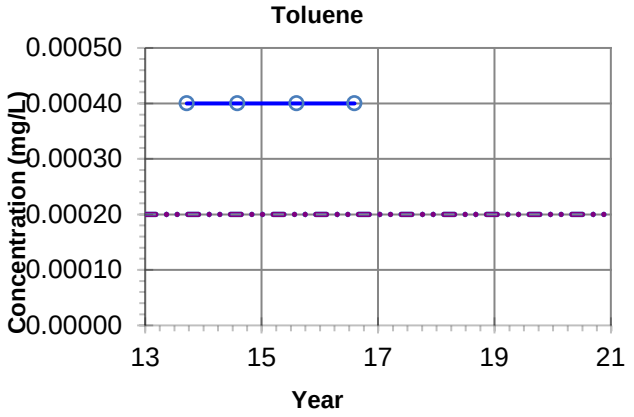
Figure F-4

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NOTES: - Filled symbols denote Sample Values
- Unfilled symbols denote Values < Detection Limit(s)

GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: BIBG-12-1-7

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

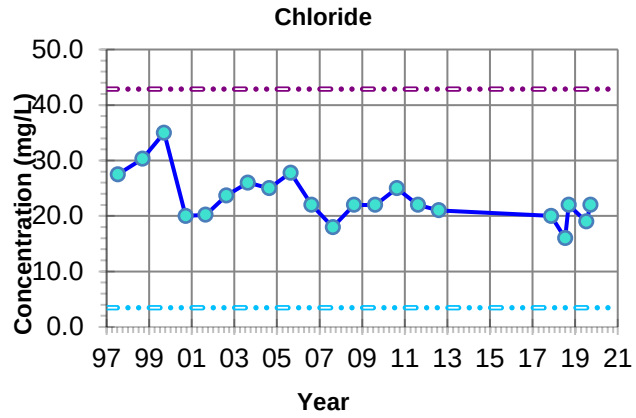
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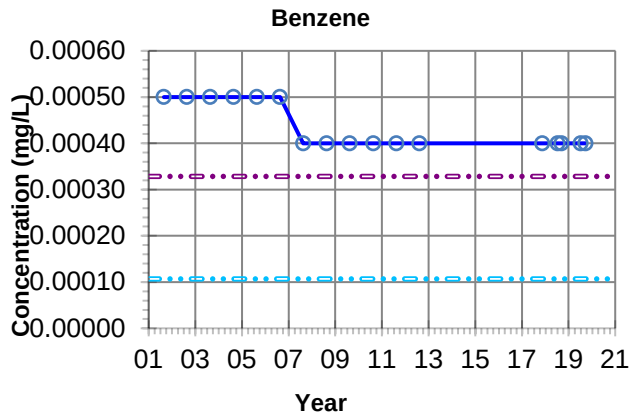
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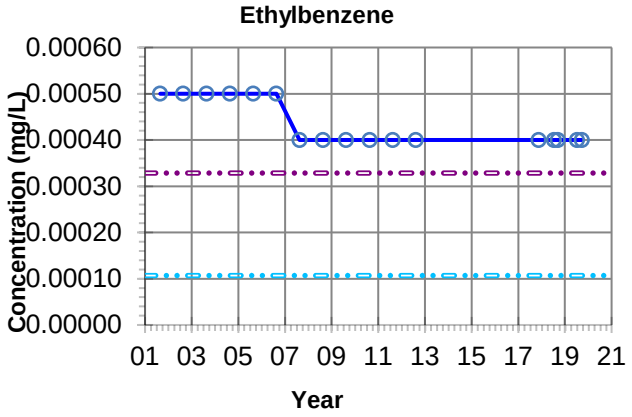
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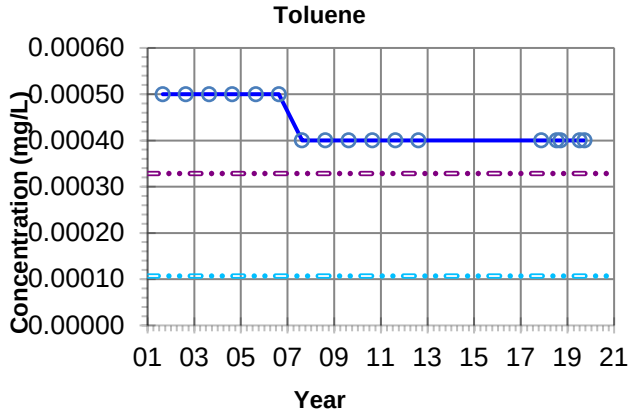
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File Path: U:\CAL\GBS\407011-00770\400 - SNP Program\9.0_Data\9.3_Working_Tables









NOTES: - Filled symbols denote Sample Values
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: BIS 97-1-3

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

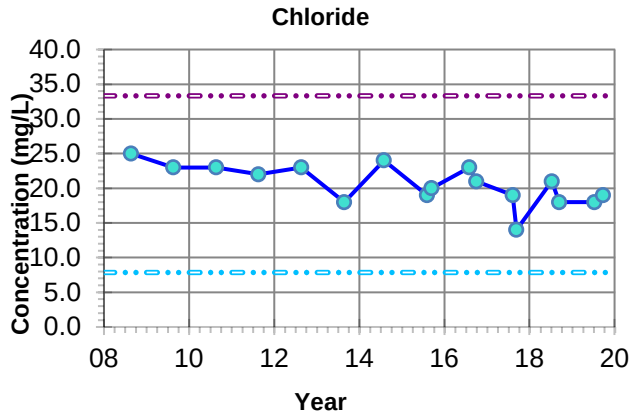
PREPARED SOLELY FOR THE USE OF OUR CLIENT AS SPECIFIED IN THE ACCOMPANYING REPORT. NO REPRESENTATION OF ANY KIND IS MADE TO OTHER PARTIES WITH WHICH WORLEYPARSONS HAS NOT ENTERED INTO A CONTRACT.

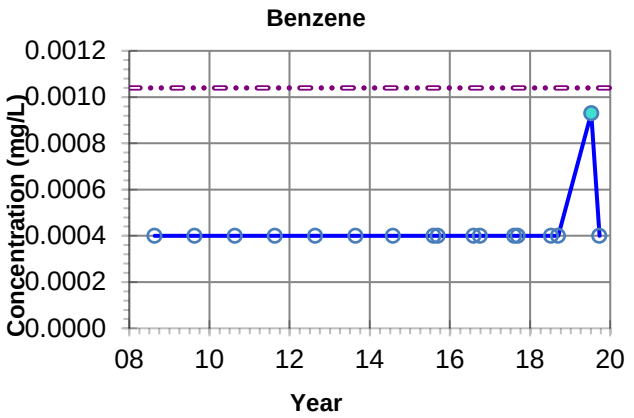
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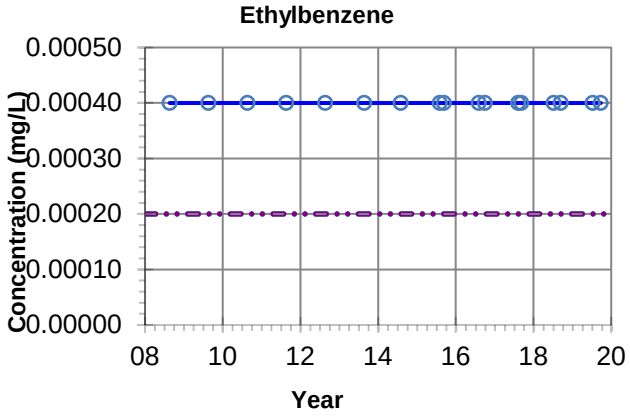
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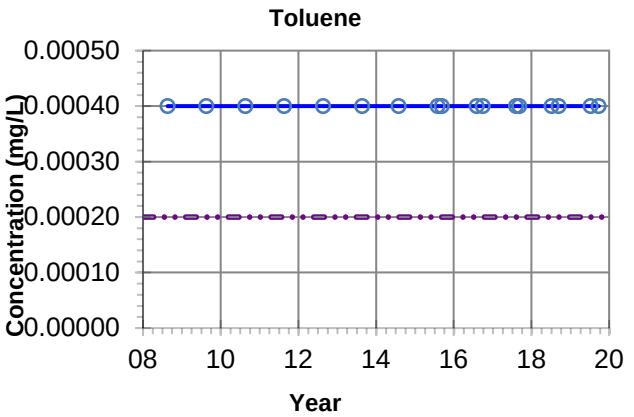
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NOTES: - Filled symbols denote Sample Values
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: C38 08-1-4

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

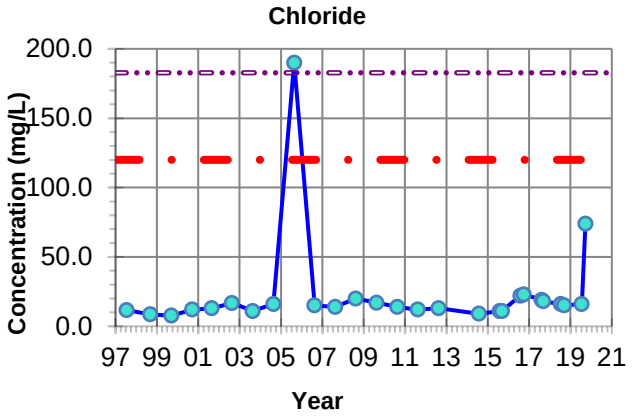
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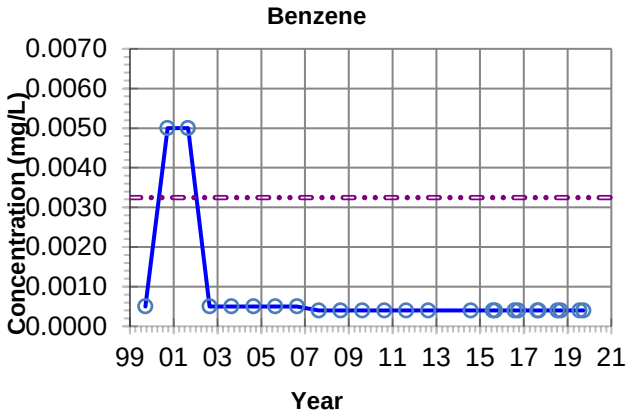
Advisian
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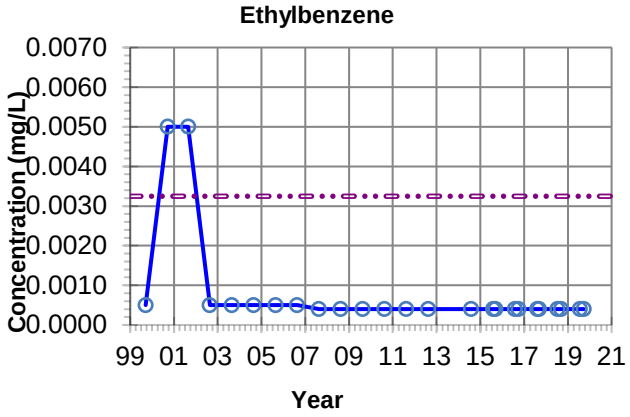
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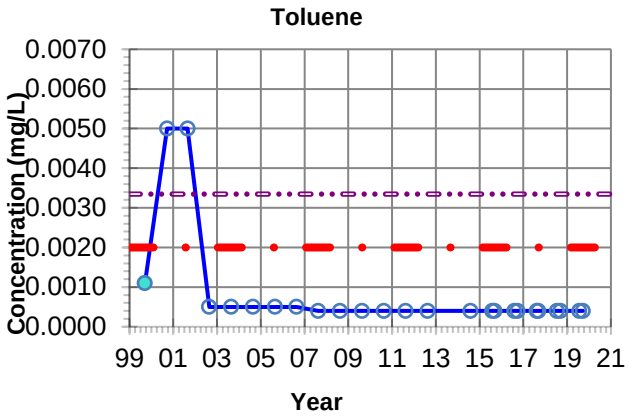
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CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit ! mg/L
Ethylbenzene - 0.09 mg/L

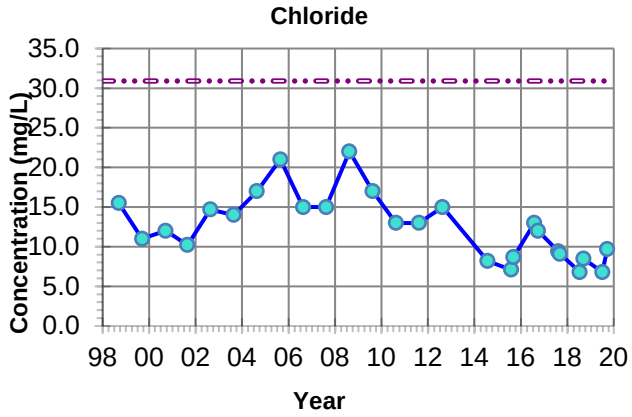
Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: CPF 97-7-5

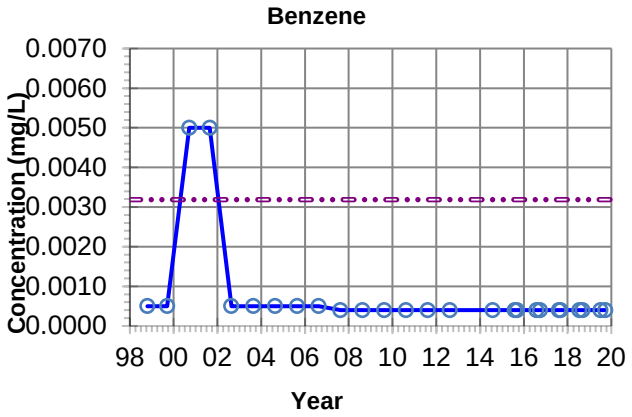
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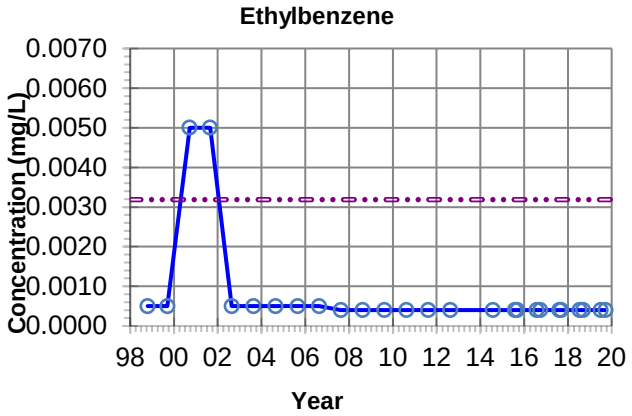
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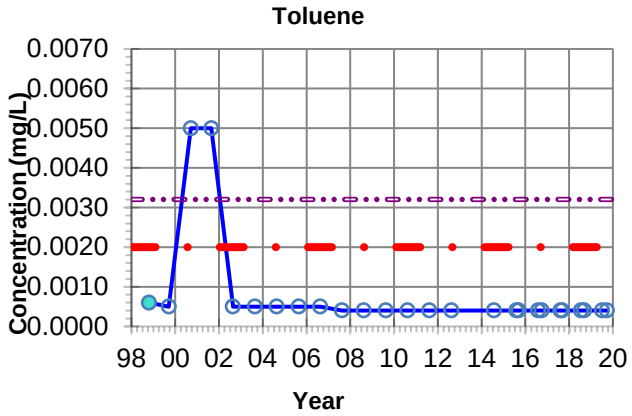
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: CPF 98-8-3

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

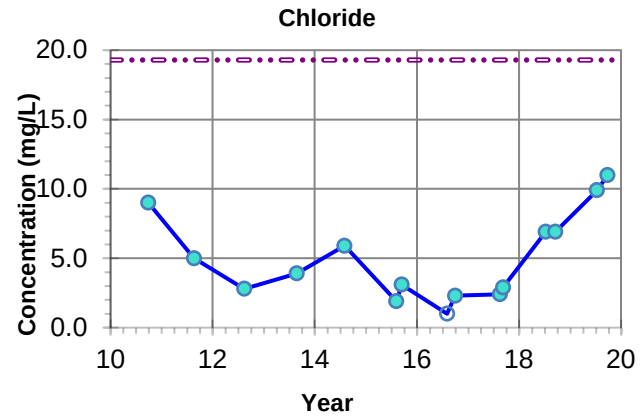
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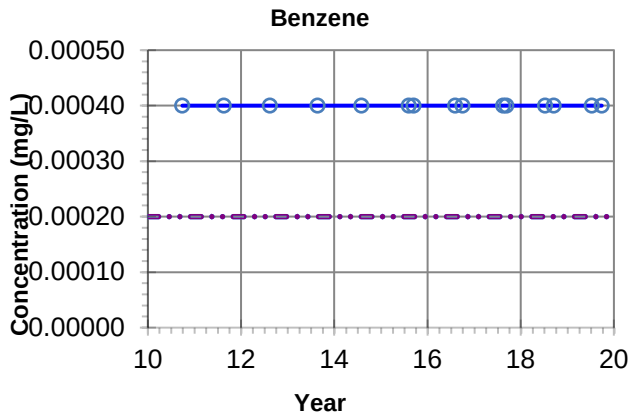
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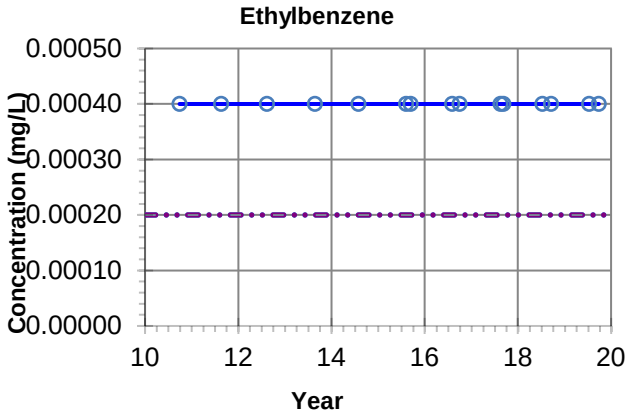
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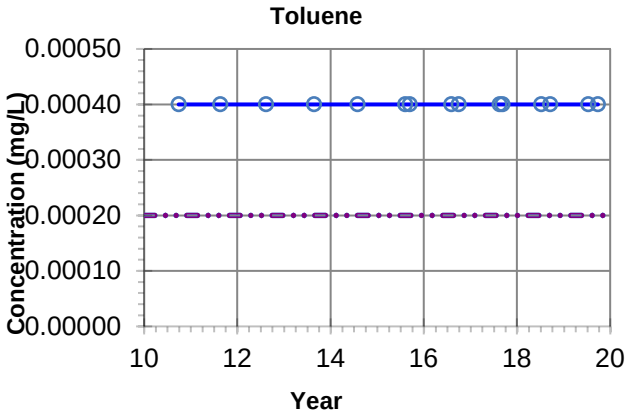
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NOTES: - Filled symbols denote Sample Values
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: GIBG-10-2-3

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

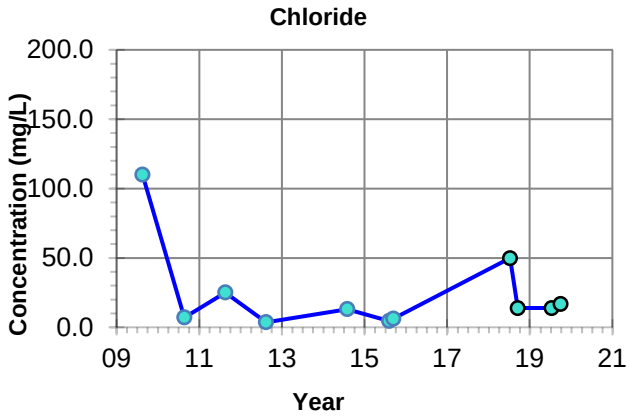
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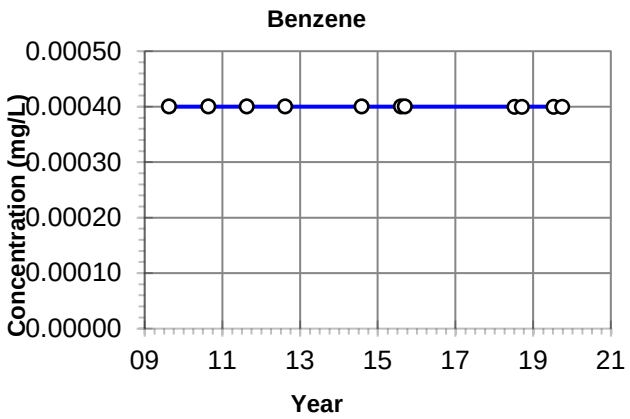
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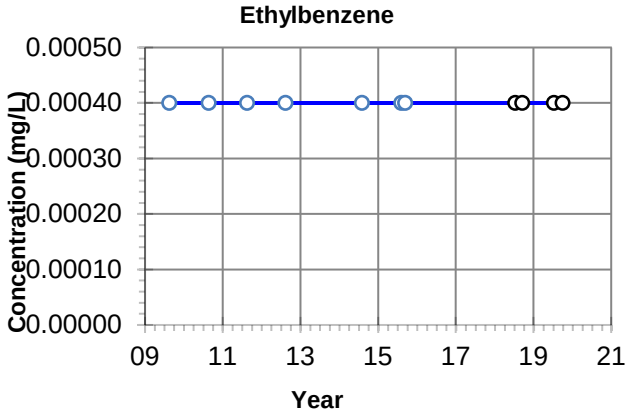
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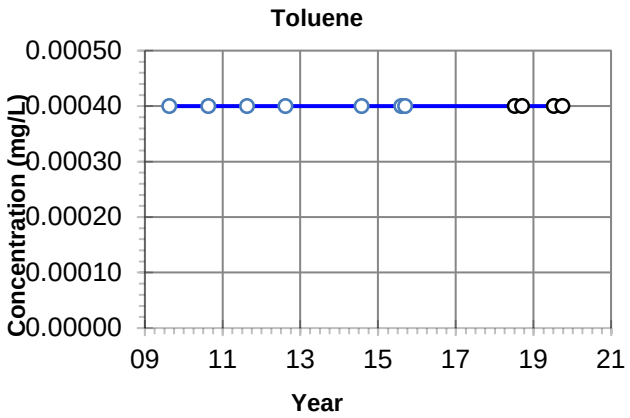
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NOTES: - Filled symbols denote Sample Values
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: GIP11 09-1-4 / GIP11 09-1-4-R

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

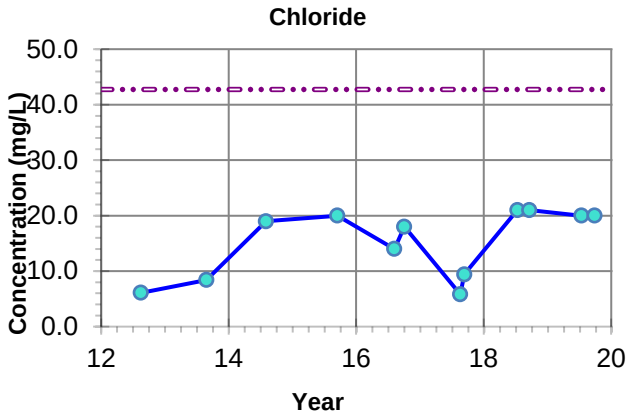
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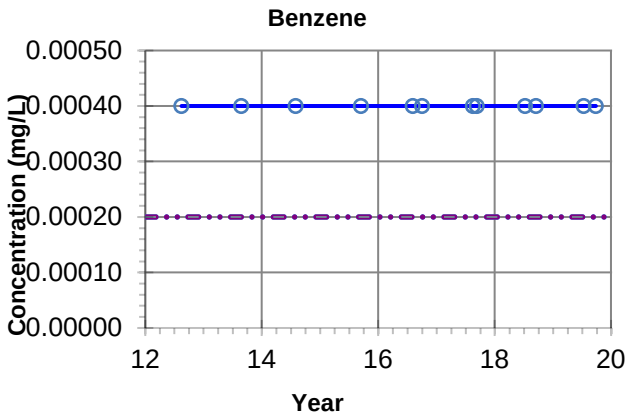
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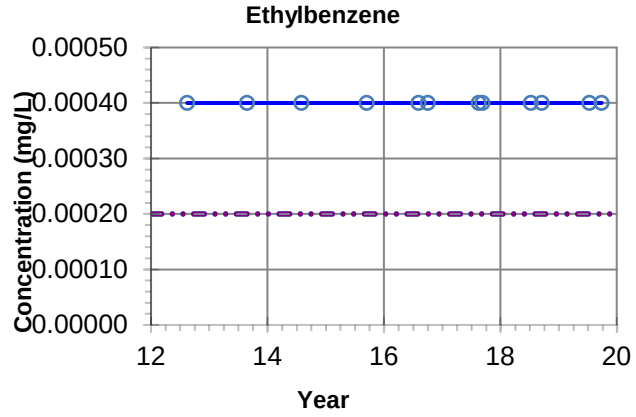
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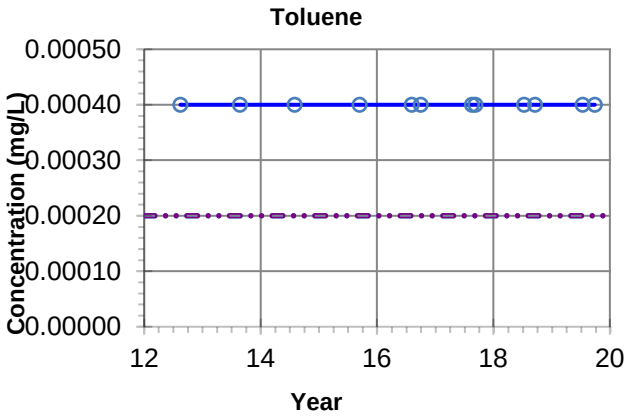
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GUIDELINE:
CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: GIQ8-10-2-4

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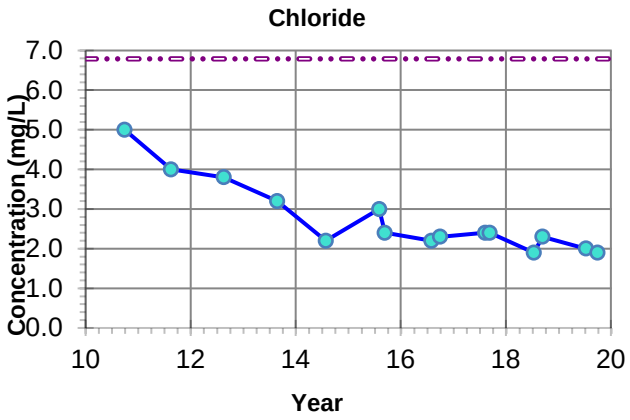
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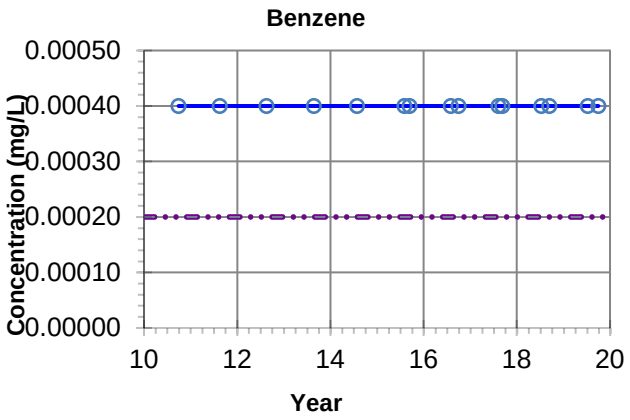
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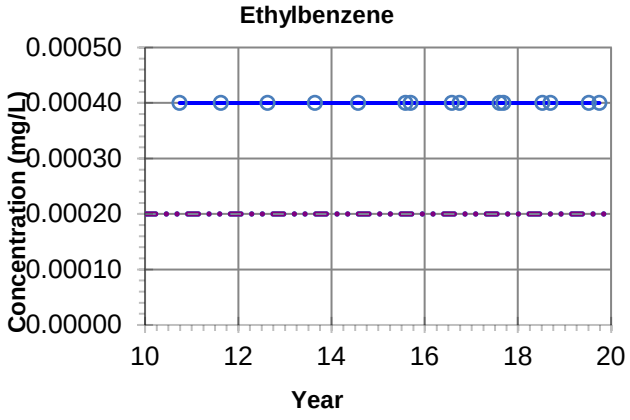
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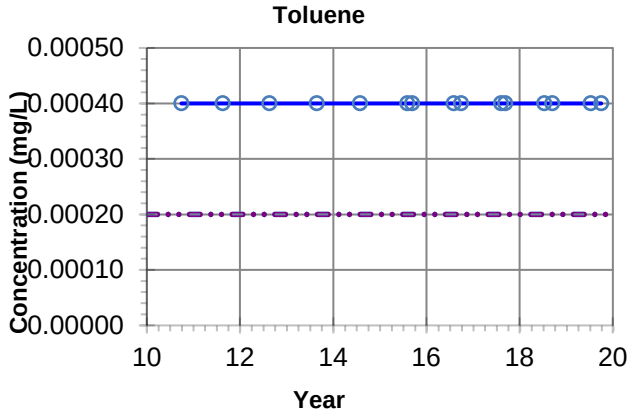
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CCME CEQG Freshwater Aquatic Life

Chloride - 120 mg/L
Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: MEBG-10-1-3

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

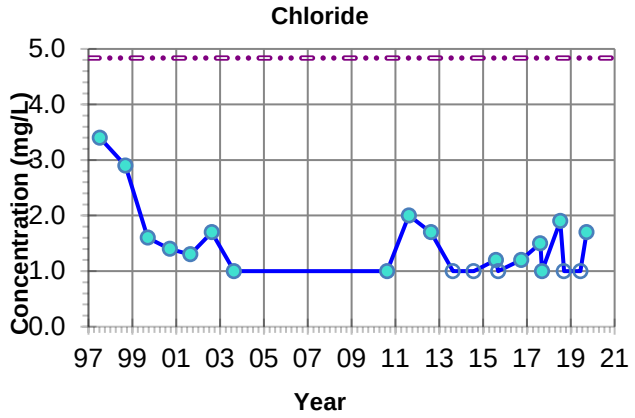
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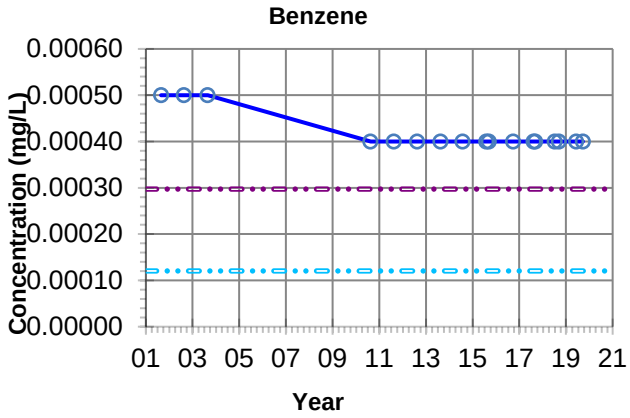
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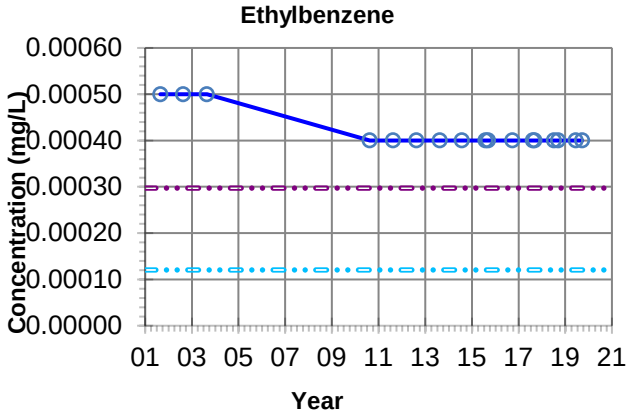
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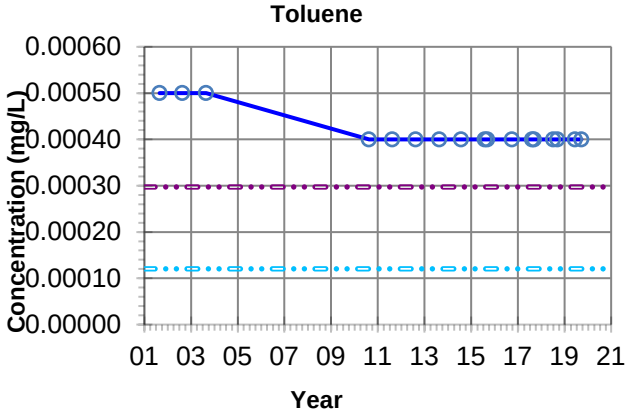
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NOTES: - Filled symbols denote Sample Values
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Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: MTF 97-1-5

12-Nov-2019 date	NA edited by	JC drawn by	NA app by

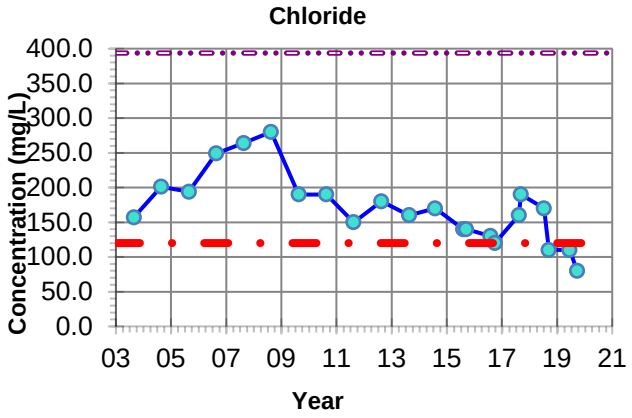
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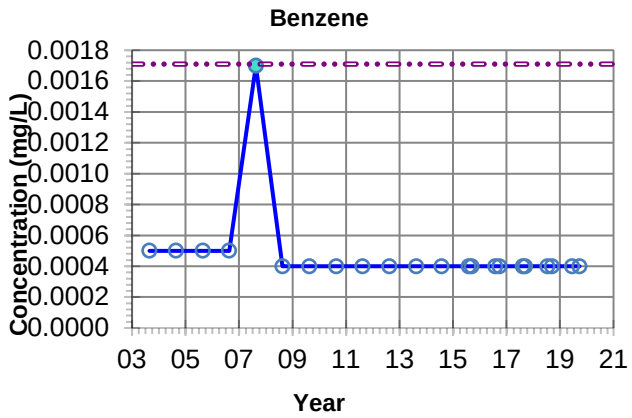
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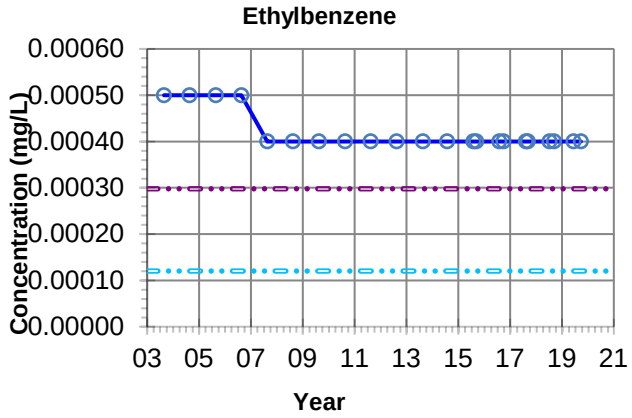
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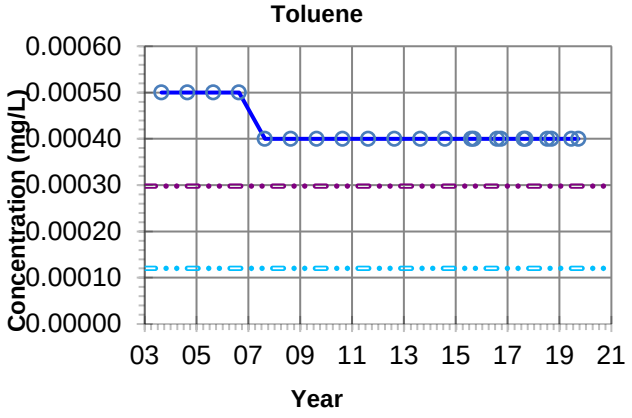
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Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: TF 03-12-3

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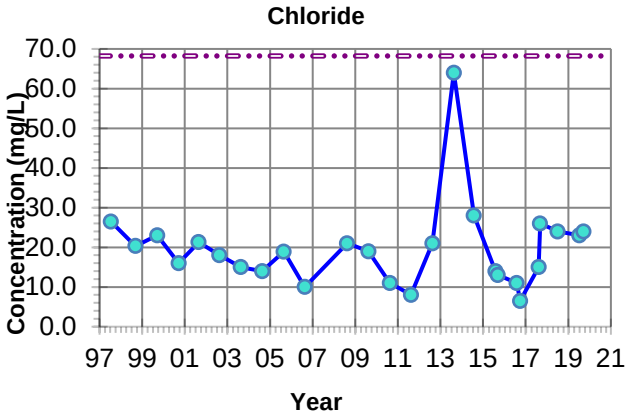
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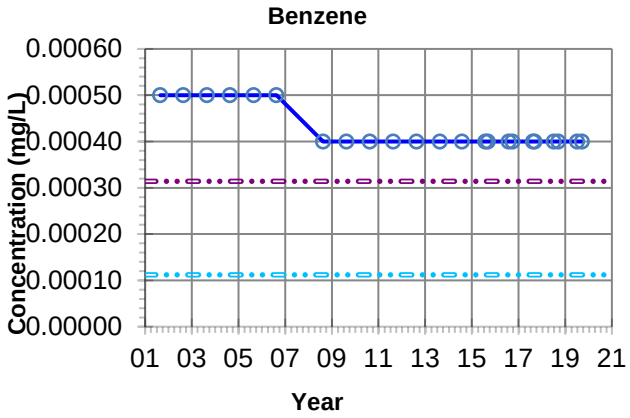
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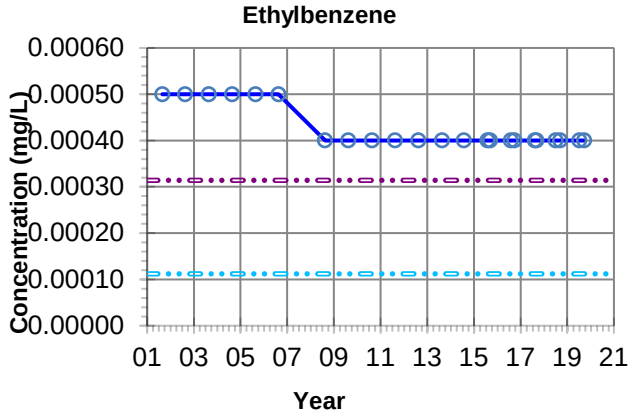
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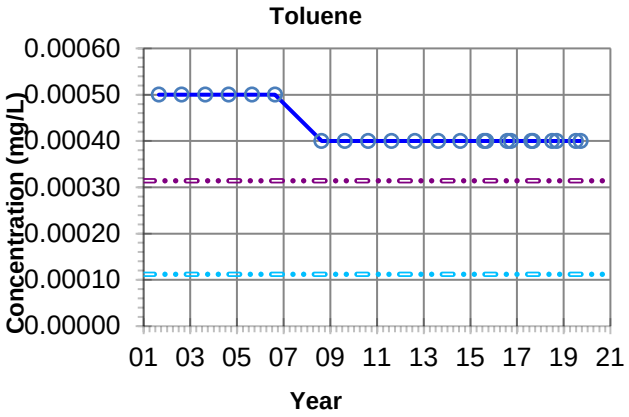
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Upper Control Limit mg/L
Lower Control Limit mg/L
Ethylbenzene - 0.09 mg/L

Imperial
2019 Groundwater Surveillance Network Program
Norman Wells, NT
Trend Graphs
Monitoring Well: WSY 97-1-5

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Figure F-16

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Appendix D Aquatic Effects Monitoring Program



Norman Wells Operations Aquatic Effects Monitoring Program Report

Imperial Norman Wells Operations

Imperial

10 March 2020

407011-00770-1000

Advisian
Worley Group

advisian.com

THIS REPORT CONTAINS PROVISIONS LIMITING LIABILITY, THE SCOPE OF THE REPORT AND THIRD PARTY RELIANCE

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PROJECT - 407011-00770-1000 WW-REP-0001: Norman Wells Operations Aquatic Effects Monitoring Program Report - Imperial Norman Wells Operations

Rev	Description	Author	Review	Advisian approval	Revision date
0	Issued as Final	N. Tanna	M. Vander Meulen	A. Haigh	10-Mar-20

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Executive Summary

Water quality samples were collected in the Mackenzie River and Bosworth Creek between June and October in 2017, 2018 and 2019 to discern potential impacts due to ongoing Norman Wells operations and/or presence of legacy contaminants.

The vast majority of analytes which were quantified in water samples were below detection limits. All hydrocarbon analytes were below detection limits, with additional analytes associated with hydrocarbon recovery and refining also below detection limits.

Al, Cu, Fe, Mg, Mn, Mo, Na, Ni, Sr, Ti, U, and concentrations of chloride and sulphate were examined in detail for longitudinal trends (spatial and temporal) because these analytes were quantifiable (i.e. above detection limits).

The resulting water quality data are characterized by appreciable variability, which limits statistical power to detect trends. An absence of differences between upstream and downstream locations, with high variability between locations sampled results in limited capacity to attribute differences to any specific driver.

1 Introduction

Imperial Oil Resources (Imperial) requested Worley Canada Services Ltd. (Worley) operating as Advisian to prepare a report to summarize monitoring activities in order to complete the 2019 Aquatic Effects Monitoring Program (AEMP) Sampling Program in Norman Wells, NT.

As the conclusion of the 2019 AEMP sampling activities marks the completion of the third sampling campaign, this report includes spatial and temporal statistical analysis of accumulated data.

1.1 Background

The Aquatic Effects Monitoring Program (AEMP) was developed in April 2017 as part of Imperial's 10-year Water License Renewal Application submitted to the Sahtu Land and Water Board (SLWB) in 2015. This approval grants Imperial permission to use water from the Mackenzie River, and stipulates that Imperial is to develop and maintain a variety of monitoring plans including the development and execution of an AEMP.

The Norman Wells Operations AEMP was created to contribute to satisfying requirements in Imperial's Water License to monitor potential effects from Imperial's operation. This includes evaluating immediate or long-term significance of potential aquatic effects as required, measuring the effect activities may be having on water, and identifying if steps are needed to prevent serious or permanent damage to aquatic life.

This program involves sampling at 13 monitoring locations three times per year (Spring, Summer, and Fall, which correspond to June, August, and October, respectively). The monitoring locations were established in order to allow characterizing of normal water quality conditions and to detect potential surface water quality issues across the area in which Norman Wells Operations maintains a presence.

1.2 Scope of Work

The scope of work for the 2019 Aquatic Effects Monitoring Program at the Site included the following:

- Collect surface water samples at AEMP locations for laboratory analysis of general, indicator, organic, nutrient, benzene, toluene, ethylbenzene and xylene [BTEX], petroleum hydrocarbon fractions F1 and F2, and metals and trace elements (total and dissolved).
- Provide a summary report presenting the work completed and any highlights.

The scope of this work is to simply identify any irregular or notable results and to provide a detailed record of the work completed during the program (2017-2019).

1.3 Environmental Assessment Guidelines

Currently, no specific water quality guidelines exist for the Northwest Territories. As a conservative measure, surface water assessment parameters in this report are compared to the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for the Protection of Freshwater Aquatic Life (FWAL; CCME 2017), as surface water bodies (e.g. Bosworth Creek and the Mackenzie River) are potential receptors of concern in most areas of interest for this program.

It should be emphasized that the aforementioned guidelines are used for comparative purposes only in the context of this report, and that ultimately this 3-year program is intended to measure system variability to serve as a foundation for detecting future change. Statistical analysis to evaluate variability and capacity for detecting change is included in the body of this report.

1.4 AEMP Locations

Monitoring locations have been established in Bosworth Creek and the Mackenzie River to:

- Obtain data both upstream and downstream from potential points of inputs;
- Capture the longitudinal nature of these watercourses so that the potential effects attributable to position along channel are quantified; and
- Support quantifying seasonal variability to account for it in subsequent analysis.

This conceptual basis is intended to allow comparison of water potentially influenced by operations with water not influenced by operations. The AEMP document submitted to the SLWB develops this rationale in relation to program design and resulted in the 13 sampling points listed in Table A below and illustrated in Figure 1.

Table A AEMP Monitoring Locations

Location	Name	Description	Stressors	Latitude	Longitude
Boat Access					
AEMP-01	Man-made Islands	Most downstream island in Mackenzie River	Flowline, Island Maintenance	65°16'37.13"N	126°55'3.13"W
AEMP-05	Bear Island	Surface water on island	Bunker, Flowline, Surface Water Release	65°15'37.76"N	126°52'36.48"W
AEMP-10	Upstream from Imperial Site	Upstream from Imperial's Norman Wells Operations		65°14'0.06"N	126°44'9.66"W
AEMP-11	Downstream from Imperial Site	Downstream at Radar Island and downstream of Imperial's Norman Wells Operations		65°18'11.70"N	127° 3'30.30"W
AEMP-13	Bear Island	Edge of the Mackenzie River adjacent to island		65°15'43.21"N	126° 52'42.32"W
Wading					
AEMP-02	Downstream Bosworth Creek	Near mouth with the Mackenzie River	Fuel Storage, Historical, Surface Water Release, Waste Storage	65°16'58.66"N	126°51'55.83"W
AEMP-03	Midstream Bosworth Creek	Down gradient from SNP – GWP Well	Fuel Storage, Historical, Surface Water Release, Waste Storage	65°17'4.81"N	126°52'34.54"W
AEMP-04	Upstream Bosworth Creek	Upstream of Imperial Norman Wells Operations		65°17'24.50"N	126°52'29.39"W
AEMP-06	Historical – Refinery	On Mackenzie River near refinery basin discharge	Fuel Storage, Historical, Surface Water Release, Waste Storage	65°16'41.29"N	126°50'25.99"W
AEMP-07	Natural Seep	Near observed natural seep on Mackenzie River	Seep	65°16'46.39"N	126°50'59.46"W

Location	Name	Description	Stressors	Latitude	Longitude
AEMP-08	Imperial's Main dock on Mackenzie River	On downstream side of dock projecting into Mackenzie River channel	Boat Activity, Bunker, Surface Water Release, Water Use	65°16'46.01"N	126°52'27.93"W
AEMP-09	Upstream CPF Effluent Discharge	Where effluent enters the Mackenzie River	Water Return, Water Use	65°16'57.61"N	126°53'10.86"W
AEMP-12	Seep	Downstream from Bosworth Creek inflow, near natural seep	Natural input of hydrocarbons	65°16'51.10"N	126°52'27.04"W

2 Sampling and Methodology

The AEMP surface water program was conducted by Advisian personnel between June and October of 2017, 2018 and 2019. Advisian staff followed field procedures as summarized in Appendix B.

Surface water samples were collected using lab-provided containers as grab samples. Results were compared with CCME FWAL guidelines (CCME 2017).

All surface water samples were submitted for laboratory analysis at an accredited third-party laboratory in Edmonton (Bureau Veritas) in accordance with standard packaging, preservation, and chain-of-custody (COC) procedures.

3 Results

The AEMP at Norman Wells currently consists of seasonal surface water sampling (approximately spring, summer, and fall) as a first step to detect and quantify any possible changes in water quality in the vicinity of Imperial's operations. It is assumed that detectable changes in water quality would motivate subsequent investigations of aquatic effects, such as time-integrated measures of water quality or changes in the status of biota.

Sampling locations are illustrated in Figure 1 and include an upstream location (AEMP-10) to characterize background conditions in the Mackenzie River relative to what may result from the proximity of operations. There are three sampling locations on Bosworth Creek (AEMP-04 is the farthest upstream and characterizes background conditions) and one on Bear Island. Most of the remaining locations are along the right bank of the Mackenzie River, AEMP-13 is adjacent to Bear Island, and AEMP-11 is downstream and perhaps reflective of any net incremental change in water quality. Sampling began in summer 2017 at some locations (AEMP-01 to 09), but not until summer 2018 at others (AEMP-10 to 13).

Water quality data (routine variables, petroleum hydrocarbons [PHCs], and total and dissolved metals) are presented in Tables 1 through 4. Many results are below respective detection limits, and notably this is the case for all analyses for presence of PHCs. Lack of detections places some constraints on possibilities for statistical analysis of results. Therefore, total concentrations of several metals (Al, Cu, Fe, Mg, Mn, Mo, Na, Ni, Sr, Ti, and U) and concentrations of chloride and sulphate were examined in detail for longitudinal trends (spatial and temporal) because these had detections. The only exception is iron at AEMP-03 in fall 2019, and the detection limit was entered as the datum; total iron was retained for analysis despite this single non-detection because it often is indicative of regional water chemistry.

3.1 Seasonal Trends

For any of the 13 sampling locations there are as many as 10 data points in the time series depending on when sampling began. Preliminary examination suggested that any seasonal patterns were repeated each year, so results from successive years of sampling were superimposed by day of year (each datum numbered day 0 to day 365). Figure A displays results for total aluminum as an example. A logarithmic scale is used to accommodate variability, and it is readily apparent that locations AEMP-02, -03, -04, and -05 (Bosworth Creek and on Bear Island) have concentrations different than the main channel. In the main channel, total aluminum concentrations are highest in spring with a decreasing trend during the year, but there is considerable variability. As a first cut at quantifying temporal trends, a simple exponential function was fitted for each location (these are superimposed for total aluminum at all 13 locations in Figure A). Table A summarizes regression coefficients, the proportion of variation explained (coefficient of determination, r^2) and whether the slope differs significantly from zero. The fact that only two of the slopes indicate statistically significant change for total aluminum concentration is a function of considerable variation (low r^2) and also relatively flat lines in some cases (e.g. AEMP-11). Note that ideally, analysis would include volume of flow in the river as a covariate to reduce variability, but such data were not available.

An important consideration for any monitoring program is the capacity to detect change when there is change. This is referred to as statistical power, and it was evaluated for each trend, such as those illustrated in Figure A. A desirable goal is to have statistical power of 0.8 (80%) to detect change of specified size (effect). Power was calculated *a posteriori* for data collected to date in the AEMP program using the pwr.f2.test statement in the pwr package of the R statistical programming language. The test requires input of the numerator and denominator degrees of freedom in the general linear model test, the probability indicative of statistical significance (0.05, by convention) and the effect size, which was estimated as $f2=r^2/(1-r^2)$, so that effect size is a function of both the slope and residual variability. Effect size and power also are given in Table B; power to detect change appears to have been adequate only for AEMP-08 and AEMP-13.

Figure A Total Aluminum Concentration, AEMP 2017 - 2019

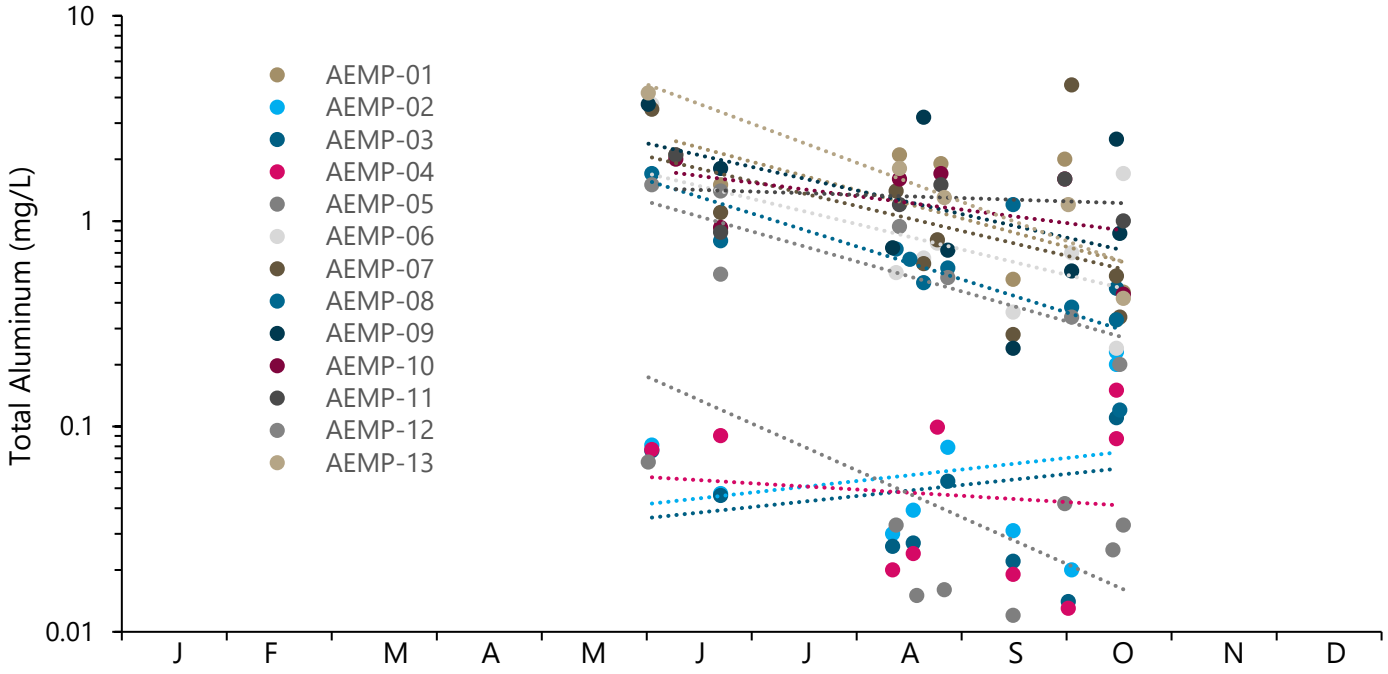


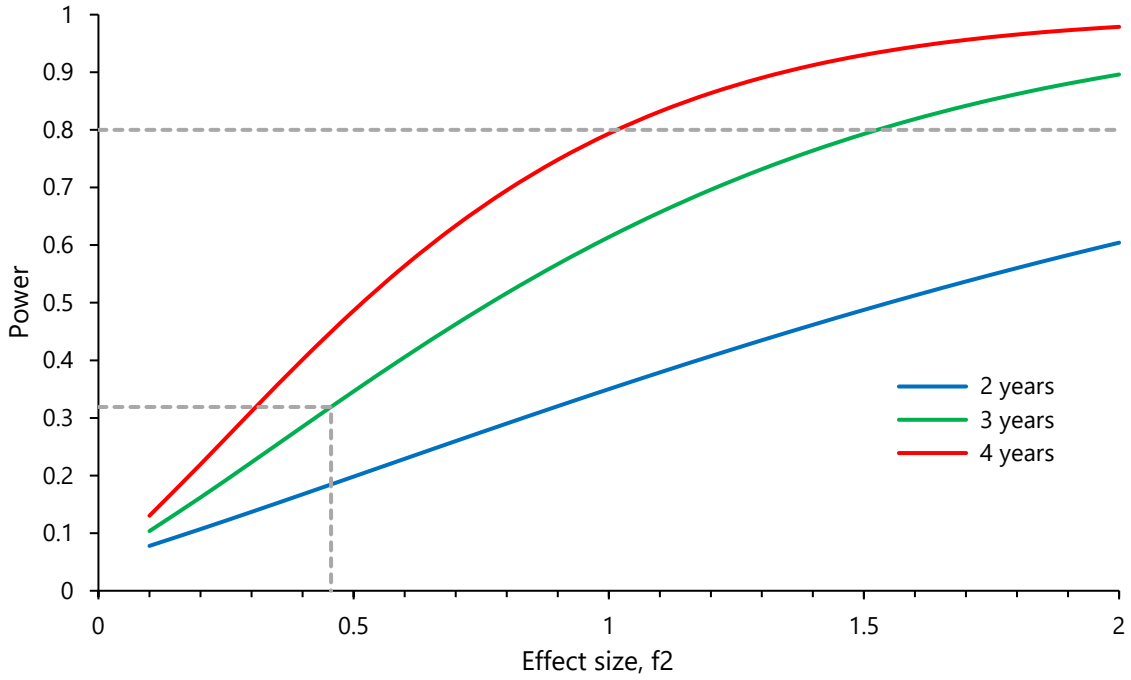
Table B Regression parameters and power for seasonal trends in total aluminum concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	13.098	-0.00452	0.427		0.745	0.419
2	0.022	0.001842	0.057		0.061	0.082
3	0.019	0.001759	0.034		0.035	0.068
4	0.081	-0.001	0.015		0.015	0.058
5	2.419	-0.00748	0.015		0.504	0.348
6	7.100	-0.00405	0.335		0.456	0.319
7	8.360	-0.00397	0.313		0.264	0.201
8	10.058	-0.00527	0.209	*	1.300	0.798
9	8.974	-0.00376	0.565		0.268	0.203
10	3.816	-0.00215	0.207		0.261	0.125
11	1.738	-0.00052	0.038		0.040	0.061
12	6.677	-0.00478	0.697		2.304	0.664
13	41.589	-0.00625	0.870	*	6.687	0.882

The same calculations were made for all other water quality variables with consistent detections. These are compiled in Appendix C as figures and tables, as for total aluminum. In all instances, results for Bosworth Creek (AEMP-02, -03, -04) and for the location on Bear Island (AEMP-05) appear to behave differently.

More generally, power curves were generated for two, three, and four years of sampling (assuming three samples per year). Figure B presents these curves and includes as an example the effect size and estimated power for three years of sampling for total aluminum at AEMP-06 (f2=0.456 and power=0.319, Table B). For any given effect size, power increases with ongoing sampling, as expected. The red curve presents expected power after another year of sampling. Power increases the probability that effects will be detected if there are any, or conversely, provides confidence that lack of effect is real.

Figure B Power curves for successive years of AEMP sampling



Presentation of data and analysis (Figure A and Table B) considered seasonal trends at given locations and the capacity to detect them, however, any differences among the lines in Figure A could be interpreted as effects on water quality if the seasonal pattern is different depending on location (i.e. upstream vs. downstream). Figure C uses concentration of total copper as an example, and regression coefficients (slopes, Table A) are plotted against the position of the sampling location. Data for each sampling event are plotted from upstream to downstream with spacing reflective of the distance between locations. Specifically, the upstream location AEMP-10 and the downstream location AEMP-11 are on opposite ends of the horizontal axis, and clustered in the middle are AEMP-06, -07, -12, -08, -09, and -01 all of which are along the right bank near operations or mid-channel (AEMP-01) (Figure1). Locations on Bosworth Creek (AEMP-02, 03, and 04), on Bear Island (AEMP-05) and beside it (AEMP-13) are not included so as to consider only a series along which water might flowing in an approximately straight path. All slopes are negative (see Figure C-1) but less so with distance downstream. However, the slope in Figure C is not significant, and the effect size and power are small (Table C). This is true also for all other water quality variables (Table C); the comparable figures are given in Appendix D.

Figure C *Summary of regression slopes for sampling locations, spatial differences in seasonal total copper concentration*

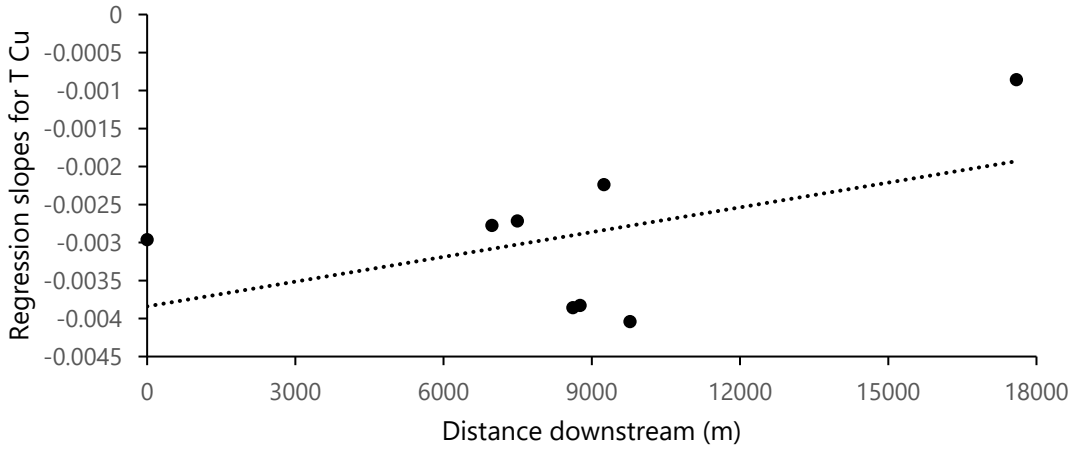


Table C *Regression parameters and power for seasonal trends across sampling locations*

Water quality variable	Intercept	Slope	Coefficient of determination, r^2	Effect size, f2	Power
Total Aluminum	-0.0044	9.276E-08	0.081	0.089	0.090
Total Copper	-3.84E-03	1.085E-07	0.244	0.323	0.206
Total Iron	-0.0048	1.533E-07	0.190	0.235	0.161
Total Magnesium	0.0002	-5.932E-09	0.006	0.006	0.053
Total Manganese	-0.0038	9.450E-08	0.092	0.101	0.095
Total Molybdenum	-9.71E-04	3.281E-08	0.094	0.104	0.097
Total Sodium	0.0011	1.596E-08	0.017	0.017	0.058
Total Nickel	-0.0034	6.884E-08	0.102	0.114	0.101
Total Strontium	-4.3090	1.321E-03	0.464	0.866	0.476
Total Titanium	-0.0021	-4.855E-09	0.000	0.000	0.050
Total Uranium	-8.22E-04	2.688E-08	0.068	0.073	0.082
Chloride	0.0013	5.374E-09	0.002	0.002	0.051
Sulphate	0.0003	3.567E-08	0.108	0.121	0.105

3.2 Spatial Trends

The preceding considered seasonal trends for given water quality variables, presented data graphically, and quantified trends, and then examined differences in seasonal trends as a metric of effects on water quality. However, a more direct search for effects considers how at any time (season) water quality changes with distance downstream (i.e. from background upstream, past operations, and downstream). Therefore, monitoring results for the same water quality variables were examined for separate sampling events.

Figure D uses total aluminum again as an example, and the three seasonal sampling events for 2018 and 2019 are shown. Data are plotted relative to distance downstream. Figure D has six relatively flat lines indicative of no change in total aluminum concentration as water flows downstream; slopes are not significant, and with the variation in the middle cluster of points, there is almost no statistical power (Table D). Lines for Fall 2018 and Spring 2019 also are flat, but have lower and higher concentrations, respectively.

As before, the conditions for regression are not ideal given the uneven spacing of the points and the potentially disproportionate influence of those widely removed on either end; however, the alternative is simply to compare those two points. More positively, the lack of difference between the extremes of upstream and downstream suggests that the variability near operations represents at most only localized effects. The same analyses were made for all other water quality variables with consistent detections. These are compiled in Appendix E as figures and tables, as for total aluminum.

Figure D Total aluminum concentration, AEMP spatial trends

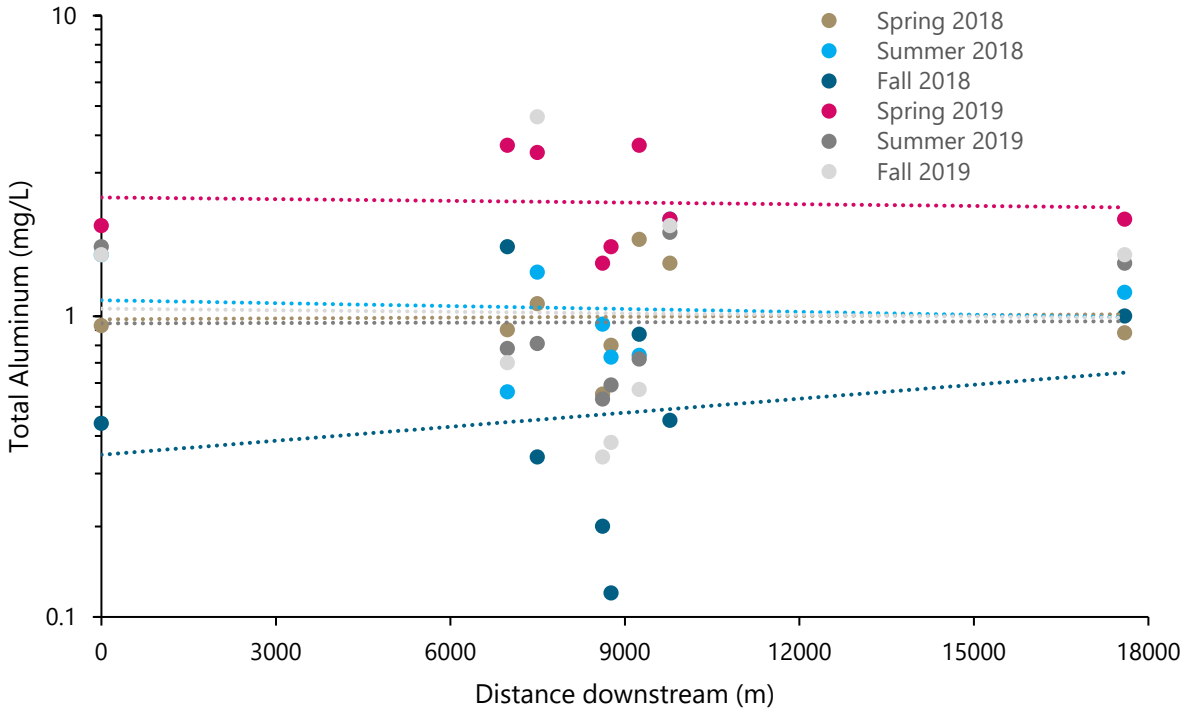


Table D Regression parameters and power for spatial trends in total aluminum concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	0.977	9.419E-07	0.0008		0.001	0.050
Summer 2018	1.130	-3.221E-06	0.0062		0.006	0.052
Fall 2018	0.346	1.554E-05	0.0387		0.040	0.061
Spring 2019	2.484	-1.876E-06	0.0032		0.003	0.051
Summer 2019	0.947	4.007E-07	0.0001		0.000	0.050
Fall 2019	1.060	-1.731E-06	0.0004		0.000	0.050

4 Summary

AEMP water quality data are characterized by appreciable variability, which limits statistical power to detect trends. Note that power was examined *post hoc*, so it includes no information that was not contained in respective coefficients of determination and tests of significance, but the analysis does provide perspective as to the strength of any conclusions.

Seasonal trends were examined at each sampling location for a suite of water quality variables for which there were consistent detections. Whereas seasonal changes in water quality may be expected, the patterns of changes were examined to see if they differed with location in a manner that might be indicative of influence of operations; however, there was no evidence that position of sampling along the river had any effect on seasonal trends in water quality.

Similarly, for the same suite of water quality variables, data were considered for longitudinal trends (upstream to downstream) among locations at particular sampling times (this done for spring, summer, and fall, 2018 and 2019). In no instance was there a significant increasing trend in concentration for any analyte (i.e. no net difference between upstream background concentration and downstream concentration). There is variability in water quality adjacent to operations, but any higher concentration do not manifest in increases downstream and any effects may eb highly localized.

5 Closure

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned at any time.

Report Prepared by



R. Neal Tanna, M.Sc., P.Biol.
Technical Consultant

Senior Review by:



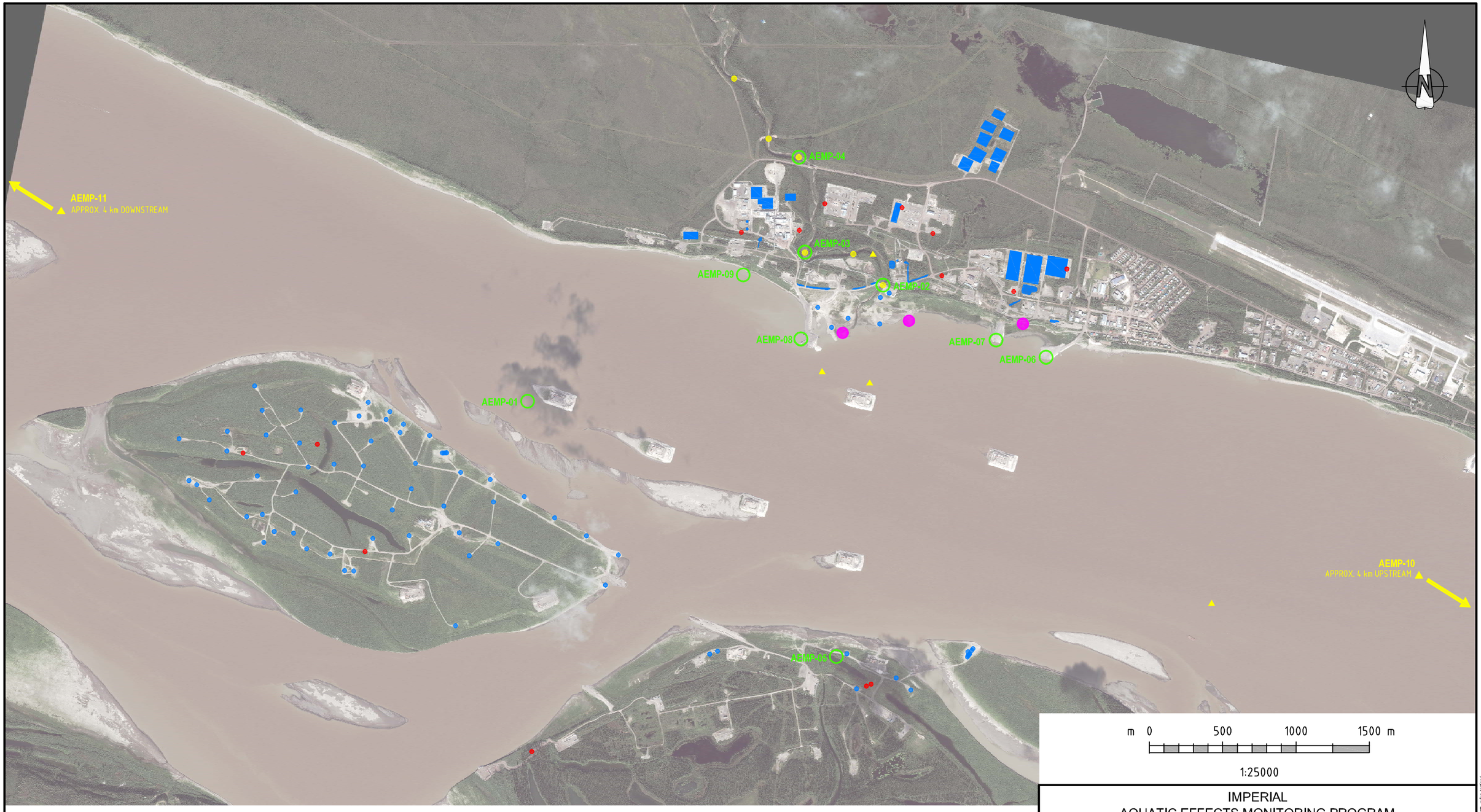
Michael Vander Meulen, Ph.D., P.Biol.
Senior Aquatic Ecologist

Advisian Americas

6 References

CCME (Canadian Council of Ministers for the Environment) 2017. Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Winnipeg, Manitoba. Available online at: http://st-ts.ccme.ca/en/index.html

Figure



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1:25000

LEGEND

- SNP - SURFACE WATER LOCATIONS
- SNP GROUNDWATER WELLS
- GNWT COMMUNITY BASED WATER MONITORING PROGRAM LOCATION
- AEMP MONITORING LOCATIONS
- MOST ACTIVE NATURAL SEEPS
- 2009-2011 BOSWORTH CREEK SURFACE WATER MONITORING STATIONS

IMPERIAL
AQUATIC EFFECTS MONITORING PROGRAM
NORMAN WELLS, NT

AEMP MONITORING LOCATIONS

Date:	Drawn by:	Edited by:	App'd by:
22-JAN-20	OTHERS	MYT	

Advisian
Worley Group

Project No. 407011-00770-1000

FIG No 1 | REV A

"This drawing is prepared for the use of our customer as specified in the accompanying report. Worley Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

PLOT DATE & TIME: 22/1/2020 2:01:58 PM
SAVE DATE & TIME: 22/1/2020 2:01:16 PM
USER NAME: mka.telford
ISSUING OFFICE: eCAD

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Tables

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Table 1
Surface Water Analytical Results: Indicator Analysis Parameters

PROJECT No.: 407011-00770		Anions					Cations						General									Inorganic Nitrogen Compounds							Inorganic Sulphur Compounds	Miscellaneous			
Monitoring Station	Date (dd-mmm-yyyy)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Hydroxide (mg/L)	Calcium (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity (Total; as $CaCO_3$) (mg/L)	Alkalinity (PP; as $CaCO_3$) (mg/L)	Colour (color unit)	Electrical Conductivity (uS/cm)	Hardness (Total; as $CaCO_3$) (mg/L)	pH (pH Units)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)	Ammonia (Total; as N) (mg/L)	Nitrate (mg/L)	Nitrate (as N) (mg/L)	Nitrite (mg/L)	Nitrite (as N) (mg/L)	Nitrite-plus-Nitrate (as N) (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Sulphide (asH2S) (mg/L)	Biochemical Oxygen Demand (mg/L)	Chemical Oxygen Demand (mg/L)	Dissolved Organic Carbon (mg/L)	Total Organic Carbon (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		---	---	120	---	---	---	0.3	---	---	---	---	---	---	---	---	---	(6.5 - 9)	---	---	---	8.5	---	2.9	---	0.06	---	---	---	---	---	---	---
AEMP																																	
AEMP-01	16-Sep-2017	120	< 0.50	9.4	48	< 0.50	42	< 0.060	11	< 0.0040	0.94	9.0	99	< 0.50	---	320	150	---	160	22	---	---	0.17	0.038	< 0.033	< 0.010	0.038	---	< 0.0020	< 2.0 [#2]	---	4.3	3.5
	16-Oct-2017	120	< 1.0	10	47	< 1.0	37	< 0.060	11	< 0.0040	0.94	9.3	97	< 1.0	---	310	140	---	170	8.0	---	---	0.20	0.046	< 0.033	< 0.010	0.046	---	0.0020	< 2.0	---	3.6	4.2
	23-Jun-2018	100	< 1.0	6.3	44	< 1.0	33	< 0.060	9.5	< 0.0040	0.82	6.1	82	< 1.0	---	260	120	---	160	71	60	0.024	0.16	0.035	< 0.033	< 0.010	0.035	0.28	< 0.0020	---	32	5.7	5.0
	14-Aug-2018	120	< 1.0	8.7	57	< 1.0	38	< 0.060	12	< 0.0040	0.84	7.6	98	< 1.0	---	330	140	---	190	220	130	0.033	0.095	0.021	< 0.033	< 0.010	0.021	0.64	0.016	< 2.0	41	4.9	5.2
	18-Oct-2018	110	< 1.0	11	32	< 1.0	30	< 0.060	10	0.0093	0.91	10	86	< 1.0	---	260	120	---	160	58	7.3	< 0.015	0.35	0.079	< 0.033	< 0.010	0.079	0.21	0.0050	2.1	22	2.8	3.1
	10-Jun-2019	98	< 1.0	5.8	37	< 1.0	31	< 0.060	8.1	< 0.0040	0.78	5.7	80	< 1.0	19	250	110	8.00	180	150	120	< 0.015	0.23	0.052	< 0.033	< 0.010	0.052	0.44	0.0090	< 2.0 [#3]	45	6.8	5.8
	26-Aug-2019	120	< 1.0	9.6	57	< 1.0	38	< 0.060	12	< 0.0040	0.86	8.2	99	< 1.0	9.8	330	150	8.20	190	55	49	0.027	0.17	0.038	< 0.033	< 0.010	0.038	0.30	0.0050	< 2.0	21	5.2	4.7
	01-Oct-2019	120	< 1.0	11	60	< 1.0	39	< 0.060	11	< 0.0040	0.93	8.9	96	< 1.0	21	320	140	8.07	220	76	92	0.020	0.15	0.033	< 0.033	< 0.010	0.033	0.37	0.011	2.2	45	6.7	5.9
AEMP-02	18-Aug-2017	230	< 0.50	24	140	< 0.50	76	< 0.060	28	0.0077	1.1	23	190	< 0.50	---	650	310	---	400	4.0	---	---	0.054	0.012	< 0.033	< 0.010	< 0.014	---	---	< 2.0 [#4]	---	3.3	4.0
	16-Sep-2017	220	< 0.50	19	130	< 0.50	80	< 0.060	29	0.0081	1.0	18	180	< 0.50	---	630	320	---	390	2.7	---	---	0.15	0.033	< 0.033	< 0.010	0.033	---	0.0030	< 2.0 [#2]	---	5.1	4.2
(Duplicate)	16-Sep-2017	220	< 0.50	19	130	< 0.50	79	< 0.060	29	0.0078	0.96	18	180	< 0.50	---	630	320	---	380	1.3	---	---	0.15	0.033	< 0.033	< 0.010	0.033	---	0.0020	< 2.0 [#2]	---	4.3	3.7
	16-Oct-2017	220	< 1.0	20	150	< 1.0	75	< 0.060	30	0.0091	0.97	19	180	< 1.0	---	650	310	---	420	21	---	---	0.26	0.059	< 0.033	< 0.010	0.059	---	< 0.0020	< 2.0	---	3.8	4.0
	23-Jun-2018	230	< 1.0	19	130	< 1.0	78	< 0.060	28	0.0058	1.1	17	180	< 1.0	---	620	310	---	400	2.0	1.3	0.019	0.17	0.038	< 0.033	< 0.010	0.038	0.21	< 0.0020	---	13	4.8	4.3
	12-Aug-2018	220	< 1.0	14	140	< 1.0	74	< 0.060	29	0.0079	1.0	16	180	< 1.0	---	610	300	---	400	3.3	---	0.018	0.068	0.015	< 0.033	< 0.010	0.015	0.23	0.0030	< 2.0	19	3.8	4.2
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.086	0.019	< 0.033	< 0.010	0.019	---	---	---	---	---	---
	16-Oct-2018	230	< 1.0	17	160	< 1.0	78	< 0.060	31	0.0046	1.0	18	190	< 1.0	---	660	320	---	410	19	1.5	< 0.015	0.17	0.038	< 0.033	< 0.010	0.038	0.17	< 0.0020	2.5 [#2]	13	2.7	2.9
	03-Jun-2019	190	< 1.0	17	120	< 1.0	65	< 0.060	24	0.0050	0.85	14	160	< 1.0	16	560	260	8.21	350	4.7	3.7	< 0.015	0.18	0.041	< 0.033	< 0.010	0.041	0.21	< 0.0020	< 2.0	15	5.2	4.7
(Duplicate)	03-Jun-2019	190	< 1.0	17	120	< 1.0	65	< 0.060	24	0.0049	0.84	14	160	< 1.0	18	560	260	8.18	360	4.0	4.1	< 0.015	0.19	0.042	< 0.033	< 0.010	0.042	0.21	< 0.0020	< 2.0	20	5.0	4.9
	28-Aug-2019	230	< 1.0	17	140	< 1.0	76	< 0.060	27	0.0069	0.96	16	190	< 1.0	15	630	300	8.29	400	3.3	2.0	0.028	0.18	0.040	< 0.033	< 0.010	0.040	0.24	< 0.0020	< 2.0	< 10	5.6	4.5
	03-Oct-2019	230	< 1.0	19	160	< 1.0	83	< 0.060	32	0.0069	1.0	19	190	< 1.0	7.0	670	340	---	430	3.3	2.0	0.022	0.27	0.060	< 0.033	< 0.010	0.060	0.19	0.0020	< 2.0	20	3.1	2.9
AEMP-03	18-Aug-2017	220	2.6	24	140	< 0.50	76	< 0.060	28	0.0056	1.1	22	190	2.2	---	650	310	---	400	1.3	---	---	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	---	---	< 2.0 [#4]	---	3.3	3.7
	16-Sep-2017	220	< 0.50	19	130	< 0.50	79	< 0.060	29	0.0057	1.0	17	180	< 0.50	---	630	320	---	400	2.7	---	---	0.14	0.032	< 0.033	< 0.010	0.032	---	< 0.0020	< 2.0 [#2]	---	4.4	4.0
	16-Oct-2017	220	< 0.50	20	150	< 0.50	75	< 0.060	30	0.0063	0.94	19	180	< 0.50	---	650	310	---	420	10	---	---	0.26	0.059	< 0.033	< 0.010	0.059	---	< 0.0020	< 2.0	---	3.6	4.1
	23-Jun-2018	230	< 1.0	20	140	< 1.0	77	< 0.060	28	0.0060	1.1	18	190	< 1.0	---	630	310	---	380	2.0	1.4	0.019	0.17	0.038	< 0.033	< 0.010	0.038	0.20	< 0.0020	---	24	5.1	4.3
	12-Aug-2018	220	< 1.0	14	140	< 1.0	73	< 0.060	29	0.0057	1.0	15	180	< 1.0	---	610	300	---	400	2.7	---	< 0.015	0.057	0.013	< 0.033	< 0.010	< 0.014	0.23	0.0020	< 2.0	21	3.8	4.2
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.089	0.020	< 0.033	< 0.010	0.020	---	---	---	---	---	---
	16-Oct-2018	220	< 1.0	17	160	< 1.0	78	< 0.060	31	< 0.0040	1.0	17	180	< 1.0	---	660	320	---	420	42	3.6	< 0.015	0.17	0.038	< 0.033	< 0.010	0.038	0.24	< 0.0020	< 2.0 [#2]	15	3.1	3.0
	03-Jun-2019	190	< 1.0	17	110	< 1.0	65	< 0.060	24	0.0052	0.91	14	160	< 1.0	16	560	260	8.29	370	3.3	3.2	< 0.015	0.19	0.043	< 0.033	< 0.010	0.043	0.20	< 0.0020	< 2.0	21	5.5	4.8
	28-Aug-2019	220	< 1.0	17	140	< 1.0	76	< 0.060	28	0.0055	1.0	16	180	< 1.0	14	630	300	8.22	400	3.3	1.8	0.015	0.18	0.041	< 0.033	< 0.010	0.041	0.23	< 0.0020	< 2.0	< 10	5.4	4.7
	02-Oct-2019	230	< 1.0	19	150	< 1.0	79	< 0.060	30	0.0044	0.99	18	180	< 1.0	7.9	680	320	8.31	440	2.7	0.55	0.024	0.26	0.060	< 0.033	< 0.010	0.060	0.23	< 0.0020	< 2.0	13	3.6	3.7
AEMP-04	18-Aug-2017	230	< 0.50	24	140	< 0.50	76	< 0.060	28	0.0047	1.1	21	190	< 0.50	---	650	310	---	440	3.3	---	---	0.058	0.013	< 0.033	< 0.010	< 0.014	---	---	< 2.0	---	4.6	4.3
	16-Sep-2017	210	< 0.50	19	130	< 0.50	73	< 0.060	28	0.0049	0.99	17	180	< 0.50	---	620	300	---	390	2.0	---	---	0.14	0.031	< 0.033	< 0.010	0.031	---	< 0.0020	< 2.0 [#2]	---	4.0	4.3
	16-Oct-2017	210	< 1.0	21	150	< 1.0	75	< 0.060	30	0.0050	0.98	19	170	< 1.0	---	660	310	---	420	6.0	---	---	0.26	0.059	< 0.033	< 0.010	0.059	---	< 0.0020	< 2.0	---	3.0	3.5
	23-Jun-2018	230	< 1.0	20	140	< 1.0	76	< 0.060	28	0.0070	1.1	18	180	< 1.0	---	640	300	---	380	4.7	1.4	0.039	0.18	0.041	< 0.033	< 0.010	0.041	0.20	< 0.0020	---	15	4.9	3.9
(Duplicate)	23-Jun-2018	230	< 1.0	19	140	< 1.0	71	< 0.060	26	0.0066	1.0	17	190	< 1.0	---	640	280	---	390	4.7	1.1	0.037	0.18	0.040	< 0.033	< 0.010	0.040	0.21	< 0.0020	---	22	4.7	4.1
	12-Aug-2018	220	< 1.0	14	140	< 1.0	73	< 0.060	29	0.0055	0.99	15	180	< 1.0	---	610	300	---	400	3.3	---	< 0.015	0.054	0.012	< 0.033	< 0.010	< 0.014	0.19	< 0.0020	< 2.0	16	4.0	3.8
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.083	0.019	< 0.033	< 0.010	0.019	---	---	---	---	---	---
	16-Oct-2018	230	< 1.0	17	160	< 1.0	79	< 0.060	31	< 0.0040	1.0	17	180	< 1.0	---	660	330	---	420	16	1.3	< 0.015	0.17	0.037	< 0.033	< 0.010	0.037	0.15	0.0030	< 2.0 [#2]	14	2.5	2.7
	03-Jun-2019	190	< 1.0	17	120	< 1.0	65	< 0.060	24	0.0041	0.86	14	160	< 1.0	16	560	260	8.22	360	6.0	4.2	< 0.015	0.18	0.041	< 0.033	< 0.010	0.041	0.31	< 0.0020	< 2.0	15	5.3	4.3
	25-Aug-2019	210	< 1.0	13	140	< 1.0	69	< 0.060	28	0.0049	0.91	13	180	< 1.0	9.8	600	290	8.26	360	3.3	2.9	0.030 [#5]	0.16	0.036	< 0.033	< 0.010	0.036	0.22	< 0.0020	< 2.0 [#4]	13	4.5	4.7
	02-Oct-2019	230	< 1.0	18	150	< 1.0	78	< 0.060	30	< 0.0040	1.0	17	180	< 1.0	7.9	690	320	8.31	440	1.3	0.51	< 0.015	0.28	0.063	< 0.033	< 0.010	0.063	0.14	< 0.0020	< 2.0	15	3.7	3.2
AEMP-05	19-Aug-2017	210	< 0.50	4.5	19	< 0.50	52	0.073	14	0.0071	1.5	5.6	170	< 0.50	---	360	190	---	210	2.7	---	---	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	---	---	< 2.0	---	10	9.0
	16-Sep-2017	200	< 0.50	4.7	18	< 0.50	53	< 0.060	13	< 0.0040	1.7	5.1	160	< 0.50	---	350	190	---	180	1.3	---	---	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	---	< 0.0020	2.0 [#2]	---	9.1	7.8
	15-Oct-2017	200	< 0.50	5.6	18	< 0.50	48	< 0.060	14	0.0052	2.3	5.2	170	< 0.50	---	350	180	---	180	2.0	---	---	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	---	< 0.0020	< 2.0	---	10	10
	23-Jun-2018	110	< 1.0	6.6	47	< 1.0	34	< 0.060	10	0.013	0.84	6.3	88	< 1.0	---	280	130	---	150	71	61	0.030	0.14	0.031	< 0.033	< 0.010	0.031	0.35	0.0030	---	35	5.6	5.4
	13-Aug-2018	190	< 1.0	3.7	5.0	< 1.0	42	**0.34** [#1]	14	0.028	1.4	3.9	160	< 1.0	---	310	160	---	200	3.3	---	0.028	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	0.55	0.0040	< 2.0	42	12	12
	14-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	---	---	---	---	---	---
	18-Oct-2018	230	< 1.0	5.1	14	< 1.0	52	0.18	15	0.18	3.6	4.6	190	< 1.0	---	380	190	---	220	2.0	2.4	< 0.015	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	0.52	0.0040	2.9	32	12	12
	02-Jun-2019	190	< 1.0	3.6	9.8	< 1.0	43	0.25	14	0.040	2.4	3.8	150	< 1.0	20	320	160	7.98	210	4.0	4.9	< 0.015	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	0.47	0.0030	< 2.0	35	12	12
	27-Aug-2019	190	< 1.0	3.3	7.3	< 1.0	43	< 0.060	13	< 0.0040	2.0	3.3	160	< 1.0	15	310	160	8.21	190	1.3	0.90	0.034	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	0.51	< 0.0020	< 2.0 [#4]	26	13	11
	01-Oct-2019	190	< 1.0	4.0	5.3	< 1.0	42	0.11	16	< 0.0040	1.7	3.1	160	< 1.0	18	310	170	8.16	200	6.7	1.1	0.015	< 0.044	< 0.010	< 0.033	< 0.010	< 0.014	0.51	0.0030	< 2.0	38	14	13

Advisian
Worley Group

Table 1
Surface Water Analytical Results: Indicator Analysis Parameters

PROJECT No.: 407011-00770		Anions					Cations						General									Inorganic Nitrogen Compounds							Inorganic Sulphur Compounds	Miscellaneous			
Monitoring Station	Date (dd-mmm-yyyy)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Hydroxide (mg/L)	Calcium (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity (Total; as $CaCO_3$) (mg/L)	Alkalinity (PP; as $CaCO_3$) (mg/L)	Colour (color unit)	Electrical Conductivity (uS/cm)	Hardness (Total; as $CaCO_3$) (mg/L)	pH (pH Units)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)	Ammonia (Total; as N) (mg/L)	Nitrate (mg/L)	Nitrate (as N) (mg/L)	Nitrite (mg/L)	Nitrite (as N) (mg/L)	Nitrite-plus-Nitrate (as N) (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Sulphide (asH2S) (mg/L)	Biochemical Oxygen Demand (mg/L)	Chemical Oxygen Demand (mg/L)	Dissolved Organic Carbon (mg/L)	Total Organic Carbon (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		---	---	120	---	---	---	0.3	---	---	---	---	---	---	---	---	---	(6.5 - 9)	---	---	---	8.5	---	2.9	---	0.06	---	---	---	---	---	---	---
AEMP-06	21-Aug-2017	110	< 0.50	9.0	41	< 0.50	31	< 0.060	9.7	< 0.0040	0.84	8.2	87	< 0.50	---	270	120	---	170	39	---	---	0.25	0.057	< 0.033	< 0.010	0.057	---	---	< 2.0 [#6]	---	4.4	4.5
	16-Sep-2017	100	< 0.50	9.8	36	< 0.50	30	< 0.060	9.9	< 0.0040	0.91	8.6	85	< 0.50	---	260	120	---	140	19	---	---	0.31	0.070	< 0.033	< 0.010	0.070	---	< 0.0020	< 2.0 [#2]	---	4.6	4.3
	16-Oct-2017	110	< 0.50	10	38	< 0.50	32	< 0.060	10	0.0068	0.90	9.2	90	< 0.50	---	280	120	---	190	13	---	---	0.36	0.082	< 0.033	< 0.010	0.082	---	< 0.0020	< 2.0	---	3.8	4.3
	23-Jun-2018	92	< 1.0	7.5	34	< 1.0	28	< 0.060	8.5	< 0.0040	0.78	6.7	76	< 1.0	---	230	100	---	120	33	33	0.023	0.23	0.051	< 0.033	< 0.010	0.051	0.25	< 0.0020	---	21	5.1	4.5
	13-Aug-2018	110	< 1.0	11	43	< 1.0	30	< 0.060	9.6	< 0.0040	0.77	8.5	89	< 1.0	---	280	110	---	180	19 [#7]	24	0.015	0.16	0.035	< 0.033	< 0.010	0.035	0.23	0.0050	< 2.0	23	4.4	4.8
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.16	0.035	< 0.033	< 0.010	0.035	---	---	---	---	---	---
	18-Oct-2018	98	< 1.0	11	34	< 1.0	28	< 0.060	9.3	0.018	0.92	9.4	80	< 1.0	---	260	110	---	140	170	52	0.016	0.41	0.093	< 0.033	< 0.010	0.093	0.36	0.0030	2.8	29	3.1	2.7
	03-Jun-2019	93	< 1.0	8.2	32	< 1.0	26	< 0.060	8.4	< 0.0040	0.73	6.5	76	< 1.0	18	240	100	8.00	150	220	180	< 0.015	0.35	0.079	< 0.033	< 0.010	0.080	0.45	0.012	< 2.0	53	5.3	5.0
	25-Aug-2019	110	< 1.0	11	50	< 1.0	29	< 0.060	10	< 0.0040	0.80	8.3	88	< 1.0	6.9	270	110	8.15	160	22	25	0.031 [#5]	0.34	0.076	< 0.033	< 0.010	0.076	0.23	< 0.0020	< 2.0 [#4]	17	4.0	4.1
	02-Oct-2019	100	< 1.0	10	36	< 1.0	29	< 0.060	9.7	< 0.0040	0.79	8.0	82	< 1.0	9.9	260	110	8.06	160	18	21	< 0.015	0.35	0.078	< 0.033	< 0.010	0.078	0.20	0.0030	< 2.0	24	4.2	4.2
(Duplicate)	03-Oct-2019	99	< 1.0	10	35	< 1.0	29	< 0.060	9.6	< 0.0040	0.81	8.0	81	< 1.0	13	260	110	8.07	160	19	21	0.038	0.36	0.081	< 0.033	< 0.010	0.081	0.20	< 0.0020	< 2.0	20	4.3	3.8
AEMP-07	21-Aug-2017	110	< 0.50	9.1	41	< 0.50	31	< 0.060	9.7	< 0.0040	0.79	8.1	88	< 0.50	---	270	120	---	170	35	---	---	0.25	0.056	< 0.033	< 0.010	0.056	---	---	< 2.0 [#4]	---	4.5	3.6
(Duplicate)	21-Aug-2017	100	< 0.50	9.2	41	< 0.50	30	< 0.060	9.5	< 0.0040	0.82	8.0	86	< 0.50	---	270	110	---	180	37	---	---	0.25	0.056	< 0.033	< 0.010	0.056	---	---	< 2.0 [#4]	---	4.0	3.1
	16-Sep-2017	100	< 0.50	9.7	35	< 0.50	30	< 0.060	9.8	< 0.0040	0.88	8.6	86	< 0.50	---	260	110	---	140	25	---	---	0.31	0.070	< 0.033	< 0.010	0.070	---	< 0.0020	< 2.0 [#2]	---	5.2	4.2
	16-Oct-2017	100	< 0.50	10	37	< 0.50	29	< 0.060	9.5	0.022	0.85	8.8	82	< 0.50	---	260	110	---	170	17	---	---	0.37	0.083	< 0.033	< 0.010	0.083	---	< 0.0020	< 2.0 [#6]	---	3.8	3.3
	23-Jun-2018	93	< 1.0	7.7	33	< 1.0	27	< 0.060	8.4	< 0.0040	0.78	6.9	76	< 1.0	---	230	100	---	120	43	44	0.022	0.23	0.053	< 0.033	< 0.010	0.053	0.31	0.0050	---	32	5.0	5.0
	13-Aug-2018	110	< 1.0	11	43	< 1.0	31	< 0.060	10	< 0.0040	0.79	8.9	87	< 1.0	---	290	120	---	180	110	56	0.028	0.15	0.034	< 0.033	< 0.010	0.034	0.43	0.0040	< 2.0	41	4.6	5.0
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.14	0.032	< 0.033	< 0.010	0.032	---	---	---	---	---	---
	17-Oct-2018	100	< 1.0	11	35	< 1.0	28	< 0.060	9.5	0.013	0.94	10	82	< 1.0	---	260	110	---	150	24	12	< 0.015	0.40	0.091	< 0.033	< 0.010	0.091	0.18	< 0.0020	2.9 [#4]	9.2	3.0	2.5
(Duplicate)	17-Oct-2018	100	< 1.0	12	36	< 1.0	28	< 0.060	9.6	0.018	0.94	10	83	< 1.0	---	260	110	---	150	27	22	< 0.015	0.40	0.090	< 0.033	< 0.010	0.090	0.13	0.0020	2.6 [#4]	6.1	3.0	2.6
	03-Jun-2019	100	< 1.0	8.8	35	< 1.0	28	< 0.060	8.6	0.0098	0.81	8.7	82	< 1.0	18	260	100	8.16	170	230	190	< 0.015	0.35	0.078	< 0.033	< 0.010	0.078	0.52	0.017	2.5	62	6.0	5.4
	25-Aug-2019	100	< 1.0	11	38	< 1.0	29	< 0.060	10	< 0.0040	0.81	8.2	85	< 1.0	5.9	270	110	8.12	160	18	22	0.044 [#5]	0.34	0.077	< 0.033	< 0.010	0.077	0.22	0.0020	< 2.0 [#4]	15	4.5	3.8
	03-Oct-2019	100	< 1.0	9.7	35	< 1.0	29	< 0.060	9.6	0.029	0.78	7.9	85	< 1.0	8.9	260	110	8.03	140	920	120	0.027	0.34	0.078	< 0.033	< 0.010	0.078	0.78	0.0070	< 2.0	81	3.7	3.8
AEMP-08	17-Aug-2017	120	< 0.50	7.1	54	< 0.50	40	< 0.060	12	< 0.0040	0.93	7.8	96	< 0.50	---	310	150	---	180	33	---	---	0.18	0.040	< 0.033	< 0.010	0.040	---	< 0.0020	< 2.0	---	4.8	4.1
	21-Aug-2017	110	< 0.50	9.4	42	< 0.50	31	< 0.060	9.9	< 0.0040	0.83	8.4	88	< 0.50	---	280	120	---	160	31	---	---	0.25	0.057	< 0.033	< 0.010	0.057	---	---	< 2.0	---	3.7	3.6
	16-Sep-2017	110	< 0.50	10	38	< 0.50	33	< 0.060	10	0.0041	0.83	8.8	86	< 0.50	---	270	130	---	150	110	---	---	0.30	0.068	< 0.033	< 0.010	0.068	---	0.0080	< 2.0 [#2]	---	4.7	4.0
	16-Oct-2017	100	< 0.50	9.9	44	< 0.50	30	< 0.060	10	0.0049	0.89	8.8	82	< 0.50	---	270	120	---	130	29	---	---	0.38	0.086	< 0.033	< 0.010	0.086	---	< 0.0020	< 2.0	---	3.0	3.6
	23-Jun-2018	97	< 1.0	8.9	36	< 1.0	26	0.20	8.1	0.011	0.72	6.3	79	< 1.0	---	250	99	---	140	51	33	0.037	0.23	0.052	< 0.033	< 0.010	0.052	0.27	< 0.0020	---	33	5.5	4.9
	13-Aug-2018	110	< 1.0	11	45	< 1.0	33	< 0.060	11	< 0.0040	0.83	10	90	< 1.0	---	290	130	---	200	29	---	0.018	0.17	0.037	< 0.033	< 0.010	0.037	0.28	0.0030	< 2.0	25	4.8	4.8
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.17	0.038	< 0.033	< 0.010	0.038	---	---	---	---	---	---
	17-Oct-2018	100	< 1.0	11	40	< 1.0	31	< 0.060	11	< 0.0040	0.92	9.4	85	< 1.0	---	270	120	---	160	5.3	2.2	< 0.015	0.41	0.093	< 0.033	< 0.010	0.093	0.12	< 0.0020	2.4 [#6]	7.2	3.0	2.8
	03-Jun-2019	110	< 1.0	8.7	39	< 1.0	31	< 0.060	10	0.0048	0.82	7.4	87	< 1.0	17	280	120	8.07	190	130	97	< 0.015	0.54	0.12	< 0.033	< 0.010	0.12	0.38	0.0070	< 2.0	52	6.7	5.1
	28-Aug-2019	110	< 1.0	9.4	47	< 1.0	34	< 0.060	11	< 0.0040	0.84	8.5	94	< 1.0	14	300	130	8.17	180	22	17	0.026	0.31	0.069	< 0.033	< 0.010	0.069	0.23	0.0020	< 2.0	< 10	4.7	3.6
	03-Oct-2019	110	< 1.0	10	43	< 1.0	32	< 0.060	11	< 0.0040	0.81	8.5	89	< 1.0	8.9	290	120	---	150	18	20	0.015	0.34	0.077	< 0.033	< 0.010	0.077	0.19	0.0030	< 2.0	26	3.6	3.5
AEMP-09	21-Aug-2017	110	< 0.50	9.5	43	< 0.50	31	< 0.060	10	0.013	0.82	8.5	89	< 0.50	---	280	120	---	180	130	---	---	0.17	0.038	< 0.033	< 0.010	0.038	---	---	< 2.0	---	3.8	4.0
	16-Sep-2017	110	< 0.50	11	44	< 0.50	38	< 0.060	11	0.019	0.86	9.7	90	< 0.50	---	300	140	---	170	16 [#7]	---	---	0.18	0.040	< 0.033	< 0.010	0.040	---	0.0070	< 2.0 [#2]	---	4.9	4.7
	16-Oct-2017	160	< 0.50	16	45	< 0.50	36	< 0.060	12	0.092	1.0	26	130	< 0.50	---	380	140	---	200	290 [#7]	---	---	0.31	0.071	< 0.033	< 0.010	0.071	---	0.0030	< 2.0	---	6.2	7.5
	23-Jun-2018	96	< 1.0	8.2	34	< 1.0	28	< 0.060	8.6	< 0.0040	0.81	7.3	78	< 1.0	---	240	110	---	140	200	64	0.032	0.22	0.050	< 0.033	< 0.010	0.050	0.40	< 0.0020	---	34	5.0	4.7
	12-Aug-2018	110	< 1.0	12	44	< 1.0	35	0.20	11	0.020	0.93	11	94	< 1.0	---	300	130	---	190	45	---	0.024	0.093	0.021	< 0.033	< 0.010	0.021	0.30	0.0060	< 2.0	29	5.6	4.9
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.080	0.018	< 0.033	< 0.010	0.018	---	---	---	---	---	---
	17-Oct-2018	120	< 1.0	13	42	< 1.0	31	< 0.060	11	0.019	0.91	12	100	< 1.0	---	310	120	---	170	74	5.3	0.029	0.38	0.085	< 0.033	< 0.010	0.085	0.25	0.0060	2.4 [#6]	12	3.5	2.9
	02-Jun-2019	100	< 1.0	7.3	34	< 1.0	32	< 0.060	9.4	0.021	0.84	8.5	86	< 1.0	19	270	120	8.05	190	240 [#8]	180	0.018	0.33	0.074	< 0.033	< 0.010	0.074	0.57	0.013	< 2.0	64	6.6	6.9
	28-Aug-2019	120	< 1.0	9.5	40	< 1.0	33	< 0.060	11	0.0078	0.83	10	94	< 1.0	15	290	130	8.07	180	18	19	0.031	0.30	0.067	< 0.033	< 0.010	0.067	0.28	0.0030	< 2.0	16	6.6	5.4
	03-Oct-2019	110	< 1.0	9.9	41	< 1.0	31	< 0.060	10	0.0071	0.83	9.6	88	< 1.0	9.9	280	120	---	160	38	35	0.022	0.33	0.074	< 0.033	< 0.010	0.074	0.24	0.0050	< 2.0	25	3.6	3.1
AEMP-10	23-Jun-2018	99	< 1.0	7.3	38	< 1.0	31	< 0.060	8.7	< 0.0040	0.79	6.1	81	< 1.0	---	250	110	---	140	39	40	0.025	0.099	0.022	< 0.033	< 0.010	0.022	0.27	0.0040	---	33	5.8	5.1
	14-Aug-2018	120	< 1.0	8.6	49	< 1.0	36	< 0.060	11	< 0.0040	0.83	7.7	97	< 1.0	---	310	130	---	180	59	51	0.016	0.093	0.021	< 0.033	< 0.010	0.021	0.30	0.0040	< 2.0	25	4.5	4.8
(Duplicate)	14-Aug-2018	120	< 1.0	8.6	49	< 1.0	37	0.28	11	0.018	0.93	7.7	96	< 1.0	---	310	140	---	170	66	51	0.023	0.085	0.019	< 0.033	< 0.010	0.019	0.32	0.0030	< 2.0	26	5.3	4.9
	18-Oct-2018	100	< 1.0	11	33	< 1.0	28	< 0.060	9.5	0.0099	0.91	9.7	85	< 1.0	---	260	110	---	150	39	12	0.020	0.41	0.093	< 0.033	< 0.010	0.093	0.19	0.0030	< 2.0	9.2	2.9	3.0
	10-Jun-2019	96	< 1.0	6.2	35	< 1.0	30	< 0.060	7.6	< 0.0040	0.78	5.7	79	< 1.0	20	240	110	8.06	170	150	120	< 0.015	0.23	0.052	< 0.033	< 0.010	0.052	0.45	0.010	2.0 [#3]	44	7.3	6.0
	26-Aug-2019	120	< 1.0	11	50	< 1.0	35	< 0.060	11	< 0.0040	0.86	8.1	98	< 1.0	11	310	130	8.12	180	46	43	0.018	0.17	0.039	< 0.033	< 0.010	0.039	0.26	0.0050	< 2.0	26	5.7	4.6
	01-Oct-2019	120	< 1.0	9.9	60	< 1.0	39	< 0.060	11	< 0.0040	0.90	8.9	100	< 1.0	21	320	140	8.04	230	32	75	0.029	0.16	0.036	< 0.033	< 0.010	0.036	0.32	0.014	2.1	39	6.5	5.9

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Table 1
Surface Water Analytical Results: Indicator Analysis Parameters

PROJECT No.: 407011-00770		Anions					Cations						General									Inorganic Nitrogen Compounds							Inorganic Sulphur Compounds	Miscellaneous			
Monitoring Station	Date (dd-mmm-yyyy)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Hydroxide (mg/L)	Calcium (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity (Total; as $CaCO_3$) (mg/L)	Alkalinity (PP; as $CaCO_3$) (mg/L)	Colour (color unit)	Electrical Conductivity (uS/cm)	Hardness (Total; as $CaCO_3$) (mg/L)	pH (pH Units)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)	Ammonia (Total; as N) (mg/L)	Nitrate (mg/L)	Nitrate (as N) (mg/L)	Nitrite (mg/L)	Nitrite (as N) (mg/L)	Nitrite-plus-Nitrate (as N) (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Sulphide (asH2S) (mg/L)	Biochemical Oxygen Demand (mg/L)	Chemical Oxygen Demand (mg/L)	Dissolved Organic Carbon (mg/L)	Total Organic Carbon (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		---	---	**120**	---	---	---	**0.3**	---	---	---	---	---	---	---	---	---	**(6.5 - 9)**	---	---	---	**8.5**	---	**2.9**	---	**0.06**	---	---	---	---	---	---	---
AEMP-11	23-Jun-2018	96	< 1.0	6.8	35	< 1.0	29	< 0.060	8.4	< 0.0040	0.82	6.4	79	< 1.0	---	240	110	---	140	78	37	0.024	0.18	0.039	< 0.033	< 0.010	0.039	0.29	< 0.0020	---	31	5.2	5.0
	14-Aug-2018	110	< 1.0	9.3	44	< 1.0	37	< 0.060	10	0.0043	0.79	7.6	91	< 1.0	---	290	130	---	180	61	45	0.015	0.13	0.029	< 0.033	< 0.010	0.029	0.27	0.0040	< 2.0	28	4.3	4.8
	18-Oct-2018	110	< 1.0	12	36	< 1.0	29	< 0.060	9.3	< 0.0040	0.96	9.3	88	< 1.0	---	280	110	---	150	81	23	< 0.015	0.40	0.090	< 0.033	< 0.010	0.090	0.24	0.0020	< 2.0	16	3.1	2.7
	10-Jun-2019	92	< 1.0	7.7	31	< 1.0	28	< 0.060	7.6	< 0.0040	0.75	5.8	76	< 1.0	20	230	100	7.99	160	200	120	< 0.015	0.27	0.061	< 0.033	< 0.010	0.061	0.39	0.0060	< 2.0 [#3]	41	6.4	5.6
	26-Aug-2019	120	< 1.0	9.8	60	< 1.0	35	< 0.060	11	< 0.0040	0.85	8.1	98	< 1.0	9.8	310	130	8.18	180	47	43	0.026	0.18	0.040	< 0.033	< 0.010	0.040	0.28	0.0040	< 2.0	20	4.9	4.4
	01-Oct-2019	110	< 1.0	10	56	< 1.0	37	**0.91 [#1]**	11	0.054	0.92	9.6	94	< 1.0	18	320	140	8.27	200	130	120	0.051 [#9]	0.25	0.056	< 0.033	< 0.010	0.056	0.44	0.0060	< 2.0	47	5.5	5.3
AEMP-12	23-Jun-2018	99	< 1.0	8.2	40	< 1.0	31	< 0.060	9.4	< 0.0040	0.79	7.3	81	< 1.0	---	260	120	---	130	23	23	0.022	0.23	0.053	< 0.033	< 0.010	0.053	0.24	< 0.0020	---	24	5.6	4.7
	14-Aug-2018	130	< 1.0	11	59	< 1.0	42	< 0.060	14	0.012	0.91	11	110	< 1.0	---	350	160	---	190	86	33	0.023	0.13	0.030	< 0.033	< 0.010	0.030	0.29	0.0040	2.5	31	4.2	4.3
	15-Aug-2018	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.15	0.033	< 0.033	< 0.010	0.033	---	---	< 2.0	---	---	---
	17-Oct-2018	180	< 1.0	15	120	< 1.0	62	< 0.060	25	0.0054	0.99	15	150	< 1.0	---	530	260	---	340	21	2.9	< 0.015	0.35	0.079	< 0.033	< 0.010	0.079	0.13	< 0.0020	2.6 [#6]	< 5.0	2.7	2.4
	03-Jun-2019	130	< 1.0	10	57	< 1.0	38	< 0.060	13	0.0071	0.81	9.1	100	< 1.0	18	350	150	8.10	230	93	74	< 0.015	0.28	0.064	< 0.033	< 0.010	0.064	0.32	0.0040	< 2.0	36	5.6	4.7
	28-Aug-2019	120	< 1.0	10	46	< 1.0	34	< 0.060	12	< 0.0040	0.84	9.1	95	< 1.0	12	310	130	8.18	190	16	16	0.026	0.36	0.081	< 0.033	< 0.010	0.081	0.21	< 0.0020	< 2.0	< 10	3.9	4.1
(Duplicate)	28-Aug-2019	110	< 1.0	10	48	< 1.0	34	< 0.060	12	0.0072	0.84	9.1	94	< 1.0	62	300	140	8.19	180	13	17	0.027	0.30	0.067	< 0.033	< 0.010	0.067	0.21	< 0.0020	< 2.0	< 10	5.5	3.7
	03-Oct-2019	110	< 1.0	11	45	< 1.0	32	< 0.060	11	0.0042	0.80	8.7	92	< 1.0	9.9	290	130	8.19	140	13	16	0.017	0.33	0.074	< 0.033	< 0.010	0.074	0.21	0.0030	< 2.0	30	3.4	3.6
AEMP-13	14-Aug-2018	120	< 1.0	10	60	< 1.0	41	**0.32 [#1]**	12	0.042	0.92	8.5	100	< 1.0	---	350	150	---	200	220	83	0.039	0.098	0.022	< 0.033	< 0.010	0.022	0.42	0.020	< 2.0	28	5.1	5.2
	18-Oct-2018	150	< 1.0	14	51	< 1.0	43	< 0.060	12	0.040	1.1	11	120	< 1.0	---	370	160	---	210	23	19	0.022	0.17	0.038	< 0.033	< 0.010	0.038	0.20	0.0020	< 2.0	11	4.4	4.5
	02-Jun-2019	100	< 1.0	6.5	41	< 1.0	35	< 0.060	9.4	0.0065	0.91	6.6	84	< 1.0	20	270	130	8.09	180	330 [#8]	230	0.021	0.26	0.058	< 0.033	< 0.010	0.058	0.62	0.0070	< 2.0	73	5.9	6.2
	27-Aug-2019	150	< 1.0	9.6	62	< 1.0	43	< 0.060	13	0.022	0.96	8.8	130	< 1.0	14	380	160	8.15	240	10	35	0.064	0.14	0.031	< 0.033	< 0.010	0.031	0.31	0.0050	< 2.0 [#4]	14	6.2	5.4
	02-Oct-2019	250	< 1.0	9.7	72	< 1.0	79	< 0.060	22	0.68	1.6	8.7	210	< 1.0	18	520	290	8.03	350	16	61	0.32 [#9]	0.099	0.022	< 0.033	< 0.010	0.022	0.68	0.0070	< 2.0	32	8.1	7.6

NOTES:

1. --- in guideline row(s) denotes no criteria for that parameter.
2. --- in detail data row(s) denotes parameter not analyzed.
3. Highlighting indicates parameters above applied guideline/criteria.
4. Highlighting indicates non-detect parameters above applied guideline/criteria.
5. Highlighting indicates parameters at applied guideline/criteria.
6. Superscript [#1] denotes values exceeding
   (CCME. 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1 accessed Aug 22, 2018.)

   Guideline based on chronic exposure
   Ammonia (Total; as N):
   Guideline for total ammonia is dependent on pH and temperature of surface water. Guideline based on Temperature of 10oC and pH of 7
   Nitrate (as N):
   Guideline based on long term exposure
   Nitrite (as N):
   Standard is for NO_2 as N, equivalent standard for NO_2 is 0.197 mg/L.
7. Superscript [#2] - Method blank exceeds 0.2 mg/L stipulated in Reference Method. No other Quality Control measures affected.
8. Superscript [#3] - Sample incubation time was outside method specifications. This may increase the uncertainty associated with these results.
9. Superscript [#4] - Sample analyzed past hold time. Sample analysis is recommended within 48 hours of sampling.
10. Superscript [#5] - Detection limits raised due to dilution to bring analyte within the calibrated range.
11. Superscript [#6] - Sample was past hold time when received.
12. Superscript [#7] - Detection limit raised based on sample volume used for analysis.
13. Superscript [#8] - Detection limit raised based on sample volume used and sample matrix
14. Superscript [#9] - Detection limits raised due to matrix interference.

Table 2
Surface Water Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	m&p-Xylene (mg/L)	o-Xylene (mg/L)	Xylenes (Total) (mg/L)	PHC F1 (C_6-C_{10}) (mg/L)	PHC F1 (C_6-C_{10}) - BTEX (mg/L)	PHC F2 (C_{10}-C_{16}) (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		**0.37**	**0.002**	**0.09**	**---**	**---**	**---**	**---**	**---**	**---**
AEMP										
AEMP-01	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	10-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	26-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	01-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-02	18-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
(Duplicate)	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	12-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	16-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	28-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-03	18-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	12-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	16-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	28-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-04	18-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	12-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	16-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	25-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-05	19-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	15-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	13-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10

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Table 2
Surface Water Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	m&p-Xylene (mg/L)	o-Xylene (mg/L)	Xylenes (Total) (mg/L)	PHC F1 (C_6-C_{10}) (mg/L)	PHC F1 (C_6-C_{10}) - BTEX (mg/L)	PHC F2 (C_{10}-C_{16}) (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		**0.37**	**0.002**	**0.09**	**---**	**---**	**---**	**---**	**---**	**---**
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	27-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	01-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-06	21-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	13-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	25-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-07	21-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
(Duplicate)	21-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	13-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	17-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	17-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	25-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-08	17-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	21-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	13-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	17-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	28-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-09	21-Aug-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Sep-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	16-Oct-2017	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00080	< 0.10	< 0.10	< 0.10
	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	12-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	17-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	28-Aug-2019	0.00043	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10

Table 2
Surface Water Analytical Results: Petroleum Hydrocarbons (PHCs)

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	m&p-Xylene (mg/L)	o-Xylene (mg/L)	Xylenes (Total) (mg/L)	PHC F1 (C_6-C_{10}) (mg/L)	PHC F1 (C_6-C_{10}) - BTEX (mg/L)	PHC F2 (C_{10}-C_{16}) (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		**0.37**	**0.002**	**0.09**	**---**	**---**	**---**	**---**	**---**	**---**
AEMP-10	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	10-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	26-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	01-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-11	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	10-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	26-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	01-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-12	23-Jun-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	17-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	28-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
(Duplicate)	28-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	03-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
AEMP-13	14-Aug-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	18-Oct-2018	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Jun-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	27-Aug-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10
	02-Oct-2019	< 0.00040	< 0.00040	< 0.00040	< 0.00080	< 0.00040	< 0.00089	< 0.10	< 0.10	< 0.10

NOTES:

1. --- in guideline row(s) denotes no criteria for that parameter.
2. --- in detail data row(s) denotes parameter not analyzed.
3. Highlighting indicates parameters above applied guideline/criteria.
4. Highlighting indicates non-detect parameters above applied guideline/criteria.
5. Highlighting indicates parameters at applied guideline/criteria.
6. Superscript [#1] denotes values exceeding

(CCME. 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1 accessed Aug 22, 2018.)

Advisian
Worley Group

Table 3
Surface Water Analytical Results: Dissolved Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life		**0.1**	**---**	**0.005**	**---**	**---**	**1.5**	**0.00009**	**0.0089**	**---**	**0.002**	**0.3**	**0.001**	**---**	**---**	**0.000026**	**0.073**	**0.025**	**---**	**0.001**	**---**	**0.00025**	**---**	**0.0008**	**---**	**---**	**0.015**	**---**	**0.03**
AEMP																													
AEMP-01	16-Sep-2017	0.051	< 0.00060	0.00025	0.047	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0010	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00092	0.0014	< 0.10	0.00035	1.8	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00072	< 0.0010	< 0.0030
	16-Oct-2017	0.024	< 0.00060	0.00028	0.047	< 0.0010	< 0.020	0.000022	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0010	0.0017	< 0.10	0.00034	1.7	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00076	< 0.0010	< 0.0030
	23-Jun-2018	0.047	< 0.00060	0.00036	0.044	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00097	0.0011	< 0.10	0.00029	1.6	< 0.00010	0.17	< 0.00020	< 0.0010	< 0.0010	0.00065	< 0.0010	< 0.0030
	14-Aug-2018	0.090	< 0.00060	0.00028	0.048	< 0.0010	< 0.020	0.000023	< 0.0010	< 0.00030	0.0015	< 0.060	< 0.00020	< 0.020	< 0.0040	0.0000031	0.00090	0.0015	< 0.10	0.00034	1.6	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00083	< 0.0010	< 0.0030
	18-Oct-2018	0.0060	< 0.00060	0.00031	0.047	< 0.0010	0.020	< 0.000020	< 0.0010	< 0.00030	0.00088	< 0.060	< 0.00020	< 0.020	0.0093	< 0.0000020	0.00075	0.00092	< 0.10	< 0.00020	1.4	< 0.00010	0.27	< 0.00020	< 0.0010	< 0.0010	0.00056	< 0.0010	< 0.0030
	10-Jun-2019	0.020	< 0.00060	0.00021	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0017	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00085	0.0014	< 0.10	0.00026	1.7	< 0.00010	0.18	< 0.00020	< 0.0010	< 0.0010	0.00066	< 0.0010	< 0.0030
	26-Aug-2019	0.047	< 0.00060	0.00020	0.048	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0012	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00094	0.0014	< 0.10	0.00036	1.8	< 0.00010	0.27	< 0.00020	< 0.0010	< 0.0010	0.00084	< 0.0010	< 0.0030
	01-Oct-2019	0.032	< 0.00060	0.00033	0.051	< 0.0010	< 0.020	0.000021	< 0.0010	< 0.00030	0.0015	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0011	0.0017	< 0.10	0.00057	1.8	< 0.00010	0.24	< 0.00020	< 0.0010	0.0011	0.00078	< 0.0010	0.0057
AEMP-02	18-Aug-2017	< 0.0030	< 0.00060	< 0.00020	0.087	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.00086	< 0.060	< 0.00020	< 0.020	0.0077	< 0.0000020	0.0019	0.00088	< 0.10	< 0.00020	2.1	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.00099	< 0.0010	< 0.0030
	16-Sep-2017	0.0054	< 0.00060	0.00020	0.077	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	0.00042	< 0.060	< 0.00020	< 0.020	0.0081	0.0000023	0.0017	0.00069	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
(Duplicate)	16-Sep-2017	0.0051	< 0.00060	< 0.00020	0.076	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	0.00037	< 0.060	< 0.00020	< 0.020	0.0078	0.0000021	0.0017	0.00074	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	16-Oct-2017	0.0033	< 0.00060	0.00021	0.072	< 0.0010	0.024	< 0.000020	< 0.0010	< 0.00030	0.00042	< 0.060	< 0.00020	< 0.020	0.0091	< 0.0000020	0.0018	0.00077	< 0.10	< 0.00020	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	23-Jun-2018	< 0.0030	< 0.00060	0.00023	0.085	< 0.0010	0.028	< 0.000020	< 0.0010	< 0.00030	0.00045	< 0.060	< 0.00020	< 0.020	0.0058	< 0.0000020	0.0019	0.00074	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	12-Aug-2018	< 0.0030	< 0.00060	< 0.00020	0.078	< 0.0010	0.029	< 0.000020	< 0.0010	< 0.00030	0.00062	< 0.060	< 0.00020	< 0.020	0.0079	0.0000020	0.0017	0.00078	< 0.10	0.00024	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	16-Oct-2018	0.0060	< 0.00060	< 0.00020	0.068	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.00092	< 0.060	< 0.00020	< 0.020	0.0046	< 0.0000020	0.0019	< 0.00050	< 0.10	< 0.00020	2.0	< 0.00010	1.5	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	03-Jun-2019	0.0033	< 0.00060	0.00023	0.072	< 0.0010	0.021	< 0.000020	< 0.0010	< 0.00030	0.00086	< 0.060	< 0.00020	< 0.020	0.0050	< 0.0000020	0.0017	0.00060	< 0.10	< 0.00020	1.6	< 0.00010	1.1	< 0.00020	< 0.0010	< 0.0010	0.00098	< 0.0010	< 0.0030
(Duplicate)	03-Jun-2019	0.0035	< 0.00060	0.00020	0.071	< 0.0010	0.021	< 0.000020	< 0.0010	< 0.00030	0.00047	< 0.060	< 0.00020	< 0.020	0.0049	< 0.0000020	0.0016	0.00058	< 0.10	< 0.00020	1.6	< 0.00010	1.1	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	28-Aug-2019	< 0.0030	< 0.00060	< 0.00020	0.076	< 0.0010	0.024	< 0.000020	< 0.0010	< 0.00030	0.0014	< 0.060	< 0.00020	< 0.020	0.0069	< 0.0000020	0.0016	< 0.00050	< 0.10	< 0.00020	1.9	< 0.00010	1.3	< 0.00020	0.0047	< 0.0010	0.0011	< 0.0010	< 0.0030
	03-Oct-2019	< 0.0030	< 0.00060	< 0.00020	0.076	< 0.0010	0.029	< 0.000020	< 0.0010	< 0.00030	0.00059	< 0.060	< 0.00020	< 0.020	0.0069	< 0.0000020	0.0018	0.00062	< 0.10	0.00020	2.1	< 0.00010	1.4	< 0.00020	0.0020	< 0.0010	0.0012	< 0.0010	0.0055
AEMP-03	18-Aug-2017	0.0060	< 0.00060	0.00022	0.088	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.0015	< 0.060	< 0.00020	< 0.020	0.0056	0.0000025	0.0018	0.00076	< 0.10	< 0.00020	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	0.0046
	16-Sep-2017	0.0054	< 0.00060	< 0.00020	0.076	< 0.0010	0.025	< 0.000020	< 0.0010	< 0.00030	0.00051	< 0.060	< 0.00020	< 0.020	0.0057	0.0000033	0.0017	0.00073	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	16-Oct-2017	< 0.0030	< 0.00060	< 0.00020	0.070	< 0.0010	0.022	< 0.000020	< 0.0010	< 0.00030	0.00033	< 0.060	< 0.00020	< 0.020	0.0063	< 0.0000020	0.0018	0.00074	< 0.10	< 0.00020	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
	23-Jun-2018	0.0097	< 0.00060	0.00028	0.084	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.00085	< 0.060	< 0.00020	< 0.020	0.0060	< 0.0000020	0.0021	0.00068	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	12-Aug-2018	0.0039	< 0.00060	0.00021	0.081	< 0.0010	0.028	< 0.000020	< 0.0010	< 0.00030	0.00070	< 0.060	< 0.00020	< 0.020	0.0057	< 0.0000020	0.0018	0.0016	< 0.10	< 0.00020	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	16-Oct-2018	< 0.0030	< 0.00060	< 0.00020	0.068	< 0.0010	0.024	< 0.000020	< 0.0010	< 0.00030	0.00058	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0018	< 0.00050	< 0.10	< 0.00020	2.0	< 0.00010	1.5	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	03-Jun-2019	0.025	< 0.00060	< 0.00020	0.070	< 0.0010	0.020	< 0.000020	< 0.0010	< 0.00030	0.00041	< 0.060	< 0.00020	< 0.020	0.0052	0.0000020	0.0015	0.00085	< 0.10	< 0.00020	1.7	< 0.00010	1.1	< 0.00020	< 0.0010	0.0011	0.0010	< 0.0010	< 0.0030
	28-Aug-2019	< 0.0030	< 0.00060	< 0.00020	0.077	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.00032	< 0.060	< 0.00020	< 0.020	0.0055	< 0.0000020	0.0015	< 0.00050	< 0.10	< 0.00020	1.9	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	02-Oct-2019	< 0.0030	< 0.00060	< 0.00020	0.070	< 0.0010	0.027	< 0.000020	< 0.0010	< 0.00030	0.00030	< 0.060	< 0.00020	< 0.020	0.0044	< 0.0000020	0.0018	0.00057	< 0.10	0.00026	1.8	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
AEMP-04	18-Aug-2017	< 0.0030	< 0.00060	0.00042	0.087	< 0.0010	0.025	**0.00019** [#1]	< 0.0010	< 0.00030	0.00082	< 0.060	< 0.00020	< 0.020	0.0047	< 0.0000020	0.0020	0.0010	< 0.10	0.00029	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
	16-Sep-2017	0.0033	< 0.00060	0.00021	0.079	< 0.0010	0.025	0.000028	< 0.0010	< 0.00030	0.00071	< 0.060	< 0.00020	< 0.020	0.0049	< 0.0000020	0.0018	0.00076	< 0.10	< 0.00020	1.9	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	0.019
	16-Oct-2017	< 0.0030	< 0.00060	< 0.00020	0.070	< 0.0010	0.022	< 0.000020	< 0.0010	< 0.00030	0.00031	< 0.060	< 0.00020	< 0.020	0.0050	< 0.0000020	0.0018	0.00051	< 0.10	0.00022	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
	23-Jun-2018	0.0032	< 0.00060	0.00029	0.084	< 0.0010	0.029	< 0.000020	< 0.0010	< 0.00030	0.00055	< 0.060	< 0.00020	< 0.020	0.0070	< 0.0000020	0.0019	0.00059	< 0.10	< 0.00020	2.0	< 0.00010	1.3	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
(Duplicate)	23-Jun-2018	0.0034	< 0.00060	0.00029	0.083	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	0.0010	< 0.060	< 0.00020	< 0.020	0.0066	< 0.0000020	0.0018	0.00063	< 0.10	< 0.00020	1.8	< 0.00010	1.2	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	0.019
	12-Aug-2018	0.0069	< 0.00060	< 0.00020	0.078	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	0.00053	< 0.060	< 0.00020	< 0.020	0.0055	< 0.0000020	0.0018	0.0010	< 0.10	< 0.00020	2.1	< 0.00010	1.4	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	16-Oct-2018	< 0.0030	< 0.00060	< 0.00020	0.071	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	0.00097	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0019	< 0.00050	< 0.10	0.00020	2.0	< 0.00010	1.5	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
	03-Jun-2019	< 0.0030	< 0.00060	< 0.00020	0.070	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00037	< 0.060	< 0.00020	< 0.020	0.0041	< 0.0000020	0.0016	0.00063	< 0.10	< 0.00020	1.6	< 0.00010	1.1	< 0.00020	< 0.0010	< 0.0010	0.0010	< 0.0010	< 0.0030
	25-Aug-2019	< 0.0030	< 0.00060	< 0.00020	0.075	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00031	< 0.060	< 0.00020	< 0.020	0.0049	< 0.0000020	0.0016	0.00058	< 0.10	< 0.00020	1.9	< 0.00010	1.3	< 0.00020	0.0019	< 0.0010	0.0011	< 0.0010	< 0.0030
	02-Oct-2019	< 0.0030	< 0.00060	0.00020	0.070	< 0.0010	0.026	< 0.000020	< 0.0010	< 0.00030	**0.0037** [#1]	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0019	0.00064	< 0.10	0.00024	1.8	< 0.00010	1.4	< 0.00020	0.0015	< 0.0010	0.0012	< 0.0010	0.0095
AEMP-05	19-Aug-2017	0.0030	< 0.00060	0.00089	0.15	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	< 0.00020	0.073	< 0.00020	< 0.020	0.0071	< 0.0000020	0.0015	0.00099	< 0.10	< 0.00020	0.21	< 0.00010	0.25	< 0.00020	< 0.0010	< 0.0010	0.00034	< 0.0010	< 0.0030
	16-Sep-2017	0.0043	< 0.00060	0.00049	0.14	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	< 0.00020	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0016	0.0010	< 0.10	< 0.00020	0.25	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00033	< 0.0010	< 0.0030
	15-Oct-2017	< 0.0030	< 0.00060	0.00064	0.13	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00042	< 0.060	< 0.00020	< 0.020	0.0052	< 0.0000020	0.0013	0.0012	< 0.10	< 0.00020	0.39	< 0.00010	0.20	< 0.00020	< 0.0010	< 0.0010	0.00029	< 0.0010	< 0.0030
	23-Jun-2018	0.040	< 0.00060	0.00030	0.052	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0014	< 0.060	< 0.00020	< 0.020	0.013	0.0000025	0.0010	0.0011	< 0.10	0.00033	1.5	< 0.00010	0.17	< 0.00020	< 0.0010	< 0.0010	0.00066	< 0.0010	< 0.0030
	13-Aug-2018	< 0.0030	< 0.00060	0.0011	0.15	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00055	**0.34** [#1]	< 0.00020	< 0.020	0.028	< 0.0000020	0.0017	0.0013	< 0.10	< 0.00020	0.44	< 0.00010	0.17	< 0.00020	< 0.0010	< 0.0010	0.00018	< 0.0010	< 0.0030
	18-Oct-2018	0.015	< 0.00060	0.00081	0.17	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0012	0.18	< 0.00020	< 0.020	0.18	< 0.0000020	0.0015	0.0017	< 0.10	< 0.00020	0.34	< 0.00010	0.19	< 0.00020	< 0.0010	< 0.0010	0.00032	< 0.0010	0.0032
	02-Jun-2019	0.0051	< 0.00060	0.00090	0.13	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00024	0.25	< 0.00020	< 0.020	0.040	< 0.0000020	0.00093	0.0011	< 0.10	< 0.00020	1.1	< 0.00010	0.16	< 0.00020	< 0.0010	< 0.0010	0.00022	< 0.0010	< 0.0030
	27-Aug-2019	< 0.0030	< 0.00060	0.00062	0.15	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	< 0.00020	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0014	0.00068	< 0.10	< 0.00020	0.17	< 0.00010	0.17	< 0.00020	0.0018	< 0.0010	0.00018	< 0.0010	< 0.0030
	01-Oct-2019	< 0.0030	< 0.00060	0.00047	0.15	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00031	0.11	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0011	0.00080	< 0.10	< 0.00020	0.25	< 0.00010	0.15	< 0.00020	< 0.0010	< 0.0010	0.00018	< 0.0010	< 0.0030
AEMP-06	21-Aug-2017	0.032	< 0.00060	0.00038	0.043	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00087	0.0010	< 0.10	0.00033	1.5	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
	16-Sep-2017	0.027	< 0.00060	0.00024	0.040	< 0.0010	< 0.020	0.000021	< 0.0010	< 0.00030	0.00091	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00079	0.0011	< 0.10	< 0.00020	1.4	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00054	< 0.0010	0.010
	16-Oct-2017	0.013	< 0.00060	0.00030	0.040	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00083	< 0.060	< 0.00020	< 0.020	0.0068	< 0.0000020	0.0014	0.0013	< 0.10	0.00022	1.5	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00080	< 0.0010	< 0.0030
	23-Jun-2018	0.027	< 0.00060	0.00032	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00086	0.00096	< 0.10	0.00021	1.4	< 0.00010	0.16	< 0.00020	< 0.0010	< 0.0010	0.00054	< 0.0010	< 0.0030
	13-Aug-2018	0.048	< 0.00060	0.00029	0.043	< 0.0010	< 0.020	0.000020	< 0.0010	< 0.00030	0.0017	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00085	0.0017	< 0.10	0.00031	1.4	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00064	< 0.0010	0.0034
	18-Oct-2018	0.0069	< 0.00060	0.00049	0.047	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00079	< 0.060	< 0.00020	< 0.020	0.018	< 0.0000020	0.00077	0.00092	< 0.10	0.00027	1.4	< 0.00010	0.22	< 0.00020	0.0023	< 0.0010	0.00048	< 0.0010	< 0.0030
	03-Jun-2019	0.015	< 0.00060	0.00029	0.035	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	0.0000021	0.00074	0.00096	< 0.10	< 0.00020	1.4	< 0.00010	0.18	< 0.00020	< 0.0010	< 0.0010	0.00058	< 0.0010	< 0.0030
	25-Aug-2019	0.024	< 0.00060	0.00023	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00091	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00068	0.00068	< 0.10	0.00022	1.5	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
	02-Oct-2019	0.015	< 0.00060	0.00024	0.036	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00078	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00077	0.00098	< 0.10	0.00021	1.4	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00054	< 0.0010	< 0.0030

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Table 3
Surface Water Analytical Results: Dissolved Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life		**0.1**	**---**	**0.005**	**---**	**---**	**1.5**	**0.00009**	**0.0089**	**---**	**0.002**	**0.3**	**0.001**	**---**	**---**	**0.000026**	**0.073**	**0.025**	**---**	**0.001**	**---**	**0.00025**	**---**	**0.0008**	**---**	**---**	**0.015**	**---**	**0.03**
(Duplicate)	03-Oct-2019	0.016	< 0.00060	0.00028	0.036	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00081	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00077	0.00096	< 0.10	0.00023	1.4	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00055	< 0.0010	< 0.0030
AEMP-07	21-Aug-2017	0.033	< 0.00060	0.00034	0.043	< 0.0010	< 0.020	0.000028	< 0.0010	< 0.00030	0.0012	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00084	0.0011	< 0.10	0.00032	1.5	< 0.00010	0.22	< 0.00020	0.0010	< 0.0010	0.00065	< 0.0010	< 0.0030
(Duplicate)	21-Aug-2017	0.030	< 0.00060	0.00036	0.042	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0014	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00083	0.00089	< 0.10	0.00032	1.5	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00059	< 0.0010	< 0.0030
	16-Sep-2017	0.026	< 0.00060	0.00022	0.040	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00075	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00072	0.0011	< 0.10	0.00022	1.4	< 0.00010	0.22	< 0.00020	0.0019	< 0.0010	0.00054	< 0.0010	< 0.0030
	16-Oct-2017	0.012	< 0.00060	0.00036	0.044	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00070	< 0.060	< 0.00020	< 0.020	0.022	< 0.0000020	0.00082	0.0010	< 0.10	< 0.00020	1.4	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00060	< 0.0010	< 0.0030
	23-Jun-2018	0.028	< 0.00060	0.00025	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0012	< 0.060	< 0.00020	< 0.020	< 0.0040	0.0000031	0.00081	0.0010	< 0.10	< 0.00020	1.4	< 0.00010	0.16	< 0.00020	< 0.0010	< 0.0010	0.00053	< 0.0010	< 0.0030
	13-Aug-2018	0.048	< 0.00060	0.00027	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	0.0000022	0.00076	0.0014	< 0.10	0.00026	1.4	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
	17-Oct-2018	0.0077	< 0.00060	0.00044	0.046	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00092	< 0.060	< 0.00020	< 0.020	0.013	< 0.0000020	0.00081	0.00086	< 0.10	0.00025	1.3	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00050	< 0.0010	< 0.0030
(Duplicate)	17-Oct-2018	0.0088	< 0.00060	0.00046	0.048	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00081	< 0.060	< 0.00020	< 0.020	0.018	< 0.0000020	0.00087	0.00091	< 0.10	0.00024	1.4	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00048	< 0.0010	< 0.0030
	03-Jun-2019	0.016	< 0.00060	0.00033	0.037	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0017	< 0.060	< 0.00020	< 0.020	0.0098	0.0000020	0.00089	0.0012	< 0.10	0.00023	1.4	< 0.00010	0.19	< 0.00020	0.0018	< 0.0010	0.00060	< 0.0010	< 0.0030
	25-Aug-2019	0.022	< 0.00060	0.00030	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00084	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00085	0.00092	< 0.10	0.00024	1.5	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00069	< 0.0010	< 0.0030
	03-Oct-2019	0.014	< 0.00060	0.00043	0.062	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00070	< 0.060	< 0.00020	< 0.020	0.029	< 0.0000020	0.00081	0.0025	< 0.10	0.00022	1.4	< 0.00010	0.20	< 0.00020	< 0.0010	< 0.0010	0.00057	< 0.0010	< 0.0030
AEMP-08	17-Aug-2017	0.067	< 0.00060	0.00043	0.051	< 0.0010	< 0.020	0.000030	< 0.0010	< 0.00030	0.0019	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0012	0.0015	< 0.10	0.00044	1.9	< 0.00010	0.25	< 0.00020	< 0.0010	< 0.0010	0.00085	0.0011	0.0049
	21-Aug-2017	0.035	< 0.00060	0.00035	0.044	< 0.0010	< 0.020	0.000032	< 0.0010	< 0.00030	0.0017	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00086	0.0011	< 0.10	0.00026	1.6	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00065	< 0.0010	< 0.0030
	16-Sep-2017	0.033	< 0.00060	0.00027	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	0.0041	< 0.0000020	0.00070	0.0010	< 0.10	< 0.00020	1.5	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00053	< 0.0010	< 0.0030
	16-Oct-2017	0.015	< 0.00060	0.00035	0.036	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0010	< 0.060	< 0.00020	< 0.020	0.0049	< 0.0000020	0.00070	0.0011	< 0.10	0.00025	1.4	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00054	< 0.0010	< 0.0030
	23-Jun-2018	**0.13** [#1]	< 0.00060	0.00031	0.047	< 0.0010	< 0.020	0.000023	< 0.0010	< 0.00030	**0.0030** [#1]	0.20	0.00026	< 0.020	0.011	0.0000026	0.00079	0.0012	< 0.10	0.00021	1.4	< 0.00010	0.18	< 0.00020	< 0.0010	0.0010	0.00050	< 0.0010	0.0078
	13-Aug-2018	0.048	< 0.00060	0.00036	0.044	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00086	0.0017	< 0.10	0.00022	1.5	< 0.00010	0.26	< 0.00020	< 0.0010	< 0.0010	0.00067	< 0.0010	< 0.0030
	17-Oct-2018	0.0097	< 0.00060	0.00023	0.039	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00077	0.00099	< 0.10	< 0.00020	1.4	< 0.00010	0.28	< 0.00020	< 0.0010	< 0.0010	0.00055	< 0.0010	< 0.0030
	03-Jun-2019	0.018	< 0.00060	0.00029	0.040	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	0.0048	< 0.0000020	0.00081	0.00096	< 0.10	0.00028	1.4	< 0.00010	0.28	< 0.00020	< 0.0010	< 0.0010	0.00056	< 0.0010	< 0.0030
	28-Aug-2019	0.022	< 0.00060	0.00024	0.042	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00079	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00091	0.00088	< 0.10	0.00021	1.5	< 0.00010	0.31	< 0.00020	< 0.0010	< 0.0010	0.00066	< 0.0010	< 0.0030
	03-Oct-2019	0.014	< 0.00060	0.00039	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	**0.0021** [#1]	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00091	0.00086	< 0.10	0.00026	1.4	< 0.00010	0.27	< 0.00020	< 0.0010	0.0012	0.00057	< 0.0010	0.0098
AEMP-09	21-Aug-2017	0.031	< 0.00060	0.00039	0.045	< 0.0010	< 0.020	0.000027	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	0.013	< 0.0000020	0.00088	0.00098	< 0.10	0.00032	1.5	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00064	< 0.0010	< 0.0030
	16-Sep-2017	0.029	< 0.00060	0.00026	0.045	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0012	< 0.060	< 0.00020	< 0.020	0.019	< 0.0000020	0.0010	0.0013	< 0.10	0.00028	1.4	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00080	< 0.0010	< 0.0030
	16-Oct-2017	0.0076	< 0.00060	0.00053	0.071	< 0.0010	0.050	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	0.092	< 0.0000020	0.00084	0.0012	< 0.10	0.00023	1.7	< 0.00010	0.26	< 0.00020	< 0.0010	< 0.0010	0.00060	< 0.0010	< 0.0030
	23-Jun-2018	0.026	< 0.00060	0.00036	0.039	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	< 0.0040	0.0000023	0.00091	0.00095	< 0.10	< 0.00020	1.4	< 0.00010	0.18	< 0.00020	< 0.0010	< 0.0010	0.00051	< 0.0010	< 0.0030
	12-Aug-2018	**0.13** [#1]	< 0.00060	0.00038	0.053	< 0.0010	< 0.020	0.000025	< 0.0010	< 0.00030	0.0014	0.20	0.00023	< 0.020	0.020	0.0000027	0.00083	0.0016	< 0.10	0.00023	1.6	< 0.00010	0.27	< 0.00020	< 0.0010	0.0011	0.00070	< 0.0010	< 0.0030
	17-Oct-2018	0.0099	< 0.00060	0.00050	0.067	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0020 [#1]	< 0.060	< 0.00020	< 0.020	0.019	< 0.0000020	0.0010	0.0010	< 0.10	0.00020	1.4	< 0.00010	0.27	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
	02-Jun-2019	0.017	< 0.00060	0.00039	0.049	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0014	< 0.060	< 0.00020	< 0.020	0.021	0.0000021	0.0011	0.0012	< 0.10	0.00021	1.5	< 0.00010	0.19	< 0.00020	< 0.0010	< 0.0010	0.00067	< 0.0010	< 0.0030
	28-Aug-2019	0.027	< 0.00060	0.00035	0.052	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	**0.0023** [#1]	< 0.060	< 0.00020	< 0.020	0.0078	< 0.0000020	0.0010	0.00094	< 0.10	0.00025	1.6	< 0.00010	0.26	< 0.00020	0.0014	< 0.0010	0.00064	< 0.0010	< 0.0030
	03-Oct-2019	0.020	< 0.00060	0.00034	0.045	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	0.0071	< 0.0000020	0.00084	0.00094	< 0.10	0.00021	1.4	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00059	< 0.0010	0.0039
AEMP-10	23-Jun-2018	0.045	< 0.00060	0.00025	0.044	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00094	0.0012	< 0.10	0.00029	1.5	< 0.00010	0.16	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
	14-Aug-2018	0.074	< 0.00060	< 0.00020	0.047	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0015	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00097	0.0017	< 0.10	0.00036	1.6	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00076	< 0.0010	< 0.0030
(Duplicate)	14-Aug-2018	**0.24** [#1]	< 0.00060	0.00050	0.054	< 0.0010	< 0.020	0.000065	< 0.0010	0.00050	0.0019	0.28	0.00034	< 0.020	0.018	0.0000021	0.00090	0.0024	< 0.10	0.00037	2.0	< 0.00010	0.22	< 0.00020	< 0.0010	0.0027	0.00077	< 0.0010	0.0079
	18-Oct-2018	0.0061	< 0.00060	0.00030	0.048	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00081	< 0.060	< 0.00020	< 0.020	0.0099	< 0.0000020	0.00077	0.00079	< 0.10	< 0.00020	1.4	< 0.00010	0.22	< 0.00020	< 0.0010	< 0.0010	0.00050	< 0.0010	< 0.0030
	10-Jun-2019	0.017	< 0.00060	0.00021	0.040	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	**0.0022** [#1]	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00090	0.0013	< 0.10	0.00026	1.6	< 0.00010	0.17	< 0.00020	< 0.0010	< 0.0010	0.00065	< 0.0010	< 0.0030
	26-Aug-2019	0.039	< 0.00060	< 0.00020	0.047	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0012	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00077	0.0012	< 0.10	0.00038	1.8	< 0.00010	0.25	< 0.00020	0.0019	< 0.0010	0.00078	< 0.0010	< 0.0030
	01-Oct-2019	0.026	< 0.00060	0.00028	0.048	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0014	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0011	0.0018	< 0.10	0.00048	1.8	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00082	< 0.0010	< 0.0030
AEMP-11	23-Jun-2018	0.037	< 0.00060	0.00027	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.0011	0.0011	< 0.10	0.00027	1.5	< 0.00010	0.15	< 0.00020	< 0.0010	< 0.0010	0.00059	< 0.0010	0.0031
	14-Aug-2018	0.068	< 0.00060	0.00037	0.044	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0013	< 0.060	< 0.00020	< 0.020	0.0043	0.0000022	0.00084	0.0017	< 0.10	0.00024	1.5	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00067	< 0.0010	< 0.0030
	18-Oct-2018	0.0074	< 0.00060	0.00021	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00099	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00076	0.00097	< 0.10	< 0.00020	1.4	< 0.00010	0.21	< 0.00020	< 0.0010	< 0.0010	0.00053	< 0.0010	< 0.0030
	10-Jun-2019	0.014	< 0.00060	0.00025	0.038	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0016	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00076	0.0011	< 0.10	0.00024	1.5	< 0.00010	0.16	< 0.00020	< 0.0010	< 0.0010	0.00055	< 0.0010	< 0.0030
	26-Aug-2019	0.038	< 0.00060	< 0.00020	0.046	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00079	0.0013	< 0.10	0.00033	1.8	< 0.00010	0.25	< 0.00020	< 0.0010	< 0.0010	0.00079	< 0.0010	< 0.0030
	01-Oct-2019	0.023	< 0.00060	0.00024	0.042	< 0.0010	0.020	0.000027	< 0.0010	0.00092	**0.0023** [#1]	**0.91** [#1]	< 0.00020	< 0.020	0.054	< 0.0000020	0.00085	0.0030	< 0.10	0.00032	1.7	< 0.00010	0.24	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	0.011
AEMP-12	23-Jun-2018	0.027	< 0.00060	0.00031	0.041	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0010	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00096	0.0011	< 0.10	0.00022	1.4	< 0.00010	0.23	< 0.00020	< 0.0010	< 0.0010	0.00054	< 0.0010	< 0.0030
	14-Aug-2018	0.044	< 0.00060	0.00031	0.051	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00092	< 0.060	< 0.00020	< 0.020	0.012	0.0000027	0.0010	0.0012	< 0.10	0.00028	1.6	< 0.00010	0.44	< 0.00020	< 0.0010	< 0.0010	0.00074	< 0.0010	< 0.0030
	17-Oct-2018	0.0037	< 0.00060	0.00026	0.060	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00065	< 0.060	< 0.00020	< 0.020	0.0054	< 0.0000020	0.0015	0.00068	< 0.10	< 0.00020	1.9	< 0.00010	1.1	< 0.00020	< 0.0010	< 0.0010	0.00096	< 0.0010	< 0.0030
	03-Jun-2019	0.026	< 0.00060	0.00031	0.048	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00097	< 0.060	< 0.00020	< 0.020	0.0071	0.0000020	0.0010	0.0010	< 0.10	0.00022	1.5	< 0.00010	0.46	< 0.00020	< 0.0010	< 0.0010	0.00067	< 0.0010	< 0.0030
	28-Aug-2019	0.021	< 0.00060	0.00023	0.045	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00071	< 0.060	< 0.00020	< 0.020	< 0.0040	< 0.0000020	0.00089	0.00087	< 0.10	0.00026	1.5	< 0.00010	0.36	< 0.00020	< 0.0010	< 0.0010	0.00062	< 0.0010	< 0.0030
(Duplicate)	28-Aug-2019	0.021	< 0.00060	0.00026	0.045	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00075	< 0.060	< 0.00020	< 0.020	0.0072	< 0.0000020	0.00084	0.00083	< 0.10	0.00022	1.5	< 0.00010	0.35	< 0.00020	< 0.0010	< 0.0010	0.00063	< 0.0010	< 0.0030
	03-Oct-2019	0.019	< 0.00060	0.00023	0.040	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.00065	< 0.060	< 0.00020	< 0.020	0.0042	< 0.0000020	0.00081	0.00086	< 0.10	0.00023	1.4	< 0.00010	0.28	< 0.00020	< 0.0010	< 0.0010	0.00058	< 0.0010	0.0050
AEMP-13	14-Aug-2018	**0.21** [#1]	< 0.00060	0.00049	0.063	< 0.0010	< 0.020	0.000071	< 0.0010	0.00041	**0.0024** [#1]	**0.32** [#1]	0.00039	< 0.020	0.042	0.0000028	0.00093	0.0031	< 0.10	0.00036	2.0	< 0.00010	0.24	< 0.00020	< 0.0010	0.0030	0.00090	< 0.0010	0.0072
	18-Oct-2018	0.0090	< 0.00060	0.00032	0.056	< 0.0010	< 0.020	0.000021	< 0.0010	< 0.00030	0.0016	< 0.060	< 0.00020	< 0.020	0.040	< 0.0000020	0.0010	0.0017	< 0.10	0.00029	1.7	< 0.00010	0.28	< 0.00020	< 0.0010	< 0.0010	0.00081	< 0.0010	< 0.0030
	02-Jun-2019	0.027	< 0.00060	0.00033	0.046	< 0.0010	< 0.020	< 0.000020	< 0.0010	< 0.00030	0.0017	< 0.060	< 0.00020	< 0.020	0.0065	0.0000026	0.00090	0.0014	< 0.10	0.00036	1.6	< 0.00010	0.19	< 0.00020	0.0013	< 0.0010	0.00070	< 0.0010	< 0.0030
	27-Aug-2019	0.042	< 0.00060	0.00028	0.055	< 0.0010	< 0.020	0.000028	< 0.0010	< 0.00030	0.0011	< 0.060	< 0.00020	< 0.020	0.022	< 0.0000020	0.0011	0.0016	< 0.10	0.00038	1.8	< 0.00010	0.30	< 0.00020	< 0.0010	< 0.0010	0.00091	< 0.0010	< 0.0030
	02-Oct-2019	0.0067	< 0.00060	0.00027	0.097	< 0.0010	< 0.020	0.000043	< 0.0010	0.0014	0.0011	< 0.060	< 0.00020	< 0.020	0.68	< 0.0000020	0.0012	0.0035	< 0.10	0.00032	2.9	< 0.00010	0.49	< 0.00020	< 0.0010	< 0.0010	0.00088	< 0.0010	< 0.0030

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Table 3
Surface Water Analytical Results: Dissolved Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life [1]		0.1	---	0.005	---	---	1.5	0.00009	0.0089	---	0.002	0.3	0.001	---	---	0.000026	0.073	0.025	---	0.001	---	0.00025	---	0.0008	---	---	0.015	---	0.03

NOTES:

1. --- in guideline row(s) denotes no criteria for that parameter.
2. --- in detail data row(s) denotes parameter not analyzed.
3. Highlighting indicates parameters above applied guideline/criteria.
4. Highlighting indicates non-detect parameters above applied guideline/criteria.
5. Highlighting indicates parameters at applied guideline/criteria.
6. Superscript [#1] denotes values exceeding
   (CCME. 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1 accessed Aug 22, 2018.)

Aluminum:
Standard varies with pH.
pH < 6.5 = 0.005 mg/L
pH >= 6.5 = 0.1 mg/L

Boron:
Guideline based on long term exposure

Cadmium:
Guideline based on long term exposure

Chromium (Total):
Limit is for Chromium(III).

Copper:
Guideline is hardness dependent. Presented guideline set to lower limit.

Lead:
Guideline is hardness dependent. Presented guideline set to lower limit.

Mercury:
Guideline for Inorganic mercury

Nickel:
Guideline is hardness dependent. Presented guideline set to lower limit.

Silver:
Guideline based on long term exposure

Uranium:
Guideline based on long term exposure

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Table 4
Surface Water Analytical Results: Total Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Calcium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		**0.1**	**---**	**0.005**	**---**	**---**	**1.5**	**0.00009**	**---**	**0.0089**	**---**	**0.002**	**0.3**	**0.001**	**---**	**---**	**---**	**0.000026**	**0.073**	**0.025**	**---**	**---**	**0.001**	**---**	**0.00025**	**---**	**---**	**0.0008**	**---**	**---**	**0.015**	**---**	**0.03**
AEMP																																	
AEMP-01	16-Sep-2017	**0.52** [#1]	< 0.00060	0.00065	0.061	< 0.0010	< 0.020	0.000040	38	0.0010	0.00054	0.0020 [#1]	**0.88** [#1]	0.00048	< 0.020	11	0.022	< 0.0000020	0.0011	0.0029	< 0.10	1.1	0.00034	2.4	< 0.00010	9.4	0.23	< 0.00020	< 0.0010	0.0082	0.00083	0.0026	0.023
	16-Oct-2017	**0.33** [#1]	< 0.00060	0.00050	0.053	< 0.0010	< 0.020	0.000050	37	< 0.0010	0.00034	0.0017	**0.50** [#1]	0.00034	< 0.020	11	0.015	< 0.0000020	0.0011	0.0026	< 0.10	1.1	0.00039	2.1	< 0.00010	9.1	0.24	< 0.00020	< 0.0010	0.0083	0.00080	0.0020	0.0045
	23-Jun-2018	**1.5** [#1]	< 0.00060	0.0015	0.073	< 0.0010	< 0.020	**0.00015** [#1]	37	0.0028	0.0025	**0.0055** [#1]	**2.3** [#1]	**0.0016** [#1]	< 0.020	11	0.054	0.0000049	0.0016	0.0086	< 0.10	1.2	0.00060	2.9	< 0.00010	6.4	0.17	< 0.00020	< 0.0010	0.018	0.0011	0.0040	0.026
	14-Aug-2018	**2.1** [#1]	< 0.00060	0.0016	0.099	< 0.0010	< 0.020	**0.00042** [#1]	51	0.0022	0.0033	**0.0064** [#1]	**3.3** [#1]	**0.0023** [#1]	< 0.020	15	0.13	0.000010	0.0010	0.011	0.17	1.3	0.00048	4.3	< 0.00010	7.5	0.27	< 0.00020	< 0.0010	0.024	0.0011	0.0054	**0.056** [#1]
	18-Oct-2018	**0.45** [#1]	< 0.00060	0.00070	0.059	< 0.0010	< 0.020	0.000065	32	< 0.0010	0.00053	**0.0021** [#1]	**1.0** [#1]	0.00063	< 0.020	10	0.028	0.0000047	0.00076	0.0025	< 0.10	1.1	0.00030	2.1	< 0.00010	9.4	0.22	< 0.00020	< 0.0010	0.0079	0.00057	0.0016	0.0070
	10-Jun-2019	**2.1** [#1]	0.00094	0.0023	0.10	< 0.0010	< 0.020	**0.00015** [#1]	39	0.0038	0.0024	**0.0078** [#1]	**5.0** [#1]	**0.0026** [#1]	< 0.020	11	0.11	0.0000089	0.0013	0.0087	0.11	1.6	0.00045	4.2	< 0.00010	6.3	0.19	< 0.00020	< 0.0010	0.028	0.00086	0.0059	**0.045** [#1]
	26-Aug-2019	**1.9** [#1]	< 0.00060	0.0011	0.077	< 0.0010	< 0.020	0.000084	42	0.0028	0.0012	**0.0034** [#1]	**2.2** [#1]	0.0010 [#1]	< 0.020	12	0.040	0.0000033	0.0011	0.0049	< 0.10	1.5	0.00062	5.5	< 0.00010	8.3	0.27	< 0.00020	< 0.0010	0.086	0.0011	0.0055	0.013
	01-Oct-2019	**2.0** [#1]	< 0.00060	0.0017	0.11	< 0.0010	< 0.020	**0.00012** [#1]	39	0.0037	0.0015	**0.0050** [#1]	**3.4** [#1]	**0.0018** [#1]	< 0.020	12	0.047	0.0000074	0.0014	0.0066	< 0.10	1.5	0.00061	3.3	< 0.00010	9.2	0.25	< 0.00020	< 0.0010	0.037	0.00097	0.0060	0.017
AEMP-02	18-Aug-2017	0.039	< 0.00060	0.00026	0.085	< 0.0010	0.031	0.000020	74	< 0.0010	< 0.00030	0.00092	0.11	< 0.00020	< 0.020	27	0.0098	0.0000021	0.0018	0.00079	< 0.10	1.1	0.00021	2.1	< 0.00010	22	1.3	< 0.00020	< 0.0010	0.0032	0.0010	0.0014	< 0.0030
	16-Sep-2017	0.031	< 0.00060	0.00032	0.082	< 0.0010	0.024	< 0.000020	73	< 0.0010	< 0.00030	0.00064	0.096	< 0.00020	< 0.020	29	0.0087	< 0.0000020	0.0017	0.00077	< 0.10	1.0	< 0.00020	2.1	< 0.00010	19	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
(Duplicate)	16-Sep-2017	0.032	< 0.00060	0.00027	0.080	< 0.0010	0.023	< 0.000020	72	< 0.0010	< 0.00030	0.00035	0.10	< 0.00020	< 0.020	28	0.0084	< 0.0000020	0.0018	0.00078	< 0.10	0.98	< 0.00020	2.1	< 0.00010	19	1.2	< 0.00020	< 0.0010	< 0.0010	0.0011	0.0013	< 0.0030
	16-Oct-2017	**0.23** [#1]	< 0.00060	0.00040	0.079	< 0.0010	0.022	0.000027	75	< 0.0010	< 0.00030	0.00074	**0.57** [#1]	0.00030	< 0.020	31	0.020	< 0.0000020	0.0019	0.0014	< 0.10	1.1	0.00025	2.3	< 0.00010	20	1.4	< 0.00020	< 0.0010	0.0039	0.0012	0.0020	< 0.0030
	23-Jun-2018	0.047	< 0.00060	0.00036	0.086	< 0.0010	0.029	< 0.000020	76	< 0.0010	< 0.00030	0.00073	0.12	< 0.00020	< 0.020	27	0.0085	< 0.0000020	0.0027	0.0012	< 0.10	1.1	0.00031	2.0	< 0.00010	18	1.3	< 0.00020	< 0.0010	< 0.0010	0.0016	< 0.0010	< 0.0030
	12-Aug-2018	0.030	< 0.00060	0.00026	0.073	< 0.0010	0.023	< 0.000020	72	< 0.0010	< 0.00030	0.00033	0.11	< 0.00020	< 0.020	28	0.0091	0.0000025	0.0018	0.0010	< 0.10	0.93	< 0.00020	2.1	< 0.00010	14	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0030
	16-Oct-2018	**0.20** [#1]	< 0.00060	0.00024	0.074	< 0.0010	0.027	0.000031	78	< 0.0010	< 0.00030	0.00071	**0.50** [#1]	0.00026	< 0.020	31	0.017	0.0000020	0.0019	0.0013	< 0.10	1.1	0.00031	2.3	< 0.00010	18	1.5	< 0.00020	< 0.0010	0.0038	0.0013	< 0.0010	< 0.0030
	03-Jun-2019	0.081	< 0.00060	0.00032	0.076	< 0.0010	0.022	< 0.000020	67	< 0.0010	< 0.00030	0.00076	0.18	< 0.00020	< 0.020	25	0.0078	< 0.0000020	0.0016	0.00089	< 0.10	1.1	< 0.00020	1.8	< 0.00010	15	1.1	< 0.00020	< 0.0010	0.0012	0.0011	< 0.0010	< 0.0030
(Duplicate)	03-Jun-2019	0.078	< 0.00060	0.00027	0.077	< 0.0010	0.022	< 0.000020	68	< 0.0010	< 0.00030	0.00061	0.19	< 0.00020	< 0.020	25	0.0081	< 0.0000020	0.0017	0.00079	< 0.10	1.0	< 0.00020	1.8	< 0.00010	15	1.1	< 0.00020	< 0.0010	0.0022	0.0011	< 0.0010	< 0.0030
	28-Aug-2019	0.079	< 0.00060	0.00023	0.083	< 0.0010	0.023	< 0.000020	79	< 0.0010	< 0.00030	0.00047	0.17	< 0.00020	< 0.020	28	0.0087	< 0.0000020	0.0018	0.00083	< 0.10	1.1	< 0.00020	2.1	< 0.00010	17	1.2	< 0.00020	< 0.0010	0.077	0.0011	< 0.0010	< 0.0030
	03-Oct-2019	0.020	< 0.00060	< 0.00020	0.075	< 0.0010	0.029	< 0.000020	79	< 0.0010	< 0.00030	0.00051	0.082	< 0.00020	< 0.020	28	0.0078	< 0.0000020	0.0016	0.0010	< 0.10	1.0	0.00032	1.8	< 0.00010	19	1.4	< 0.00020	< 0.0010	0.0010	0.0012	< 0.0010	< 0.0030
AEMP-03	18-Aug-2017	0.027	< 0.00060	0.00036	0.085	< 0.0010	0.029	< 0.000020	74	< 0.0010	< 0.00030	0.00093	0.087	< 0.00020	< 0.020	27	0.0075	0.0000091	0.0020	0.00068	< 0.10	1.1	0.00023	2.1	< 0.00010	21	1.3	< 0.00020	< 0.0010	< 0.0010	0.00096	0.0022	< 0.0030
	16-Sep-2017	0.022	< 0.00060	0.00034	0.081	< 0.0010	0.023	0.000024	73	< 0.0010	< 0.00030	0.00054	0.071	< 0.00020	< 0.020	28	0.0063	< 0.0000020	0.0021	0.00059	< 0.10	0.98	0.00024	2.1	< 0.00010	19	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	< 0.0010	0.0042
	16-Oct-2017	**0.11** [#1]	< 0.00060	0.00026	0.073	< 0.0010	0.021	< 0.000020	73	< 0.0010	< 0.00030	0.00049	0.28	< 0.00020	< 0.020	30	0.014	< 0.0000020	0.0019	0.00091	< 0.10	1.0	0.00027	2.2	< 0.00010	19	1.4	< 0.00020	< 0.0010	0.0035	0.0012	0.0014	< 0.0030
	23-Jun-2018	0.046	< 0.00060	0.00035	0.086	< 0.0010	0.029	< 0.000020	76	< 0.0010	< 0.00030	0.00084	0.10	< 0.00020	< 0.020	27	0.0084	< 0.0000020	0.0026	0.0010	< 0.10	1.1	0.00025	2.0	< 0.00010	18	1.3	< 0.00020	< 0.0010	0.0022	0.0015	< 0.0010	< 0.0030
	12-Aug-2018	0.026	< 0.00060	0.00037	0.074	< 0.0010	0.020	< 0.000020	73	< 0.0010	< 0.00030	0.00026	0.091	< 0.00020	< 0.020	28	0.0081	0.0000025	0.0017	0.00069	< 0.10	0.97	< 0.00020	2.1	< 0.00010	14	1.4	< 0.00020	< 0.0010	0.0041	0.0010	< 0.0010	< 0.0030
	16-Oct-2018	**0.47** [#1]	< 0.00060	0.00041	0.081	< 0.0010	0.030	0.000032	78	< 0.0010	0.00051	0.0011	**1.1** [#1]	0.00062	< 0.020	31	0.034	0.0000021	0.0018	0.0021	< 0.10	1.1	0.00027	2.6	< 0.00010	18	1.5	< 0.00020	< 0.0010	0.0095	0.0013	< 0.0010	0.0053
	03-Jun-2019	0.076	< 0.00060	0.00025	0.077	< 0.0010	0.022	< 0.000020	68	< 0.0010	< 0.00030	0.00063	0.18	< 0.00020	< 0.020	25	0.0071	< 0.0000020	0.0017	0.00084	< 0.10	1.0	0.00022	1.8	< 0.00010	15	1.1	< 0.00020	< 0.0010	0.0012	0.0011	< 0.0010	< 0.0030
	28-Aug-2019	0.054	< 0.00060	0.00026	0.081	< 0.0010	< 0.020	< 0.000020	77	< 0.0010	< 0.00030	0.00030	0.12	< 0.00020	< 0.020	27	0.0063	< 0.0000020	0.0016	0.00052	< 0.10	1.0	0.00020	2.0	< 0.00010	16	1.2	< 0.00020	< 0.0010	0.0011	0.0011	< 0.0010	< 0.0030
	02-Oct-2019	0.014	< 0.00060	0.00027	0.072	< 0.0010	< 0.020	< 0.000020	83	< 0.0010	< 0.00030	**0.0024** [#1]	< 0.060	< 0.00020	< 0.020	31	0.011	< 0.0000020	0.0019	0.00080	< 0.10	1.1	0.00023	2.0	< 0.00010	20	1.4	< 0.00020	< 0.0010	< 0.0010	0.0013	< 0.0010	< 0.0030
AEMP-04	18-Aug-2017	0.024	< 0.00060	0.00030	0.089	< 0.0010	0.030	< 0.000020	77	< 0.0010	< 0.00030	0.00058	0.10	< 0.00020	< 0.020	28	0.0068	< 0.0000020	0.0021	0.00089	< 0.10	1.2	0.00021	2.2	< 0.00010	22	1.3	< 0.00020	< 0.0010	0.0012	0.0010	0.0018	< 0.0030
	16-Sep-2017	0.019	< 0.00060	0.00031	0.081	< 0.0010	0.022	< 0.000020	74	< 0.0010	< 0.00030	0.00028	0.069	< 0.00020	< 0.020	29	0.0057	< 0.0000020	0.0018	0.00076	< 0.10	1.0	< 0.00020	2.1	< 0.00010	19	1.3	< 0.00020	< 0.0010	< 0.0010	0.0011	0.0011	< 0.0030
	16-Oct-2017	0.087	< 0.00060	0.00027	0.072	< 0.0010	< 0.020	< 0.000020	74	< 0.0010	< 0.00030	0.00041	0.21	< 0.00020	< 0.020	31	0.010	< 0.0000020	0.0020	0.00088	< 0.10	1.0	0.00025	2.1	< 0.00010	19	1.4	< 0.00020	< 0.0010	0.0015	0.0013	0.0015	< 0.0030
	23-Jun-2018	0.090	< 0.00060	0.00044	0.086	< 0.0010	0.029	< 0.000020	76	< 0.0010	< 0.00030	0.00083	0.14	< 0.00020	< 0.020	27	0.0098	< 0.0000020	0.0028	0.0012	< 0.10	1.1	0.00028	2.0	< 0.00010	19	1.3	< 0.00020	< 0.0010	0.0014	0.0015	< 0.0010	< 0.0030
(Duplicate)	23-Jun-2018	0.057	< 0.00060	0.00034	0.089	< 0.0010	0.031	< 0.000020	78	< 0.0010	< 0.00030	0.00077	0.15	< 0.00020	< 0.020	28	0.010	< 0.0000020	0.0023	0.00087	< 0.10	1.2	0.00023	2.1	< 0.00010	19	1.3	< 0.00020	< 0.0010	0.0015	0.0013	< 0.0010	< 0.0030
	12-Aug-2018	0.020	< 0.00060	0.00024	0.076	< 0.0010	0.023	< 0.000020	73	< 0.0010	< 0.00030	0.00050	0.088	< 0.00020	< 0.020	29	0.0072	0.0000027	0.0018	0.00074	< 0.10	0.92	< 0.00020	2.1	< 0.00010	14	1.4	< 0.00020	< 0.0010	0.0012	0.0011	< 0.0010	< 0.0030
	16-Oct-2018	**0.15** [#1]	< 0.00060	0.00027	0.072	< 0.0010	0.027	< 0.000020	76	< 0.0010	< 0.00030	0.00081	**0.35** [#1]	0.00021	< 0.020	31	0.012	< 0.0000020	0.0019	0.0010	< 0.10	1.0	0.00079	2.2	< 0.00010	17	1.5	< 0.00020	< 0.0010	0.0031	0.0012	< 0.0010	< 0.0030
	03-Jun-2019	0.077	< 0.00060	0.00026	0.076	< 0.0010	0.021	< 0.000020	68	< 0.0010	< 0.00030	0.00066	0.17	< 0.00020	< 0.020	25	0.0070	< 0.0000020	0.0018	0.00091	< 0.10	1.0	< 0.00020	1.8	< 0.00010	15	1.2	< 0.00020	< 0.0010	0.0013	0.0011	< 0.0010	< 0.0030
	25-Aug-2019	0.099	< 0.00060	0.00021	0.074	< 0.0010	0.020	< 0.000020	72	< 0.0010	< 0.00030	0.00050	0.19	< 0.00020	< 0.020	26	0.0075	< 0.0000020	0.0016	0.00084	< 0.10	0.94	0.00033	1.9	< 0.00010	13	1.2	< 0.00020	< 0.0010	0.0055	0.0012	< 0.0010	< 0.0030
	02-Oct-2019	0.013	< 0.00060	< 0.00020	0.072	< 0.0010	< 0.020	< 0.000020	84	< 0.0010	< 0.00030	0.00030	< 0.060	< 0.00020	< 0.020	31	0.0044	< 0.0000020	0.0019	0.00071	< 0.10	1.1	0.00025	2.0	< 0.00010	20	1.4	< 0.00020	< 0.0010	< 0.0010	0.0012	< 0.0010	< 0.0030
AEMP-05	19-Aug-2017	0.015	< 0.00060	0.0011	0.16	< 0.0010	< 0.020	< 0.000020	52	< 0.0010	< 0.00030	0.00034	0.17	< 0.00020	< 0.020	14	0.013	0.0000038	0.0017	0.0011	< 0.10	1.7	< 0.00020	0.27	< 0.00010	5.7	0.25	< 0.00020	< 0.0010	< 0.0010	0.00041	0.0024	< 0.0030
	16-Sep-2017	0.012	< 0.00060	0.00073	0.15	< 0.0010	< 0.020	< 0.000020	48	< 0.0010	< 0.00030	0.00032	0.078	< 0.00020	< 0.020	13	0.0051	< 0.0000020	0.0016	0.0013	< 0.10	1.7	< 0.00020	0.27	< 0.00010	5.4	0.20	< 0.00020	< 0.0010	< 0.0010	0.00036	0.0011	< 0.0030
	15-Oct-2017	0.025	< 0.00060	0.00060	0.15	< 0.0010	< 0.020	< 0.000020	51	< 0.0010	< 0.00030	0.00030	0.11	< 0.00020	< 0.020	14	0.0060	< 0.0000020	0.0016	0.0011	< 0.10	2.3	0.00027	0.41	< 0.00010	5.4	0.20	< 0.00020	< 0.0010	< 0.0010	0.00034	0.0015	< 0.0030
	23-Jun-2018	**1.4** [#1]	< 0.00060	0.0018	0.089	< 0.0010	< 0.020	**0.00017** [#1]	39	0.0025	0.0022	**0.0058** [#1]	**2.4** [#1]	**0.0018** [#1]	< 0.020	11	0.075	0.0000049	0.0016	0.0081	< 0.10	1.2	0.00054	2.8	< 0.00010	6.4	0.19	< 0.00020	< 0.0010	0.022	0.0011	0.0044	0.024
	13-Aug-2018	0.033	< 0.00060	0.0011	0.14	< 0.0010	< 0.020	< 0.000020	42	< 0.0010	< 0.00030	0.00029	**0.50** [#1]	< 0.00020	< 0.020	14	0.031	0.0000028	0.0017	0.0011	< 0.10	1.4	< 0.00020	0.50	< 0.00010	3.6	0.16	< 0.00020	< 0.0010	0.0011	0.00017	< 0.0010	< 0.0030
	18-Oct-2018	0.033	< 0.00060	0.00075	0.17	< 0.0010	< 0.020	< 0.000020	50	< 0.0010	< 0.00030	0.00042	**0.34** [#1]	< 0.00020	< 0.020	15	0.18	< 0.0000020	0.0016	0.0016	< 0.10	3.5	< 0.00020	0.36	< 0.00010	4.2	0.20	< 0.00020	< 0.0010	0.0014	0.00035	< 0.0010	< 0.0030
	02-Jun-2019	0.067	< 0.00060	0.0011	0.14	< 0.0010	< 0.020	< 0.000020	44	< 0.0010	< 0.00030	0.00038	**0.56** [#1]	< 0.00020	< 0.020	13	0.041	< 0.0000020	0.0010	0.0014	< 0.10	2.3	< 0.00020	1.1	< 0.00010	3.8	0.14	< 0.00020	< 0.0010	0.0011	0.00028	< 0.0010	0.0071
	27-Aug-2019	0.016	< 0.00060	0.00085	0.16	< 0.0010	< 0.020	< 0.000020	44	< 0.0010	< 0.00030	0.00027	0.12	< 0.00020	< 0.020	13	0.0056	< 0.0000020	0.0014	0.00078	< 0.10	2.0	< 0.00020	0.25	< 0.00010	3.4	0.16	< 0.00020	< 0.0010	< 0.0010	0.00020	< 0.0010	< 0.0030
	01-Oct-2019	0.042	< 0.00060	0.00069	0.16	< 0.0010	< 0.020	< 0.000020	42	< 0.0010	< 0.00030	0.00038	**0.41** [#1]	< 0.00020	< 0.020	16	0.0094	< 0.0000020	0.0013	0.0011	< 0.10	1.8	< 0.00020	0.33	< 0.00010	3.3	0.15	< 0.00020	< 0.0010	0.0012	0.00017	< 0.0010	< 0.0030
AEMP-06	21-Aug-2017	**0.66** [#1]	< 0.00060	0.00095	0.061	< 0.0010	< 0.020	0.000055	34	0.0011	0.00079	**0.0023** [#1]	**1.3** [#1]	0.00071	< 0.020	11	0.031	0.0000028	0.0010	0.0031	< 0.10	1.1	0.00035	2.4	< 0.00010	8.3	0.23	< 0.00020	< 0.0010	0.0087	0.00075	0.0023	0.0074
	16-Sep-2017	**0.36** [#1]	< 0.00060	0.00063	0.049	< 0.0010	< 0.020	0.000032	31	< 0.0010	0.00042	0.0014	**0.68** [#1]	0.00043	< 0.020	10	0.019	< 0.0000020	0.00086	0.0021	< 0.10	0.96	0.00022	2.0	< 0.00010	9.4	0.21	< 0.00020	< 0.0010	0.0061	0.00062	0.0020	0.0065
	16-Oct-2017	**0.24** [#1]	< 0.00060	0.00050	0.044	< 0.0010	< 0.020	0.000023	31	< 0.0010	< 0.00030	0.0013	**0.36** [#1]	0.00025	< 0.020	11	0.016	< 0.0000020	0.0013	0.0018	< 0.10	1.0	0.00024	1.8	< 0.00010	9.1	0.22	< 0.00020	< 0.0010	0.0069	0.00080	0.0019	0.0036
	23-Jun-2018	**0.90** [#1]	< 0.00060	0.0012	0.055	< 0.0010	< 0.020	0.000087	29	0.0017	0.0012	**0.0038** [#1]	**1.2** [#1]	0.0010 [#1]	< 0.020	8.8	0.029	< 0.0000020	0.0014	0.0051	< 0.10	0.98	0.00043	2.1	< 0.00010	6.8	0.17	< 0.00020	< 0.0010	0.010	0.00092	0.0030	0.012
	13-Aug-2018	**0.56** [#1]	< 0.00060	0.00068	0.049	< 0.0010	< 0.020	0.000061	33	< 0.0010	0.00054	0.0018	**0.70** [#1]	0.00045	< 0.020	10	0.021	0.0000033	0.00085	0.0028	< 0.10	0.92	0.00030	2.2	< 0.00010	8.7	0.22	< 0.00020	< 0.0010	0.0071	0.00066	0.0016	0.0094
	18-Oct-2018	**1.7** [#1]	0.00098	0.0020	0.10	< 0.0010	< 0.020	**0.00015** [#1]	35	0.0033	0.0024	**0.0075** [#1]	**4.5** [#1]	**0.0027** [#1]	< 0.020	11	0.099	0.0000079	0.0012	0.0086	0.12	1.5	0.00031	5.0	< 0.00010	9.1	0.23	< 0.00020	< 0.0010	0.019	0.00076	0.0046	**0.036** [#1]
	03-Jun-2019	**3.7** [#1]	< 0.00060	0.0027	0.11	< 0.0010	< 0.020	**0.00014** [#1]	37	0.0060	0.0035	**0.0078** [#1]	**7.4** [#1]	**0.0031** [#1]	< 0.020	12	0.13	0.000011	0.0011	0.011	0.14	1.9	0.00030	5.6	< 0.00010	7.0	0.20	< 0.00020	< 0.0010	0.048	0.00083	0.0095	**0.034** [#1]
	25-Aug-2019	**0.78** [#1]	< 0.00060	0.00072	0.054	< 0.0010	< 0.020	0.000047	32	0.0013	0.00054	0.0017	**1.1** [#1]	0.00059	< 0.020	10	0.021	0.0000021	0.00085	0.0025	< 0.10	1.1	0.00039	3.2	< 0.00010	8.4	0.22	< 0.00020	< 0.0010	0.020 [#2]	0.00065	0.0024	0.0073
(Duplicate)	02-Oct-2019	**0.66** [#1]	< 0.00060	0.00061	0.053	< 0.0010	< 0.020	0.000037	29	0.0011	0.00039	0.0017	**0.88** [#1]	0.00043	< 0.020	9.5	0.015	< 0.0000020	0.00084	0.0024	< 0.10	1.1	0.00027	3.0	< 0.00010	8.2	0.21	< 0.00020	< 0.0010	0.014	0.00062	0.0024	0.0052
	03-Oct-2019	**0.70** [#1]	< 0.00060	0.00069	0.054	< 0.0010	< 0.020	0.000024	32	0.0016	0.00043	0.0017	**0.88** [#1]	0.00046	< 0.020	10	0.014	< 0.0000020	0.00084	0.0023	< 0.10	1.2	0.00025	3.2	< 0.00010	9.1	0.22	< 0.00020	< 0.0010	0.016	0.00066	0.0024	0.0050
AEMP-07	21-Aug-2017	**0.62** [#1]	< 0.00060	0.00083	0.058	< 0.0010	< 0.020	0.000060	33	0.0011	0.00069	**0.0023** [#1]	**1.2** [#1]	0.00063	< 0.020	10	0.029	0.0000024	0.00097	0.0030	< 0.10	1.1	0.00034	2.4	< 0.00010	8.1	0.23	< 0.00020	< 0.0010	0.0089	0.00074	0.0022	0.0082
(Duplicate)	21-Aug-2017	**0.67** [#1]	< 0.00060	0.00093	0.059	< 0.0010	< 0.020	0.000053	33	0.0013	0.00077	**0.0025** [#1]	**1.3** [#1]	0.00074	< 0.020	11	0.031	0.0000026	0.0010	0.0032	< 0.10	1.1	0.00038	2.4	< 0.00010	8.2	0.23	< 0.00020	< 0.0010	0.011	0.00079	0.0024	0.0078
	16-Sep-2017	**0.28** [#1]	< 0.00060	0.00056	0.047	< 0.0010	< 0.020	0.000028	30	< 0.0010	0.00034	0.0013	**0.67** [#1]	0.00039	< 0.020	10	0.018	< 0.0000020	0.00076	0.0018	< 0.10	0.89	< 0.00020	1.9	< 0.00010	9.0	0.20	< 0.00020	< 0.0010	0.0038	0.00057	0.0017	0.0042

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Table 4
Surface Water Analytical Results: Total Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Calcium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life [#1]		**0.1**	---	**0.005**	---	---	**1.5**	**0.00009**	---	**0.0089**	---	**0.002**	**0.3**	**0.001**	---	---	---	**0.000026**	**0.073**	**0.025**	---	---	**0.001**	---	**0.00025**	---	---	**0.0008**	---	---	**0.015**	---	**0.03**
	16-Oct-2017	**0.54** [#1]	< 0.00060	0.00086	0.056	< 0.0010	< 0.020	0.000057	29	0.0010	0.00050	0.0020 [#1]	**0.80** [#1]	0.00058	< 0.020	10	0.048	< 0.0000020	0.00095	0.0026	< 0.10	1.1	0.00028	1.9	< 0.00010	8.8	0.22	< 0.00020	< 0.0010	0.023	0.00075	0.0038	0.0064
	23-Jun-2018	**1.1** [#1]	< 0.00060	0.0013	0.060	< 0.0010	< 0.020	**0.000098** [#1]	29	0.0022	0.0015	**0.0042** [#1]	**1.6** [#1]	**0.0014** [#1]	< 0.020	8.9	0.038	0.0000033	0.0014	0.0059	< 0.10	1.1	0.00042	2.4	< 0.00010	7.2	0.16	< 0.00020	< 0.0010	0.017	0.00094	0.0040	0.014
	13-Aug-2018	**1.4** [#1]	< 0.00060	0.0018	0.093	< 0.0010	< 0.020	**0.00017** [#1]	39	0.0019	0.0017	**0.0044** [#1]	**3.0** [#1]	**0.0019** [#1]	< 0.020	12	0.079	0.000010	0.00098	0.0060	0.12	1.2	0.00040	3.2	< 0.00010	9.0	0.23	< 0.00020	< 0.0010	0.019	0.00081	0.0043	0.021
	17-Oct-2018	**0.34** [#1]	< 0.00060	0.00060	0.052	< 0.0010	< 0.020	0.000040	28	< 0.0010	0.00042	0.0018	**0.66** [#1]	0.00047	< 0.020	9.1	0.024	< 0.0000020	0.00091	0.0020	< 0.10	1.0	< 0.00020	2.1	< 0.00010	9.5	0.21	< 0.00020	< 0.0010	0.013	0.00059	< 0.0010	0.0039
(Duplicate)	17-Oct-2018	**0.34** [#1]	< 0.00060	0.00046	0.053	< 0.0010	< 0.020	0.000038	28	< 0.0010	0.00040	0.0015	**0.72** [#1]	0.00047	< 0.020	9.2	0.026	< 0.0000020	0.00078	0.0020	< 0.10	1.0	< 0.00020	2.2	< 0.00010	9.7	0.21	< 0.00020	< 0.0010	0.0069	0.00054	< 0.0010	0.0038
	03-Jun-2019	**3.5** [#1]	< 0.00060	0.0028	0.11	< 0.0010	< 0.020	**0.00015** [#1]	37	0.0062	0.0036	**0.0083** [#1]	**7.5** [#1]	**0.0034** [#1]	< 0.020	12	0.15	0.000013	0.0014	0.012	0.15	1.9	0.00031	5.5	< 0.00010	9.8	0.20	< 0.00020	< 0.0010	0.12	0.00088	0.0096	**0.035** [#1]
	25-Aug-2019	**0.81** [#1]	< 0.00060	0.00061	0.051	< 0.0010	< 0.020	0.000028	31	0.0011	0.00047	0.0017	**0.89** [#1]	0.00046	< 0.020	9.9	0.018	< 0.0000020	0.00082	0.0024	< 0.10	1.1	0.00035	3.0	< 0.00010	8.3	0.22	< 0.00020	< 0.0010	0.013	0.00065	0.0017	0.0060
	03-Oct-2019	**4.6** [#1]	< 0.00060	**0.0062** [#1]	0.34	< 0.0010	0.021	**0.00048** [#1]	70	**0.0093** [#1]	0.0069	**0.014** [#1]	**16** [#1]	**0.0077** [#1]	< 0.020	24	0.36	0.000021	0.0019	0.021	0.51	2.2	0.00063	9.0	< 0.00010	8.6	0.27	< 0.00020	< 0.0010	0.059	0.0012	0.015	**0.072** [#1]
AEMP-08	17-Aug-2017	**0.65** [#1]	< 0.00060	0.0011	0.066	< 0.0010	< 0.020	0.000071	39	0.0011	0.00079	**0.0025** [#1]	**1.2** [#1]	0.00077	< 0.020	12	0.031	0.0000038	0.0012	0.0037	< 0.10	1.1	0.00052	2.6	< 0.00010	7.3	0.25	< 0.00020	< 0.0010	0.011	0.00094	0.0032	0.011
	21-Aug-2017	**0.50** [#1]	< 0.00060	0.00079	0.056	< 0.0010	< 0.020	0.000035	33	< 0.0010	0.00056	0.0020 [#1]	**0.98** [#1]	0.00054	< 0.020	10	0.024	0.0000026	0.00095	0.0027	< 0.10	1.1	0.00031	2.2	< 0.00010	8.3	0.24	< 0.00020	< 0.0010	0.011	0.00072	0.0019	0.0057
	16-Sep-2017	**1.2** [#1]	< 0.00060	0.0015	0.085	< 0.0010	< 0.020	**0.000092** [#1]	39	0.0022	0.0016	**0.0037** [#1]	**3.2** [#1]	**0.0017** [#1]	< 0.020	14	0.077	0.0000026	0.00095	0.0051	< 0.10	1.2	0.00026	3.0	< 0.00010	9.4	0.24	< 0.00020	< 0.0010	0.016	0.00074	0.0043	0.016
	16-Oct-2017	**0.33** [#1]	< 0.00060	0.00056	0.048	< 0.0010	< 0.020	0.000029	31	< 0.0010	0.00039	0.0013	**0.74** [#1]	0.00040	< 0.020	11	0.020	< 0.0000020	0.00077	0.0020	< 0.10	0.99	0.00033	2.1	< 0.00010	9.2	0.23	< 0.00020	< 0.0010	0.0069	0.00060	0.0026	0.0040
	23-Jun-2018	**0.80** [#1]	< 0.00060	0.00098	0.063	< 0.0010	< 0.020	0.000066	31	0.0014	0.0011	**0.0031** [#1]	**1.6** [#1]	0.00089	< 0.020	9.5	0.038	0.0000030	0.0011	0.0043	< 0.10	1.0	0.00028	2.3	< 0.00010	7.3	0.20	< 0.00020	< 0.0010	0.010	0.00073	0.0026	0.011
	13-Aug-2018	**0.73** [#1]	< 0.00060	0.00083	0.057	< 0.0010	< 0.020	0.000087	35	< 0.0010	0.00072	**0.0023** [#1]	**1.1** [#1]	0.00060	< 0.020	11	0.028	0.0000039	0.0010	0.0034	< 0.10	1.0	0.00034	2.6	< 0.00010	9.2	0.26	< 0.00020	< 0.0010	0.015	0.00074	0.0021	0.011
	17-Oct-2018	**0.12** [#1]	< 0.00060	0.00029	0.041	< 0.0010	< 0.020	< 0.000020	29	< 0.0010	< 0.00030	0.00095	0.19	< 0.00020	< 0.020	10	0.0069	< 0.0000020	0.00075	0.0012	< 0.10	0.94	< 0.00020	1.6	< 0.00010	9.4	0.28	< 0.00020	< 0.0010	0.0020	0.00052	< 0.0010	< 0.0030
	03-Jun-2019	**1.7** [#1]	< 0.00060	0.0017	0.086	< 0.0010	< 0.020	**0.00012** [#1]	37	0.0031	0.0021	**0.0048** [#1]	**4.0** [#1]	**0.0021** [#1]	< 0.020	13	0.092	0.0000080	0.0012	0.0065	< 0.10	1.4	0.00039	3.7	< 0.00010	7.9	0.31	< 0.00020	< 0.0010	0.019	0.00076	0.0046	0.021
	28-Aug-2019	**0.59** [#1]	< 0.00060	0.00052	0.056	< 0.0010	< 0.020	0.000023	35	< 0.0010	0.00037	0.0015	**0.86** [#1]	0.00042	< 0.020	11	0.018	< 0.0000020	0.00091	0.0018	< 0.10	1.1	0.00032	2.9	< 0.00010	8.8	0.29	< 0.00020	< 0.0010	0.015 [#2]	0.00069	0.0024	0.0044
	03-Oct-2019	**0.38** [#1]	< 0.00060	0.00064	0.054	< 0.0010	< 0.020	0.000031	33	< 0.0010	0.00039	0.0015	**0.87** [#1]	0.00041	< 0.020	10	0.015	0.0000020	0.00092	0.0023	< 0.10	1.1	0.00037	3.1	< 0.00010	8.9	0.27	< 0.00020	< 0.0010	0.0074	0.00060	0.0018	0.0051
AEMP-09	21-Aug-2017	**3.2** [#1]	< 0.00060	0.0033	0.12	< 0.0010	0.021	**0.00021** [#1]	48	0.0067	0.0040	**0.0092** [#1]	**7.1** [#1]	**0.0040** [#1]	< 0.020	16	0.16	0.000011	0.0015	0.013	0.18	1.6	0.00051	5.0	< 0.00010	8.8	0.28	< 0.00020	< 0.0010	0.030	0.0011	0.0087	**0.034** [#1]
	16-Sep-2017	**0.24** [#1]	< 0.00060	0.00057	0.052	< 0.0010	< 0.020	0.000033	34	< 0.0010	0.00032	0.0014	**0.40** [#1]	0.00038	< 0.020	11	0.028	0.0000022	0.00094	0.0017	< 0.10	0.94	0.00024	1.8	< 0.00010	10	0.24	< 0.00020	< 0.0010	0.0054	0.00076	0.0014	0.0032
	16-Oct-2017	**2.5** [#1]	< 0.00060	0.0024	0.14	< 0.0010	0.052	**0.00020** [#1]	45	0.0041	0.0029	**0.0073** [#1]	**6.2** [#1]	**0.0031** [#1]	< 0.020	15	0.21	< 0.0000020	0.0011	0.0090	0.11	1.8	0.00043	5.3	< 0.00010	28	0.26	< 0.00020	< 0.0010	0.028	0.00081	0.0081	0.026
	23-Jun-2018	**1.8** [#1]	< 0.00060	0.0023	0.083	< 0.0010	< 0.020	**0.00012** [#1]	34	0.0037	0.0025	**0.0061** [#1]	**3.4** [#1]	**0.0024** [#1]	< 0.020	11	0.082	0.0000069	0.0012	0.0083	< 0.10	1.2	0.00042	3.0	< 0.00010	7.5	0.18	< 0.00020	< 0.0010	0.019	0.00095	0.0059	0.024
	12-Aug-2018	**0.74** [#1]	< 0.00060	0.0010	0.062	< 0.0010	< 0.020	0.000073	36	0.0011	0.00079	**0.0023** [#1]	**1.3** [#1]	0.00076	< 0.020	11	0.038	0.0000043	0.0010	0.0034	< 0.10	1.1	0.00036	2.4	< 0.00010	10	0.26	< 0.00020	< 0.0010	0.019	0.00071	0.0024	0.010
	17-Oct-2018	**0.87** [#1]	< 0.00060	0.0013	0.087	< 0.0010	0.020	**0.000091** [#1]	32	0.0016	0.0011	**0.0057** [#1]	**1.9** [#1]	**0.0012** [#1]	< 0.020	11	0.058	0.0000043	0.0011	0.0039	< 0.10	1.2	0.00031	2.6	< 0.00010	12	0.27	< 0.00020	< 0.0010	0.061	0.00070	0.0025	0.011
	02-Jun-2019	**3.7** [#1]	0.0028	0.0035	0.13	< 0.0010	< 0.020	**0.00020** [#1]	43	0.0067	0.0045	**0.011** [#1]	**8.9** [#1]	**0.0043** [#1]	< 0.020	13	0.18	0.000015	0.0017	0.015	0.18	1.8	0.00048	5.7	< 0.00010	9.1	0.21	< 0.00020	< 0.0010	0.035	0.0010	0.011	**0.074** [#1]
	28-Aug-2019	**0.72** [#1]	< 0.00060	0.00050	0.062	< 0.0010	< 0.020	0.000032	34	< 0.0010	0.00046	**0.0024** [#1]	**0.89** [#1]	0.00049	< 0.020	11	0.022	< 0.0000020	0.0011	0.0018	< 0.10	1.1	0.00032	2.9	< 0.00010	9.4	0.24	< 0.00020	< 0.0010	0.016	0.00069	0.0027	0.0038
	03-Oct-2019	**0.57** [#1]	< 0.00060	0.00076	0.067	< 0.0010	< 0.020	0.000047	33	0.0011	0.00058	**0.0028** [#1]	**1.4** [#1]	0.00076	< 0.020	10	0.031	0.0000029	0.0011	0.0055	< 0.10	1.2	0.00033	2.9	< 0.00010	10	0.24	< 0.00020	< 0.0010	0.010	0.00062	0.0024	0.0086
AEMP-10	23-Jun-2018	**0.93** [#1]	< 0.00060	0.0011	0.061	< 0.0010	< 0.020	0.000080	32	0.0018	0.0012	**0.0036** [#1]	**1.5** [#1]	0.00093	< 0.020	8.7	0.031	0.0000033	0.0011	0.0050	< 0.10	1.1	0.00041	2.5	< 0.00010	6.1	0.15	< 0.00020	< 0.0010	0.024	0.00085	0.0027	0.011
	14-Aug-2018	**1.6** [#1]	< 0.00060	0.0013	0.077	< 0.0010	< 0.020	**0.00015** [#1]	40	0.0014	0.0016	**0.0037** [#1]	**2.0** [#1]	**0.0012** [#1]	< 0.020	12	0.052	0.0000068	0.0011	0.0057	< 0.10	1.3	0.00047	4.1	< 0.00010	7.8	0.24	< 0.00020	< 0.0010	0.029	0.00084	0.0035	0.021
(Duplicate)	14-Aug-2018	**1.4** [#1]	< 0.00060	0.0011	0.076	< 0.0010	< 0.020	**0.00015** [#1]	40	0.0016	0.0015	**0.0036** [#1]	**2.1** [#1]	**0.0011** [#1]	< 0.020	12	0.052	0.0000052	0.0011	0.0054	< 0.10	1.3	0.00042	3.8	< 0.00010	7.7	0.23	< 0.00020	< 0.0010	0.068	0.00086	0.0037	0.020
	18-Oct-2018	**0.44** [#1]	< 0.00060	0.00069	0.057	< 0.0010	< 0.020	0.000053	28	< 0.0010	0.00047	0.0016	**0.89** [#1]	0.00057	< 0.020	9.6	0.028	< 0.0000020	0.00079	0.0031	< 0.10	0.98	< 0.00020	1.9	< 0.00010	9.5	0.22	< 0.00020	< 0.0010	0.014	0.00057	0.0016	0.0055
	10-Jun-2019	**2.0** [#1]	0.00096	0.0021	0.098	< 0.0010	< 0.020	**0.00015** [#1]	38	0.0033	0.0024	**0.0074** [#1]	**4.8** [#1]	**0.0026** [#1]	< 0.020	10	0.11	0.0000090	0.0012	0.0081	0.11	1.5	0.00038	4.0	< 0.00010	6.2	0.18	< 0.00020	< 0.0010	0.028	0.00087	0.0056	**0.042** [#1]
	26-Aug-2019	**1.7** [#1]	< 0.00060	0.0013	0.076	< 0.0010	< 0.020	0.000083	40	0.0026	0.0010	**0.0031** [#1]	**2.2** [#1]	**0.0011** [#1]	< 0.020	11	0.042	< 0.0000020	0.0011	0.0043	< 0.10	1.5	0.00053	5.2	< 0.00010	8.1	0.24	< 0.00020	< 0.0010	0.028	0.00097	0.0048	0.013
	01-Oct-2019	**1.6** [#1]	< 0.00060	0.0011	0.085	< 0.0010	< 0.020	0.000086	37	0.0026	0.0010	**0.0043** [#1]	**2.3** [#1]	**0.0014** [#1]	< 0.020	11	0.028	0.0000061	0.0012	0.0051	< 0.10	1.4	0.00050	3.1	< 0.00010	8.9	0.24	< 0.00020	< 0.0010	0.039	0.00095	0.0050	0.012
AEMP-11	23-Jun-2018	**0.88** [#1]	< 0.00060	0.00099	0.066	< 0.0010	< 0.020	0.000085	32	0.0019	0.0014	**0.0036** [#1]	**1.7** [#1]	0.0010 [#1]	< 0.020	9.3	0.042	0.0000036	0.00095	0.0049	< 0.10	1.1	0.00036	2.6	< 0.00010	6.6	0.16	< 0.00020	< 0.0010	0.018	0.00079	0.0028	0.011
	14-Aug-2018	**1.2** [#1]	< 0.00060	0.00086	0.065	< 0.0010	< 0.020	**0.00013** [#1]	37	0.0012	0.0013	**0.0029** [#1]	**1.5** [#1]	0.00097	< 0.020	11	0.043	0.0000043	0.00092	0.0044	< 0.10	1.2	0.00036	3.3	< 0.00010	7.6	0.22	< 0.00020	< 0.0010	0.017	0.00080	0.0031	0.016
	18-Oct-2018	**1.0** [#1]	< 0.00060	0.0011	0.071	< 0.0010	< 0.020	0.000071	32	0.0018	0.0011	**0.0031** [#1]	**2.1** [#1]	**0.0012** [#1]	< 0.020	11	0.049	0.0000038	0.00089	0.0040	< 0.10	1.2	0.00031	2.5	< 0.00010	9.9	0.27	< 0.00020	< 0.0010	0.016	0.00059	0.0035	0.012
	10-Jun-2019	**2.1** [#1]	0.00098	0.0023	0.10	< 0.0010	< 0.020	**0.00016** [#1]	38	0.0038	0.0027	**0.0079** [#1]	**5.4** [#1]	**0.0028** [#1]	< 0.020	11	0.12	0.0000092	0.0012	0.0086	0.13	1.6	0.00040	4.2	< 0.00010	6.4	0.18	< 0.00020	< 0.0010	0.032	0.00076	0.0063	**0.038** [#1]
	26-Aug-2019	**1.5** [#1]	< 0.00060	0.0010	0.074	< 0.0010	< 0.020	0.000063	39	0.0025	0.0011	**0.0031** [#1]	**2.1** [#1]	0.00098	< 0.020	11	0.039	0.0000036	0.0011	0.0046	< 0.10	1.4	0.00047	5.0	< 0.00010	8.0	0.24	< 0.00020	< 0.0010	0.043	0.0011	0.0050	0.0096
	01-Oct-2019	**1.6** [#1]	0.0015	0.0018	0.11	< 0.0010	0.023	**0.00014** [#1]	36	0.0028	0.0025	**0.0078** [#1]	**6.7** [#1]	**0.0025** [#1]	< 0.020	11	0.086	0.0000092	0.0014	0.0090	0.10	1.7	0.00048	3.9	< 0.00010	9.8	0.24	< 0.00020	< 0.0010	0.020	0.00098	0.0048	**0.044** [#1]
AEMP-12	23-Jun-2018	**0.55** [#1]	< 0.00060	0.00069	0.055	< 0.0010	< 0.020	0.000049	31	0.0010	0.00067	**0.0024** [#1]	**0.96** [#1]	0.00058	< 0.020	9.7	0.024	< 0.0000020	0.00081	0.0030	< 0.10	0.97	0.00026	2.2	< 0.00010	7.5	0.23	< 0.00020	< 0.0010	0.0081	0.00064	0.0019	0.0072
	14-Aug-2018	**0.94** [#1]	< 0.00060	0.0011	0.073	< 0.0010	< 0.020	0.000089	44	0.0013	0.0012	**0.0029** [#1]	**1.9** [#1]	0.00099	< 0.020	14	0.051	0.0000050	0.0011	0.0045	< 0.10	1.1	0.00097	2.6	< 0.00010	9.6	0.43	< 0.00020	< 0.0010	0.013	0.00081	0.0027	0.014
	17-Oct-2018	**0.20** [#1]	< 0.00060	0.00027	0.066	< 0.0010	0.023	0.000027	63	< 0.0010	< 0.00030	0.00086	**0.48** [#1]	0.00028	< 0.020	24	0.016	< 0.0000020	0.0016	0.0016	< 0.10	1.0	0.00023	2.1	< 0.00010	16	1.1	< 0.00020	< 0.0010	0.0057	0.0011	< 0.0010	0.0042
	03-Jun-2019	**1.5** [#1]	< 0.00060	0.0014	0.081	< 0.0010	< 0.020	0.000084	43	0.0025	0.0016	**0.0040** [#1]	**3.0** [#1]	**0.0015** [#1]	< 0.020	15	0.068	0.0000054	0.0013	0.0053	< 0.10	1.4	0.00025	3.2	< 0.00010	9.5	0.49	< 0.00020	< 0.0010	0.021	0.00086	0.0042	0.016
	28-Aug-2019	**0.53** [#1]	< 0.00060	0.00046	0.053	< 0.0010	< 0.020	0.000031	35	< 0.0010	0.00034	0.0013	**0.65** [#1]	0.00031	< 0.020	11	0.014	< 0.0000020	0.00074	0.0016	< 0.10	1.0	0.00034	2.5	< 0.00010	8.7	0.30	< 0.00020	< 0.0010	0.0097	0.00073	0.0019	0.0037
(Duplicate)	28-Aug-2019	**0.61** [#1]	< 0.00060	0.00051	0.054	< 0.0010	< 0.020	0.000025	35	< 0.0010	0.00036	0.0013	**0.64** [#1]	0.00030	< 0.020	11	0.014	< 0.0000020	0.0010	0.0016	< 0.10	1.0	0.00030	2.6	< 0.00010	8.9	0.31	< 0.00020	< 0.0010	0.0073	0.00067	0.0021	0.0036
	03-Oct-2019	**0.34** [#1]	0.00072	0.00057	0.051	< 0.0010	< 0.020	0.000025	32	< 0.0010	< 0.00030	0.0016	**0.64** [#1]	0.00036	< 0.020	10	0.013	< 0.0000020	0.00068	0.0022	< 0.10	1.1	0.00032	2.3	< 0.00010	9.0	0.27	< 0.00020	< 0.0010	0.0084	0.00060	0.0014	0.0043
AEMP-13	14-Aug-2018	**1.8** [#1]	< 0.00060	0.0017	0.099	< 0.0010	< 0.020	**0.00024** [#1]	48	0.0022	0.0020	**0.0049** [#1]	**3.0** [#1]	**0.0017** [#1]	< 0.020	15	0.090	0.0000071	0.0012	0.0074	< 0.10	1.3	0.00046	4.6	< 0.00010	8.4	0.26	< 0.00020	< 0.0010	0.026	0.00099	0.0055	0.030 [#1]
	18-Oct-2018	**0.42** [#1]	< 0.00060	0.00063	0.067	< 0.0010	< 0.020	0.000075	43	< 0.0010	0.00048	0.0020 [#1]	**0.75** [#1]	0.00053	< 0.020	12	0.064	< 0.0000020	0.0011	0.0030	< 0.10	1.1	0.00040	2.2	< 0.00010	11	0.29	< 0.00020	< 0.0010	0.011	0.00090	0.0015	0.0052
	02-Jun-2019	**4.2** [#1]	< 0.00060	0.0041	0.18	< 0.0010	< 0.020	**0.00033** [#1]	56	0.0075	0.0055	**0.012** [#1]	**10** [#1]	**0.0052** [#1]	< 0.020	17	0.22	0.0000068	0.0015	0.018	0.29	2.0	0.00051	6.2	< 0.00010	7.3	0.22	< 0.00020	< 0.0010	0.039	0.0012	0.012	**0.056** [#1]
	27-Aug-2019	**1.3** [#1]	< 0.00060	0.00093	0.085	< 0.0010	< 0.020	0.000055	48	0.0016	0.00073	**0.0023** [#1]	**1.5** [#1]	0.00052	< 0.020	14	0.091	< 0.0000020	0.0013	0.0038	< 0.10	1.5	0.00037	5.3	< 0.00010	9.1	0.30	< 0.00020	< 0.0010	0.035	0.00098	0.0039	0.0066
	02-Oct-2019	**1.2** [#1]	< 0.00060	0.00097	0.12	< 0.0010	< 0.020	**0.00011** [#1]	72	0.0019	0.0020	**0.0029** [#1]	**3.6** [#1]	0.00090	< 0.020	20	0.65	0.0000045	0.0015	0.0059	< 0.10	1.8	0.00037	3.6	< 0.00010	8.9	0.47	< 0.00020	< 0.0010	0.032	0.0010	0.0039	0.0091

Table 4
Surface Water Analytical Results: Total Metals and Trace Elements

PROJECT No.: 407011-00770

Monitoring Station	Date (dd-mmm-yyyy)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Calcium (mg/L)	Chromium (Total) (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Selenium (mg/L)	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)
CCME CEQG Freshwater Aquatic Life[#1]		**0.1**	**---**	**0.005**	**---**	**---**	**1.5**	**0.00009**	**---**	**0.0089**	**---**	**0.002**	**0.3**	**0.001**	**---**	**---**	**---**	**0.000026**	**0.073**	**0.025**	**---**	**---**	**0.001**	**---**	**0.00025**	**---**	**---**	**0.0008**	**---**	**---**	**0.015**	**---**	**0.03**

NOTES:

1. --- in guideline row(s) denotes no criteria for that parameter.
2. --- in detail data row(s) denotes parameter not analyzed.
3. Highlighting indicates parameters above applied guideline/criteria.
4. Highlighting indicates non-detect parameters above applied guideline/criteria.
5. Highlighting indicates parameters at applied guideline/criteria.
6. Superscript[#1] denotes values exceeding
   (CCME. 2018. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. http://st-ts.ccme.ca/?chems=all&chapters=1 accessed Aug 22, 2018.)

   Aluminum:
   Standard varies with pH.
   pH < 6.5 = 0.005 mg/L
   pH >= 6.5 = 0.1 mg/L

   Boron:
   Guideline based on long term exposure

   Cadmium:
   Guideline based on long term exposure

   Chromium (Total):
   Limit is for Chromium(III).

   Copper:
   Guideline is hardness dependent. Presented guideline set to lower limit.

   Lead:
   Guideline is hardness dependent. Presented guideline set to lower limit.

   Mercury:
   Guideline for Inorganic mercury

   Nickel:
   Guideline is hardness dependent. Presented guideline set to lower limit.

   Silver:
   Guideline based on long term exposure

   Uranium:
   Guideline based on long term exposure
7. Superscript[#2] - Duplicate exceeds acceptance criteria due to sample non homogeneity. Reanalysis yields similar results.

Appendix A
Limitation of Liability, Scope of Report, and Third-Party Reliance

Limitation of Liability, Scope of Report, and Third-Party Reliance

This report has been prepared and the work referred to in this report has been undertaken by Worley Canada Services Ltd., operating as Advisian (Advisian) for Imperial Oil Limited. It is intended for the sole and exclusive use of Imperial Oil Limited, its affiliated companies and partners and their respective [insurers], agents, employees, and advisors (collectively, "Imperial Oil"). Any use, reliance on or decision made by any person other than Imperial Oil based on this report is the sole responsibility of such other person. Imperial Oil and Advisian make no representation or warranty to any other person with regard to this report and the work referred to in this report and they accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

The investigation undertaken by Advisian with respect to this report and any conclusions or recommendations made in this report reflect Advisian's judgment based on the site conditions observed at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. This report has been prepared for the specific application to this site and it is based, in part, upon visual observation of the site, subsurface investigation at discrete locations and depths, and specific analysis of specific chemical parameters and materials during a specific time interval, all as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, portions of the site which were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters, materials or analysis which were not addressed. Substances other than those addressed by the investigation described in this report may exist within the site, substances addressed by the investigation may exist in areas of the site not investigated and concentrations of substances addressed which are different than those reported may exist in areas other than the locations from which samples were taken.

If site conditions or applicable standards change or if any additional information becomes available at a future date, modifications to the findings, conclusions, and recommendations in this report may be necessary.

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Appendix B
Field Procedures

Scope The following procedure is applicable for field filtration of surface water quality samples.

1. SAFETY CONSIDERATIONS

This Preferred Operating Procedure (POP) does not address all of the safety issues associated with this task or with other activities that may be undertaken in conjunction with this task. Refer to the WorleyParsons safety management system and the site-specific hazard assessment to identify the potential hazards, mitigations, and controls.

2. MATERIALS AND EQUIPMENT

The following equipment is needed to complete this task:

- Disposable nitrile gloves.
- Sample containers.

Syringe Filtering

- Disposable filter disk (0.45 µm pore size).
- Disposable syringe compatible with filter disk.

Disposable Bailer Filtering

- Disposable capsule filters (0.45 µm pore size).
- Disposable bailer and spigot.
- Clean flexible tubing which fits inside the outlet of bailer or funnel.
- Waterra cutters.

3. PROCEDURES

Syringe Filtering

1) Put on clean nitrile gloves before handling sampling equipment.
2) Remove the syringe from packaging and rinse the barrel of the syringe three times with ambient surface water.
3) Fill the barrel of the syringe with sample water, and then screw the disposal filter disk firmly to the syringe tip.
4) Using the plunger of the syringe, force the sample water through the filter disk and into the sample container. Ensure that the sample container is filled to approximately 20% of capacity and the lid tightened securely. Shake the filtered sample water so that it comes in contact with the entire inside surface of the sample container. Discard filtered sample water rinsate downstream if in flowing waters, or on the opposite side of the boat/canoe in lakes or wetlands. Repeat three times.
5) Remove the filter disk and plunger, fill the barrel of the syringe with sample water, and use the plunger of the syringe to force sample water through the filter disk into the rinsed sample container. Repeat as needed until the sample container is filled. Ensure that the sample container lid is secured tightly, and that the container is labelled.
6) If required, preserve samples using laboratory-supplied preservatives according to laboratory instructions.

Disposable Bailer Filtering

1) Put on clean nitrile gloves before handling sampling equipment.
2) Use Watera cutters to cut the top half (approximately 50 cm) from the bailer to create a device that can be used as a funnel. Ensure that the portion with the ball, which prevents water from leaking from the bailer, is intact.
3) Rinse the bailer three times with sample water and discard rinsate downstream in flowing waters, or on the opposite side of the boat/canoe in lakes or wetlands.
4) Use Watera cutters to cut an appropriate length (5-10 cm) of clean PVC tubing. Attach one end of the PVC tubing to the extrusion on the curved end of the capsule filter. Place the other end firmly inside the spigot that accompanies the bailer. The open end of the spigot will be placed inside the outlet from the bailer.
5) Fill the bailer with sample water and run through filter apparatus once to rinse and ensure proper filter function. Water should be run through the filter apparatus for approximately 20 seconds.
6) Ensure that water discharging from the flat end of the capsule filter is used to fill the sample container.

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7) Rinse the sample container three times with filtered sample water. Each time, ensure that the sample container is filled to approximately 20% capacity and the lid is tightened securely. Shake the filtered sample water so that it comes in contact with the entire inside surface of the sample container. Discard filtered sample water rinsate downstream if in flowing waters, or on the opposite side of the boat/canoe in lakes or wetlands.

8) Fill the bailer with sample water as many times as needed to fill the sample container using the surface water grab sampling POP. Ensure that the sample container lid is secured tightly and that the container is labelled.

9) If required, preserve samples using laboratory-supplied preservatives according to laboratory instructions.

4. TECHNICAL CONSIDERATIONS

- Ensure new clean equipment (e.g. bailer, tubing, and filter) is used for each new station. Keep PVC tubing in clean Ziploc bags.
- To avoid sample contamination, designate one crew member to handle and prepare the filter apparatus and bottles, and the other to collect the surface water samples and filter them.
- If using filter disks, ensure that plenty are available as several (i.e. more than five) may be required when filtering highly turbid samples.

5. ADDITIONAL REFERENCES

CCME (Canadian Council of Ministers of the Environment). 2011. Protocols Manual for Water Quality Sampling in Canada. PN 1461, ISBN 978-1-896997- 7-0. Section 5.0, pp 36–37.

6. CONTROL

This POP has been prepared and reviewed for use in the WorleyParsons Infrastructure & Environment Division. Any inquiries regarding this POP should be directed to the undersigned.

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Reviewed By:



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Scope The following procedure is applicable for surface water grab sampling.

1. SAFETY CONSIDERATIONS

This Preferred Operating Procedure (POP) does not address all of the safety issues associated with this task or with other activities that may be undertaken in conjunction with this task. Refer to the WorleyParsons safety management system and the site-specific hazard assessment to identify the potential hazards, mitigations, and controls.

2. MATERIALS AND EQUIPMENT

The following equipment is required for the completion of this task:

- Labels, pen, and Sharpie® permanent marker.
- Analytical schedule.
- Sample and QA/QC bottles (provided by the accredited laboratory).
- Field data sheets or log books.
- Meters for in situ measurement of field parameters.
- GPS unit.
- Disposable nitrile gloves.
- Coolers.
- Zip-lock bags.
- Ice in zip-lock bags/ice packs (for sampling at outside temperatures above freezing).
- Tinfoil.
- Bubble wrap.

3. PROCEDURES

1) Label sample bottles before sampling. At a minimum, include the site identifier. The date is also useful to include on the label, but not necessary.

2) Grab samples should be collected in a particular order. Preferably start with field blanks. These should be followed by ultra-clean samples (mercury or bacteria). For ultra-clean protocols (e.g. “clean-hands dirty-hands”) follow instructions provided by laboratory. Any remaining samples (nutrients, metals, PAHs, BTEX, etc.) and associated replicates can be sampled in any order.

3) It is best to have one person collect the grab samples, and the other person handing the bottles to the sampler. Both should wear clean gloves which need to be changed between stations. The person handing the bottles can ensure that the contents on the sample bottle label are correct, add the preservative to the sample, if applicable, and ensure that the lid is tightened securely on the sample container.

4) For watercourses (flowing water), the sampler will wade in and choose a suitable sampling location, preferably near the middle of the watercourse. Ensure that the sample location is away from any obstacles, such as rocks, debris, and sediment deposits. Once at the sampling location, minimize movement to prevent the agitation of substrate sediments. For waterbodies (standing water), carefully wade to the sample location, if possible. If sampling from a boat or canoe, lower the anchors and ensure that the boat does not drift. Sample on one side of the boat, away from the anchors, as that area was disturbed. Ensure that the other person is on the other side boat/canoe to provide balance.

5) Lower the sampling bottle to a depth of 30 cm, or mid-column if the depth is less than 30 cm, until it is completely submerged. For watercourses, ensure that the sample is taken upstream from the sampler to avoid sampling water that may have been disturbed while wading to the sampling location.

6) Triple rinse all plastic sample containers. Ensure that the sample container is filled to approximately 20% of capacity, the lid is tightened securely, and the water is shaken inside such that it comes in contact with the entire inside surface

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of the sample container. Discard rinsate downstream if in flowing waters, or on the opposite side of the boat/canoe in lakes or wetlands. Repeat three times. Amber glass bottles do not need to be rinsed.

7) Lower the sample bottle to a depth of 30 cm, or mid-column if the depth is less than 30 cm, until it is completely submerged. Allow the bottle to fill with water sample until there are no air bubbles remaining. Samples requiring preservation must have some head space and do not need to be filled completely. Some sample bottles come pre-charged with a preservative capsule; ensure that the preservative is still in the sample bottle after sampling.

8) If a preservative is required, add it to the sample and tighten the cap securely. Otherwise, samples bottles can be capped underwater. Filter and/or add preservatives to appropriate bottles, immediately, or as soon as possible after sample collection. If samples are to be laboratory-filtered, ship them as soon as possible and ensure they arrive in the laboratory well within the specified hold time for un-filtered and un-preserved samples. Unfiltered chlorophyll a samples should be stored in dark amber bottles or plastic bottles wrapped in tinfoil to minimize light exposure.

9) Hold sample bottle caps lid-down while filling sample bottle and cap bottles immediately before and after filling and preserving. Avoid touching lids and mouths of bottles.

10) Place sampling bottles upright in cooler for transport. Ensure that glass bottles are wrapped in bubble wrap and do not contact each other directly.

11) During warmer seasons (e.g. summer), place ice bags in the cooler or shipping container immediately. As general guideline, the volume of sealed ice in a cooler should be equivalent to the volume of sampled water and greater during hot summer days or samples which require longer transport distances. In the winter, use bubble wrap to surround the samples bottles. The bubble wrap will act as an insulator and keep the temperature inside the cooler, warmer than the ambient air temperature.

4. TECHNICAL CONSIDERATIONS

1) BTEX and PAH samples require no head space. This can be achieved by capping the sample bottles under water.

2) Grab water samples can be taken by wading into the water, from a boat, bridge or dock, and from the floats on an airplane/helicopter during the open-water season. During the winter, samples may be taken through the ice.

3) Stream and ditch samples should be collected at mid-stream, unless otherwise specified in the study design. Specific sampling locations will be determined from site reconnaissance.

4) For multi-year/season programs, samples should be taken from the same location. GPS unit or marker can be used to identify the sampling location. If it is not possible for a sample to be taken at the original sampling location, document the change in location and the reason for the change.

5) Samples must arrive at the laboratory as close to 4°C as possible and within 48 hours of sampling.

6) It is a sampler's responsibility to collect samples as directed in the program/study design, note any unusual conditions at a site, and minimize field error by adhering to relevant POPs.

5. ADDITIONAL REFERENCES

AENV (Alberta Environment). 2006. Aquatic Ecosystems Field Sampling Protocols. Prepared by Alberta Environment. March 2006. W0605

CCME (Canadian Council of Ministers of the Environment). 2011. Protocols Manual for Water Quality Sampling in Canada. PN 1461, ISBN 978-1-896997- 7-0. 186 pp.

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6. CONTROL

This POP has been prepared and reviewed for use in the WorleyParsons Infrastructure & Environment Division. Any inquiries regarding this POP should be directed to the undersigned.

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Scope The following procedure is applicable for low-level mercury sampling in surface waters.

1. SAFETY CONSIDERATIONS

This Preferred Operating Procedure (POP) does not address all of the safety issues associated with this task or with other activities that may be undertaken in conjunction with this task. Refer to the WorleyParsons safety management system and the site-specific hazard assessment to identify the potential hazards, mitigations, and controls.

2. MATERIALS AND EQUIPMENT

The following equipment is required for the completion of this task:

- Disposable nitrile gloves (powder less) or non-talc gloves.
- Sample bottles provided by the accredited laboratory; should be glass or Teflon (confirm with laboratory).
- Syringe (used when dissolved mercury analysis is required).
- Syringe filter disks (used when dissolved mercury analysis is required).
- Preservative (provided by the laboratory).
- Mercury-free de-ionized water (provided by the laboratory).

3. PROCEDURES

1) Pre-label the outer bag, at a minimum identifying the sampling site; additional information can be added later.

2) Designate one individual as ‘dirty hands’ and the other individual as ‘clean hands’. Both individuals must wear nitrile or non-talc gloves. ‘Clean hands’ touches only the inner bag and the sample bottle from this point on. If dissolved low-level mercury is required, ‘clean hands’ will also touch the syringe and filter (see steps 8 to 11).

3) ‘Dirty hands’ opens the sample cooler, removes a doubly-bagged sample container, and opens the outer re-sealable plastic bag. ‘Clean hands’ reaches into the outer bag, opens the inner Ziploc bag, removes the sample container, and folds down the inner bag. ‘Dirty hands’ then re-seals the outer bag to prevent entry of any contaminant before inner bag is replaced with sample.

4) ‘Clean hands’ removes the lid from the sample container and holds the lid in one hand. With the other hand ‘clean hands’ obtains the sample by submerging the sample container approximately 30 cm, or mid-column, of the water. Care should be taken to ensure hands are downstream from the inlet of the sample container. The sample container should be filled to capacity, leaving only a small headspace. ‘Clean hands’ will secure the lid tightly. If the sample is to be persevered in the field, ‘dirty hands’ will pour the preservative into the sample container, which is held by ‘clean hands’, being careful not to touch the sample container with any part of the vial holding the preservative; ‘clean hands’ will secure the lid tightly and mix the sample by inverting the sample container several times.

5) ‘Dirty hands’ retrieves the Ziploc bags and opens the outer bag.

6) ‘Clean hands’ reaches inside and places the sample container inside tine inner bag. The inner bag is sealed.

7) ‘Dirty hands’ seals the outer bags and places the bagged sample into the shipping cooler.

8) Repeat steps 2 to 8 for each sample site.

9) If dissolved low-level mercury concentration is required, follow the syringe procedure as outlined in the Field Filtration POP.

10) ‘Dirty hands’ opens the package container the syringe and filter disk. ‘Clean hands’ removes the syringe and filter disk. The filter disk is twisted onto the syringe tip.

11) Fill syringe with sample water and push volume through syringe filter to rinse.

12) ‘Clean hands’ opens sample bottle, fills the syringe with sample, and filters into sample container. Replace lid on bottle after each syringe is filtered. Repeat until sample container is full or filter becomes clogged. If filter becomes clogged, replace the filter with a clean filter and repeat. ‘Clean hands’ will secure the lid tightly. If the sample is to be persevered in the field, ‘dirty hands’ will pour the preservative into the sample container, which is held by ‘clean

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hands', being careful not to touch the sample container with any part of the vial holding the preservative; 'clean hands' will secure the lid tightly and mix the sample by inverting the sample container several times.

4. TECHNICAL CONSIDERATIONS

- Two individuals are required to collect low-level mercury samples. One individual will be considered the 'dirty hands', and the second individual will be the 'clean hands'. The "clean hands" individual will be responsible for handling the sample container and filling the sample container from the sample source (river, ditch, lake, wetland, spigot, pump outlet, scooper, etc.). The "dirty hands" individual will be responsible for handling equipment and any other activities which do not involve direct contact with the sample or sample container.
- All sampling equipment and sample containers must be non-metallic and free of any material which might contain trace metals. Low-level mercury sample containers often are made of glass or Teflon. Other plastic bottles (other than Teflon or other fluoropolymers) are unacceptable as mercury may diffuse through, adhere to, or leach from the plastic surfaces.
- Sampling personnel will wear nitrile or non-talc disposable gloves. Gloves will be worn at all times when handling sample bottles or sampling equipment. Gloves will be removed when sample collection is complete, and new gloves will be used when a sample is collected from next the site.
- To prepare the field blank, the mercury-free water (which is provided by the laboratory) should contact all of the sampling equipment to be used for collecting normal samples (e.g. syringe barrel and plunger).
- Low-level mercury samples can be preserved at the laboratory or in the field. If preservation is to occur in the field, the laboratory will provide the proper preservatives.
- If samples are not field preserved, they must be express shipped to the laboratory so that they are received within 24 hours of sampling. If samples are field preserved, express shipping is not required.
- At least 200 ml of sample must be collected. Samples must be placed into double Ziploc bags immediately after collection following the 'Clean hands-Dirty hands' procedure, and only the outside bag should be labelled.
- Be careful not to breathe onto samples as detectible amounts of mercury can be emitted from certain tooth fillings.

5. ADDITIONAL REFERENCES

U.S. EPA., 1996. Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. 42 pp.

6. CONTROL

This POP has been prepared and reviewed for use in the WorleyParsons Infrastructure & Environment Division. Any inquiries regarding this POP should be directed to the undersigned.

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Appendix C
Seasonal Trends in Water Quality

Figure C-1 Total copper concentration, AEMP 2017-2019. Dashed red line gives CCME long-term guideline dependent on hardness – minimum hardness used for all

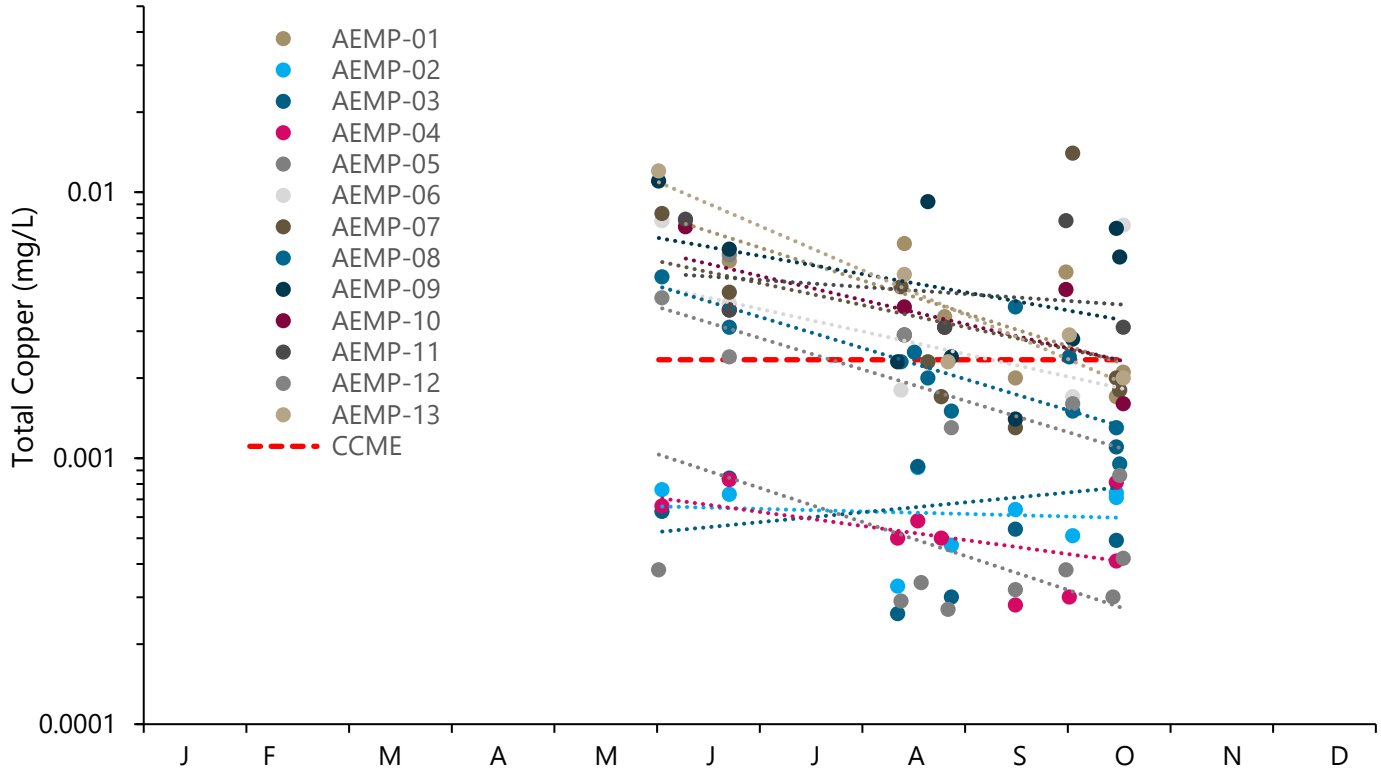


Table C-1 Regression parameters and power for seasonal trends in total copper concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.034	-0.00404	0.621	*	1.636539	0.751
2	0.001	-0.00031	0.012		0.012213	0.056
3	0.000	0.001219	0.039		0.04059	0.071
4	0.001	-0.00173	0.239		0.314187	0.232
5	0.005	-0.00419	0.233		0.303929	0.225
6	0.012	-0.00278	0.198		0.246873	0.19
7	0.014	-0.00272	0.141		0.164667	0.141
8	0.017	-0.00383	0.634	*	1.731878	0.901
9	0.015	-0.00224	0.121		0.137671	0.125
10	0.017	-0.00296	0.514		1.058568	0.367
11	0.007	-0.00086	0.047		0.049573	0.064
12	0.014	-0.00386	0.729	*	2.695251	0.73
13	0.075	-0.00547	0.862	*	6.223873	0.861

Figure C-2 Total iron concentration, AEMP 2017-2019. Dashed red line gives CCME long-term guideline

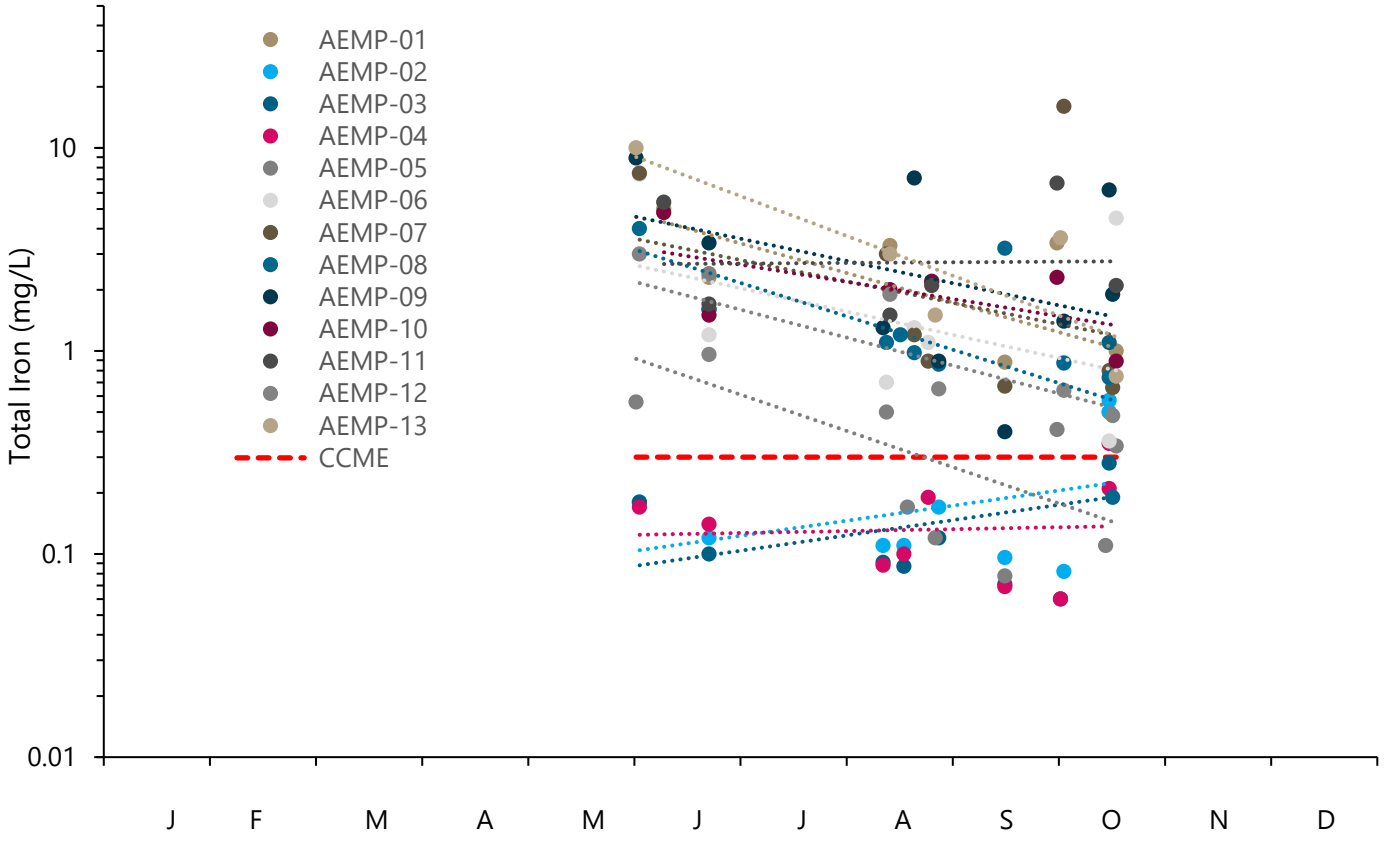


Table C-2 Regression parameters and power for seasonal trends in total iron concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	3.160	0.002052	5.418		0.903	0.492
2	3.448	0.002226	1.202		0.172	0.145
3	5.134	0.002943	0.706		0.101	0.104
4	2.978	0.001966	0.025		0.004	0.052
5	4.939	0.002873	4.153		0.593	0.402
6	5.023	0.002898	1.674		0.239	0.186
7	7.668	0.00366	0.891		0.127	0.119
8	3.190	0.002092	6.643		0.830	0.599
9	6.253	0.003291	1.186		0.169	0.144
10	2.681	0.001844	2.260		0.565	0.218
11	4.078	0.002628	0.002		0.000	0.050
12	2.557	0.001757	6.581		1.645	0.524
13	4.314	0.002628	5.969		1.990	0.436

Figure C-3 Total magnesium concentration, AEMP 2017-2019

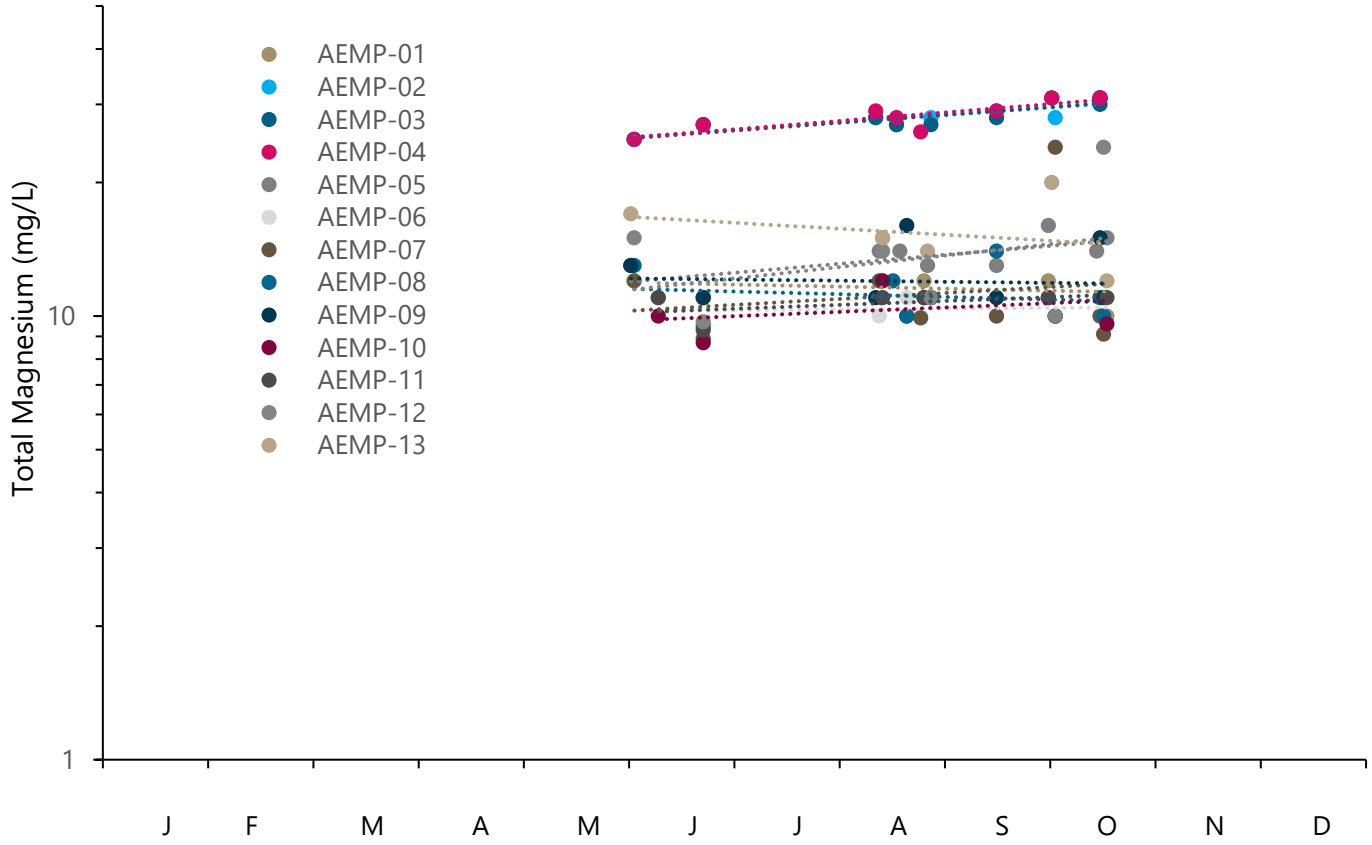


Table C-3 Regression parameters and power for seasonal trends in total magnesium concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	12.551	-0.00015	0.021		0.021	0.059
2	20.890	0.000547	0.790	*	3.768	0.993
3	20.518	0.00058	0.781	*	3.567	0.991
4	20.252	0.000625	0.753	*	3.051	0.979
5	9.473	0.000662	0.482		0.930	0.582
6	10.066	5.72E-05	0.005		0.005	0.053
7	8.812	0.000438	0.026		0.026	0.063
8	12.359	-0.0002	0.027		0.028	0.065
9	12.514	-8.2E-05	0.003		0.003	0.052
10	8.729	0.000321	0.112		0.126	0.085
11	9.209	0.000286	0.251		0.335	0.148
12	8.506	0.000847	0.096		0.106	0.08
13	19.554	-0.00044	0.080		0.087	0.067

Figure C-4 Total manganese concentration, AEMP 2017-2019

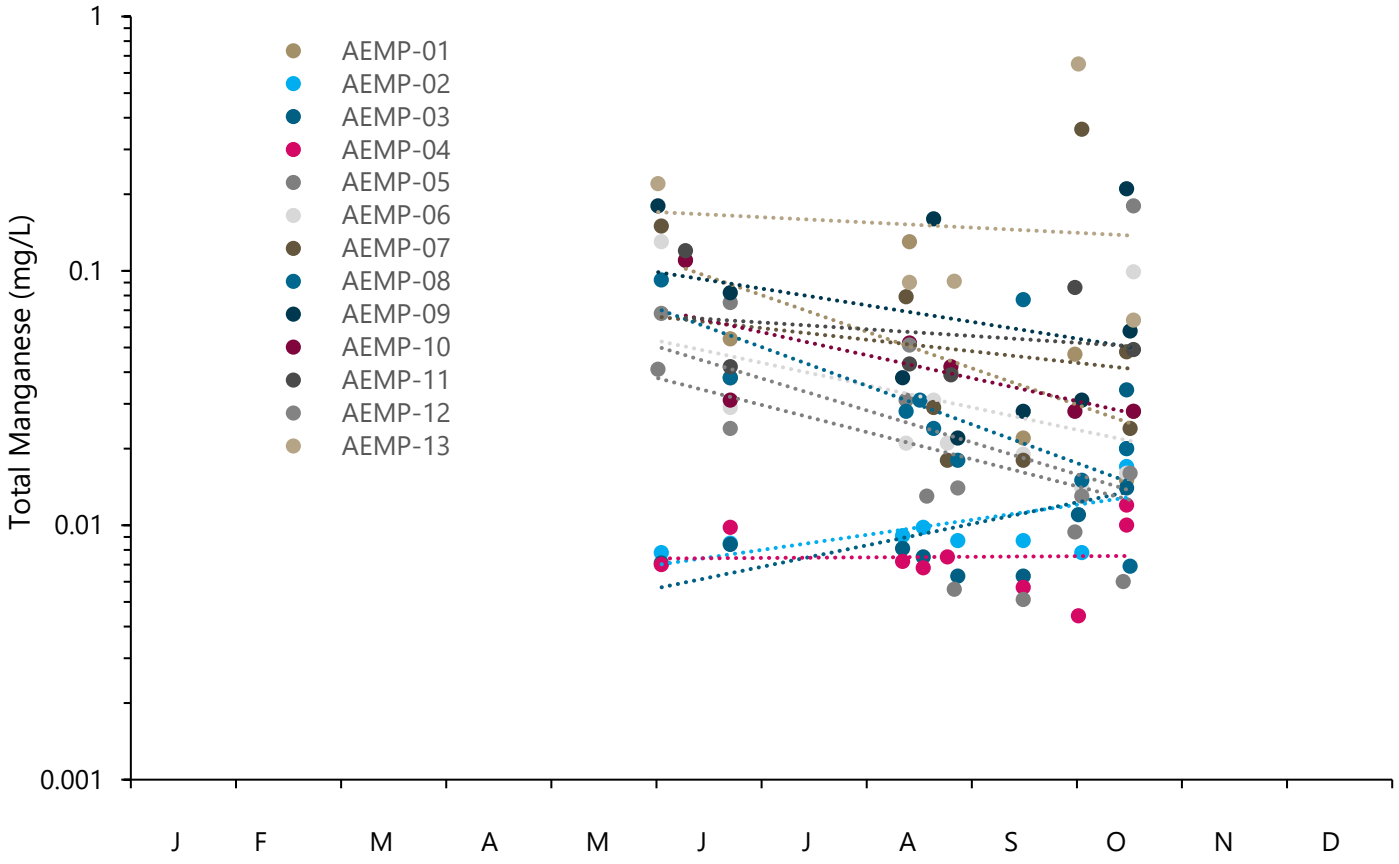


Table C-4 Regression parameters and power for seasonal trends in total manganese concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.584	-0.00471	0.520		1.084	0.569
2	0.004	0.001941	0.386		0.629	0.422
3	0.002	0.002768	0.324		0.478	0.333
4	0.007	7.53E-05	0.001		0.001	0.050
5	0.130	-0.00349	0.093		0.102	0.105
6	0.146	-0.00288	0.163		0.195	0.159
7	0.112	-0.00149	0.026		0.027	0.064
8	0.409	-0.00498	0.469		0.884	0.627
9	0.210	-0.00215	0.076		0.082	0.094
10	0.200	-0.00296	0.454		0.831	0.300
11	0.090	-0.00087	0.051		0.054	0.065
12	0.215	-0.00412	0.534		1.147	0.392
13	0.216	-0.00067	0.008		0.008	0.052

Figure C-5 Total molybdenum concentration, AEMP 2017-2019. CCME long-term guideline is 0.073 mg/L and not indicated because it exceeds monitoring results by more than an order of magnitude

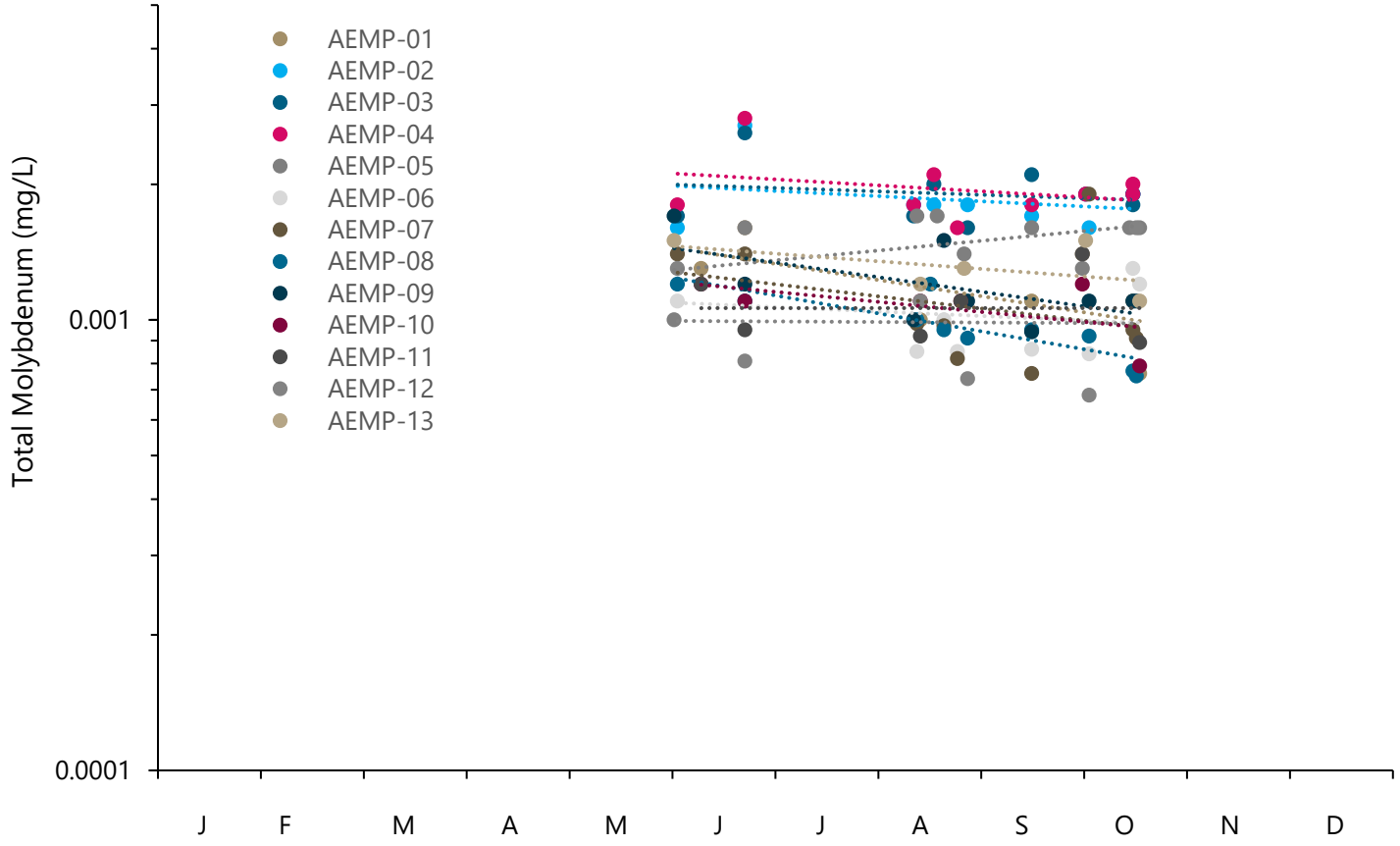


Table C-5 Regression parameters and power for seasonal trends in total molybdenum concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.002	-0.00118	0.354		0.548	0.321
2	0.002	-0.00038	0.071		0.077	0.090
3	0.002	-0.00025	0.036		0.037	0.069
4	0.002	-0.00043	0.094		0.103	0.105
5	0.001	0.000713	0.212		0.269	0.204
6	0.001	-0.00032	0.032		0.033	0.067
7	0.002	-0.00088	0.107		0.119	0.115
8	0.002	-0.00131	0.718	*	2.546	0.977
9	0.002	-0.00106	0.387		0.631	0.424
10	0.002	-0.00073	0.317		0.464	0.187
11	0.001	1.67E-06	0.000		0.000	0.050
12	0.001	-3.9E-05	0.000		0.000	0.050
13	0.002	-0.00055	0.250		0.334	0.117

Figure C-6 Total sodium concentration, AEMP 2017-2019

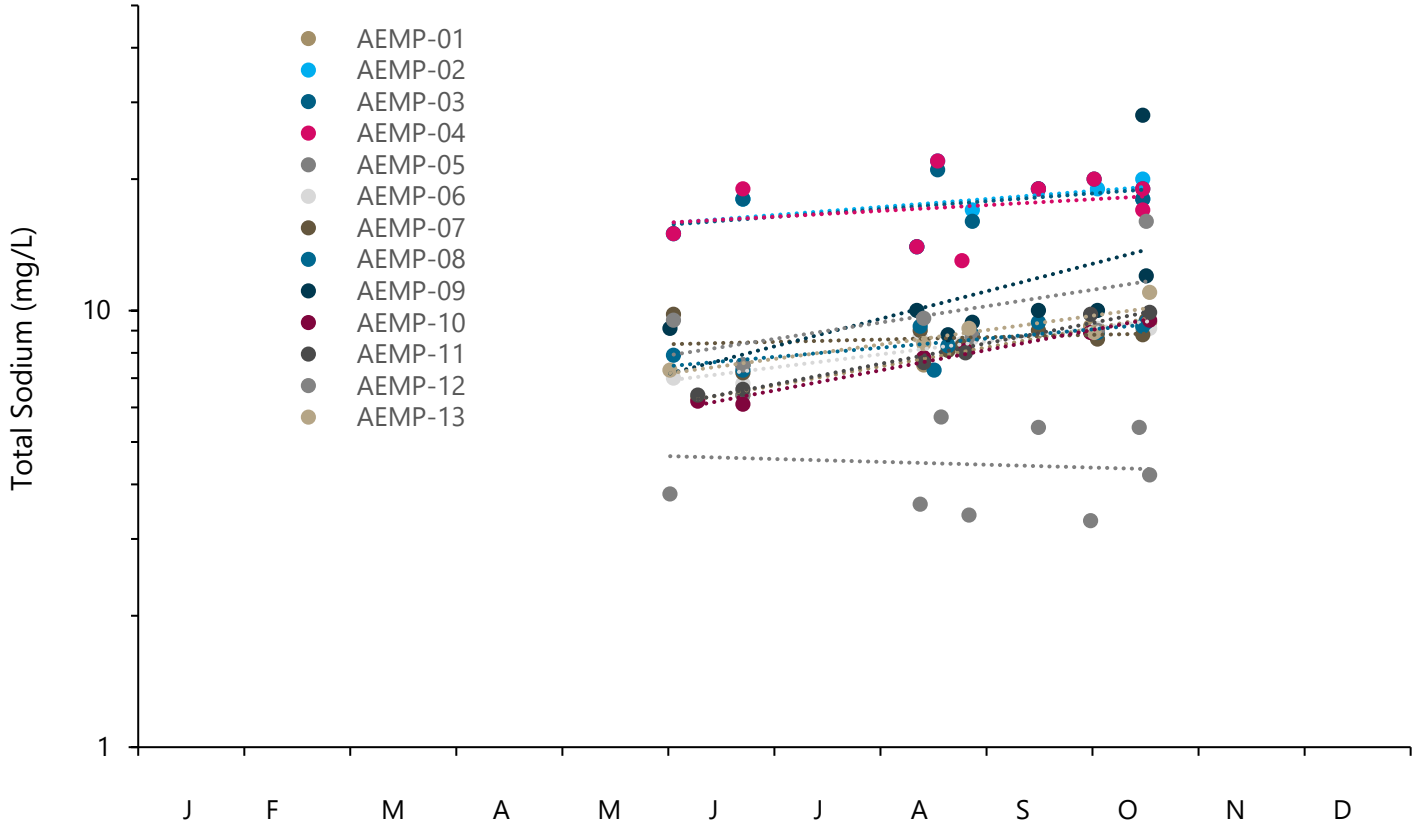


Table C-6 Regression parameters and power for seasonal trends in total sodium concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	13.098	-0.00452	0.427		0.745	0.419
2	0.022	0.001842	0.057		0.061	0.082
3	0.019	0.001759	0.034		0.035	0.068
4	0.081	-0.001	0.015		0.015	0.058
5	2.419	-0.00748	0.015		0.504	0.348
6	7.100	-0.00405	0.335		0.456	0.319
7	8.360	-0.00397	0.313		0.264	0.201
8	10.058	-0.00527	0.209	*	1.300	0.798
9	8.974	-0.00376	0.565		0.268	0.203
10	3.816	-0.00215	0.207		0.261	0.125
11	1.738	-0.00052	0.038		0.040	0.061
12	6.677	-0.00478	0.697		2.304	0.664
13	41.589	-0.00625	0.870	*	6.687	0.882

Figure C-7 Total nickel concentration, AEMP 2017-2019. Dashed red line gives CCME long-term guideline dependent on hardness – minimum hardness used for all

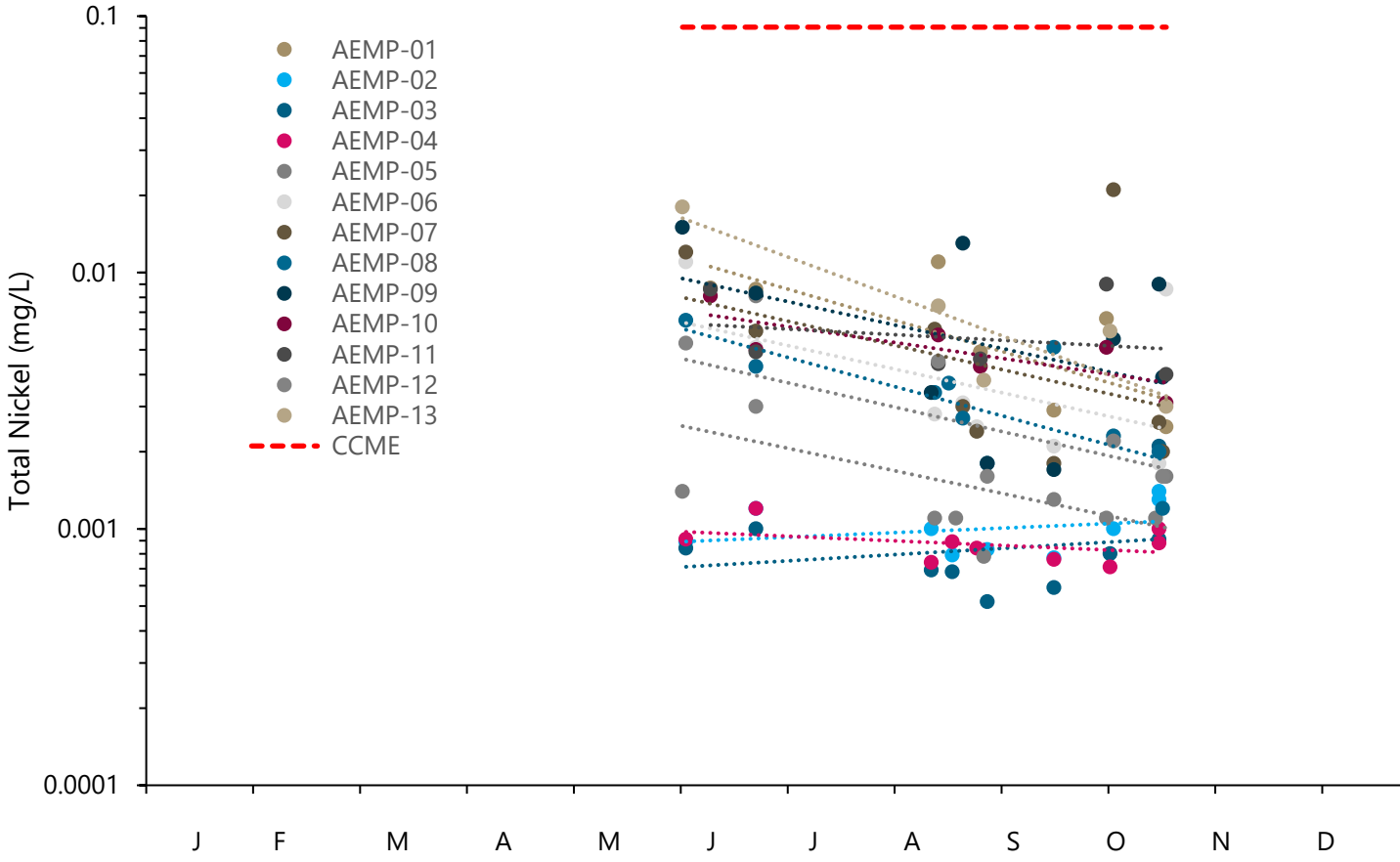


Table C-7 Regression parameters and power for seasonal trends in total nickel concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.046	-0.00398	0.582	*	1.393	0.680
2	0.001	0.000579	0.085		0.093	0.100
3	0.001	0.000797	0.047		0.050	0.076
4	0.001	-0.00059	0.159		0.188	0.155
5	0.007	-0.00288	0.222		0.286	0.214
6	0.018	-0.00301	0.271		0.371	0.267
7	0.024	-0.00309	0.160		0.191	0.157
8	0.022	-0.00372	0.567	*	1.310	0.801
9	0.027	-0.00299	0.173		0.210	0.168
10	0.014	-0.00202	0.588		1.425	0.468
11	0.008	-0.00072	0.058		0.061	0.067
12	0.014	-0.00311	0.572		1.336	0.445
13	0.096	-0.00503	0.798		3.952	0.698

Figure C-8 Total strontium concentration, AEMP 2017-2019

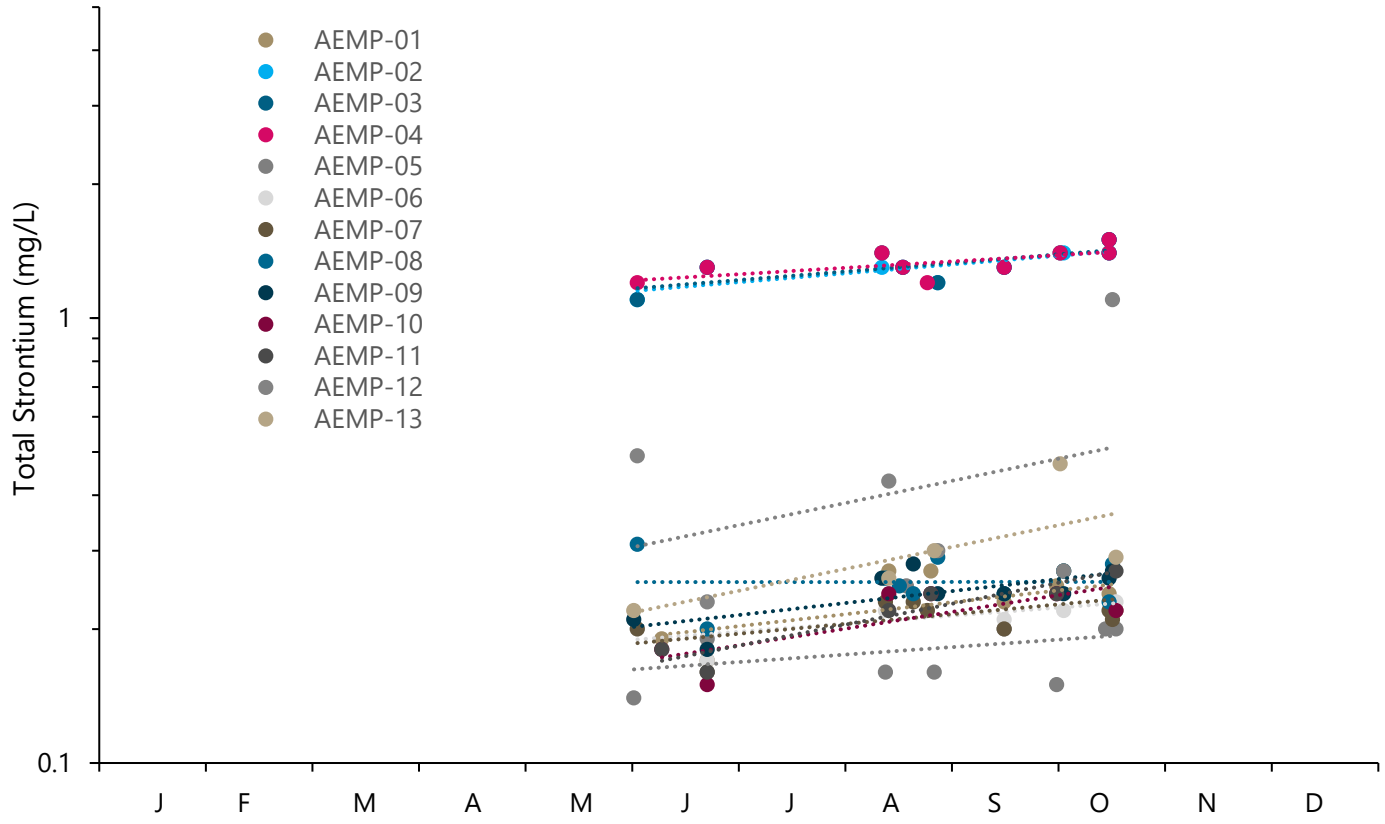


Table C-8 Regression parameters and power for seasonal trends in total strontium concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.140	0.000879	0.375		0.601	0.348
2	0.915	0.000653	0.637	*	1.757	0.854
3	0.933	0.000631	0.558	*	1.261	0.718
4	1.031	0.000468	0.474		0.901	0.568
5	0.134	0.00055	0.111		0.125	0.118
6	0.154	0.000595	0.493		0.971	0.601
7	0.144	0.000722	0.320		0.470	0.328
8	0.255	3.18E-06	0.000		0.000	0.050
9	0.148	0.000883	0.513		1.052	0.636
10	0.109	0.001234	0.570		1.327	0.442
11	0.096	0.001544	0.879	*	7.256	0.985
12	0.172	0.001633	0.129		0.148	0.092
13	0.124	0.001612	0.499		0.994	0.251

Figure C-9 Total titanium concentration, AEMP 2017-2019

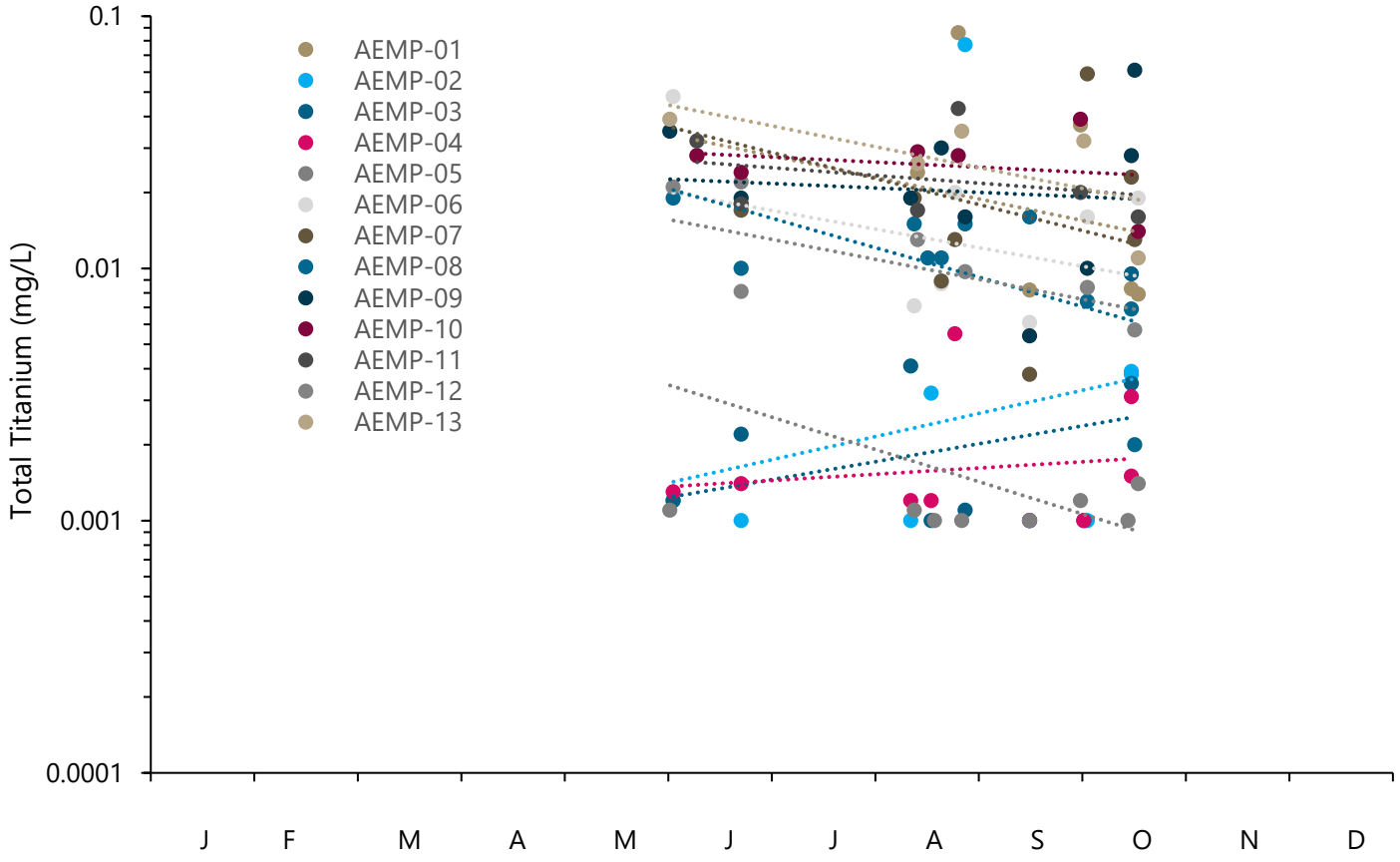


Table C-9 Regression parameters and power for seasonal trends in total titanium concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.091	-0.00281	0.142		0.165	0.126
2	0.000	0.003007	0.055		0.058	0.081
3	0.001	0.002327	0.099		0.110	0.109
4	0.001	0.000807	0.024		0.025	0.063
5	0.015	-0.00419	0.213		0.271	0.205
6	0.047	-0.00242	0.159		0.189	0.155
7	0.120	-0.00338	0.137		0.159	0.138
8	0.079	-0.00383	0.381		0.616	0.472
9	0.028	-0.00057	0.008		0.008	0.054
10	0.036	-0.00065	0.054		0.057	0.066
11	0.038	-0.001	0.090		0.099	0.078
12	0.039	-0.00259	0.517		1.071	0.371
13	0.115	-0.00271	0.434		0.767	0.206

Figure C-10 Total uranium concentration, AEMP 2017-2019. CCME long-term guideline is 0.015 mg/L and not indicated because it exceeds monitoring results by more than an order of magnitude

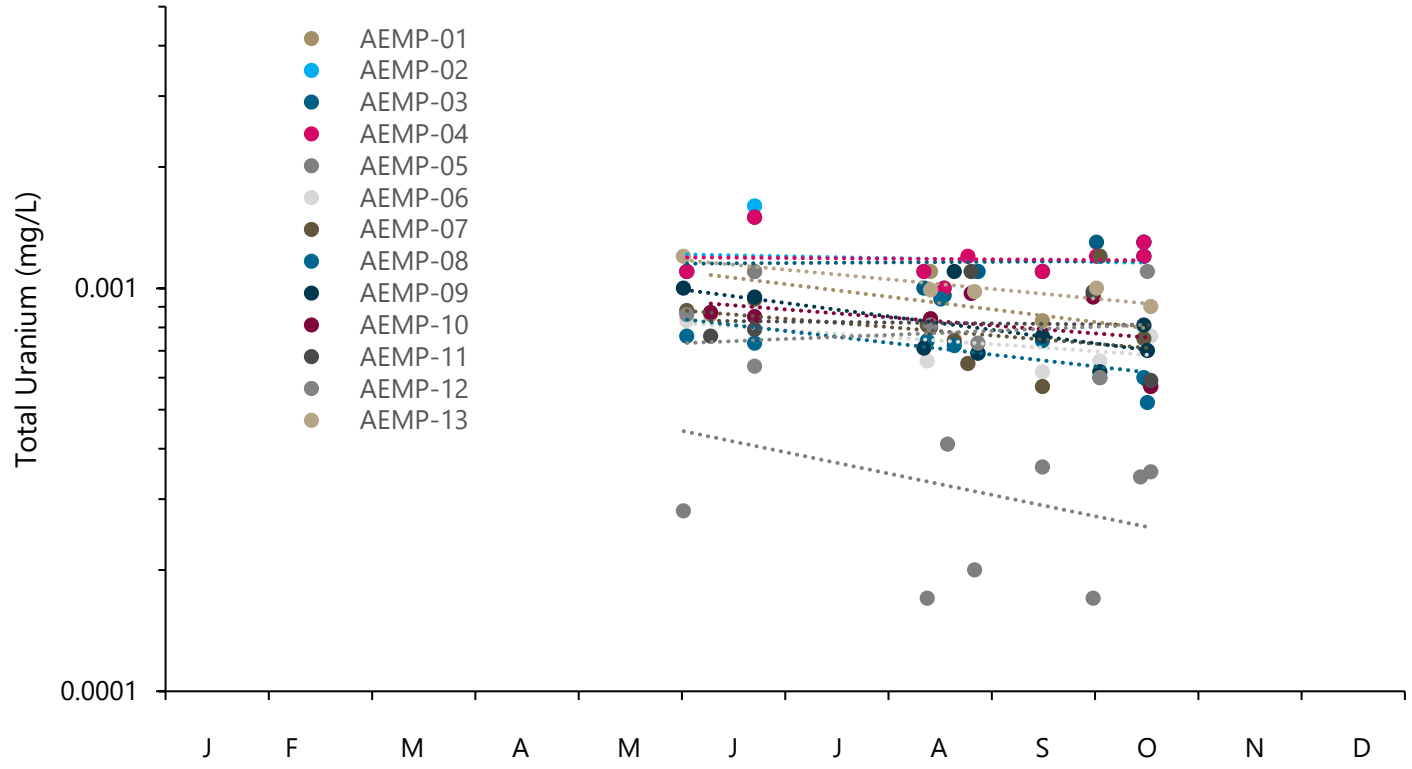


Table C-10 Regression parameters and power for seasonal trends in total uranium concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	0.002	-0.00103	0.271		0.372	0.231
2	0.001	-0.00015	0.015		0.015	0.058
3	0.001	5.08E-05	0.002		0.002	0.051
4	0.001	-5.2E-05	0.002		0.002	0.051
5	0.001	-0.00174	0.112		0.126	0.119
6	0.001	-0.00058	0.233		0.303	0.225
7	0.001	-0.00068	0.100		0.112	0.110
8	0.001	-0.00096	0.383		0.622	0.475
9	0.001	-0.0011	0.394		0.650	0.435
10	0.001	-0.00065	0.164		0.195	0.106
11	0.001	-7.8E-05	0.002		0.002	0.051
12	0.001	0.000333	0.036		0.037	0.060
13	0.002	-0.00079	0.854	*	5.859	0.842

Figure C-11 Chloride concentration, AEMP 2017-2019. CCME long-term guideline is 120 mg/L and not indicated because it exceeds monitoring results by an order of magnitude

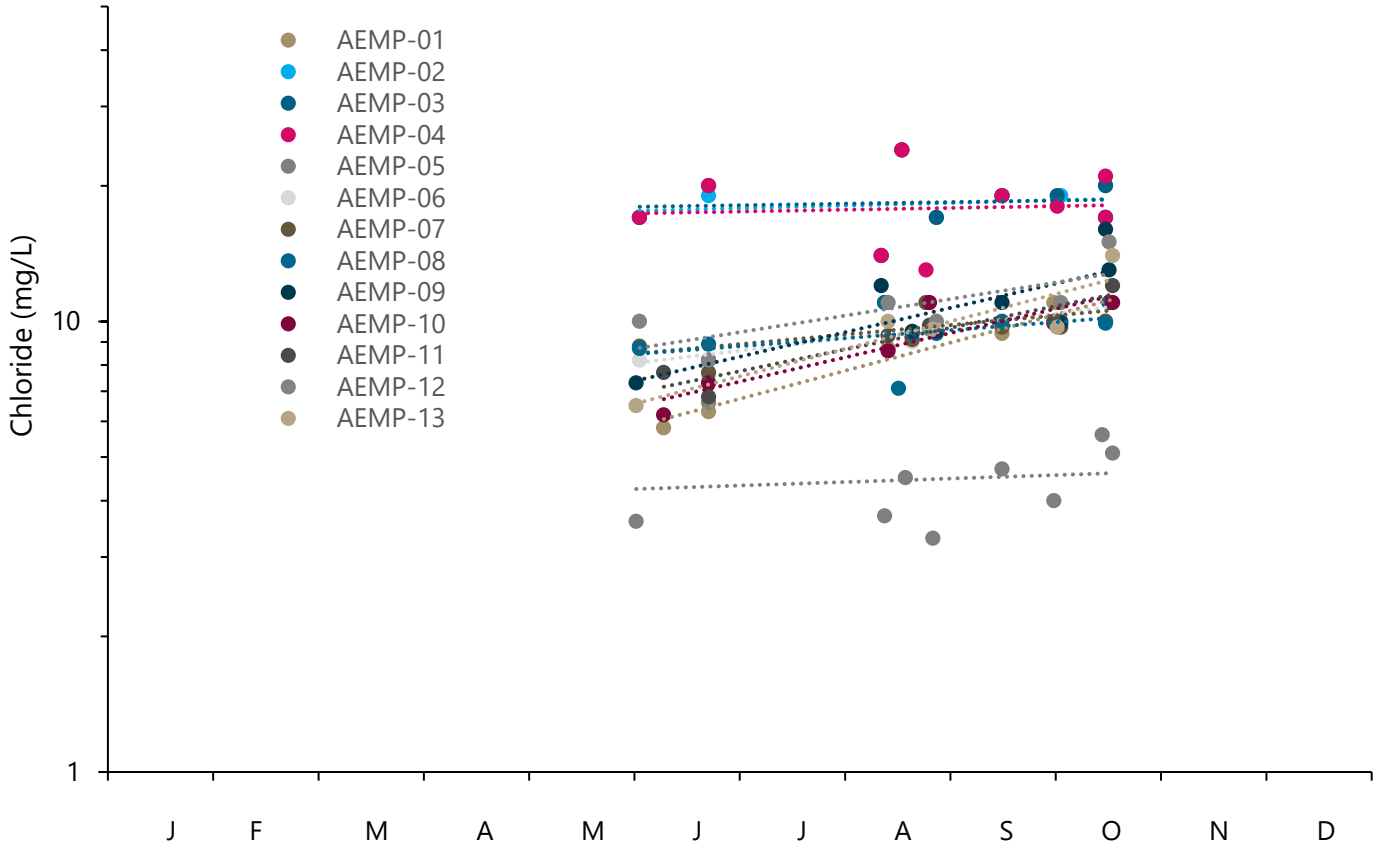


Table C-11 Regression parameters and power for seasonal trends in chloride concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	2.846	0.002043	0.927	*	12.670	1.000
2	16.445	0.000192	0.021		0.021	0.061
3	17.244	0.000116	0.007		0.007	0.054
4	16.589	0.000131	0.006		0.006	0.053
5	3.884	0.000254	0.016		0.016	0.058
6	5.885	0.000903	0.540	*	1.176	0.687
7	6.649	0.000694	0.411		0.697	0.461
8	6.888	0.000584	0.229		0.297	0.251
9	3.958	0.001772	0.679	*	2.116	0.912
10	3.491	0.001767	0.829	*	4.845	0.927
11	3.989	0.001578	0.879	*	7.283	0.985
12	5.693	0.001206	0.579		1.375	0.455
13	3.255	0.001998	0.825	*	4.719	0.767

Figure C-12 Sulphate concentration, AEMP 2017-2019

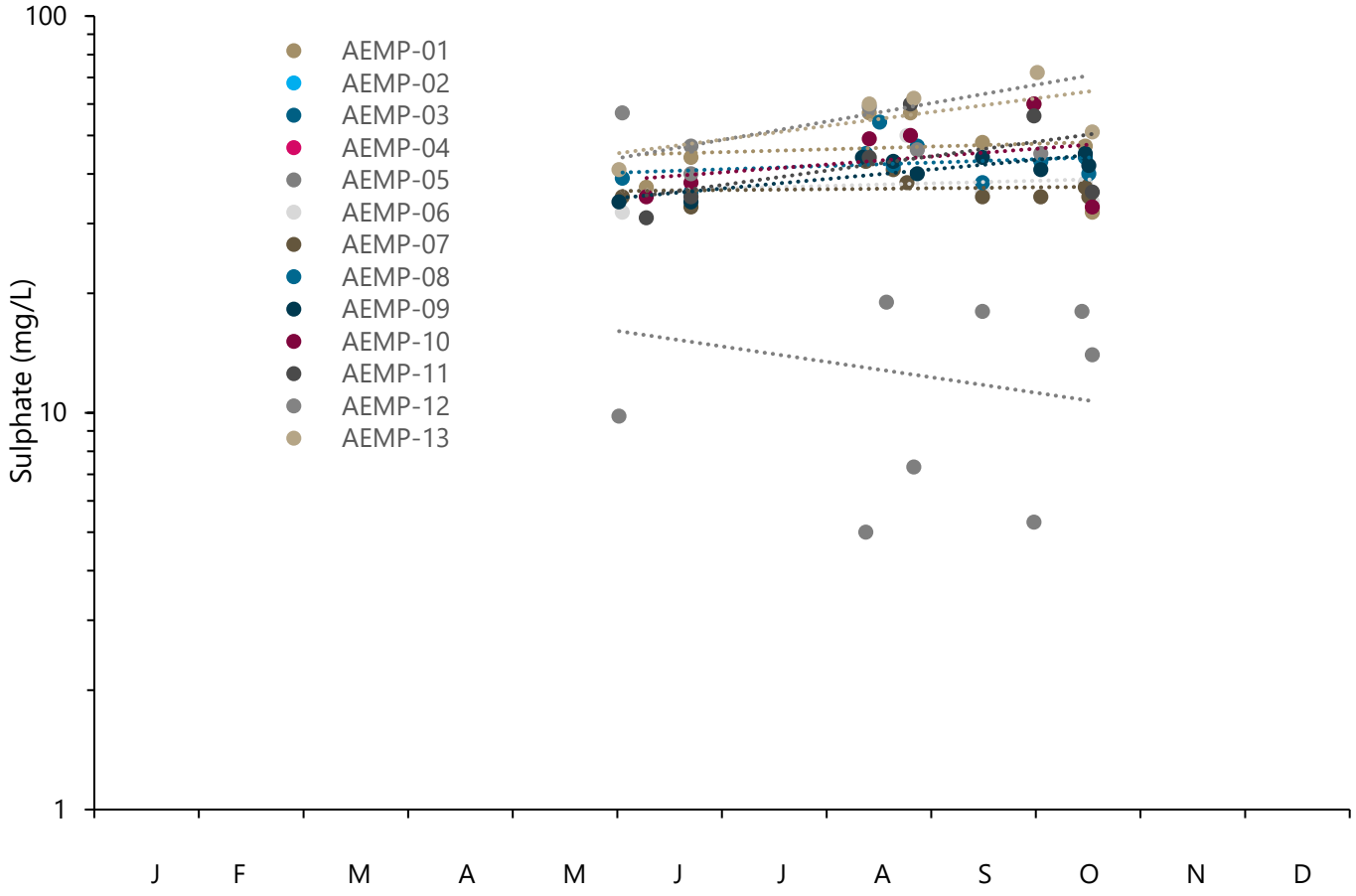


Table C-12 Regression parameters and power for seasonal trends in sulphate concentration

AEMP location	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
1	41.180	0.000231	0.014		0.015	0.056
2	93.746	0.000741	0.718	*	2.543	0.954
3	92.828	0.000744	0.595	*	1.469	0.784
4	102.884	0.000574	0.570	*	1.325	0.740
5	25.177	-0.00128	0.039		0.040	0.071
6	33.622	0.000212	0.028		0.029	0.065
7	35.246	7.72E-05	0.010		0.010	0.055
8	36.542	0.000278	0.062		0.066	0.090
9	26.346	0.00079	0.679	*	2.113	0.912
10	30.685	0.000651	0.110		0.123	0.085
11	22.727	0.001189	0.282		0.394	0.165
12	25.716	0.001517	0.229		0.297	0.136
13	30.276	0.001134	0.427		0.746	0.201

Appendix D
Seasonal Trends Across Sampling Locations

Figure D-1 Summary of regression slopes for sampling locations – spatial differences in seasonal total aluminum concentration

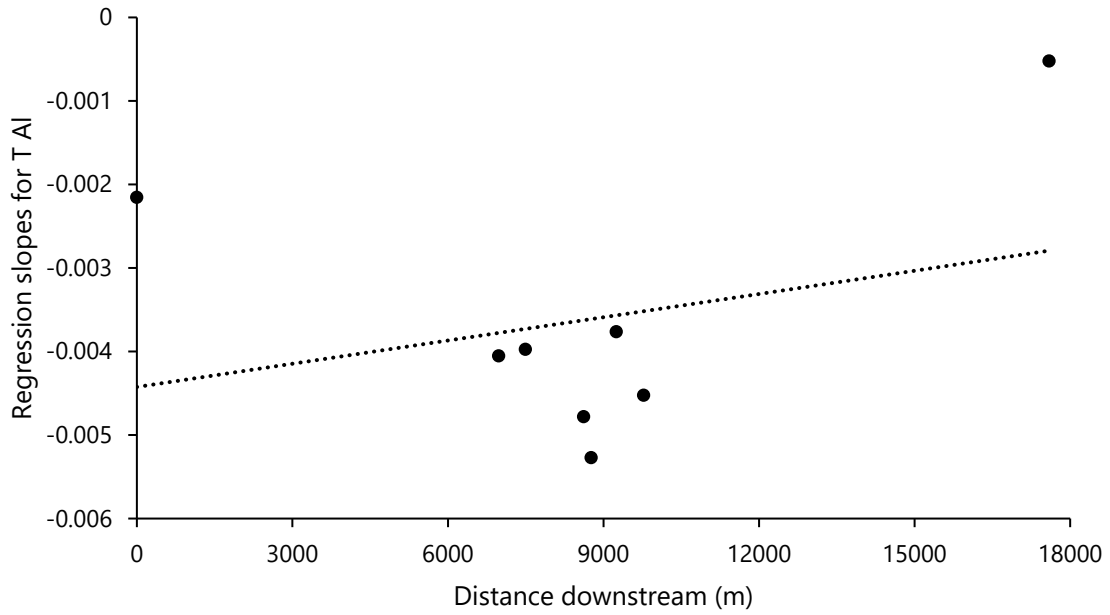


Figure D-2 Summary of regression slopes for sampling locations – spatial differences in seasonal total iron concentration

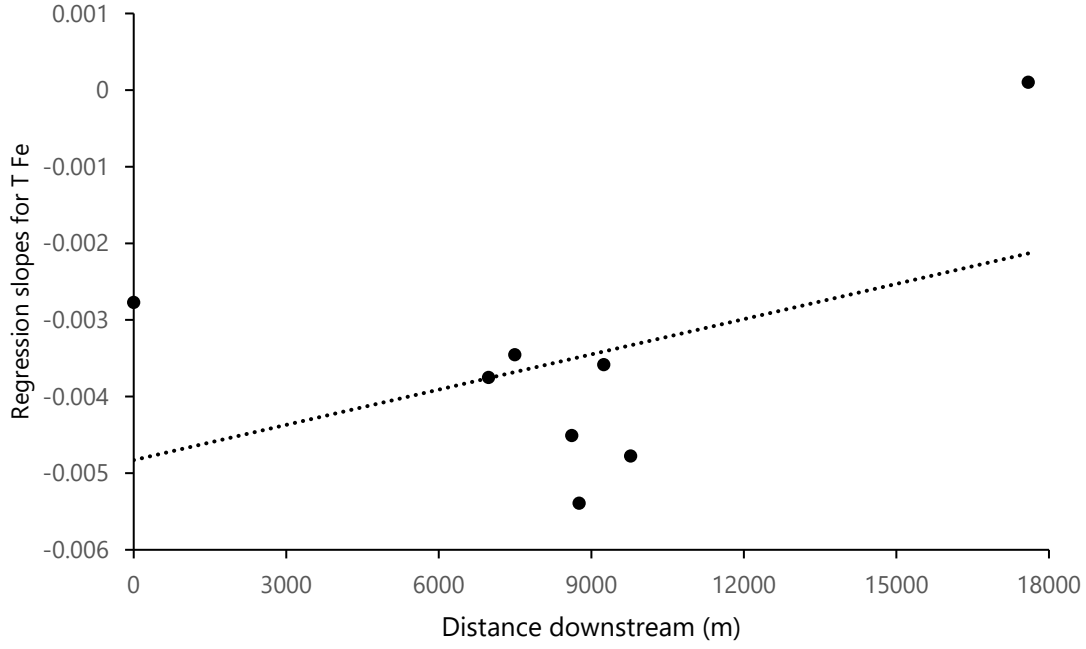


Figure D-3 Summary of regression slopes for sampling locations – spatial differences in seasonal total magnesium concentration

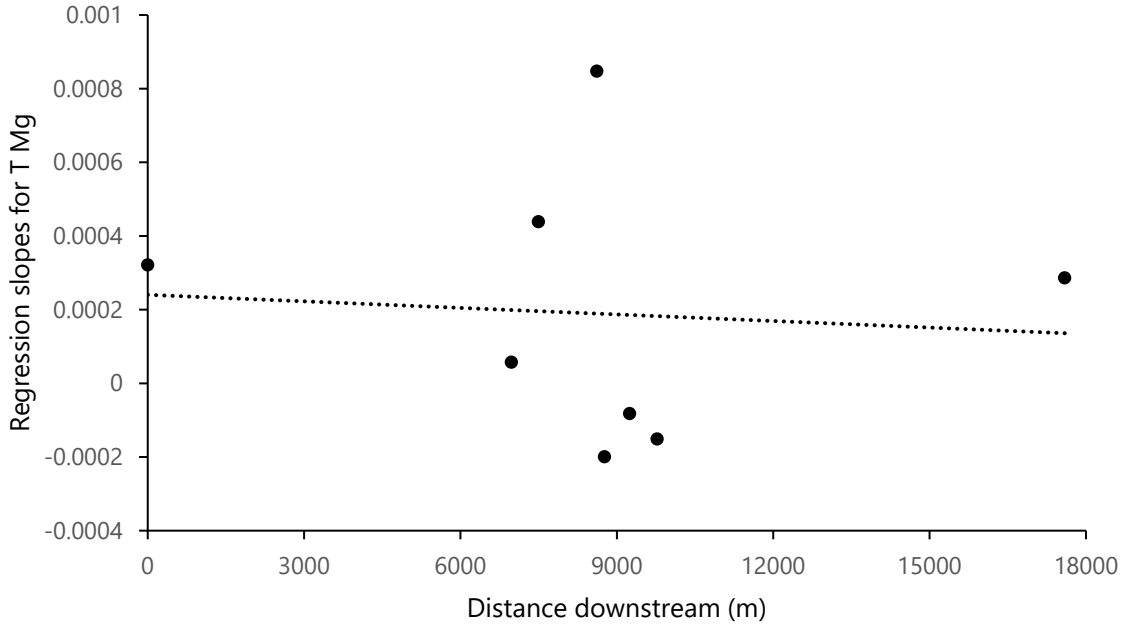


Figure D-4 Summary of regression slopes for sampling locations – spatial differences in seasonal total manganese concentration

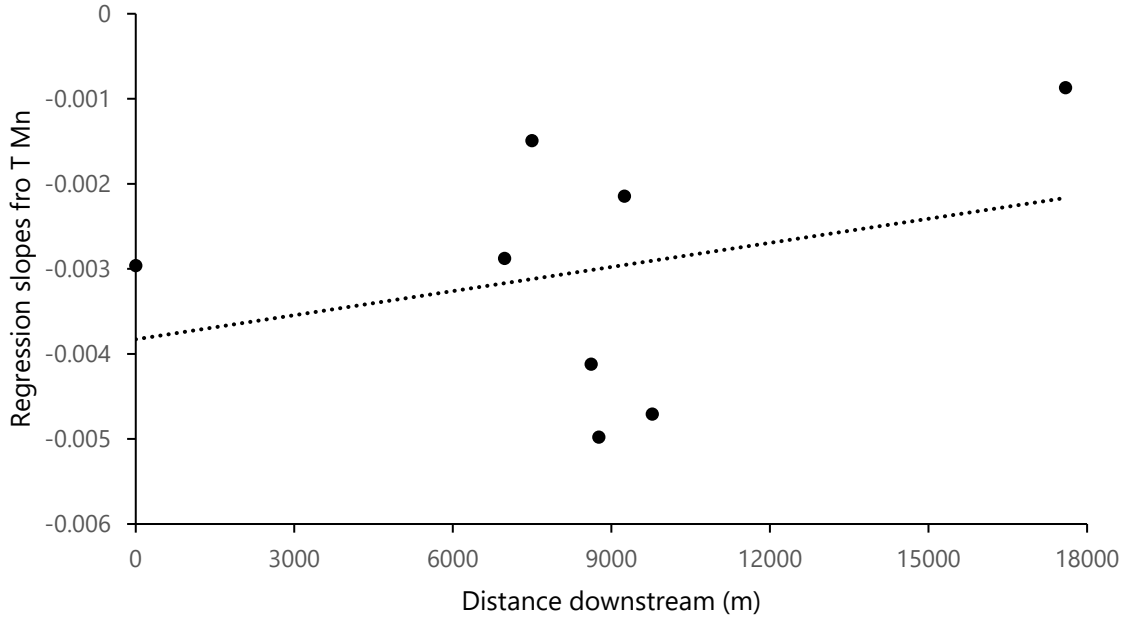


Figure D-5 Summary of regression slopes for sampling locations – spatial differences in seasonal total molybdenum concentration

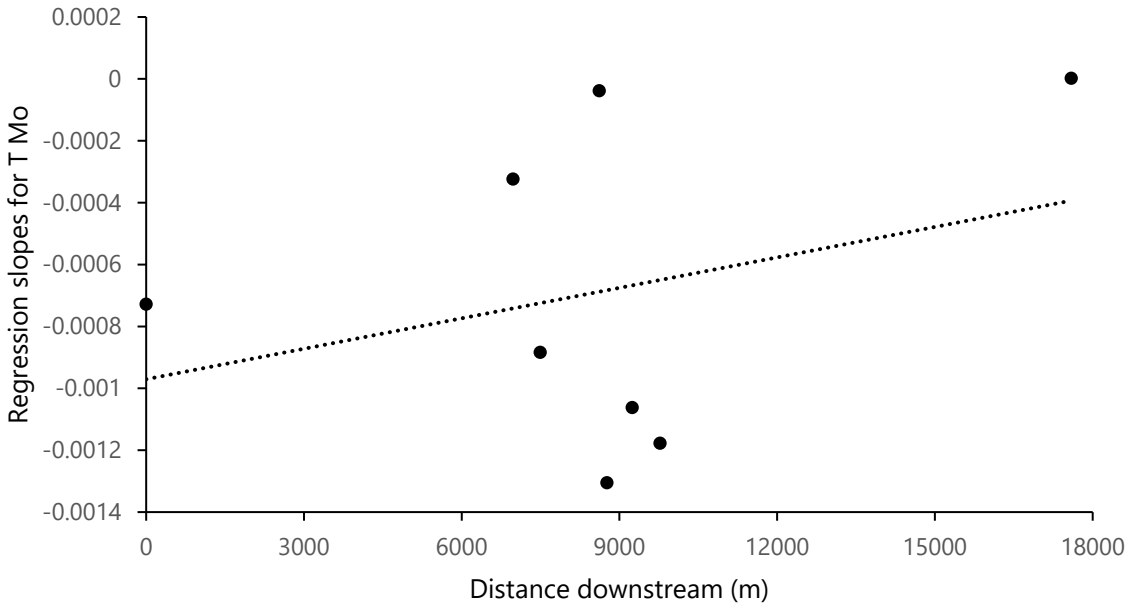


Figure D-6 Summary of regression slopes for sampling locations – spatial differences in seasonal total sodium concentration

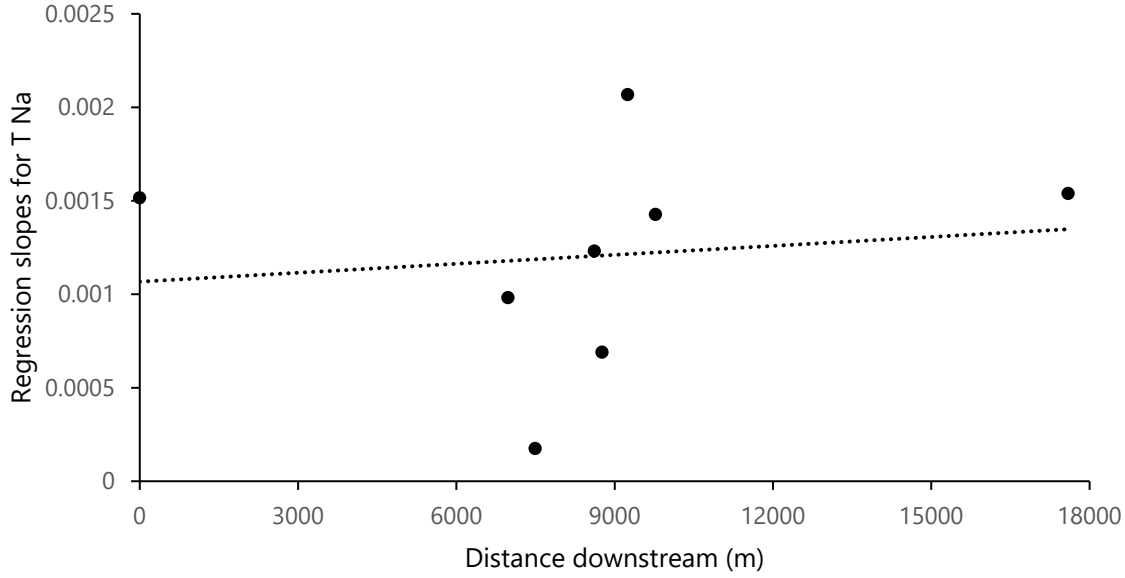


Figure D-7 Summary of regression slopes for sampling locations – spatial differences in seasonal total nickel concentration

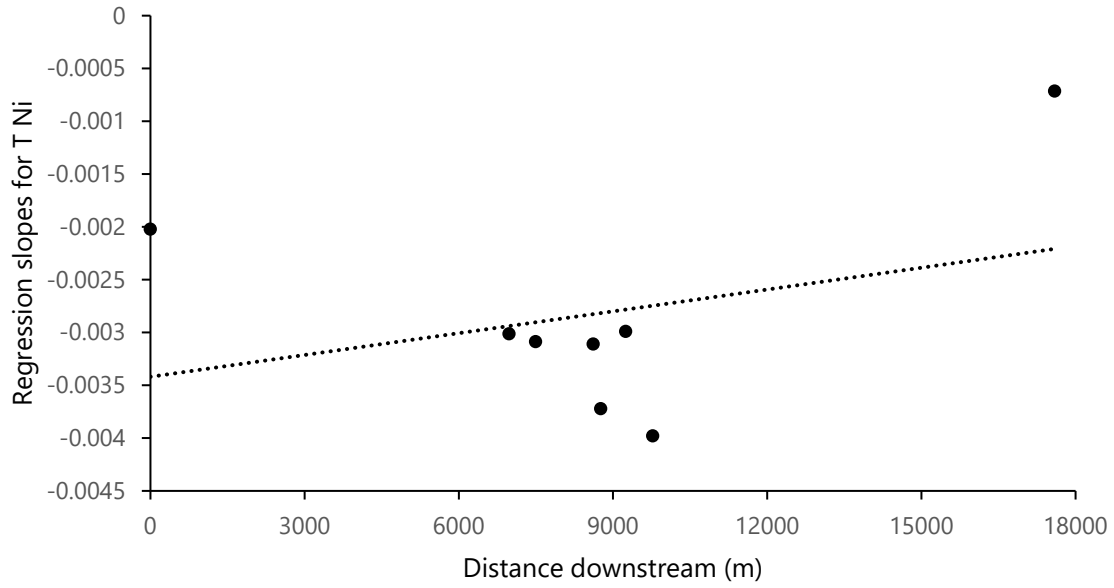


Figure D-8 Summary of regression slopes for sampling locations – spatial differences in seasonal total strontium concentration

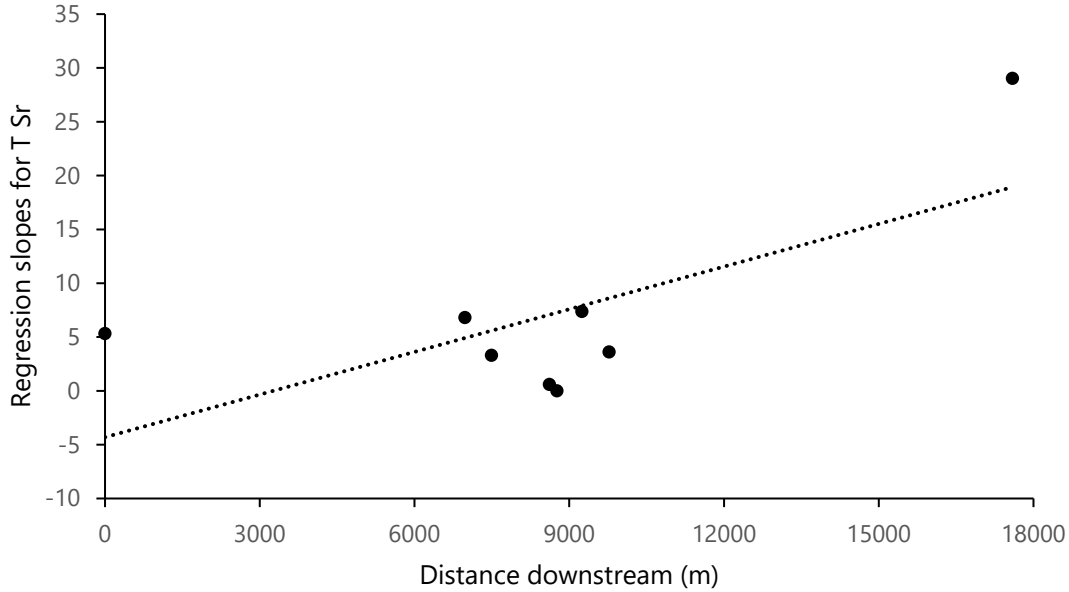


Figure D-9 Summary of regression slopes for sampling locations – spatial differences in seasonal total titanium concentration

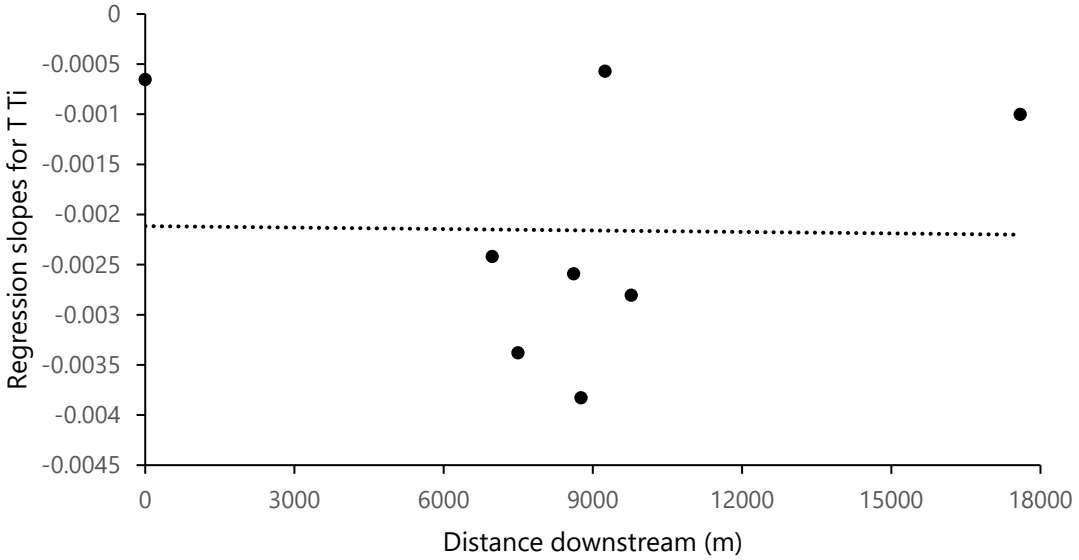


Figure D-10 Summary of regression slopes for sampling locations – spatial differences in seasonal total uranium concentration

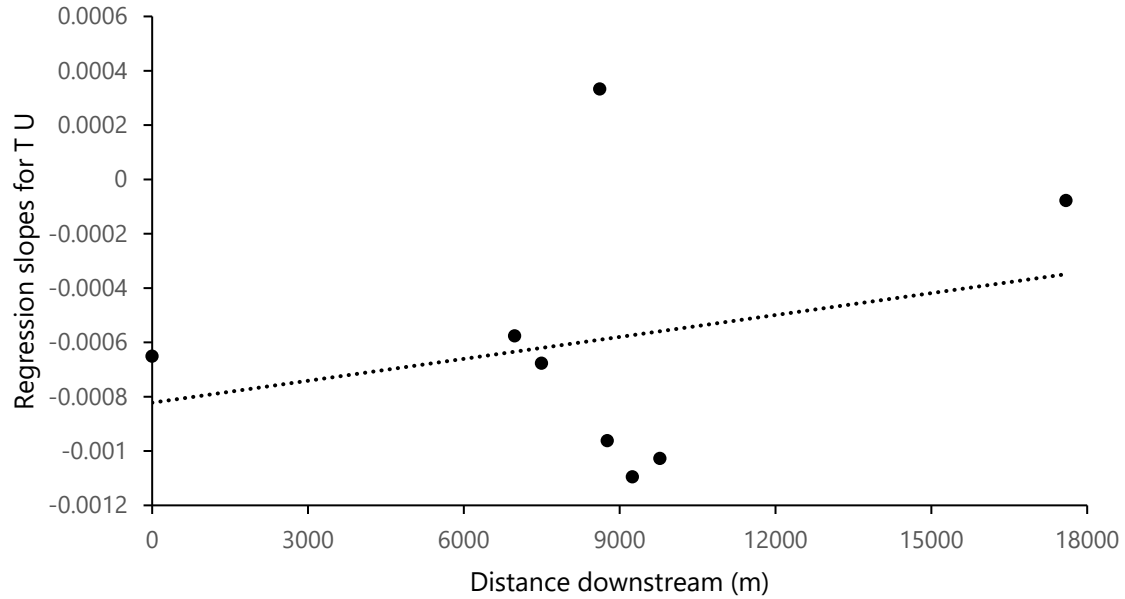


Figure D-11 Summary of regression slopes for sampling locations – spatial differences in seasonal total chloride concentration

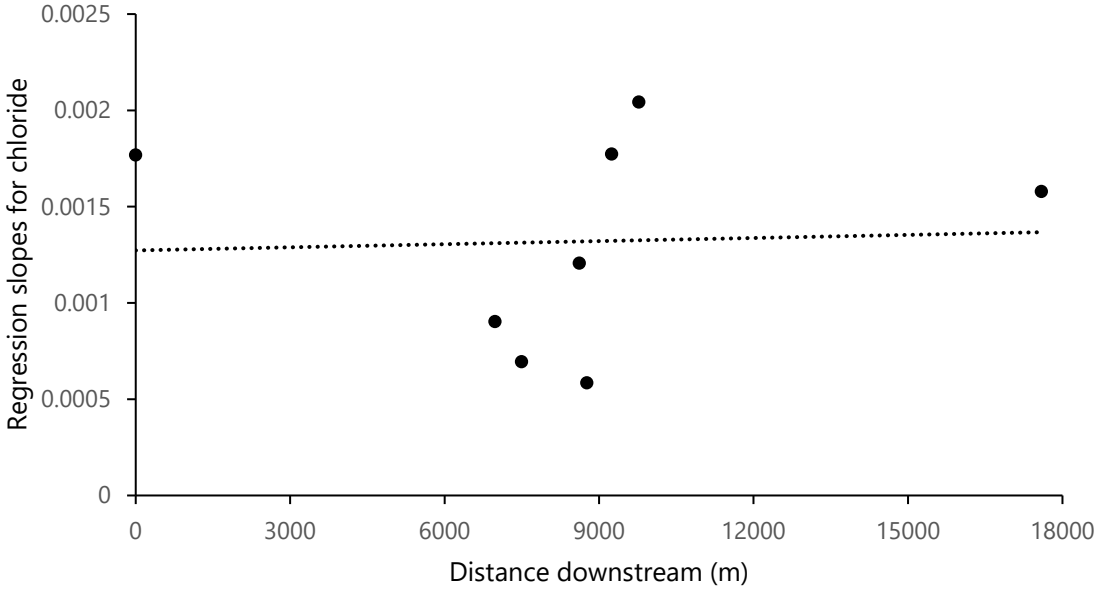
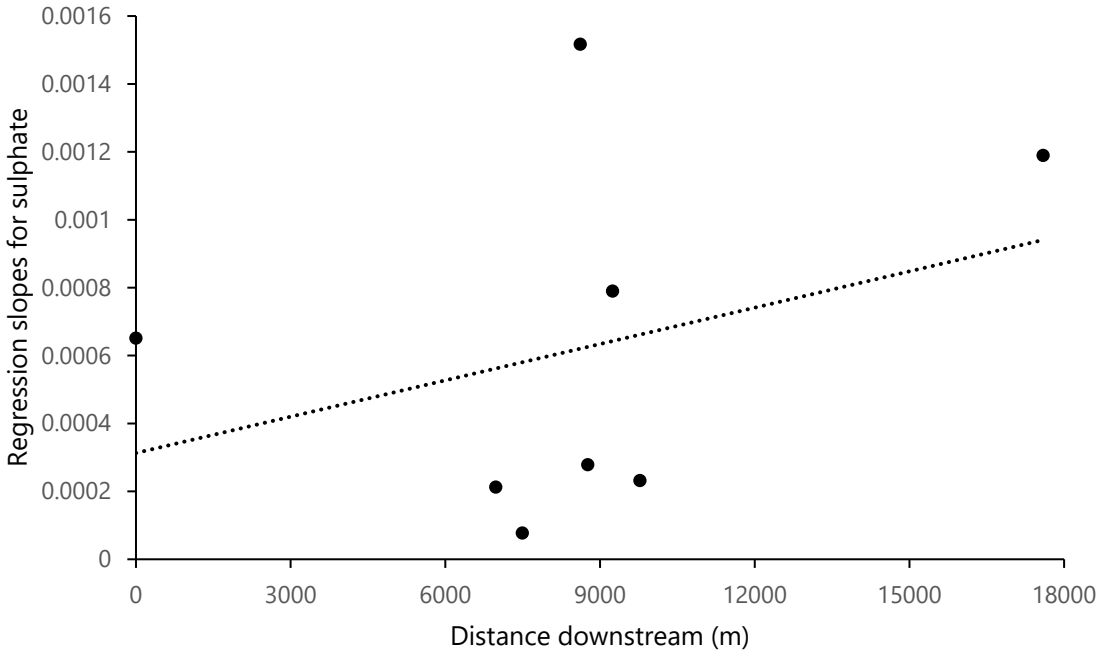


Figure D-12 Summary of regression slopes for sampling locations – spatial differences in seasonal total sulphate concentration



Appendix E
Spatial Trends in Water Quality

Figure E-1 Total copper concentration, AEMP spatial trends. Dashed red line gives CCME long-term guideline dependent on hardness – minimum hardness used for all

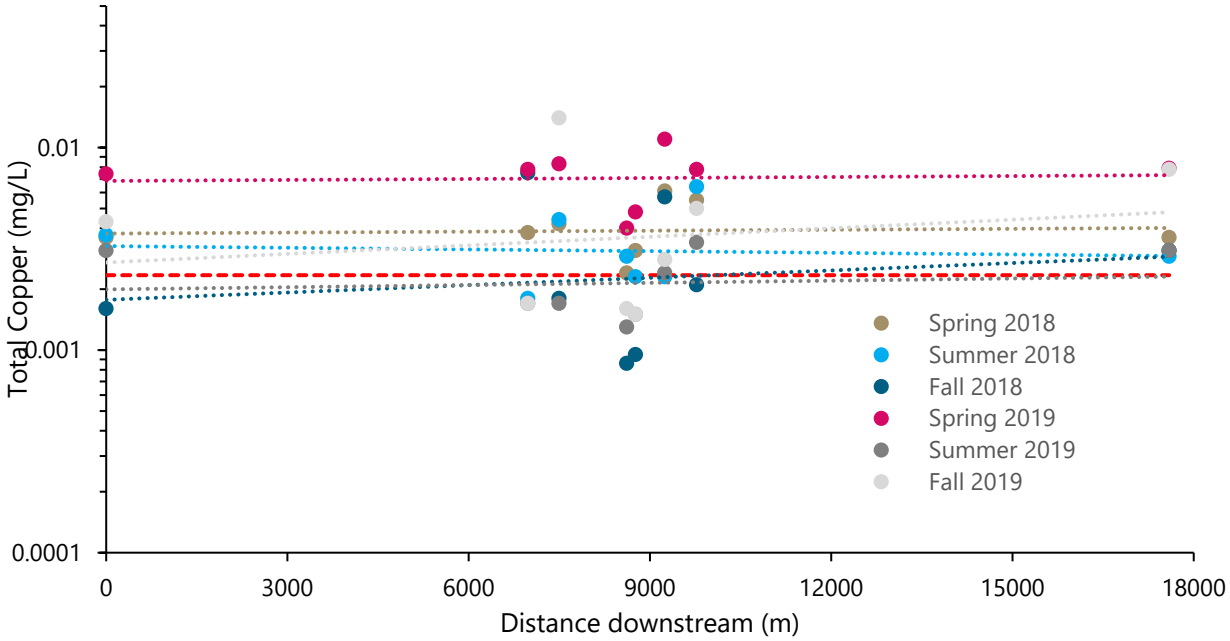


Table E-1 Regression parameters and power for spatial trends in total copper concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	3.765E-03	1.555E-06	0.0033		0.0033	0.0509
Summer 2018	3.264E-03	-2.758E-06	0.0056		0.0056	0.0515
Fall 2018	1.772E-03	1.210E-05	0.0293		0.0302	0.0583
Spring 2019	6.847E-03	1.618E-06	0.0031		0.0031	0.0508
Summer 2019	1.995E-03	3.585E-06	0.0111		0.0113	0.0531
Fall 2019	2.710E-03	1.409E-05	0.0365		0.0378	0.0604

Figure E-2 Total iron concentration, AEMP spatial trends. Dashed red line gives CCME long-term guideline

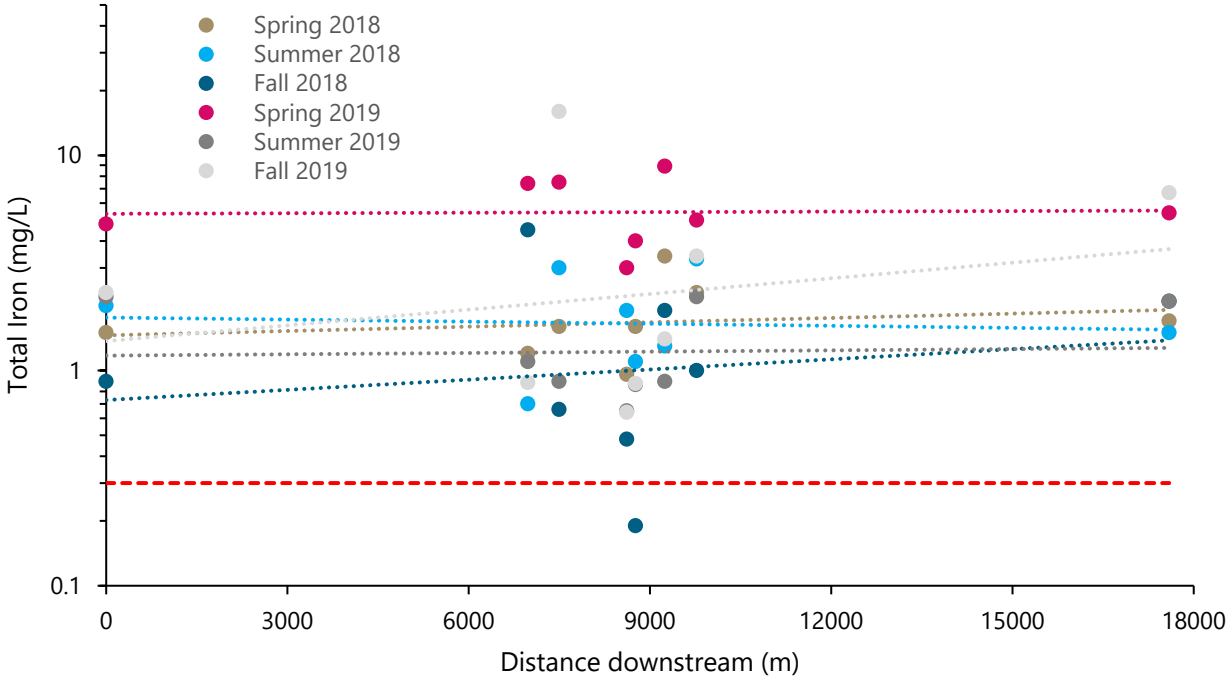


Table E-2 Regression parameters and power for spatial trends in total iron concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	1.458	6.722E-06	0.0370		0.0384	0.0606
Summer 2018	1.764	-3.206E-06	0.0047		0.0047	0.0513
Fall 2018	0.729	1.577E-05	0.0315		0.0326	0.0589
Spring 2019	5.350	8.543E-07	0.0007		0.0007	0.0502
Summer 2019	1.173	2.033E-06	0.0020		0.0021	0.0506
Fall 2019	1.371	2.429E-05	0.0571		0.0605	0.0667

Figure E-3 Total magnesium concentration, AEMP spatial trends

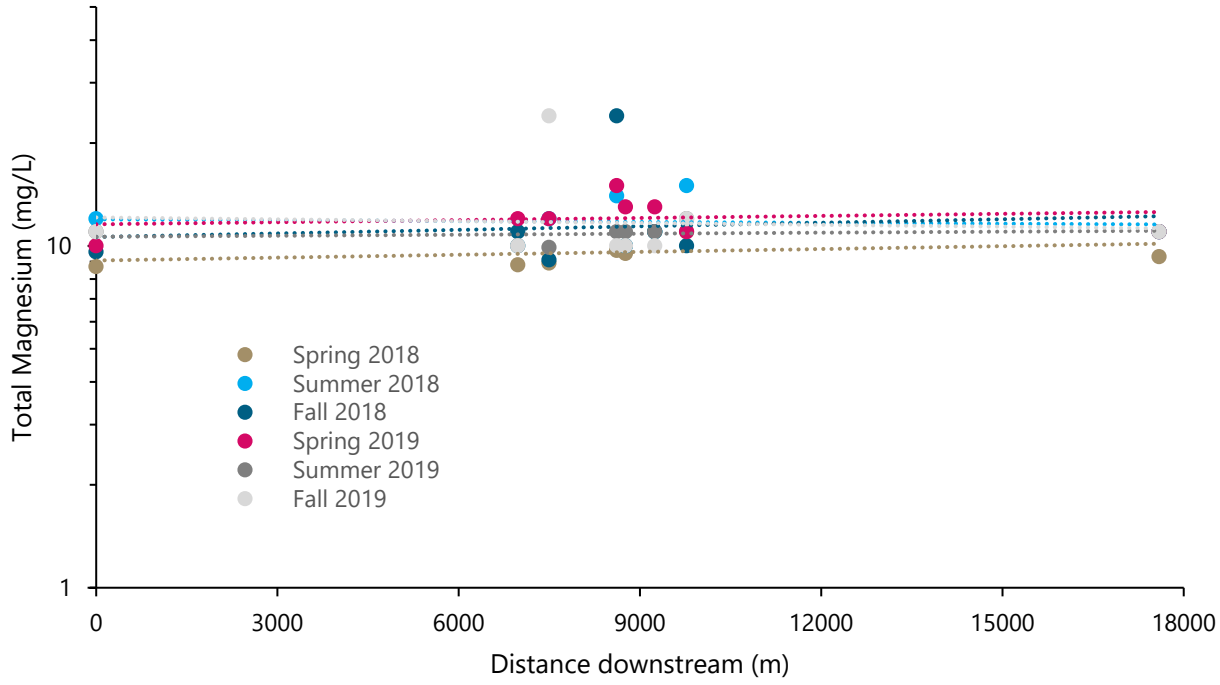


Table E-3 Regression parameters and power for spatial trends in total magnesium concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	9.06	2.790E-06	0.1082		0.1213	0.0840
Summer 2018	11.96	-8.525E-07	0.0041		0.0041	0.0511
Fall 2018	10.62	3.454E-06	0.0151		0.0153	0.0542
Spring 2019	11.57	2.037E-06	0.0318		0.0329	0.0590
Summer 2019	10.63	9.966E-07	0.0323		0.0334	0.0592
Fall 2019	12.11	-1.796E-06	0.0044		0.0044	0.0512

Figure E-4 Total manganese concentration, AEMP spatial trends

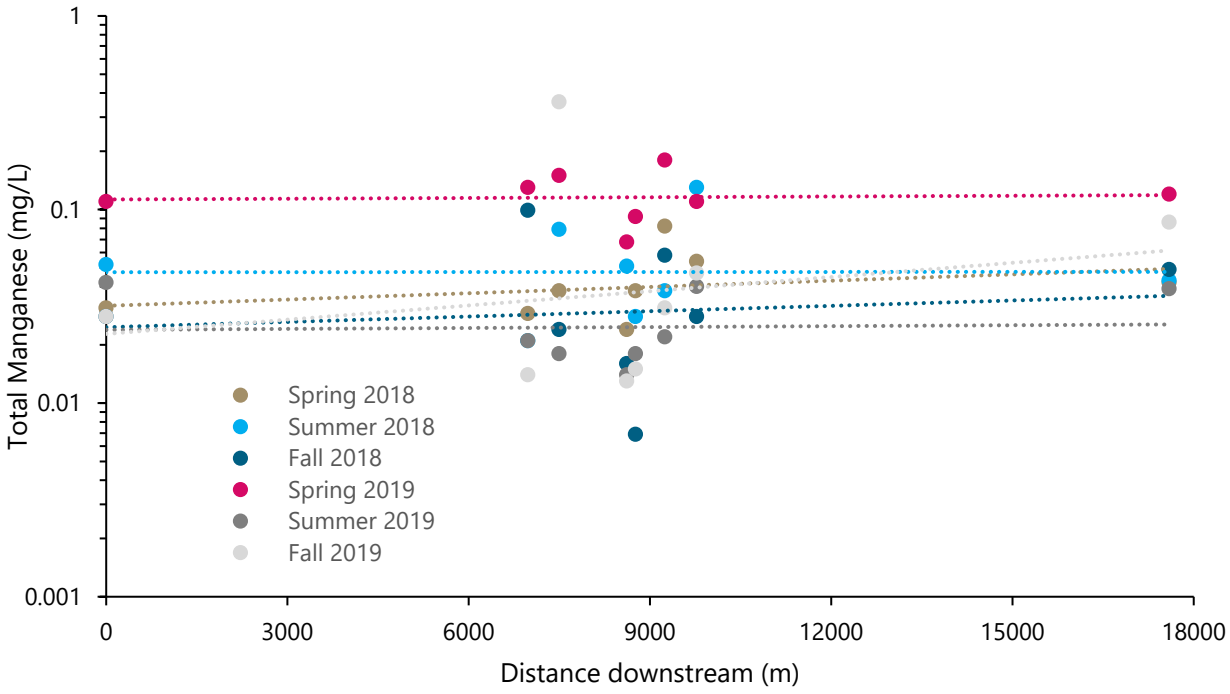


Table E-4 Regression parameters and power for spatial trends in total manganese concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	0.0318	1.083E-05	0.0960		0.1061	0.0796
Summer 2018	0.0475	1.111E-07	0.0000		4.58E-06	0.0500
Fall 2018	0.0247	9.220E-06	0.0153		0.0156	0.0543
Spring 2019	0.1128	1.263E-06	0.0022		0.0022	0.0506
Summer 2019	0.0239	1.582E-06	0.0017		0.0017	0.0505
Fall 2019	0.0228	2.448E-05	0.0572		0.0607	0.0668

Figure E-5 Total molybdenum concentration, AEMP spatial trends

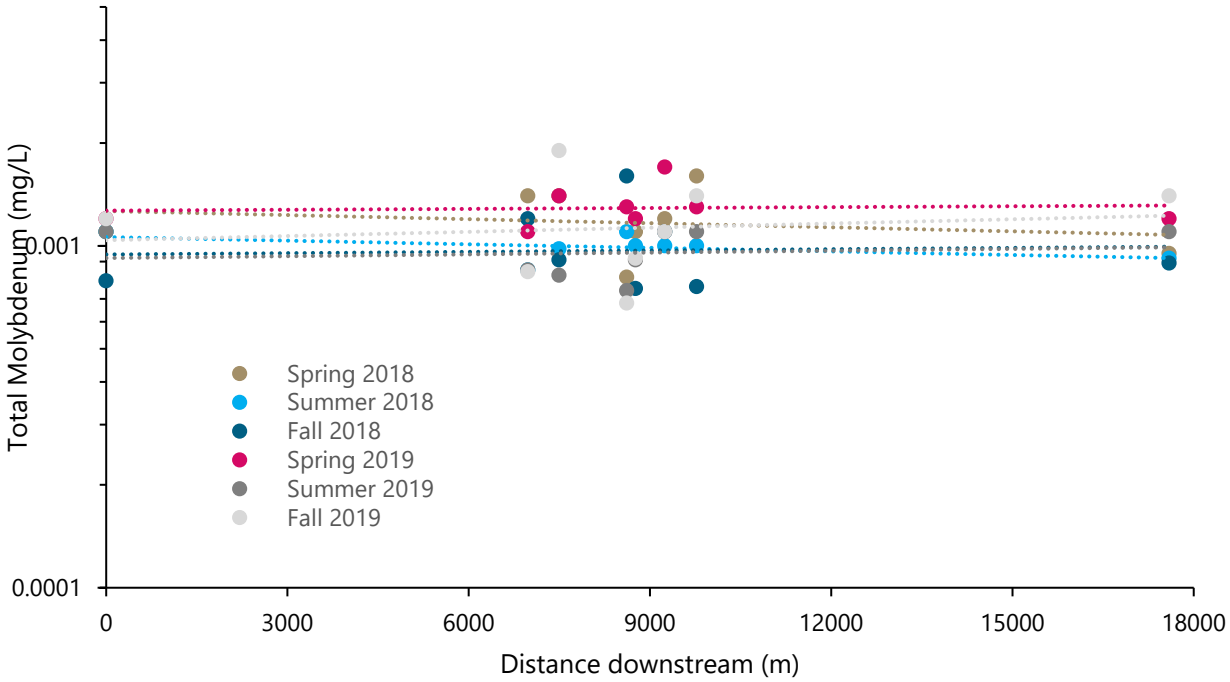


Table E-5 Regression parameters and power for spatial trends in total molybdenum concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	1.265E-03	-3.962E-06	0.0382		0.0398	0.0609
Summer 2018	1.061E-03	-3.478E-06	0.2010		0.2515	0.1223
Fall 2018	9.436E-04	1.291E-06	0.0029		0.0029	0.0508
Spring 2019	1.268E-03	8.523E-07	0.0050		0.0050	0.0514
Summer 2019	9.213E-04	1.780E-06	0.0146		0.0149	0.0541
Fall 2019	1.039E-03	4.080E-06	0.0188		0.0191	0.0552

Figure E-6 Total sodium concentration, AEMP spatial trends

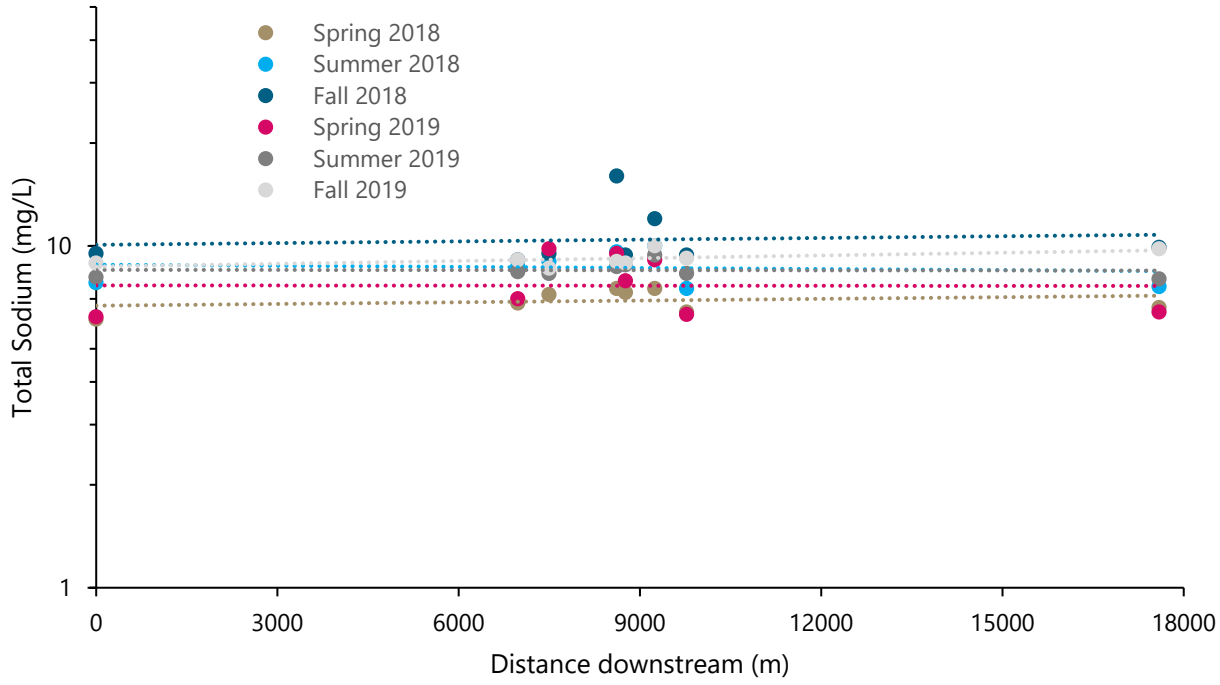


Table E-6 Regression parameters and power for spatial trends in total sodium concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	6.68	1.66E-06	0.0559		0.0592	0.0663
Summer 2018	8.81	-1.06E-06	0.0112		0.0113	0.0531
Fall 2018	10.07	1.67E-06	0.0090		0.0091	0.0525
Spring 2019	7.66	-9.18E-08	2.75E-05		2.75E-05	0.0500
Summer 2019	8.51	-1.15E-07	0.0006		0.0006	0.0502
Fall 2019	8.70	2.69E-06	0.3366		0.5075	0.2004

Figure E-7 Total nickel concentration, AEMP spatial trends. Dashed red line gives CCME long-term guideline dependent on hardness – minimum hardness used for all

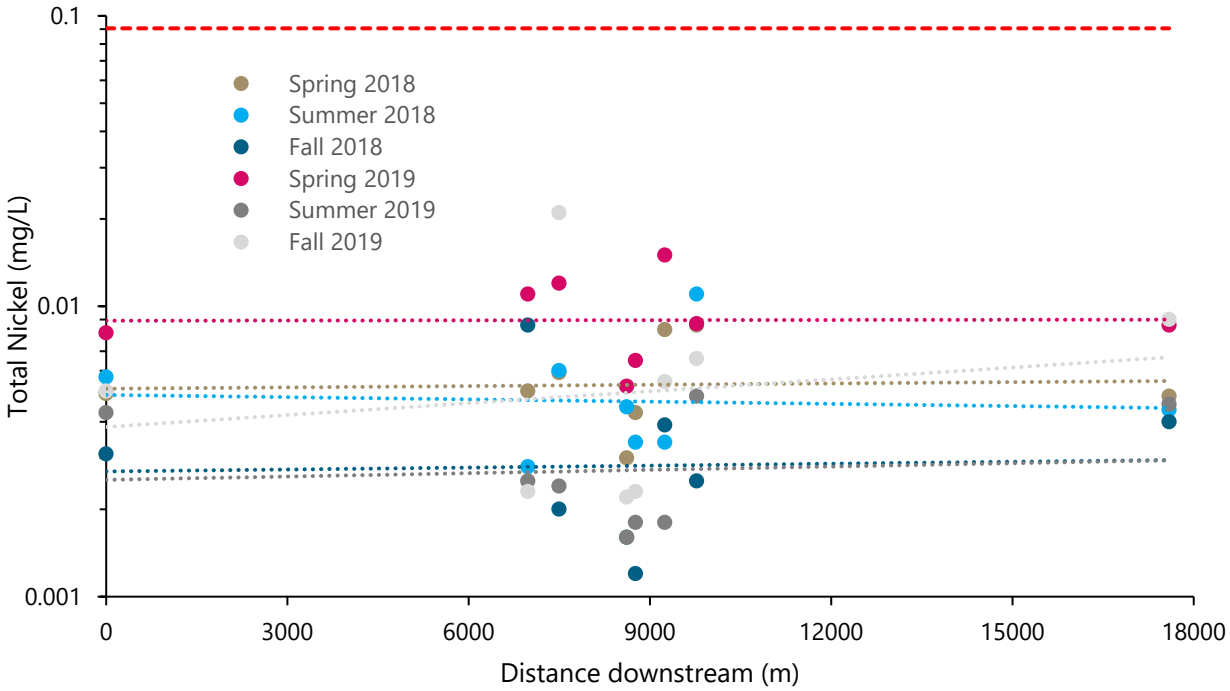


Table E-7 Regression parameters and power for spatial trends in total nickel concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	0.0052	1.509E-06	0.0023		0.0024	0.0506
Summer 2018	0.0050	-2.560E-06	0.0043		0.0043	0.0512
Fall 2018	0.0027	2.222E-06	0.0016		0.0016	0.0504
Spring 2019	0.0089	2.191E-07	0.0001		0.0001	0.0500
Summer 2019	0.0025	3.816E-06	0.0084		0.0085	0.0523
Fall 2019	0.0038	1.363E-05	0.0362		0.0375	0.0603

Figure E-8 Total strontium concentration, AEMP spatial trends

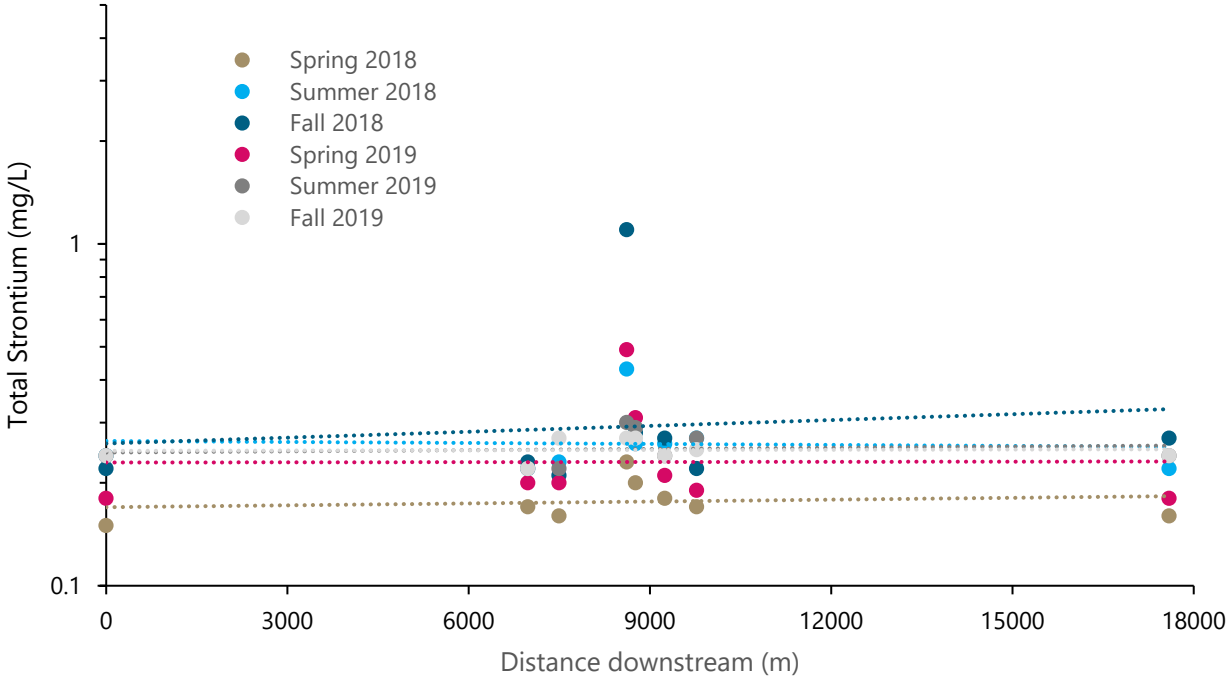


Table E-8 Regression parameters and power for spatial trends in total strontium concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	0.1697	1.835E-06	0.0213		0.0217	0.0559
Summer 2018	0.2651	-9.606E-07	0.0024		0.0024	0.0506
Fall 2018	0.2607	5.718E-06	0.0133		0.0134	0.0537
Spring 2019	0.2293	1.695E-07	2.83E-05		2.83E-05	0.0500
Summer 2019	0.2453	1.149E-06	0.0114		0.0115	0.0531
Fall 2019	0.2482	2.510E-07	0.0014		0.0014	0.0504

Figure E-9 Total titanium concentration, AEMP spatial trends

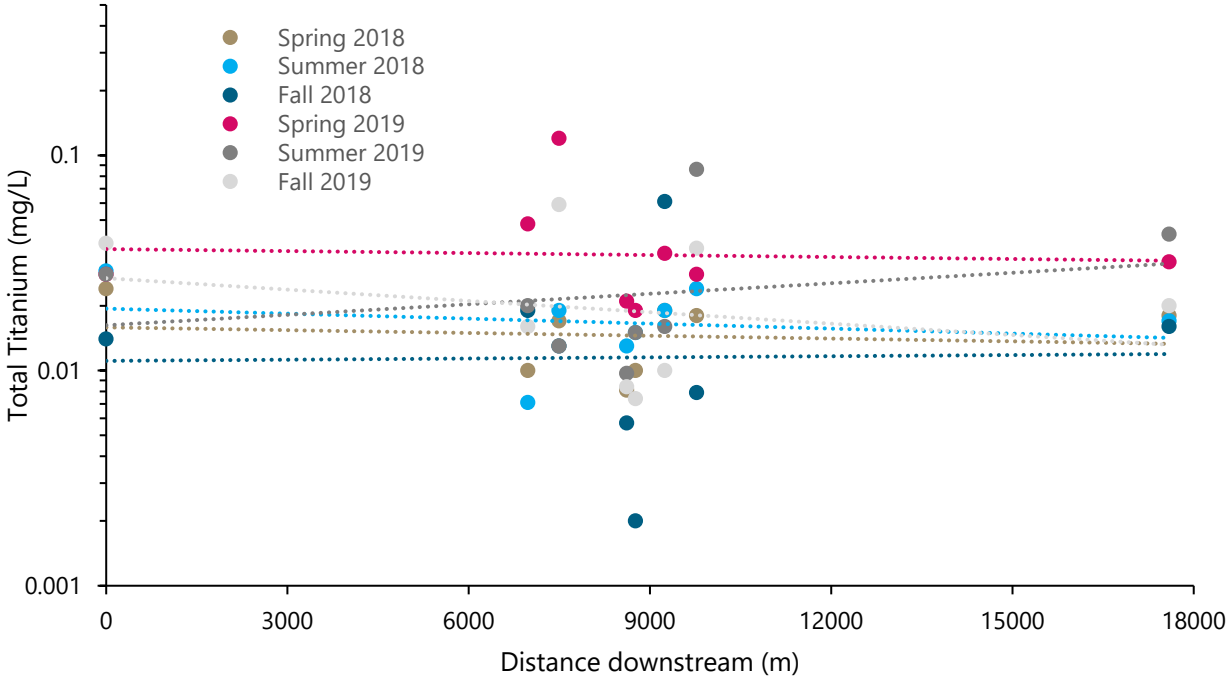


Table E-9 Regression parameters and power for spatial trends in total titanium concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	0.0159	-4.336E-06	0.0151		0.0153	0.0542
Summer 2018	0.0194	-7.727E-06	0.0398		0.0415	0.0614
Fall 2018	0.0111	1.810E-06	0.0004		0.0004	0.0501
Spring 2019	0.0367	-3.070E-06	0.0034		0.0034	0.0509
Summer 2019	0.0162	1.627E-05	0.0631		0.0674	0.0686
Fall 2019	0.0269	-1.758E-05	0.0619		0.0660	0.0683

Figure E-10 Total uranium concentration, AEMP spatial trends. CCME long-term guideline is 0.015 mg/L and not indicated because it exceeds monitoring results by more than an order of magnitude

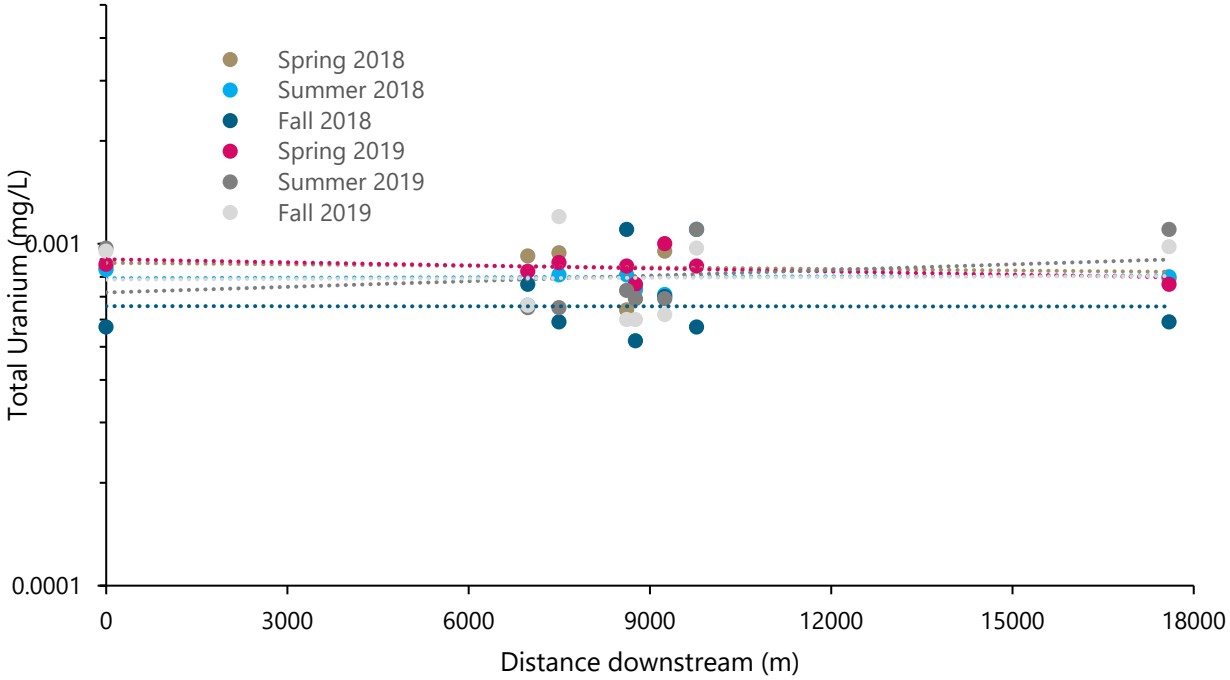


Table E-10 Regression parameters and power for spatial trends in total uranium concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	8.797E-04	-1.491E-06	0.0093		0.0094	0.0525
Summer 2018	7.933E-04	4.409E-07	0.0010		0.0010	0.0503
Fall 2018	6.569E-04	-5.071E-08	5.35E-06		5.35E-06	0.0500
Spring 2019	9.012E-04	-2.992E-06	0.1409		0.1641	0.0964
Summer 2019	7.205E-04	5.484E-06	0.0677		0.0726	0.0701
Fall 2019	7.858E-04	5.924E-07	0.0006		0.0006	0.0502

Figure E-11 Chloride concentration, AEMP spatial trends. CCME long-term guideline is 120 mg/L and not indicated because it exceeds monitoring results by an order of magnitude.

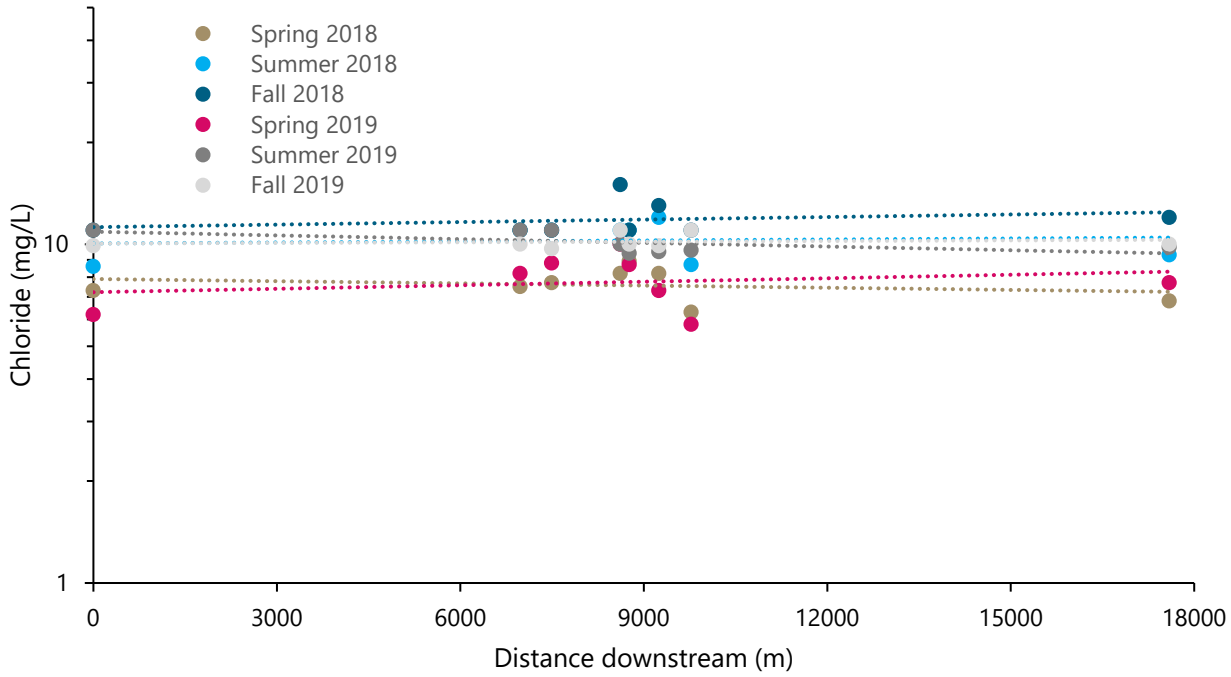


Table E-11 Regression parameters and power for spatial trends in chloride concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	7.90	-2.144E-06	0.0455		0.0477	0.0631
Summer 2018	10.06	9.860E-07	0.0074		0.0074	0.0520
Fall 2018	11.24	2.487E-06	0.0573		0.0607	0.0668
Spring 2019	7.22	3.442E-06	0.0429		0.0448	0.0623
Summer 2019	10.90	-3.647E-06	0.3306		0.4939	0.1963
Fall 2019	10.05	6.302E-07	0.0201		0.0205	0.0556

Figure E-12 Sulphate concentration, AEMP spatial trends

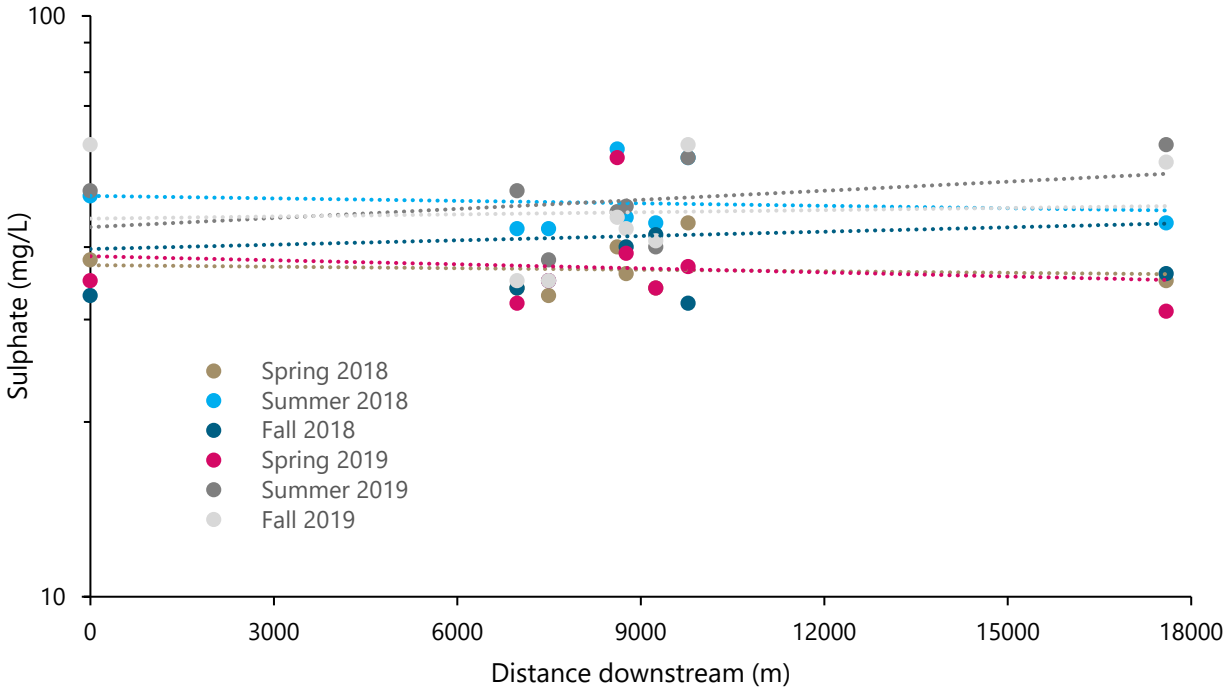


Table E-12 Regression parameters and power for spatial trends in sulphate concentration

Date	Intercept	Slope	Coefficient of determination, r^2	Significance (*<0.05)	Effect size, f2	Power
Spring 2018	3.765E-03	1.555E-06	0.003289		0.0033	0.0509
Summer 2018	3.264E-03	-2.758E-06	0.005572		0.0056	0.0515
Fall 2018	1.772E-03	1.210E-05	0.029285		0.0302	0.0583
Spring 2019	6.847E-03	1.618E-06	0.003055		0.0031	0.0508
Summer 2019	1.995E-03	3.585E-06	0.011127		0.0113	0.0531
Fall 2019	2.710E-03	1.409E-05	0.036464		0.0378	0.0604