Water Pumping Adaptive Management Plan

Rankin Inlet, Nunavut

Water Licence No. 3AM-GRA1015

Prepared by:

Government of Nunavut
Community and Government Services
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Updated: February 2016

Document Management

	Description	Prepared by	Date
1	Water Pumping Adaptive Management Plan Update – *significant changes to all sections*	GN-CGS	February 2016
2	Water Pumping Adaptive Management Plan	GN-CGS	September 2015
3			
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1. Introduction

The Government of Nunavut, Community and Government Services (GN-CGS) operates the water and sewage facilities in the Hamlet of Rankin Inlet. Nipissar Lake is utilized as the potable water source with the authorized quantity of water not to exceed eight hundred and fifty thousand (850,000) cubic metres annually. Water Licence No. 3AM-GRA1015 Amendment No. 1, issued December 23, 2014, authorizes Char River as an additional water source, to a maximum allowable quantity of 3,485 cubic metres per day transferred from Char River to Nipissar Lake. A copy of Amendment No. 1 can be found in Appendix A.

As per Part C, Item 11 of Amendment No. 1, the GN-CGS is submitting to the Nunavut Water Board (NWB) a *Water Pumping Adaptive Management Plan.* This plan includes:

a) Details of seasonal hydrological monitoring of Char River;
b) Details of Char River, Lower Landing Lake and Nipissar Lake water chemistry monitoring and assessment of impacts on Nipissar Lake water quality/chemistry due to transfer of water from Char River;
c) In-stream flow objectives for Char River including a flow based low cut-off limit of 10% of the instantaneous flow and 0.5 m minimum flow depth in the Char River;
d) Details of Char River on-going viability assessment in meeting pumping objectives and water use requirements; and
e) Mitigation options and procedures for occurrences when flow is insufficient to meet pumping objectives and consumption requirements.

2. Seasonal Hydrological Monitoring of Char River

2.1 Flow and Water Depth of Char River

Golder Associates (Golder) completed the *Technical Memorandum: Char River Theoretical Ratings Curves* found in Appendix B. The theoretical rating curves give the flow and flow depth for various cross-sections in Char River.

Golder field staff installed a staff gauge and data logger in Char River on July 10, 2015. A picture of the staff gauge in Char River can be found on the following page. Similar staff gauges and data loggers were installed in Nipissar Lake and Lower Landing Lake for additional monitoring.

Figure 1: Staff Gauge Installed at Char River

On July 13, 2015, Golder field staff demonstrated to GN-CGS staff how to remove the data loggers, download the data, and reinstall the loggers. After the data loggers were re-installed on July 13, 2015, it was supposed to remain in place until prior to freeze-up in October 2015. The data collected over the open water season would be downloaded by GN-CGS and used by Golder to calibrate the theoretical rating curves and provide accurate information on flow rates and water depths at various cross-sections in Char River.

On October 8, 2015, GN-CGS removed the data loggers from the water. Once the information was downloaded, it was apparent that the data collection had stopped on July 15, 2015. After the data was sent to Golder, they determined that their field staff had incorrectly programmed the data loggers to record at intervals of 10 seconds which caused the memory to reach capacity on July 15, 2015 rather than have enough storage space to collect information until October.

Because the data logger information could not be retroactively collected, the July 10 to 15, 2015 data and measurements taken by the Golder field staff, was used to calibrate in the final version Char River hydrological assessment. The *Technical Memorandum: Char River Theoretical Rating Curve Based on Field Data* was submitted to the NWB on February 16, 2016 as Appendix B of the *Nipissar Lake and Lower Landing Lake Water Balance Assessment.*

The technical memo states that a water depth of 0.5 m at the location of the intake corresponds to a staff gauge level of slightly below 0.6 m. Refer to the following figure for the theoretical rating curve.

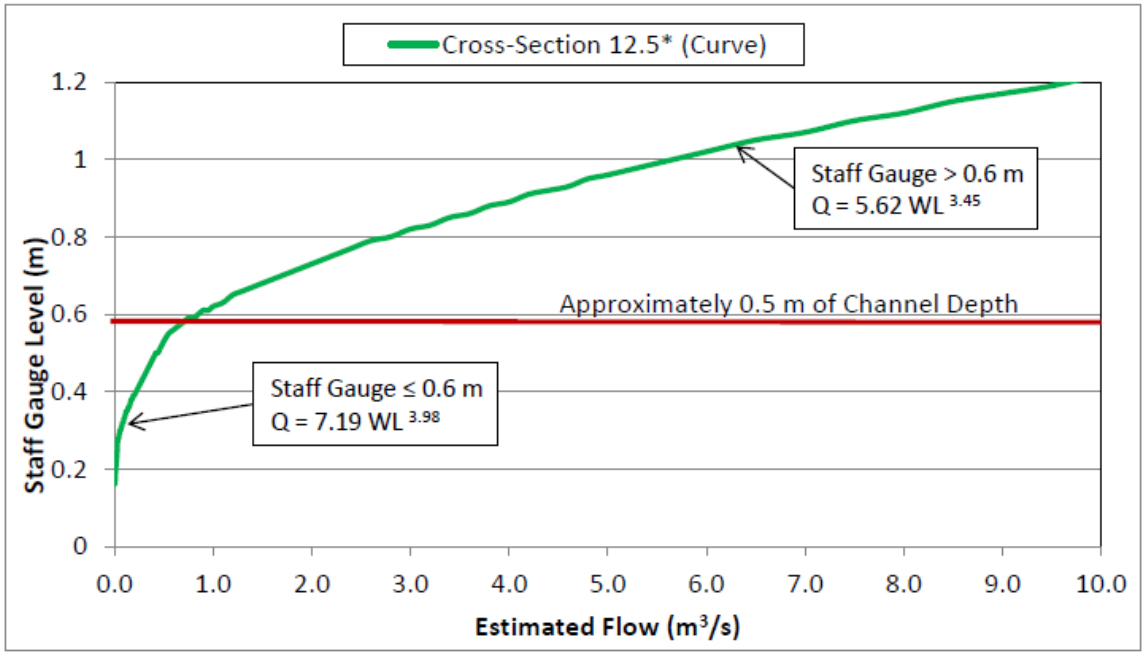

Figure 2: Char River Theoretical Rating Curve (from *Technical Memorandum: Char River Theoretical Rating Curve Based on Field Data,* Golder, February 16, 2016)

Based on the rating curve developed, a water depth of 0.5 m would result in a flow rate of approximately 0.7 m^3/s. The 10% DFO flow allowance corresponding to this water depth is approximately 0.07 m^3/s, which is greater than the maximum pumping capacity of the pump located at Char River of 0.04 m^3/s.

On-going hydrological monitoring of Char River will be done by the annual re-installation of the data logger each spring. The data loggers will be re-programmed to record water level at a larger time interval so that they record information for the entire open water season once re-installed.

2.2 Volume Pumped from Char River

Monitoring of the volume of water pumped from Char River to Nipissar Lake is done using a flow meter installed off the pump at Char River. The flow meter was installed on June 18, 2015 prior to starting the seasonal pumping from Char River. Daily readings were taken from the flow meter and recorded on a logsheet and were provided to the NWB as part of the 2015 Third Quarter Report, and will be included in the Annual Report.

Pictures of the flow meter can be found below.

Figure 3: Side View of Flow Meter at Char River

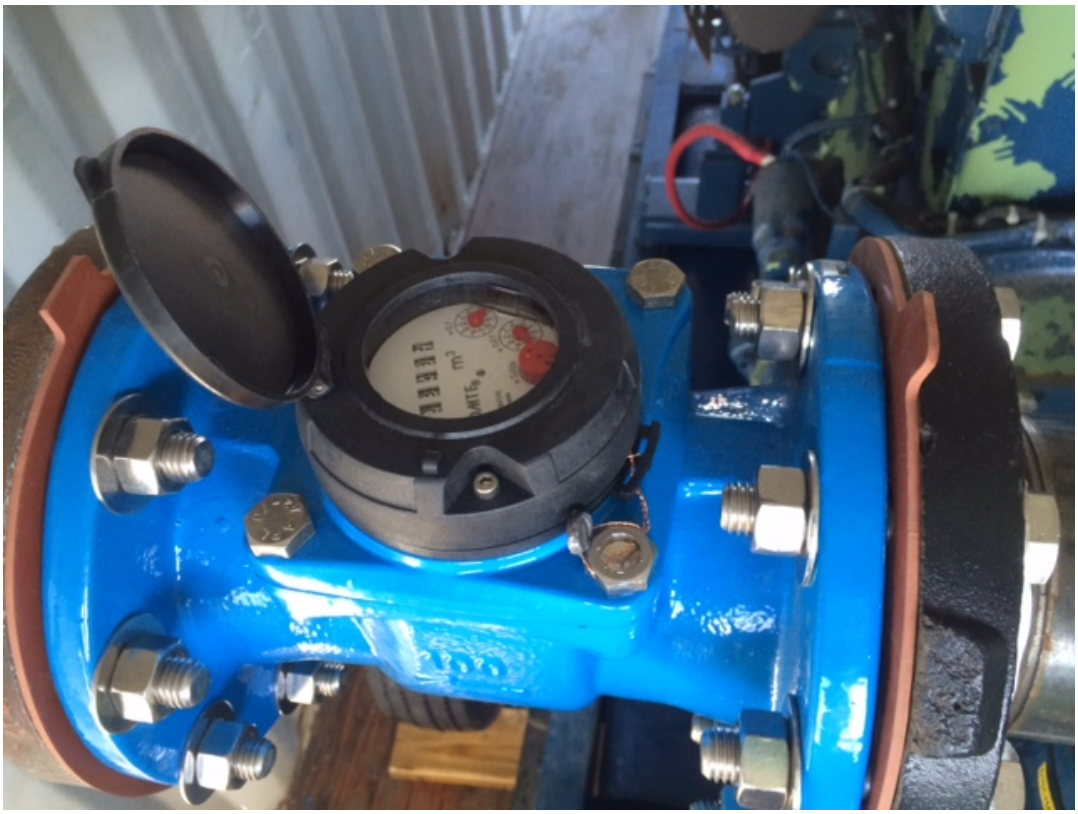

Figure 4: Top View of Flow Meter at Char River

Pumping from Char River commenced on June 18, 2015 and was stopped on September 11, 2015. The total volume of water pumped during this 86 day period was 243,644 m^3, or an average of 2833 m^3/day. Large amounts of rain in July and August resulted in higher than normal water levels in Char River, allowing pumping to continue for longer than expected. A copy of the daily flow meter readings of Char River water pumped to Nipissar Lake can be found in Appendix C.

Monitoring of the flow meter will take place when water is transferred from Char River to Nipissar Lake in 2016 and future years. Daily readings will be provided to the NWB as part of the applicable Quarterly and Annual Reports.

3. Water Chemistry Monitoring

As per Part H, Item 1 of Amendment No. 1, the Monitoring Program shall include annual water chemistry sampling at Nipissar Lake, Lower Landing Lake, and Char River. The Monitoring Program Station Numbers and corresponding GPS coordinates can be found in the following table.

Table 1: Water Chemistry Monitoring Program Stations

Monitoring Program Station Number	Description	GPS Coordinates
GRA-1	Raw water supply from Nipissar Lake prior to treatment	62° 49’ 24” N 92° 6’ 53” W
GRA-6	Char River Water pumped to Nipissar Lake	62° 51’ 35” N 92° 9’ 3” W
GRA-7	Lower Landing Lake	62° 51’ 59” N 92° 9’ 12” W

The locations of the Nipissar Lake, Lower Landing Lake, and Char River Monitoring Program Stations are displayed in the following figure.

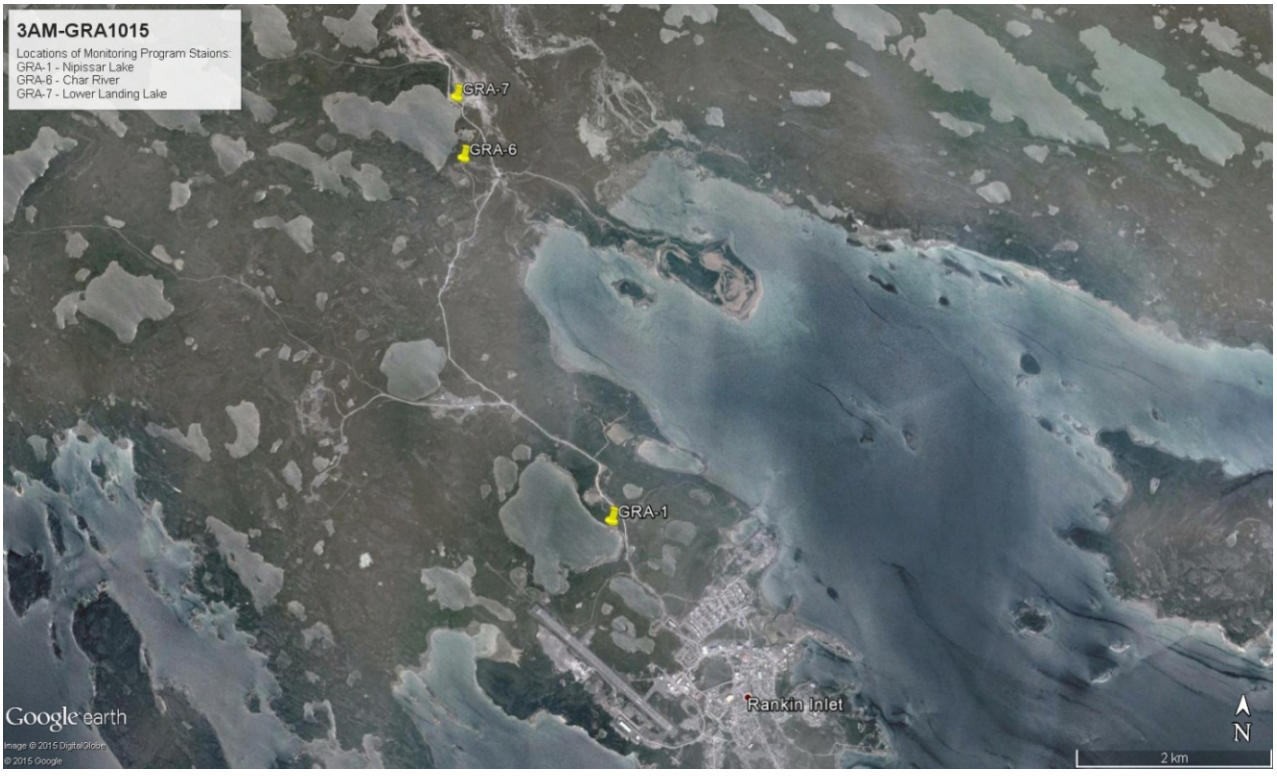

Figure 5: Locations of Monitoring Program Stations GRA-1, GRA-6 and GRA-7

3.1 Water Chemistry Data 2014

Water samples were sent to ALS Environmental in Winnipeg on June 24 and October 7, 2014. The *Summary of Water Chemistry Analysis* (Appendix D) confirms that all parameters analyzed for Nipissar Lake, Char River and Lower Landing Lake are within the maximum acceptable concentrations, as well as aesthetic objectives and operational guidance values, of the Guidelines for Canadian Drinking Water Quality.

The *Summary of Hydrocarbon Contamination Analysis* (Appendix E) confirms there is no indication of hydrocarbon presence in either Char River or Lower Landing Lake. BTEX, Total Hydrocarbon, and Polyaromatic Hydrocarbon results all came back as being under the detection limit, and within Guidelines for Canadian Drinking Water Quality.

Certificates of Analysis for these results are found in Appendix F and G.

3.2 Water Chemistry Data 2015

Water samples were collected from Nipissar Lake, Char River and Lower Landing Lake at Monitoring Program Stations GRA-1, GRA-6 and GRA-7, respectively, on June 24, 2015 and analyzed for the parameters outline in Part H, Item 14 of the Water Licence. These samples were sent to ALS Environmental in Winnipeg for analysis. The *Summary of Water Chemistry Analysis 2015* (Appendix H) confirms that all parameters analyzed for Nipissar Lake, Char River and Lower Landing Lake are within the maximum acceptable concentrations, as well as aesthetic objectives and operational guidance values, of the Guidelines for Canadian Drinking Water Quality.

The *Summary of Hydrocarbon Contamination Analysis 2015* (Appendix I) confirms there is no hydrocarbon presence in Nipissar Lake, Char River or Lower Landing Lake. BTEX, Total Hydrocarbon, and Polyaromatic Hydrocarbon results all came back as being under the detection limit, the same as results for 2014.

Certificates of Analysis for these results are found in Appendix J and K. The sample bottle for polyaromatic hydrocarbons (PAHs) from Nipissar Lake, GRA-1, broke in transit to the lab and had to be resampled.

The *Guidelines for Canadian Drinking Water Quality, October 2014* can be found in Appendix L.

3.3 Water Chemistry Data 2016

Water samples will be collected from Nipissar Lake, Char River and Lower Landing Lake at Monitoring Program Stations GRA-1, GRA-6 and GRA-7 during spring freshet 2016 (anticipated June 2016). This analysis will be included in the applicable Quarterly and Annual Reports.

3.4 Water Chemistry Assessment

The water chemistry for Nipissar Lake, Char River and Lower Landing Lake is very similar. No impacts on the water quality of Nipissar Lake are anticipated.

Aboriginal Affairs and Northern Development Canada (AANDC) submitted a review of the 2014 water chemistry data to the NWB on October 23, 2014 stating:

> *"The water chemistry results indicate that there is no significant difference between the three different waterbodies on any of the parameters tested and that all three waterbodies have water chemistry that meets the guideline for drinking water standards in Canada"*

and:

> *"At this time AANDC is satisfied that the water chemistry of all three waterbodies of similar quality as well as being suitable for drinking and poses no risk to the residents of Rankin Inlet".*

A copy of this Memorandum is available in Appendix M.

Review of the 2015 water chemistry data for Nipissar Lake, Char River and Lower Landing Lake has remained very similar. Annual sampling at these Monitoring Program Stations will confirm the water quality in Nipissar Lake is not being negatively impacted by the transfer of water.

4. In-Stream Flow Objectives for Char River

As per Part C, Item 11 of Water Licence No. 3AM-GRA1015 Amendment No. 1, the in-stream flow objectives for Char River including a flow based low cut-off limit of 10% of the instantaneous flow and 0.5 m minimum flow depth in the Char River, at which point no further water is authorized to be withdrawn from Char River.

Refer to Section 2 for details on how these flow objectives are being monitored.

The *Technical Memorandum: Char River Theoretical Ratings Curves* found in Appendix B states that flow depths of 0.5 m may result in mean channel velocities that would present an impediment to fish passage for some species, and that in the experience of Golder, much lower flow depths can provide fish passage.

5. Details of Char River on-going viability assessment

The *Technical Memorandum: Char River Theoretical Rating Curve Based on Field Data* was submitted to the NWB on February 16, 2016 as Appendix B of the *Nipissar Lake and Lower Landing Lake Water Balance Assessment.*

Due to the in-stream flow objectives imposed by Amendment No. 1, it is anticipated that sufficient volumes to meet water use requirements will not be available from Char River during average conditions because flow depth objectives can only be met for approximately 50 days each year.

Refer to Section 2 for details on how the flow objectives for Char River are being monitored and Section 6 for details on options for a long-term alternative water source to replenish Nipissar Lake.

6. Mitigation options and procedures

When flow in Char River is insufficient to meet the in-stream pumping objectives, the annual pumping from Char River to Nipissar Lake will be stopped.

GN-CGS is currently looking at options for a long-term alternative water source to replenish Nipissar Lake. CGS contracted Golder Associates to complete a water balance study for Lower Landing Lake during summer/fall 2015. This study will include details on the recharge rate and available water in Lower Landing Lake, the impact withdrawing water from Lower Landing Lake will have on Char River, and the volume of water required to be pumped to Nipissar Lake to meet the natural recharge deficit caused by increasing water consumption.

The *Nipissar Lake and Lower Landing Lake Water Balance Assessment* was submitted to the NWB on February 16, 2016. Due to the large size of the report, it is not included as an appendix of this Plan.

The Lower Landing Lake watershed is significantly larger than the Nipissar Lake watershed, cover approximately 66.9 km^2 and 3 km^2, respectively. The larger watershed area of Lower Landing Lake

accumulates more precipitation in the water balance than Nipissar Lake.

Based on this report, under historic and climate change scenarios, Lower Landing Lake is estimated to have sufficient supplementary water supplies to accommodate the water deficit from Nipissar Lake under low and moderate consumption rates (1,600 m^3/day and 3,300 m^3/day, respectively).

The total outflow (surplus) from Lower Landing Lake under median historic climatic conditions is approximately 10 million m^3/year. If the total outflow was able to be utilized for consumption, it could support consumption of approximately 40,000 people, based on the current per capita consumption rate of 0.68 m^3/person/day (approximately 1900 m^3/day).

Under extreme climatic conditions (lowest historic rainfall runoff and snowfall accumulation) and a maximum duration winter, winter consumption will exceed the available active winter storage capacity of Nipissar Lake with a daily consumption rate of approximately 3,900 m^3. Based on the current per capital consumption rate of 0.68 m^3/person/day, the daily consumption will reach 3,900 m^3 in approximately 2062 (46 years).

Lower Landing Lake is a valid option as a supplementary water source for Rankin Inlet far beyond the 8 year time frame requested in the current Licence renewal process. Full details of the water balances, predicted Nipissar Lake water supply deficits under various climate regimes, and water taking rates are presented in the *Nipissar Lake and Lower Landing Lake Water Balance Assessment*.

7. Revised Plan

As per Part C, Item 11 of Water Licence No. 3AM-GRA1015 Amendment No. 1, a revised *Water Pumping Adaptive Management Plan* was to be submitted to the NWB within ninety (90) days of completion of the 2015 hydrological field study. Due to the delay in receiving the water balance assessment from Golder, the revised *Water Pumping Adaptive Management Plan* was submitted to the NWB on February 16, 2016.

The *Water Pumping Adaptive Management Plan* will be reviewed annually and modified as necessary, with revised versions being submitted to the NWB within the Annual Reports.

8. References

AANDC (2014). *Aboriginal Affairs and Northern Development Canada's Technical Review of additional information submitted as per the public hearing proceedings which took place on Sept 25, 2014 by the Government of Nunavut, Department of Community and Government Services (GN-CGS) for the Seasonal Replenishment of Nipissar Lake.* Iqaluit, Nunavut.

Golder Associates (2016). *Nipissar Lake and Lower Landing Lake Water Balance Assessment*. Edmonton, Alberta.

Golder Associates (2015). *Technical Memo: Char River Theoretical Rating Curves*. Edmonton, Alberta.

Health Canada (2014). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Nunavut Water Board (2014). *3AM-GRA1015 Type "A" Licence Amendment No. 1*. Gjoa Haven, Nunavut.

Appendixes

Appendix A – Water Licence No. 3AM-GRA1015 Amendment No. 1

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File No. 3AM-GRA1015 / Amendment No. 1

December 23, 2014

John Kusugak,
Regional Director, Kivalliq Region
Government of Nunavut,
Department of Community and Government Services
P.O. BAG 002, GN,
Rankin Inlet, NU X0C 0G0

Email: JKusugak@gov.nu.ca

Joe Acorn, P.Eng
Project Manager
Stantec Architecture Ltd.
4910 53 Street, P.O. Box 1777
Yellowknife, NWT X1A 2P4

Email: Joe.Acorn@stantec.com

Subject: **Licence No. 3AM-GRA1015 – Hamlet of Rankin Inlet;**
Amendment No. 1 – Seasonal Replenishment of Nipissar Lake

Dear Mr. Kusugak and Mr. Acorn,

Please find attached, Amendment No. 1 to Licence No. 3AM-GRA1015 Type "A" issued to the Government of Nunavut, Community and Government Services (GN-CGS or Licensee) and as issued by the Nunavut Water Board (NWB) (**Motion 2014-23-P10-03**) pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA).

The terms and conditions of the original Licence related to the use of Waters and deposit of Waste remain an integral part of this approval. Please note that the Amendment as issued, must be approved by the Minister of Aboriginal Affairs and Northern Development Canada pursuant to s. 56 of the NWNSRTA and accordingly, the NWB has forwarded the issued Amendment to the Minister for his consideration under a separate cover.

The NWB recommends that the Licensee consult the accompanying "Reasons for Decision Including Record of Proceedings" and all comments received by interested persons on the Application during the licensing process.

Sincerely,

Thomas Kabloona
Nunavut Water Board
Chair

TK/kk/pb

Enclosure: Licence No. **3AM-GRA1015 – Amendment No. 1**
Comments - AANDC, DFO

Cc: Distribution - Kivalliq

NUNAVUT WATER BOARD

3AM-GRA1015 Type "A"
LICENCE AMENDMENT No. 1

Licensee:	**GOVERNMENT OF NUNAVUT, DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES**
Licence Issued:	**June 9, 2010**
Minister Approval of Licence:	**July 28, 2010**
Licence Expiry:	**May 31, 2015**
Amendment No. 1 Issuance:	**December 23, 2014**

Pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, with respect to an application for an amendment dated August 14, 2012 (with additional information provided on October 6, 2012 and August 12, 2013), made by Stantec Architecture Ltd. on behalf of the Government of Nunavut, Community and Government Services for the Hamlet of Rankin Inlet's Municipal Type "A" Water Licence 3AM-GRA1015, and the Reasons for Decision issued by the Nunavut Water Board following the Public Hearing held with respect to the Application, the Nunavut Water Board hereby issues Amendment No. 1 to Licence 3AM-GRA1015 as follows:

NUNAVUT WATER BOARD
WATER LICENCE 3AM-GRA1015 - AMENDMENT NO.1

Pursuant to the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada*, the Nunavut Water Board, hereinafter referred to as the Board, hereby grants to

GOVERNMENT OF NUNAVUT, COMMUNITY AND GOVERNMENT SERVICES

(Licensee)

P.O. BAG 002, GOVERNMENT OF NUNAVUT
RANKIN INLET, NUNAVUT X0C 0G0

(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use Water or dispose of Waste for a period, subject to restrictions and conditions contained within this Licence amendment:

Licence Number/Type:	3AM-GRA1015 TYPE "A"
Water Management Area:	WILSON WATERSHED (13)
Location:	RANKIN INLET, KIVALLIQ REGION, NUNAVUT LATITUDE 62º49'24'' N, LONGITUDE 92º06'53'' W
Classification:	MUNICIPAL UNDERTAKING
Purpose:	USE OF WATERS
Quantity of Water use not to Exceed:	2,330 CUBIC METERS PER DAY FROM NIPISSAR LAKE, 3,485 CUBIC METERS PER DAY FROM CHAR RIVER TO NIPISSAR LAKE
License Issuance:	JUNE 9, 2010
Expiry of Licence:	MAY 31, 2015

This Licence Amendment No.1, issued and recorded at Gjoa Haven, Nunavut on December 23, 2014.

Thomas Kabloona,
Nunavut Water Board
Chair

APPROVED BY: **Minister of Aboriginal Affairs and Northern Development Canada**

DATE:

PART A: SCOPE, DEFINITIONS AND ENFORCEMENT

2. Definitions

Amend **"Water Supply Facilities"**

"Water Supply Facilities" means the areas and associated infrastructure at the Char River exiting the Lower Landing Lake including the water intake and pipeline extending from the Char River to Nipissar Lake as described in the Application for Water Licence Amendment dated August 14, 2012 and associated documents; Nipissar Lake including intake lines, pump-houses, underground pipeline and the Williamson Lake water tank.

PART C: CONDITIONS APPLYING TO WATER USE AND MANAGEMENT

Insert
Item 11 The Licensee shall submit to the Board for approval in writing, prior to March 31, 2015, a Water Pumping Adaptive Management Plan, that shall include the following:

a. Details of seasonal hydrological monitoring of Char River;
b. Details of Char River, Lower Landing Lake and Nipissar Lake water chemistry monitoring and assessment of impacts on Nipissar Lake water quality/chemistry due to the transfer of water from Char River;
c. In-stream flow objectives for Char River including a flow based low cut-off limit of 10% of the instantaneous flow and 0.5m minimum flow depth in the Char River, at which point no further Water is authorized to be withdrawn from the Char River;
d. Details of Char River on-going viability assessment in meeting pumping objectives and water use requirements;
e. Mitigation options and procedures for occurrences when flow is insufficient to meet pumping objectives and consumption requirements.

Insert
Item 12 The Licensee may, withdraw fresh Water from the Char River, exiting the Lower Landing Lake at Monitoring Station GRA-6, and pump to Nipissar Lake annually in accordance with the approved Water Pumping Adaptive Management Plan as submitted under Part C, Item 11.

Insert
Item 13 The daily quantity of Water pumped from the Char River to Nipissar Lake shall not exceed three thousand, four hundred and eighty-five (3,485) cubic metres per day, to be withdrawn in accordance with the approved Water Pumping Adaptive Management Plan, as submitted under Part C, Item 11. Withdrawal of water shall not exceed 10 % of the instantaneous flow of Char River.

Insert
Item 14 The Licensee shall submit to the Board for approval in writing, a revised Water Pumping Adaptive Management Plan, within ninety (90) days of completion of the 2015 hydrological field study, to include actual field flow data analysis. The Licensee shall annually review the Water Pumping Adaptive Management Plan and modify it as necessary. Revised Plans shall be submitted to the Board within the Annual Reports.

Insert
Item 15 The Licensee shall cease water pumping activities from Char River to Nipissar Lake should the In-stream flow objectives for Char River, as per the Water Pumping Adaptive Management Plan and restrictions imposed in Part C, Item 13, not be met.

PART F: CONDITIONS APPLYING TO OPERATIONS AND MAINTENACE

Amend
Item 1 The Board has approved the Plan entitled "Addendum to Operations and Maintenance (O&M) Plan for the Water Supply Facility, Char River, Rankin Inlet, Nunavut", prepared for the Government of Nunavut, Department of Community and Government Services, by Stantec Architecture Ltd., dated May 2014.

Amend
Item 3 The Board has approved the Plan entitled "Spill Contingency Plan for Water Supply and Sewage Treatment Facilities Rankin Inlet, Nunavut", prepared for: the Government of Nunavut, Department of Community and Government Services, by Stantec Architecture Ltd., dated May 2014.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

Amend
Item 1 The Licensee shall maintain Monitoring Program Stations at the following locations:

Monitoring Program Station Number	Description	Frequency	Status
GRA-1	Raw water supply from Nipissar Lake prior to treatment	Daily, Monthly, Annually; Annually (spring freshet)	Active (Volume) (Quality)
GRA-2	Point of discharge in Prairie Bay (within 20	Quarterly	Inactive (Quality)

	m of discharge pipe outfall approximately 5 m below the surface)		
GRA-3	Effluent discharge from Sewage Treatment Facility	Quarterly	Active (Quality)
GRA-4	Sludge removed from the Sewage Treatment Facility	Monthly	Active (Volume)
GRA-5	Water level gauge in Nipissar Lake	Monthly (during periods of open water)	Active (Water Level)
GRA-6	Char River Water pumped to Nipissar Lake	Daily, Monthly, Annually; Annually (spring freshet)	New (Volume/Quality)
GRA-7	Lower Landing Lake	Annually (spring freshet)	New (Water Quality)

Amend
Item 2 The Licensee shall measure by instrument and record in cubic metres, the daily, monthly and annual quantities of Water extracted for all purposes at Monitoring Program Station GRA-1, and from the Char River exiting Lower Landing Lake at Monitoring Program Station GRA-6.

Insert
Item 13 The Licensee shall, during water pumping activities from Char River to Nipissar Lake, record daily the total Water flow within the Char River to ensure the Licensee adheres to the Part C, Items 13, 14 and 15 of the Licence, and "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada", (DFO 2013, or more recent).

Insert
Item 14 The Licensee shall sample annually during spring freshet, at Monitoring Program Stations GRA-1, GRA-6 and GRA-7 and analyze for the following parameters in accordance with the Canadian Council of Ministers of the Environment (CCME, 2013) Water Quality Guidelines for the Protection of Freshwater Aquatic Life:

pH	Conductivity
Total Suspended Solids	Ammonia Nitrogen
Nitrate – Nitrite	Oil and Grease (visual)
Total Phenols	Sulphate
Total Hardness	Total Alkalinity
Sodium	Potassium
Magnesium	Calcium

Chloride	Total Cadmium
Total Copper	Total Chromium
Total Iron	Total Lead
Total Mercury	Total Nickel
Total Zinc	Total Phosphorous
Total Aluminum	Total Manganese
Total Cobalt	Total Arsenic

Total Petroleum Hydrocarbons (TPH)
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)

All remaining terms and conditions of Licence 3AM-GRA1015 Type "A" dated June 9, 2010 shall continue to apply.

Appendix B – Technical Memo: Char River Theoretical Rating Curves, July 20, 2015

TECHNICAL MEMORANDUM

TO Nicole Lanchuske, Project Officer **DATE** July 20, 2015

CC Project File

FROM Chris Davidson; Nathan Schmidt **PROJECT No.** 1534002

CHAR RIVER THEORETICAL RATING CURVES

1.0 INTRODUCTION

This Technical Memorandum details the background, objectives, methodology, and results for the development of the theoretical flow rating curve for the Char River near Rankin Inlet, Nunavut.

2.0 BACKGROUND

The community of Rankin Inlet (*Kangiqtiniq*) currently depends on Nipissar Lake to provide its year-round municipal water supply (see Figure A in attachments). Given that the Nipissar Lake watershed is frozen over for approximately eight to nine months each year, raw water supplies at the outset of winter need to be sufficient to service the community over the winter until snowmelt runoff replenishes the reservoir during the following freshet. A water supply pipeline from the nearby Char River, downstream of Lower Landing Lake (also referred to as First Landing Lake), to augment water supplies in Nipissar Lake was consequently constructed; however, concerns regarding the viability of this secondary supply source have been expressed in light of sustainable flow and water depth objectives imposed by the Nunavut Water Board (NWB) and the Canada Department of Fisheries and Oceans (DFO).

Although cross-sectional data were collected at thirteen cross-sections along the Char River in 2014 (AMEC 2014), no flow or water level data have been collected to provide a characterisation of baseline flows or levels for the river. In the absence of flow and water level data for the Char River, the DFO and NWB objectives are currently set to limit withdrawals to 10% of instantaneous flow and to maintain a minimum flow depth of 0.5 m.

3.0 OBJECTIVE

IMG-Golder was retained by the Government of Nunavut in July 2015 in order to undertake water balance studies for the Char River and a potential secondary water supply supplementation source, Lower Landing Lake, located immediately upstream of the lower reach of the Char River.

As part of this work, it was requested that IMG-Golder prepare a theoretical rating curve of the Char River using available cross-sectional data to provide a temporary characterisation of baseline flows and water levels until such time that monitoring data become available.

The objective of this work was to develop a theoretical rating curve for the Char River at the water intake location, situated slightly downstream of Lower Landing Lake.

4.0 METHODOLOGY

In order to produce rating curves, a hydraulic model of the Char River between First Landing Lake and Hudson Bay was created in HEC-RAS. HEC-RAS software, created by the U.S. Army Corps of Engineers, allows one-dimensional modelling of stream systems using Manning's flow equation. Users apply river cross-sectional information, streambed roughness, bridge dimensions, boundary conditions, and a set of flows, allowing the model to estimate resulting water levels throughout the modelled reach.

4.1 Cross-Sectional Information

Cross-sectional information for the Char River was obtained from the "*Rankin Inlet – Char River Channel Topographic Survey*" technical memorandum (AMEC 2014) provided to IMG-Golder with the original request for quotation. The provided data comprises 13 surveyed cross-sections along a 1400 metres (m) length of the Char River between Lower Landing Lake and Hudson Bay (Attachment A). These surveyed cross-sections range in width from 22 m to 173 m, with an average of 14 station-elevation points defining each cross-section. The collected data depict a reasonably well-defined floodplain (with banks of 1 to 3 m in height), but do not define a low-flow channel. It is therefore currently unclear whether such a feature was accidentally omitted from the survey or whether a low-flow channel is absent altogether. Existing aerial imagery from Google Earth does not clearly show a low flow channel; but its presence/absence will be confirmed during a field visit scheduled between July 10 and 13.

Cross-sectional information for all 13 cross-sections was entered into HEC-RAS as station-elevation points taken across each cross-section. The station number for each point (i.e., distance along the cross-section) was determined using the northing and easting provided in AMEC (2014).

The Char River water taking location is shown on the AMEC drawing as being situated between Cross-section 12 and Cross-section 13; results from both of these points will be used to estimate conditions at the pumping location although it is not yet known whether the available cross-sectional data provide a suitable characterisation of channel geometry at the intake.

4.2 Hudson Bay Tide Levels

Hudson Bay is subject to tides; during high tide, the water level in Hudson Bay is expected to cause a backwater effect in the Char River, filling a portion of the channel for distance upstream and reducing channel capacity. This can cause a temporary backwater effect leading to increased water levels for a short distance upstream. As such, it is important to consider tidal effects in the hydraulic model. In particular, it is important to determine whether or not the pumping location is above the potential tidal effects in the Char River.

A maximum tidal range of 4.64 m has been reported for Rankin Inlet (TF 2015); however a more typical maximum spring tidal range may be 4.5 m as reported by DFO (2015) for 2015. Applying the latter value to the cross-sectional data provided in AMEC (2015) indicates that maximum high spring tides may encroach into Char River up to an estimated elevation of 2.25 masl (not accounting for meteorological effects).

For the purposes of the modelling exercise the 2.25 masl high tide value was used to define the downstream boundary condition for Char River within HEC-RAS. This elevation is between 6.6 m and 9.0 m below the channel invert elevation for the assumed pumping location (for Cross-section 12 and Cross-section 13, respectively).

4.3 Streambed Roughness

An empirically-derived Manning's value was assigned to represent streambed roughness at each cross-section. Manning's roughness values are assigned to simulate energy loss within the watercourse. Typically, Manning's roughness is used to calibrate hydraulic models based on observed water level and flow data. However, no flow or water level data are available at this time; therefore, a Manning's roughness value of 0.04 was assigned to all surfaces based on the literature value for unlined open rock channels (MTO 1997).

4.4 Bridge Dimensions

The aerial imagery provided in AMEC (2014) shows a single bridge crossing of the Char River immediately upstream (west) of Cross-section 9 (See Attachment A). While the elevation details for the bridge are not specifically identified, the survey information for Cross-section 9 appears to show the road and footing elevations for a single span bridge (Figure 1). In the absence of more specific information, the cross-sectional data were therefore used to estimate a solid deck bridge, with a superstructure 29.5 m long and 1.9 m deep, with a deck elevation of 12.1 masl. The width of the bridge was estimated from aerial photos to be approximately 5 m. The bridge was assumed to be located 1 m upstream of Cross-section 9. In order to provide a representation of the bridge in HEC-RAS, a second cross-section (Cross-section 9.5) was created 1 m upstream of the upstream of the bridge face, using the same cross-section data as Cross-section 9.

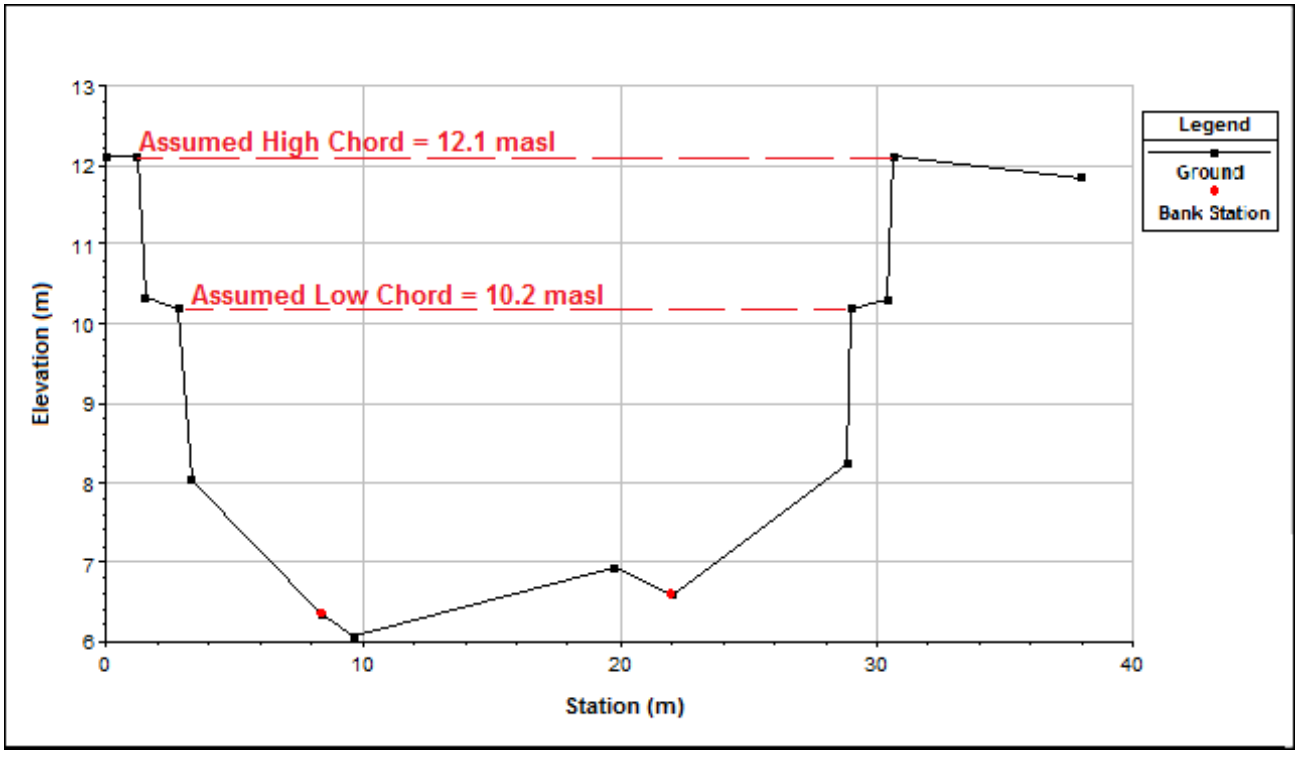


Figure 1: Assumed Bridge Dimensions on Cross-Section 9

4.5 Flows

Flow measurements for the Char River are not available to define the range of flows for the HEC-RAS model; as such, the analysis described below relies on indirect methods of flow estimation.

Flow ranges for the Char River were estimated using flow records for a nearby station. Based on available Water Survey of Canada (WSC) mapping, the nearest WSC flow gauge is located on the Diana River, approximately 18 km west of Rankin Inlet (ID# 06NC001 Diana River near Rankin Inlet). The catchment area for the Diana River WSC station (1460 km^2 based on WSC data) is roughly 20 times larger than the Char River catchment (estimated as 69.8 km^2 based on coarse topographic mapping). Mean daily flow data are available for this station from January 1989 to December 1995, although the station is now inactive.

Mean daily flows for the Diana River station were obtained from WSC, and the data were prorated to the Char River by the ratio of drainage area using the following equation:

$$Q_2 = Q_1 * (A_2/A_1)^B$$

Where:

- Q_2 is the flow rate to be estimated at the point of interest (m^3/s);
- Q_1 is the flow rate in the gauged watershed (m^3/s);
- A_2 is the watershed area contributing to the point of interest (estimated as 69.8 km^2 for the Char River based on initial coarse mapping);
- A_1 is the watershed area contributing to the reference watercourse at the gauge location (given as 1460 km^2 for the Diana River WSC gauge); and
- B is an empirical exponent equal to 1.00 for mean daily flow estimates.

The range of prorated flows for the Char River is shown on Figure 2 below. Generally, the mean daily flows range from 0 m^3/s to 4.9 m^3/s. It should be noted that actual peak flows in the Char River may be marginally greater in magnitude and shorter in duration owing to the smaller watershed associated with the Char River (approximately 5% of that for the Diana River gauge). To account for this possibility, the range of flows used in HEC-RAS for Char River was therefore expanded up to 10 m^3/s.

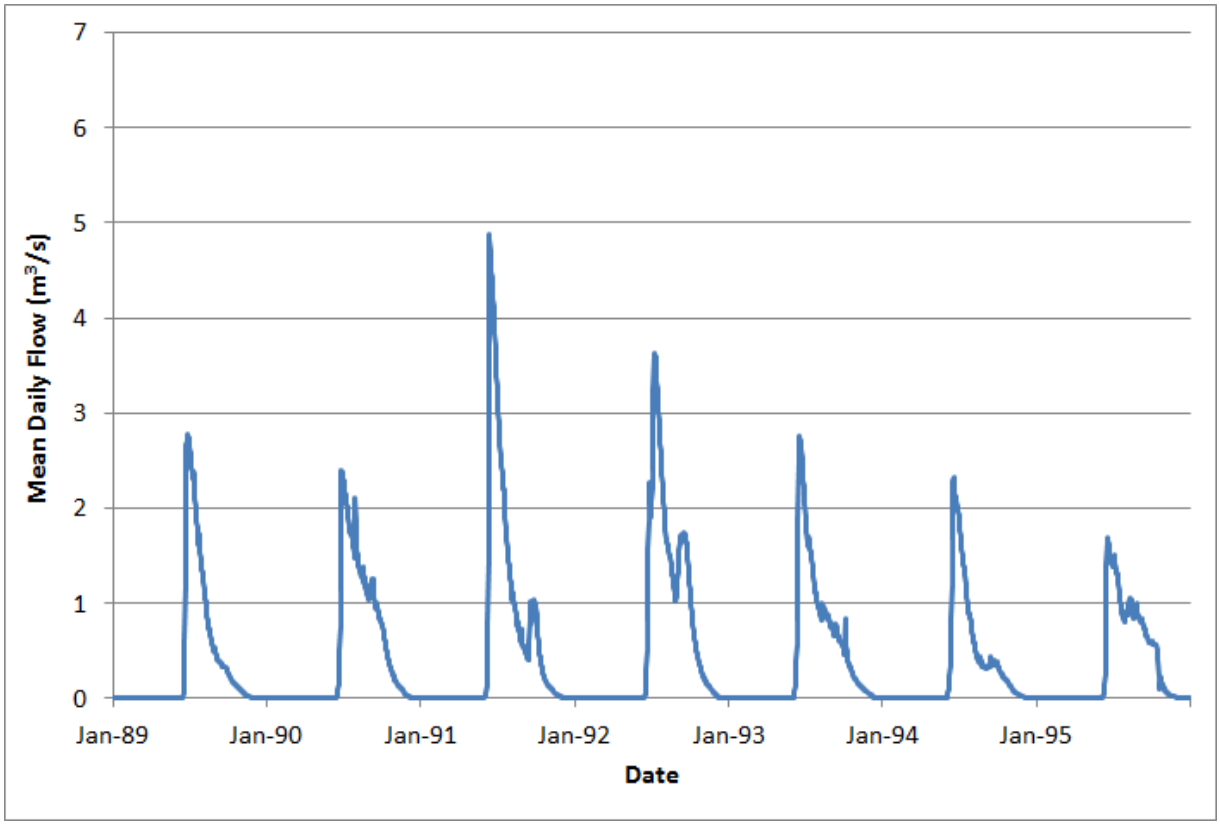


Figure 2: Prorated Flows for the Char River, 1989 to 1995

5.0 RESULTS AND DISCUSSION

5.1 Streamflow Profile

The HEC-RAS model was run for the selected range of flows; a graphical summary of the results (in the form of a stream profile) is shown on Figure 3 below. For the flows examined, water depths throughout the watercourse generally behaved similarly at each cross-section; the exceptions being Cross-sections 1 to 5 which can experience backwater effects during high tides and Cross-sections 9.5 and 10 which experience a small backwater effect as flows are constricted at the bridge. Full tabular results and graphical cross-sections are provided in Attachment B.

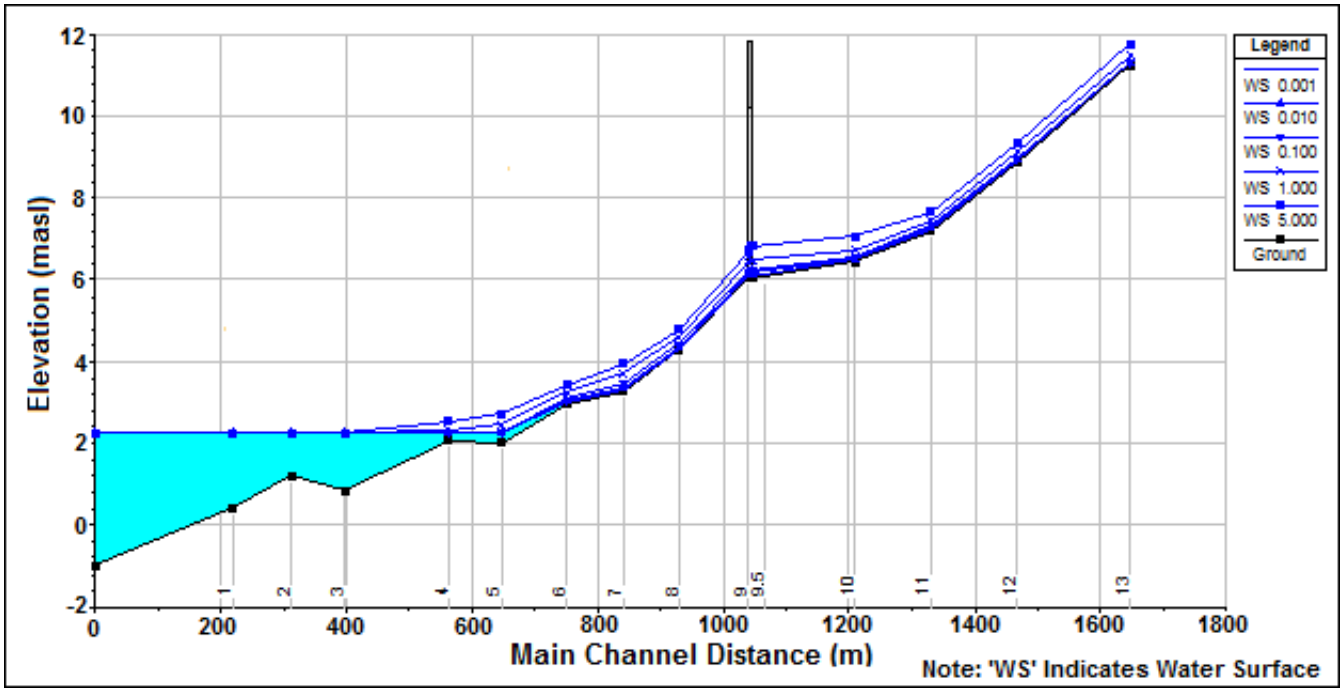


Figure 3: Char River HEC-RAS Results Profile

5.2 Theoretical Rating Curves

Based on AMEC (2014), the pumping station is located between Cross-Sections 12 and 13. The rating curves for both of these sections are plotted on Figure 4 below. In addition, theoretical rating curve equations (relating depth of flow to flow rate for both cross-sections) are provided. The equations are:

$$\text{At Cross-Section 12: } Q = 4.03\ D^{2.53}$$

$$\text{At Cross-Section 13: } Q = 4.64\ D^{1.92}$$

Where:

- Q is the flow rate (m^3/s); and
- D is the depth of flow above the lowest channel elevation (m).

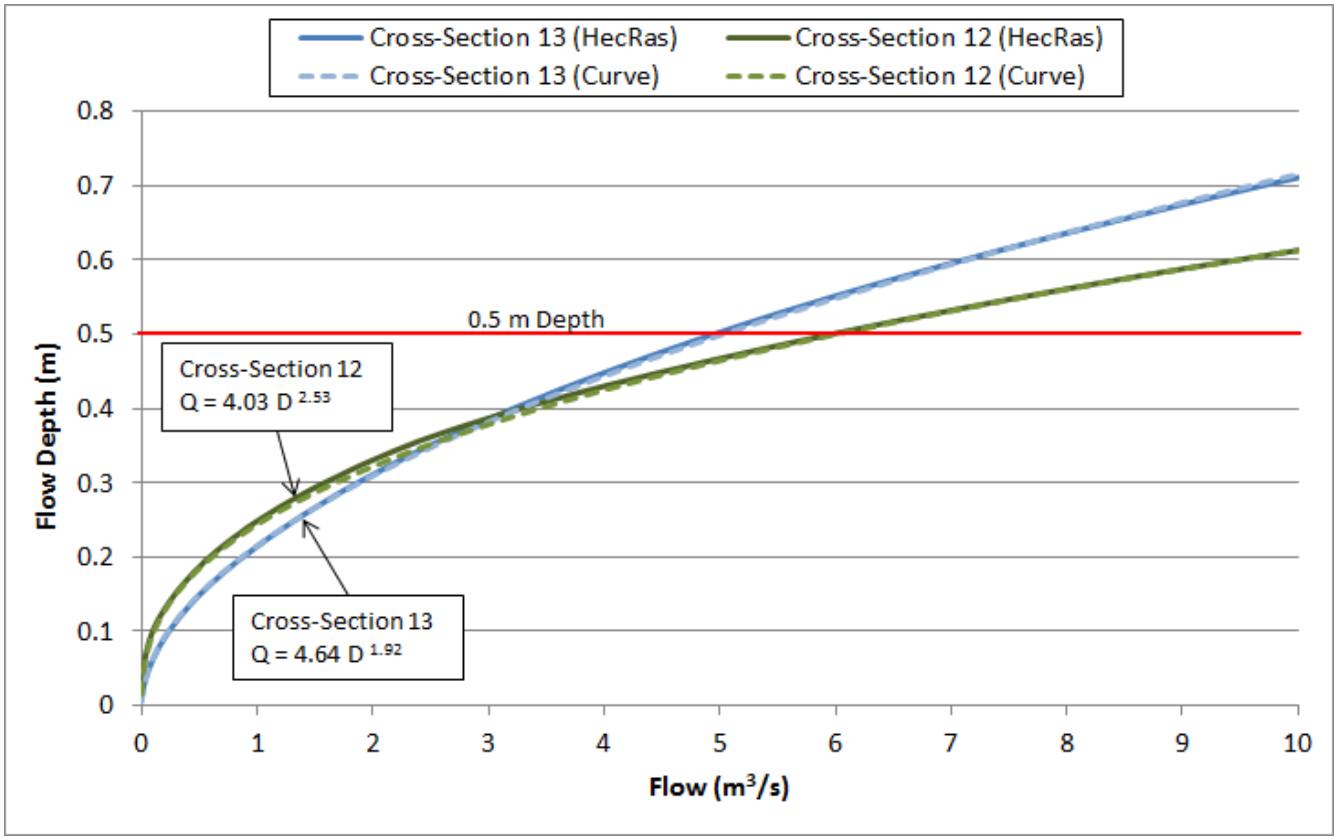


Figure 4: Char River Theoretical Rating Curves

Based on the rating curves depicted in Figure 4, the flow rate at Cross-sections 13 needs to reach approximately 6 m^3/s and the flow rate at Cross-Section 12 needs to reach approximately 5 m^3/s, in order to sustain a water depth of 0.5 m. This is finding is significant in terms of the interim water level objective established by NWB for this location when considering that the prorated flow record from the Diana River gauge (Figure 2) would suggest that this flow condition is likely to occur infrequently and for short durations. The validity of this finding would need to be revisited if a low-flow channel, not represented in available cross-sectional data (refer to Attachment B), or the presence of a pool between these cross-sections, is identified as part of the field visit.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Assumptions and Limitations

The analysis described above is based on the following assumptions and limitations:

- Cross-sectional data provided in AMEC (2014) are assumed to be accurate, up-to-date and representative of channel morphology;
- The lower boundary condition of the model was based on a high spring tide condition provided by DFO (2015);

- The channel roughness coefficient, based on literature values for an unlined rock channel, are assumed to be representative;
- The HEC-RAS model is not calibrated due to a current lack of measured flow and water level data; and
- A range of flows was assumed based on seven years of prorated flows from a nearby WSC gauge.

6.2 Conclusions

Based on the preceding information and subject to the assumptions and limitations documented herein:

- The lower portion of the Char River (Cross-Sections 1 to 5) is affected by backwater effects from high tide in Hudson Bay;
- The mid portion of the Char River (Cross-Sections 9.5 and 10) is affected by backwater effects from the bridge crossing; and
- Based on the available cross-sectional data, the 0.5 m minimum flow depth objective recommended by NWB appears to be met only infrequently under baseline conditions. The presence of a low-flow channel or pool (not represented in the existing survey) would reduce the flow rate required to achieve the 0.5 m flow depth objective specified by the NWB.

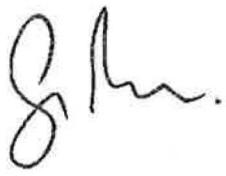
6.3 Recommendations

Based on the preceding conclusions, the following recommendations are made:

- Additional field survey work is recommended to verify the presence/absence of a low flow channel (to be verified during the upcoming field investigation);
- If no low-flow channel is identified, the rationale and appropriateness of the imposed flow depth objective should be discussed with the NWB and DFO. In our experience, much lower flow depths can provide fish passage, and the modelling indicates that at flow depths of 0.5 m, mean channel velocities may present an impediment to fish passage for some species. Site-specific considerations may result in less stringent depth criteria;
- Flow and water level measurements should also be obtained for the Char River during periods of flow in the river as a matter of priority in order to permit calibration of the HEC-RAS model (to be collected during the upcoming field investigation); and
- Any additionally available information regarding the characteristics of the Char River, including local knowledge of flooding, water levels, historically high and low flows, freeze up/thaw timing should be shared with the project team.

7.0 CLOSURE

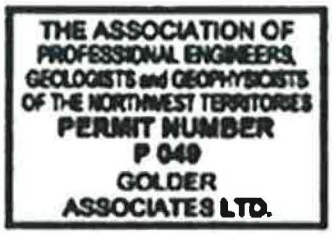
If you have any questions or require additional information, please do not hesitate to contact us at your convenience.



Signed for:

Christopher Davidson, P.Eng.
Water Resources Engineer
Mississauga, ON

Nathan Schmidt, Ph.D., P.Eng.
Principal, Senior Water Resources Engineer
Edmonton, AB



Attached:

Figure A - General Location Plan

Attachment A - Survey Figure Excerpted From AMEC 2014

Attachment B1 - HEC-RAS Modelling Results

Attachment B2 – HEC RAS Sections

8.0 REFERENCES

AMEC (2014) Rankin Inlet – Char River Channel Topographic Survey, provided to IMG-Golder as part of the RFQ package.

DFO (2015) Rankin Inlet 2015 Tide Tables, Downloaded from "*http://www.tides.gc.ca/eng/data/table/2015/wlev_sec/5100*" on July 6, 2015.

TF (2015) Tide Times for Rankin Inlet, Downloaded from "*http://www.tide-forecast.com/locations/Rankin-Inlet-Nunavut/tides/latest*" on July 6, 2015.

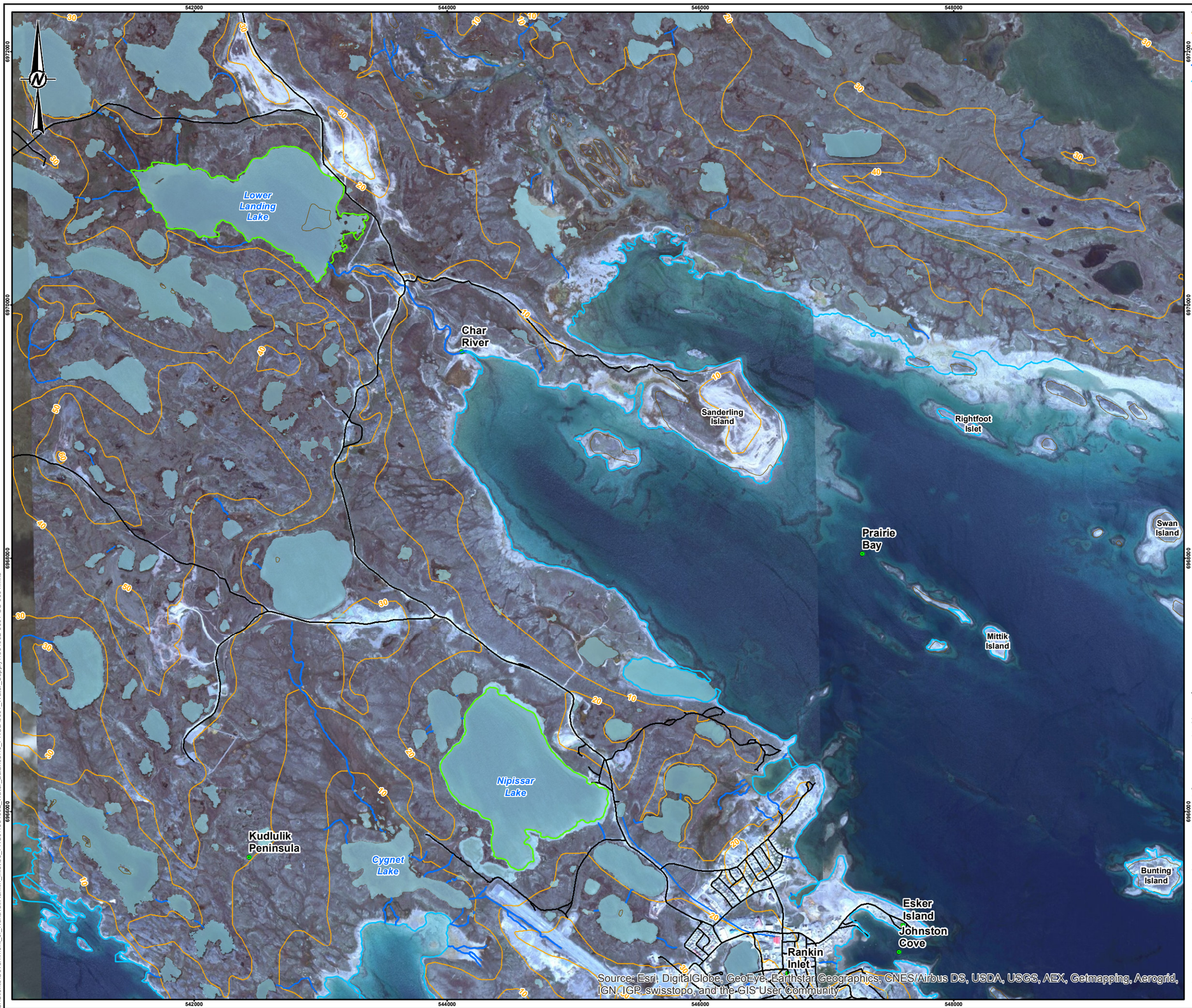
MTO (1997) Drainage Management Manual, Ontario Ministry of Transportation (MTO) Drainage and Hydrology Section, Transportation Engineering Branch, Quality and Standards Division.

\\golder.gds\gal\Mississauga\Active\2015\3 Proj\1534002 Gov of Nunavut_Water Balance & Water Supply Forecast_Rankin Inlet\05. Reporting\1. Tech Memos\1. Theoretical Rating Curve\Final\1534002 Char River Rating Curve Memo (2015-07-20) Final.docx

FIGURES AND ATTACHMENTS

FIGURE A

General Location Plan



LEGEND

- Topographic Elevation Contour
- Road
- Watercourse
- Shoreline
- Waterbody

0 0.5 1 1.5 2 2.5

1:30,000 Kilometres

REFERENCE(S)

BASE DATA DOWNLOADED FROM GOVERNRMENT OF CANADA WEBSITE, 20150707. UTM NAD83 Z15
WATERCOURSES, SHORELINE AND LAKES PROVIDED BY CGS, 20150626.

CLIENT
GOVERNMENT OF NUNAVUT

PROJECT
CHAR RIVER AND LOWER LANDING LAKE STUDIES

TITLE
GENERAL LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-07-07
DESIGNED	KD
PREPARED	KD
REVIEWED	CD
APPROVED	GR

PROJECT NO.	CONTROL	REV.	FIGURE
1534002	0001	0.0	1

S:\Clients\Government_of_Nunavut\Rankin_Inlet\99_PROJ\1534002_Water_Balance\40_PROD\0001_Water_Supply\1534002-0001-CS-0001.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

ATTACHMENT A

Survey Figure Excerpted From AMEC 2014

Legend

PS — Pump Station

Section

N S

Department of Community and Government Serivces Government of Nunavat

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd.
50 Troop Avenue, Ste. 300
Dartmouth, NS B3B 1Z1
Tel 902-468-2848 Fax 902-468-1314

PROJECT No: TV141028
DATUM: NAD83
PROJECTION: UTM Zone 15 North
SCALE: 100 50 0 100 Metres 1:4,800

TITLE: **PLAN VIEW CHAR RIVER WITH SECTIONS**

PROJECT: **TOPOGRAPHICAL SURVEY CHAR RIVER**

DWN BY: JT
CHK'D BY: KV
DATE: Oct, 2014
REV NO:
FIGURE: 1

Path: G:\GIS\PROJECTS\TV141028_Topographical_Survey_Char_River\MXD\20141021_Section_Fig.mxd User: jonathan.thornton, Date: 22/10/2014

Source: AMEC 2014/ESRI Imagery

TECHNICAL MEMORANDUM

ATTACHMENT B1

HEC-RAS Modelling Results

Date: July 20, 2015
Project No. 1534002
To: Nicole Lanchuske, Project Officer

I M G-Golder Corporation Environmental Consulting Inuvik, NT

Golder Associates

HEC-RAS Plan: Char-Rating Curve; River: Char River; Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	13	0.001	0	11.27	11.2772	11.27	11.28	0.011462	0.07	0.01	3.01	0.35
1	13	0.005	0	11.27	11.2845	11.28	11.29	0.012112	0.13	0.04	3.5	0.41
1	13	0.01	0.01	11.27	11.2898	11.28	11.29	0.012775	0.18	0.06	3.66	0.45
1	13	0.05	0.05	11.27	11.3139	11.3	11.32	0.013894	0.34	0.15	4.04	0.55
1	13	0.1	0.1	11.27	11.3333	11.32	11.34	0.014086	0.45	0.23	4.34	0.59
1	13	0.5	0.5	11.27	11.4192	11.39	11.45	0.014457	0.83	0.66	5.69	0.7
1	13	1	1	11.27	11.4846	11.46	11.53	0.013951	1.05	1.06	6.44	0.73
1	13	5	5	11.27	11.7726	11.73	11.89	0.011824	1.71	3.37	9.72	0.77
1	13	10	10	11.27	11.9805	11.94	12.15	0.010811	2.06	5.81	14.03	0.78
1	12	0.001	0	8.89	8.9082	8.9	8.91	0.015396	0.13	0.01	0.9	0.45
1	12	0.005	0	8.89	8.9228	8.91	8.92	0.014218	0.19	0.03	1.67	0.48
1	12	0.01	0.01	8.89	8.9328	8.92	8.94	0.013351	0.22	0.05	2.19	0.48
1	12	0.05	0.05	8.89	8.9688	8.95	8.97	0.012095	0.32	0.16	4.08	0.51
1	12	0.1	0.1	8.89	8.9923	8.97	9	0.011819	0.37	0.27	5.31	0.53
1	12	0.5	0.5	8.89	9.077	9.04	9.1	0.011477	0.62	0.8	7.09	0.59
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1	12	5	5	8.89	9.3571	9.32	9.46	0.015159	1.45	3.46	11.03	0.81
1	12	10	10	8.89	9.5027	9.48	9.7	0.017348	1.99	5.12	11.75	0.92
1	11	0.001	0	7.17	7.2095	7.2	7.21	0.009007	0.16	0.01	0.34	0.38
1	11	0.005	0	7.17	7.2386	7.22	7.24	0.009973	0.25	0.02	0.61	0.44
1	11	0.01	0.01	7.17	7.2612	7.24	7.26	0.010715	0.24	0.04	1.4	0.45
1	11	0.05	0.05	7.17	7.3065	7.28	7.31	0.011753	0.34	0.15	3.33	0.51
1	11	0.1	0.1	7.17	7.3328	7.31	7.34	0.012003	0.4	0.25	4.46	0.54
1	11	0.5	0.5	7.17	7.4267	7.39	7.44	0.012355	0.5	1	13.08	0.58
1	11	1	1	7.17	7.4693	7.43	7.49	0.012156	0.61	1.65	16.19	0.6
1	11	5	5	7.17	7.6478	7.58	7.7	0.009907	1.06	4.97	21.8	0.64
1	11	10	10	7.17	7.7921	7.71	7.87	0.008456	1.29	8.58	28.6	0.63
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1	10	0.01	0.01	6.45	6.4884	6.47	6.49	0.002256	0.08	0.13	7.41	0.19
1	10	0.05	0.05	6.45	6.5214	6.49	6.52	0.001409	0.11	0.46	11.97	0.17
1	10	0.1	0.1	6.45	6.5472	6.5	6.55	0.001202	0.12	0.82	15.64	0.17
1	10	0.5	0.5	6.45	6.6435	6.54	6.65	0.000826	0.17	2.87	24.12	0.16
1	10	1	1	6.45	6.7159	6.57	6.72	0.000681	0.22	4.63	24.48	0.16
1	10	5	5	6.45	7.0593	6.69	7.07	0.000538	0.38	13.31	25.97	0.17
1	10	10	10	6.45	7.3009	6.79	7.31	0.000606	0.52	19.69	26.91	0.19
1	9.5	0.001	0	6.06	6.1036	6.08	6.1	0.001028	0.06	0.02	0.71	0.13
1	9.5	0.005	0	6.06	6.1345	6.1	6.14	0.001552	0.11	0.05	1.21	0.18
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1	9.5	0.05	0.05	6.06	6.2208	6.15	6.22	0.002644	0.24	0.21	2.59	0.27
1	9.5	0.1	0.1	6.06	6.2622	6.19	6.27	0.003132	0.3	0.33	3.25	0.3
1	9.5	0.5	0.5	6.06	6.4087	6.3	6.42	0.004134	0.52	0.97	5.49	0.38
1	9.5	1	1	6.06	6.5021	6.38	6.52	0.004693	0.65	1.55	6.84	0.43
1	9.5	5	5	6.06	6.854	6.68	6.9	0.005659	0.99	5.21	14.7	0.51
1	9.5	10	10	6.06	7.0595	6.87	7.13	0.005373	1.22	8.63	17.71	0.53
1	9.25		Bridge									
1	9	0.001	0	6.06	6.0868	6.08	6.09	0.012969	0.16	0.01	0.44	0.44
1	9	0.005	0	6.06	6.1096	6.1	6.11	0.013084	0.24	0.02	0.81	0.49
1	9	0.01	0.01	6.06	6.1246	6.11	6.13	0.013165	0.29	0.03	1.05	0.51
1	9	0.05	0.05	6.06	6.1783	6.15	6.19	0.013454	0.44	0.11	1.91	0.57
1	9	0.1	0.1	6.06	6.2133	6.19	6.23	0.013617	0.53	0.19	2.47	0.6
1	9	0.5	0.5	6.06	6.3378	6.3	6.37	0.014476	0.8	0.62	4.46	0.69
1	9	1	1	6.06	6.4144	6.38	6.47	0.015145	1	1.01	5.57	0.74
1	9	5	5	6.06	6.6939	6.68	6.82	0.018967	1.61	3.18	10.66	0.91
1	9	10	10	6.06	6.8671	6.87	7.05	0.020651	1.92	5.4	15.03	0.98
1	8	0.001	0	4.3	4.3282	4.32	4.33	0.021047	0.2	0	0.38	0.56
1	8	0.005	0	4.3	4.3502	4.34	4.35	0.020594	0.3	0.02	0.7	0.61
1	8	0.01	0.01	4.3	4.3647	4.35	4.37	0.020435	0.35	0.03	0.91	0.64
1	8	0.05	0.05	4.3	4.4173	4.4	4.43	0.01983	0.52	0.1	1.67	0.7
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1	7	0.001	0	3.28	3.3215	3.3	3.32	0.001844	0.08	0.01	0.65	0.18
1	7	0.005	0	3.28	3.352	3.32	3.35	0.00218	0.12	0.04	1.15	0.21
1	7	0.01	0.01	3.28	3.3724	3.33	3.37	0.002225	0.15	0.07	1.49	0.22
1	7	0.05	0.05	3.28	3.4441	3.38	3.45	0.002468	0.23	0.22	2.67	0.26
1	7	0.1	0.1	3.28	3.4923	3.41	3.5	0.002596	0.27	0.36	3.63	0.28
1	7	0.5	0.5	3.28	3.6441	3.52	3.65	0.002979	0.32	1.57	13.89	0.3
1	7	1	1	3.28	3.7064	3.6	3.71	0.002993	0.39	2.54	16.39	0.32
1	7	5	5	3.28	3.931	3.76	3.96	0.003735	0.76	6.62	19.62	0.41
1	7	10	10	3.28	4.0716	3.89	4.13	0.004776	1.07	9.49	21.17	0.49
1	6	0.001	0	2.98	2.993	2.99	3	0.091082	0.27	0	0.53	1.05
1	6	0.005	0	2.98	3.0148	3.01	3.02	0.014717	0.21	0.02	1.36	0.49
1	6	0.01	0.01	2.98	3.0253	3.01	3.03	0.014908	0.25	0.04	1.75	0.52
1	6	0.05	0.05	2.98	3.063	3.05	3.07	0.015447	0.37	0.13	3.18	0.58
1	6	0.1	0.1	2.98	3.0873	3.07	3.1	0.01544	0.45	0.22	3.95	0.61

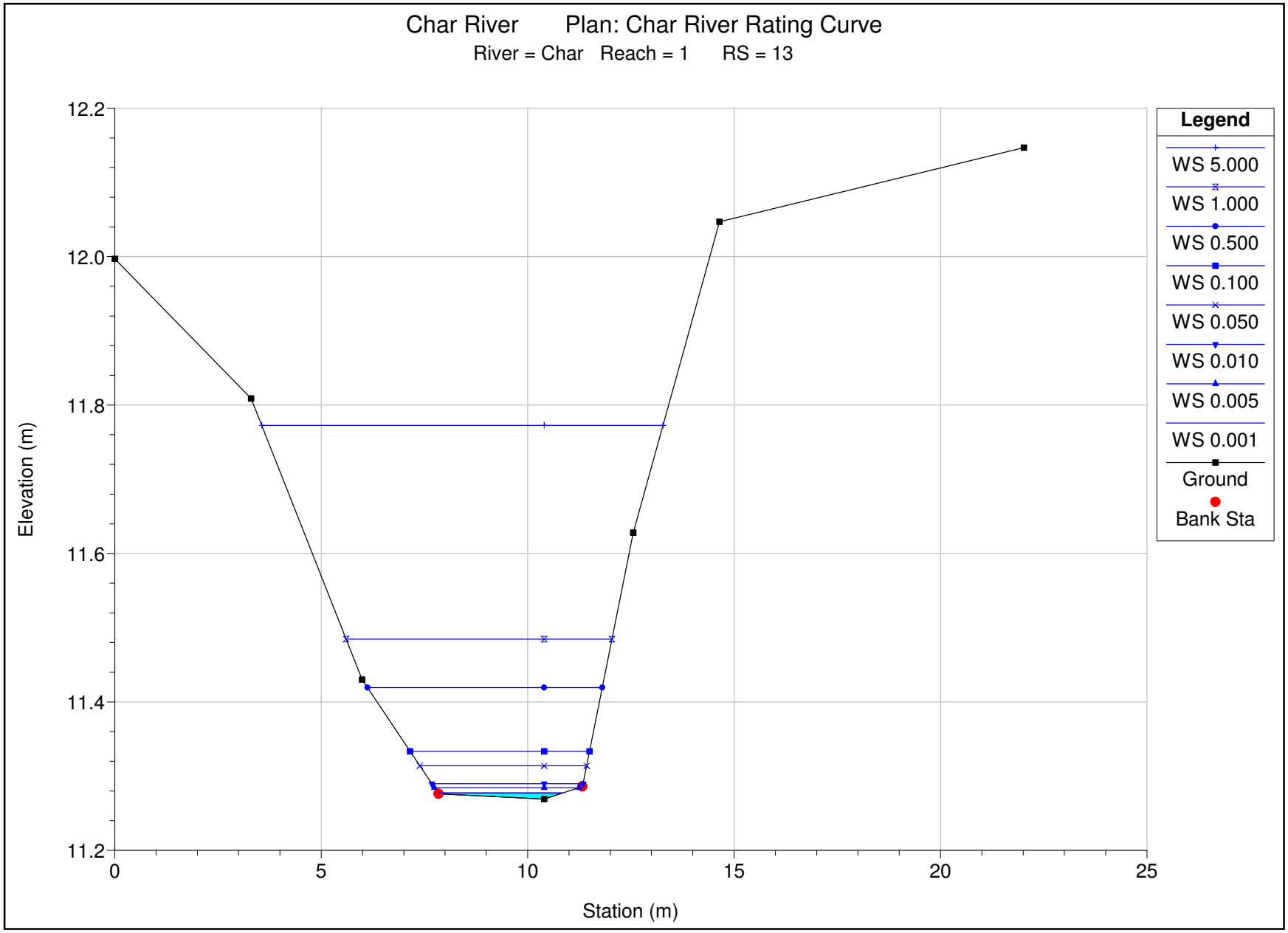
HEC-RAS Plan: Char-Rating Curve; River: Char River; Reach: 1

1	6	0.5	0.5	2.98	3.186	3.15	3.21	0.014175	0.66	0.76	7.34	0.65
1	6	1	1	2.98	3.2584	3.21	3.28	0.013452	0.64	1.56	14.98	0.63
1	6	5	5	2.98	3.446	3.38	3.48	0.009759	0.81	6.14	32.67	0.6
1	6	10	10	2.98	3.5731	3.47	3.62	0.007011	0.96	10.45	34.32	0.55
1	5	0.001	0	2.01	2.25	2.03	2.25	0	0	0.68	5.66	0
1	5	0.005	0	2.01	2.2501	2.04	2.25	0.000001	0.01	0.68	5.66	0.01
1	5	0.01	0.01	2.01	2.2503	2.05	2.25	0.000006	0.01	0.68	5.67	0.01
1	5	0.05	0.05	2.01	2.2559	2.09	2.26	0.000129	0.07	0.72	5.81	0.06
1	5	0.1	0.1	2.01	2.2695	2.11	2.27	0.000387	0.13	0.8	6.14	0.11
1	5	0.5	0.5	2.01	2.3726	2.22	2.38	0.001626	0.32	1.58	9.11	0.24
1	5	1	1	2.01	2.4512	2.28	2.46	0.002106	0.43	2.37	10.87	0.28
1	5	5	5	2.01	2.7289	2.52	2.77	0.003734	0.86	6.03	15.31	0.42
1	5	10	10	2.01	2.8745	2.68	2.95	0.005582	1.23	8.41	17.38	0.53
1	4	0.001	0	2.05	2.25	2.01	2.25	0	0	1.99	14.71	0
1	4	0.005	0	2.05	2.25	2.03	2.25	0	0	1.99	14.71	0
1	4	0.01	0.01	2.05	2.2501	2.04	2.25	0.000001	0.01	2	14.71	0
1	4	0.05	0.05	2.05	2.2511	2.07	2.25	0.000014	0.03	2.01	14.75	0.02
1	4	0.1	0.1	2.05	2.2542	2.1	2.25	0.000053	0.05	2.06	14.86	0.04
1	4	0.5	0.5	2.05	2.2956	2.15	2.3	0.000601	0.2	2.7	16.39	0.15
1	4	1	1	2.05	2.3387	2.18	2.34	0.001174	0.31	3.46	18.69	0.21
1	4	5	5	2.05	2.5187	2.35	2.53	0.00311	0.64	9.13	50.94	0.36
1	4	10	10	2.05	2.6305	2.49	2.65	0.003288	0.79	16.08	73.36	0.39
1	3	0.001	0	0.87	2.25	0.89	2.25	0	0	13.71	22.74	0
1	3	0.005	0	0.87	2.25	0.91	2.25	0	0	13.71	22.74	0
1	3	0.01	0.01	0.87	2.25	0.92	2.25	0	0	13.71	22.74	0
1	3	0.05	0.05	0.87	2.25	0.97	2.25	0	0.01	13.71	22.74	0
1	3	0.1	0.1	0.87	2.25	1	2.25	0	0.01	13.71	22.74	0
1	3	0.5	0.5	0.87	2.2502	1.12	2.25	0.000003	0.05	13.71	22.75	0.01
1	3	1	1	0.87	2.2507	1.21	2.25	0.000013	0.1	13.72	22.75	0.03
1	3	5	5	0.87	2.2663	1.58	2.27	0.000293	0.49	14.08	22.87	0.14
1	3	10	10	0.87	2.308	1.85	2.34	0.000975	0.92	15.04	23.18	0.26
1	2	0.001	0	1.2	2.25	1.21	2.25	0	0	27.62	36.68	0
1	2	0.005	0	1.2	2.25	1.23	2.25	0	0	27.62	36.68	0
1	2	0.01	0.01	1.2	2.25	1.24	2.25	0	0	27.62	36.68	0
1	2	0.05	0.05	1.2	2.25	1.26	2.25	0	0	27.62	36.68	0
1	2	0.1	0.1	1.2	2.25	1.27	2.25	0	0	27.62	36.68	0
1	2	0.5	0.5	1.2	2.2501	1.31	2.25	0.000001	0.02	27.62	36.68	0.01
1	2	1	1	1.2	2.2502	1.34	2.25	0.000003	0.04	27.62	36.68	0.01
1	2	5	5	1.2	2.2553	1.48	2.26	0.000068	0.21	27.81	36.73	0.07
1	2	10	10	1.2	2.2704	1.63	2.28	0.000255	0.4	28.37	36.87	0.13
1	1	0.001	0	0.43	2.25	0.45	2.25	0	0	38.32	38.89	0
1	1	0.005	0	0.43	2.25	0.46	2.25	0	0	38.32	38.89	0
1	1	0.01	0.01	0.43	2.25	0.46	2.25	0	0	38.32	38.89	0
1	1	0.05	0.05	0.43	2.25	0.49	2.25	0	0	38.32	38.89	0
1	1	0.1	0.1	0.43	2.25	0.51	2.25	0	0	38.32	38.89	0
1	1	0.5	0.5	0.43	2.2501	0.61	2.25	0	0.02	38.32	38.89	0
1	1	1	1	0.43	2.2501	0.68	2.25	0.000001	0.03	38.33	38.89	0.01
1	1	5	5	0.43	2.2518	0.98	2.25	0.000023	0.17	38.39	38.91	0.04
1	1	10	10	0.43	2.2571	1.2	2.26	0.000089	0.33	38.6	38.98	0.08

ATTACHMENT B2

HEC-RAS Sections

Date: July 20, 2015
Project No. 1534002
To: Nicole Lanchuske, Project Officer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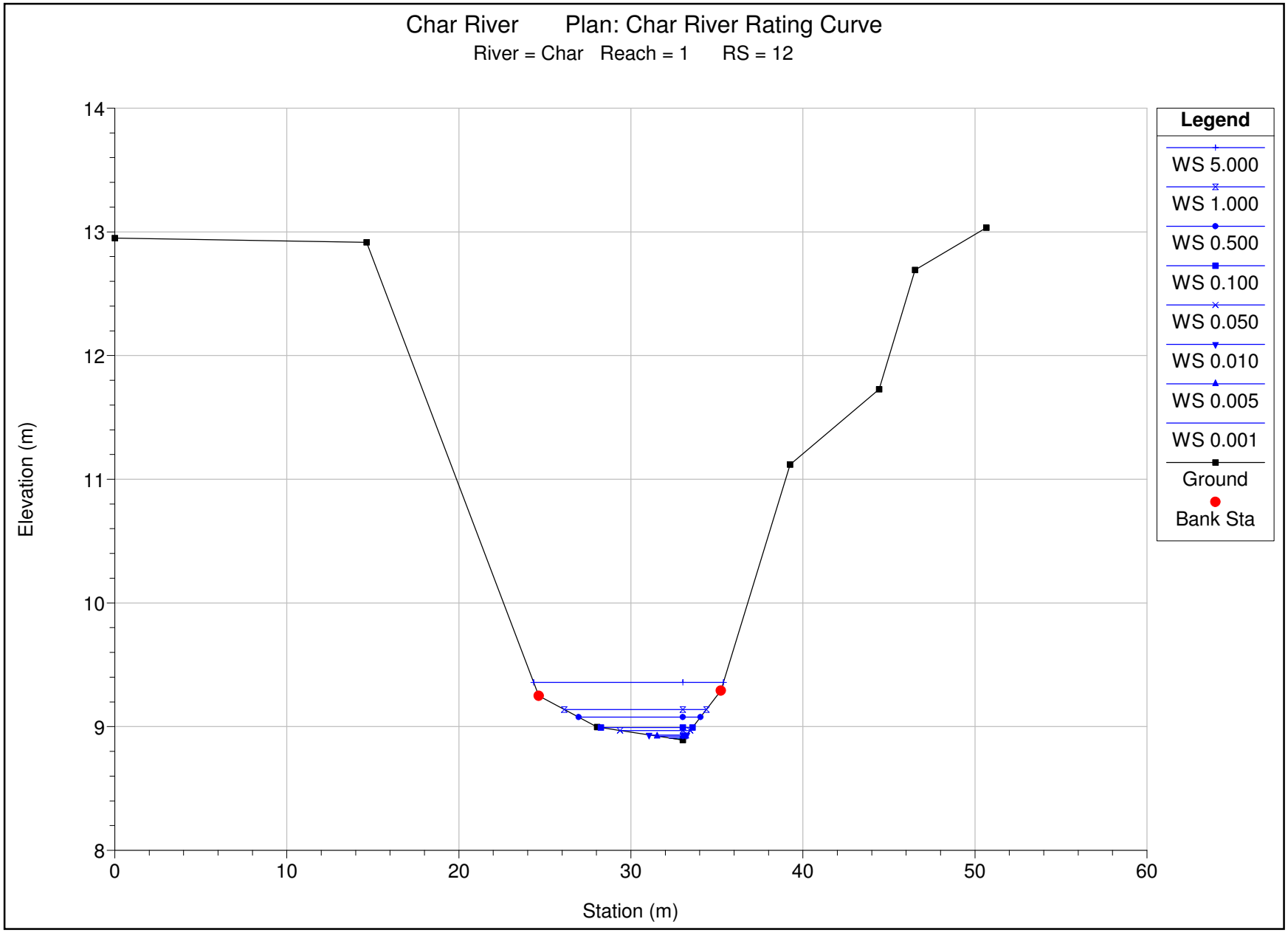
River = Char Reach = 1 RS = 13
Elevation (m)
12.2
12.0
11.8
11.6
11.4
11.2
0
5
10
15
20
25
Station (m)
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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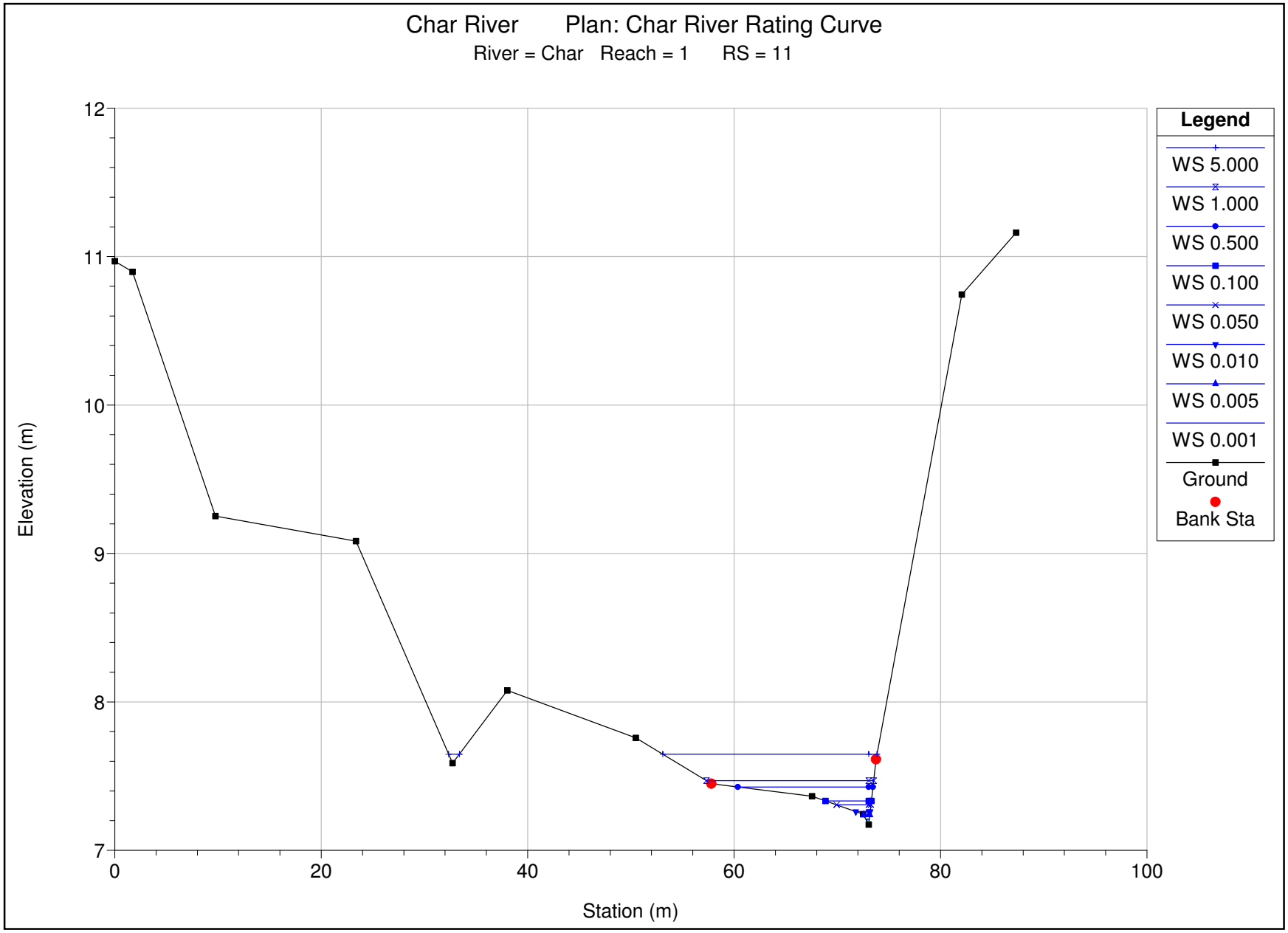
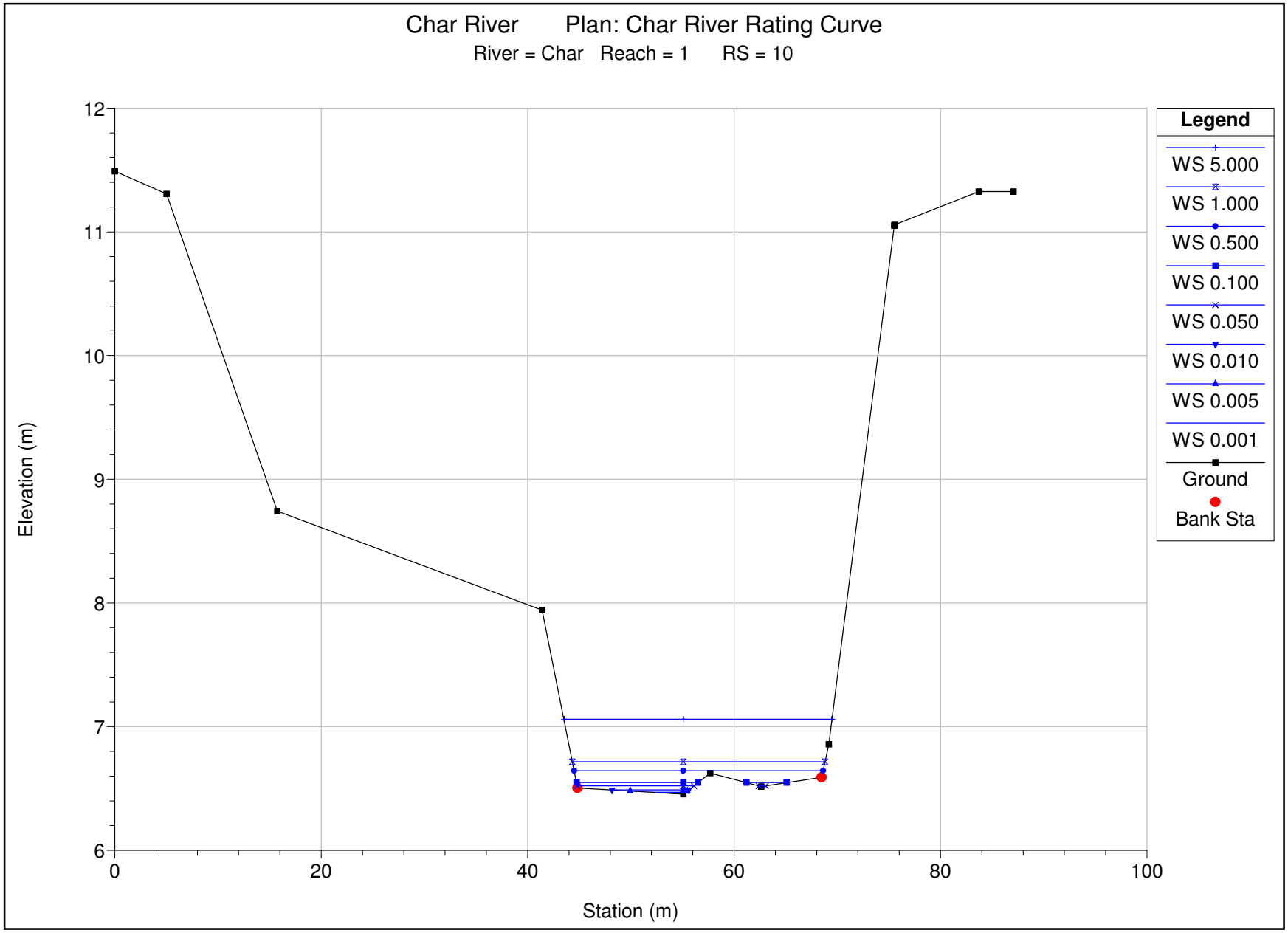
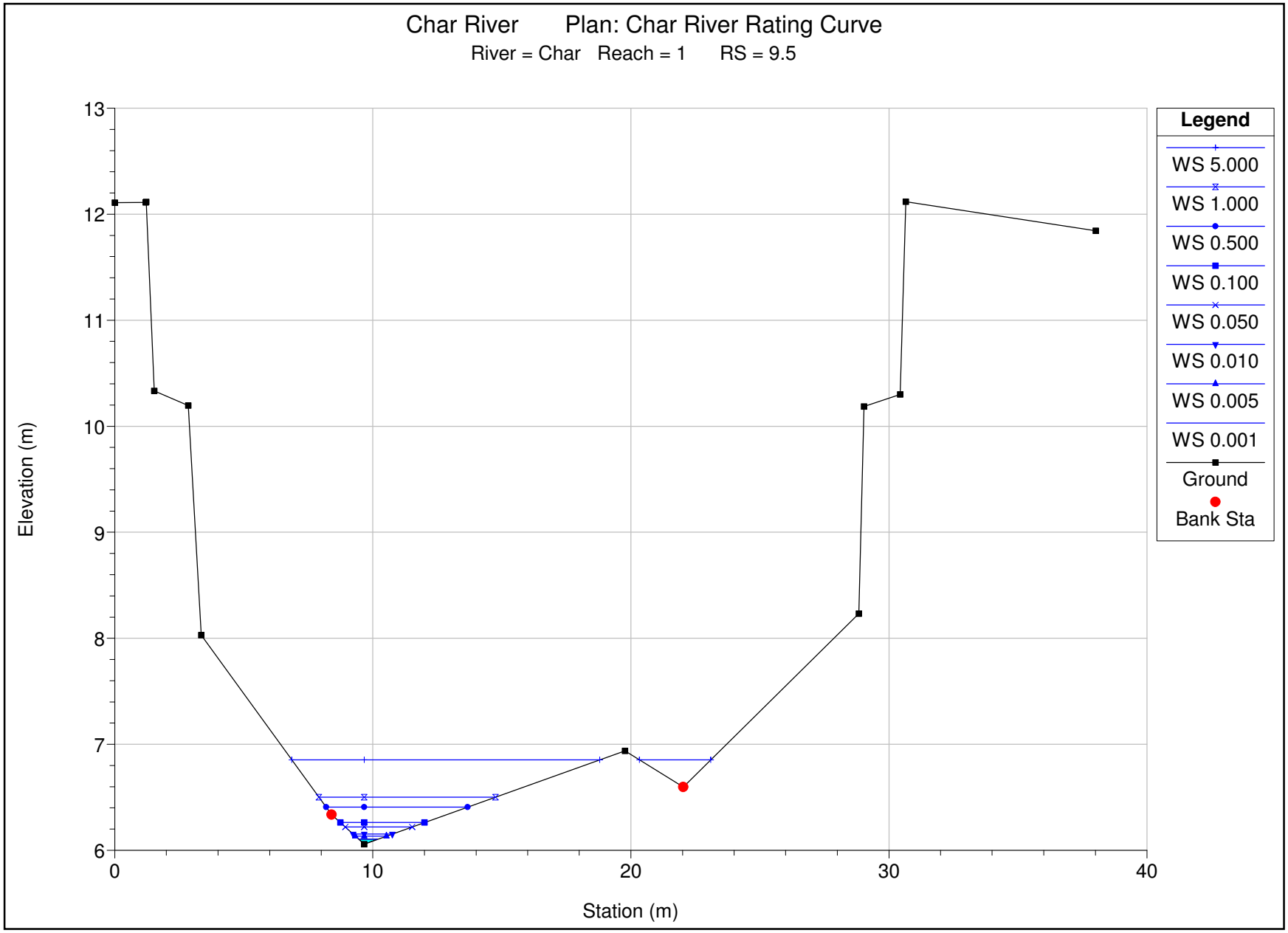
Elevation (m)
Station (m)
14
13
12
11
10
9
8
0
10
20
30
40
50
60
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 11
Elevation (m)
Station (m)
12
11
10
9
8
7
0
20
40
60
80
100
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 10
Elevation (m)
Station (m)
12
11
10
9
8
7
6
0
20
40
60
80
100
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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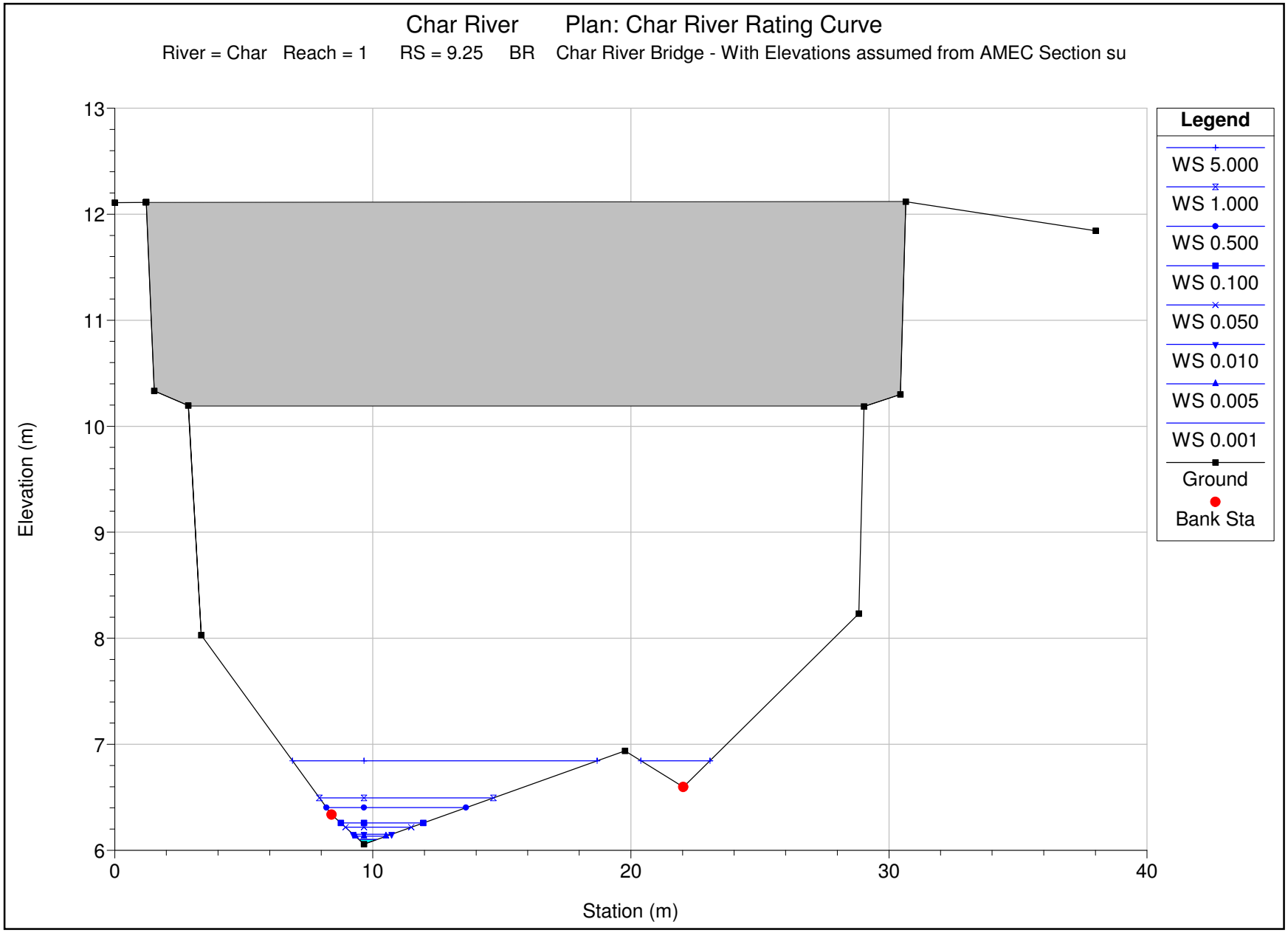
River = Char Reach = 1 RS = 9.5
Elevation (m)
13
12
11
10
9
8
7
6
0
10
20
30
40
Station (m)
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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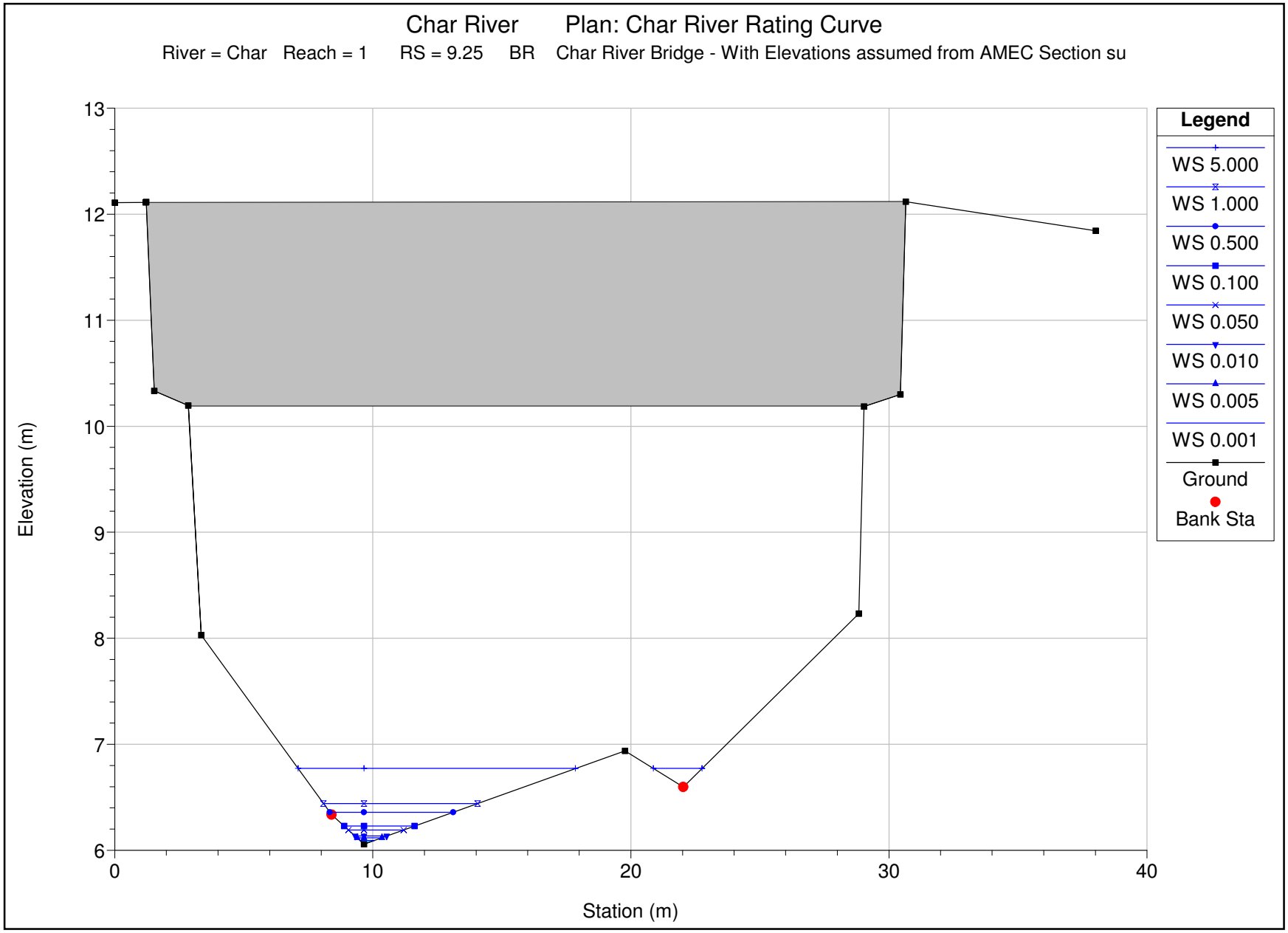
River = Char Reach = 1 RS = 9.25 BR Char River Bridge - With Elevations assumed from AMEC Section su
Elevation (m)
Station (m)
13
12
11
10
9
8
7
6
0
10
20
30
40
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 9.25 BR Char River Bridge - With Elevations assumed from AMEC Section su
Elevation (m)
13
12
11
10
9
8
7
6
0
10
20
30
40
Station (m)
Legend
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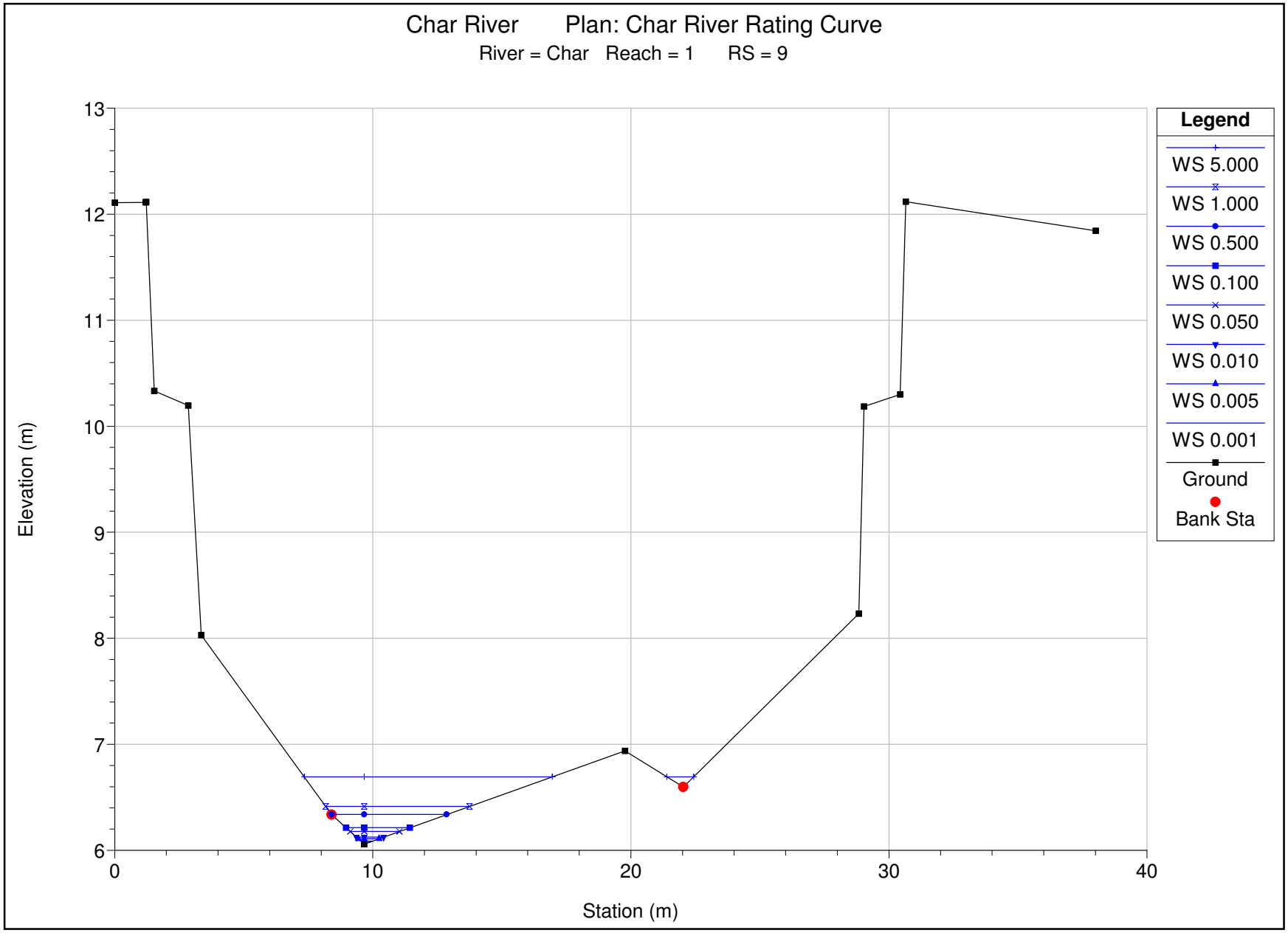
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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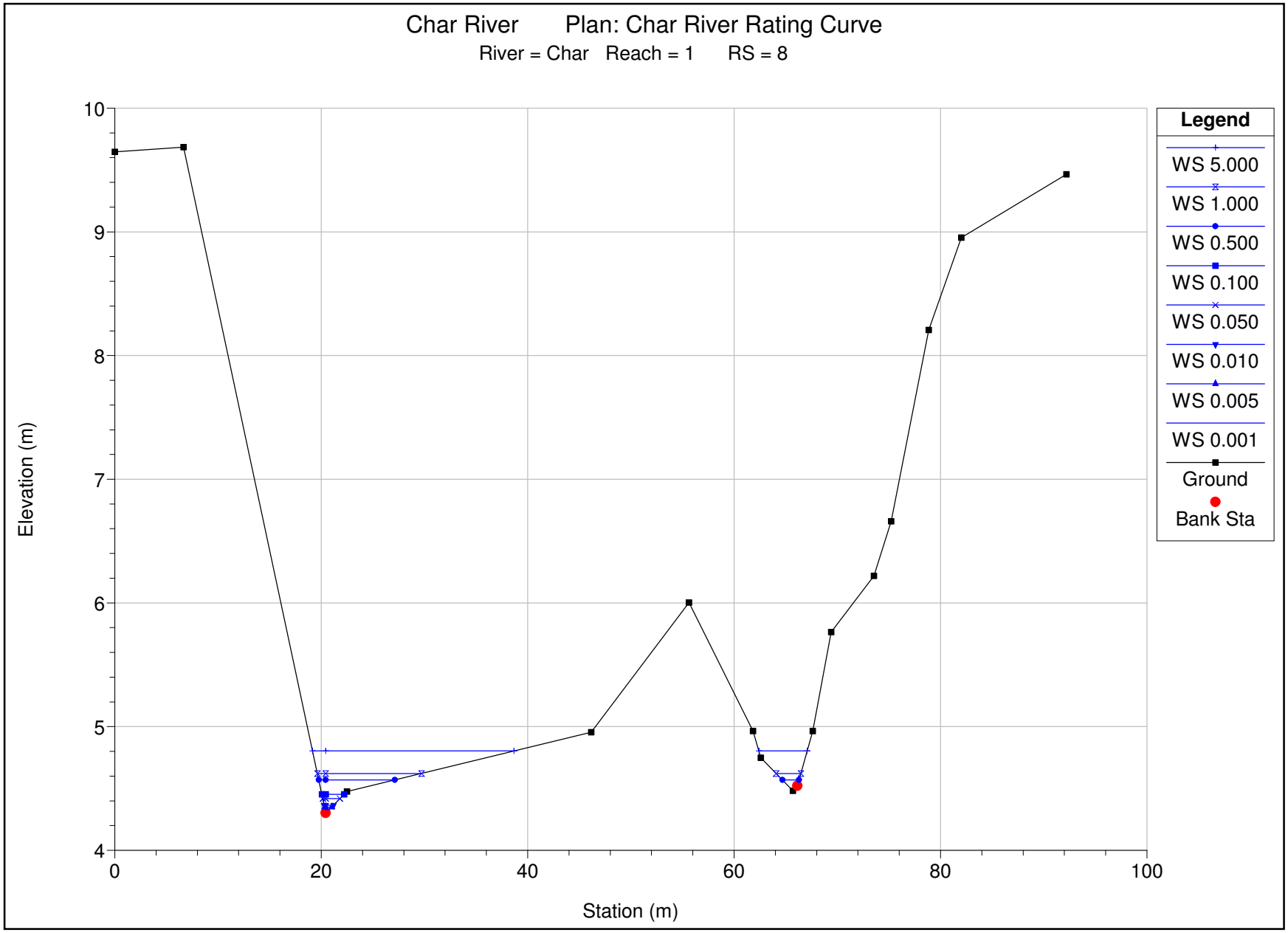
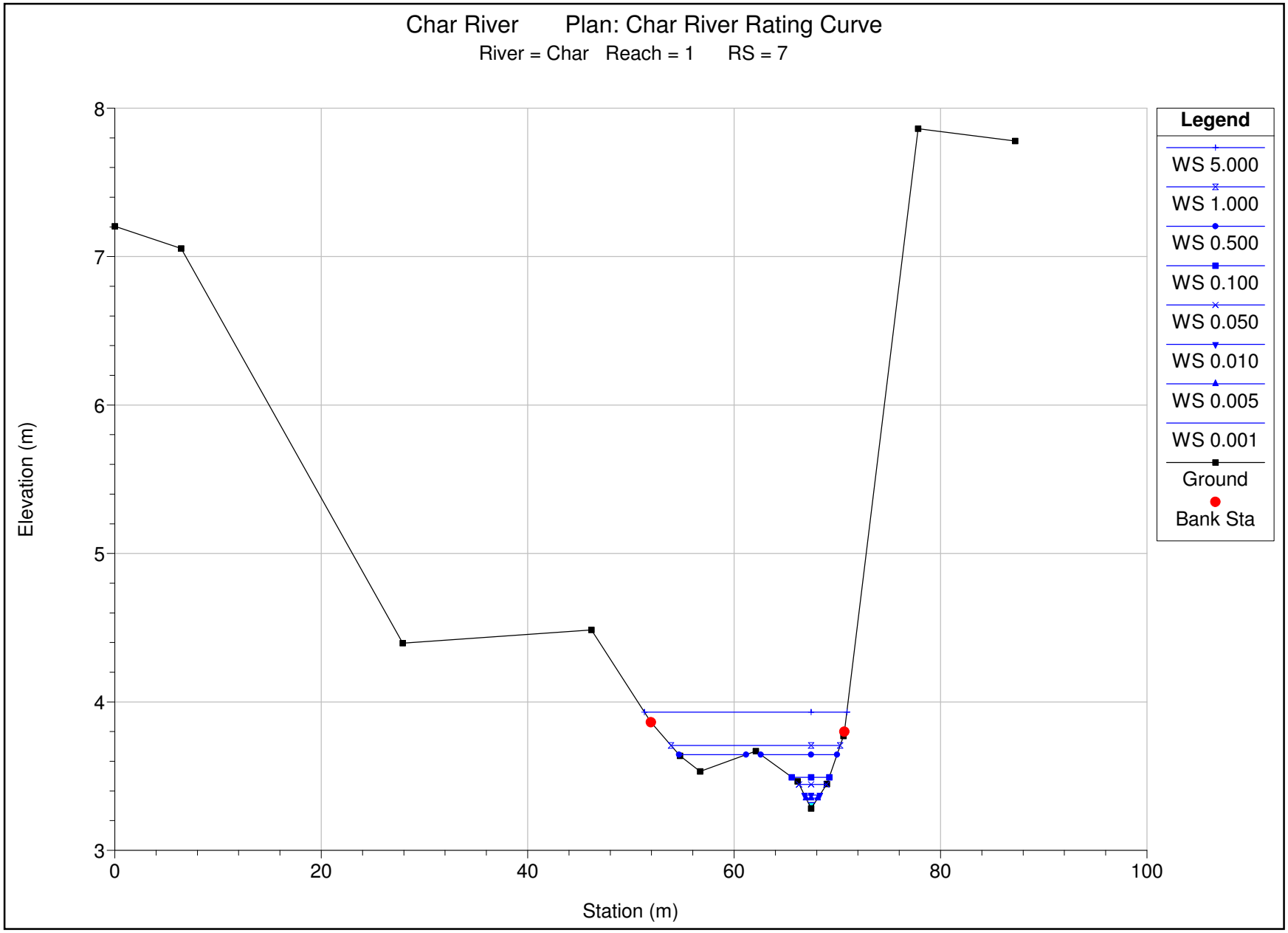
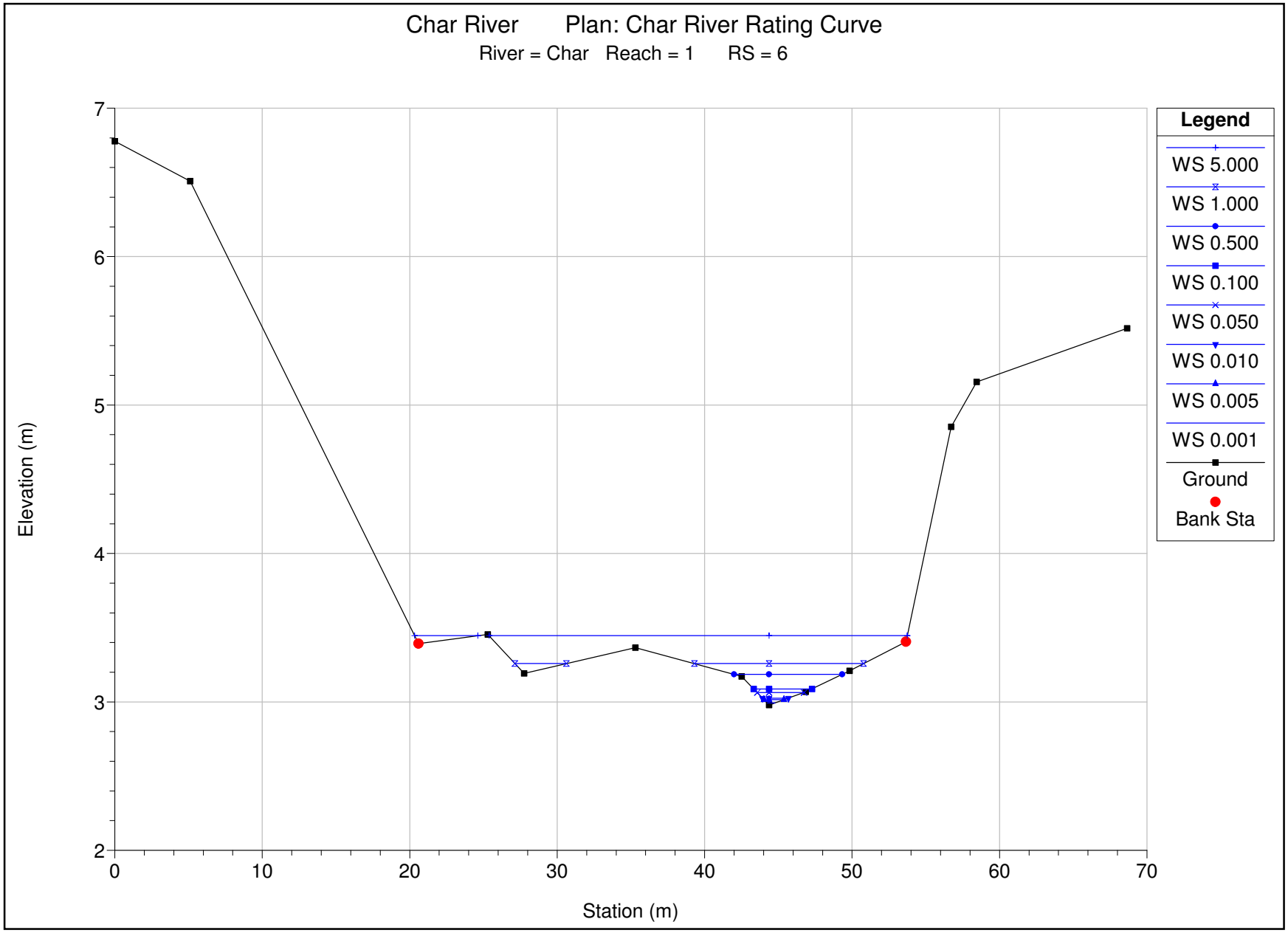
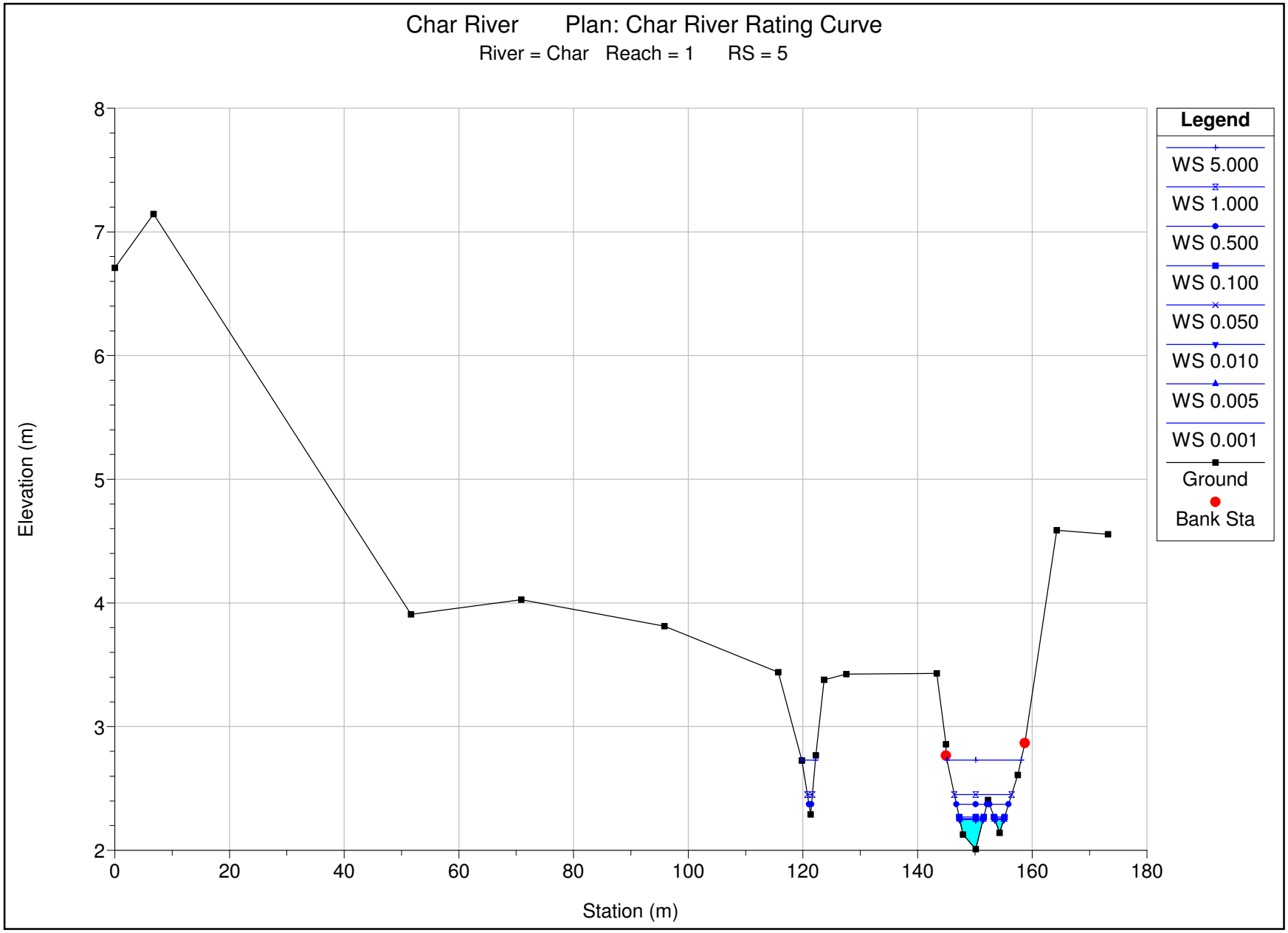
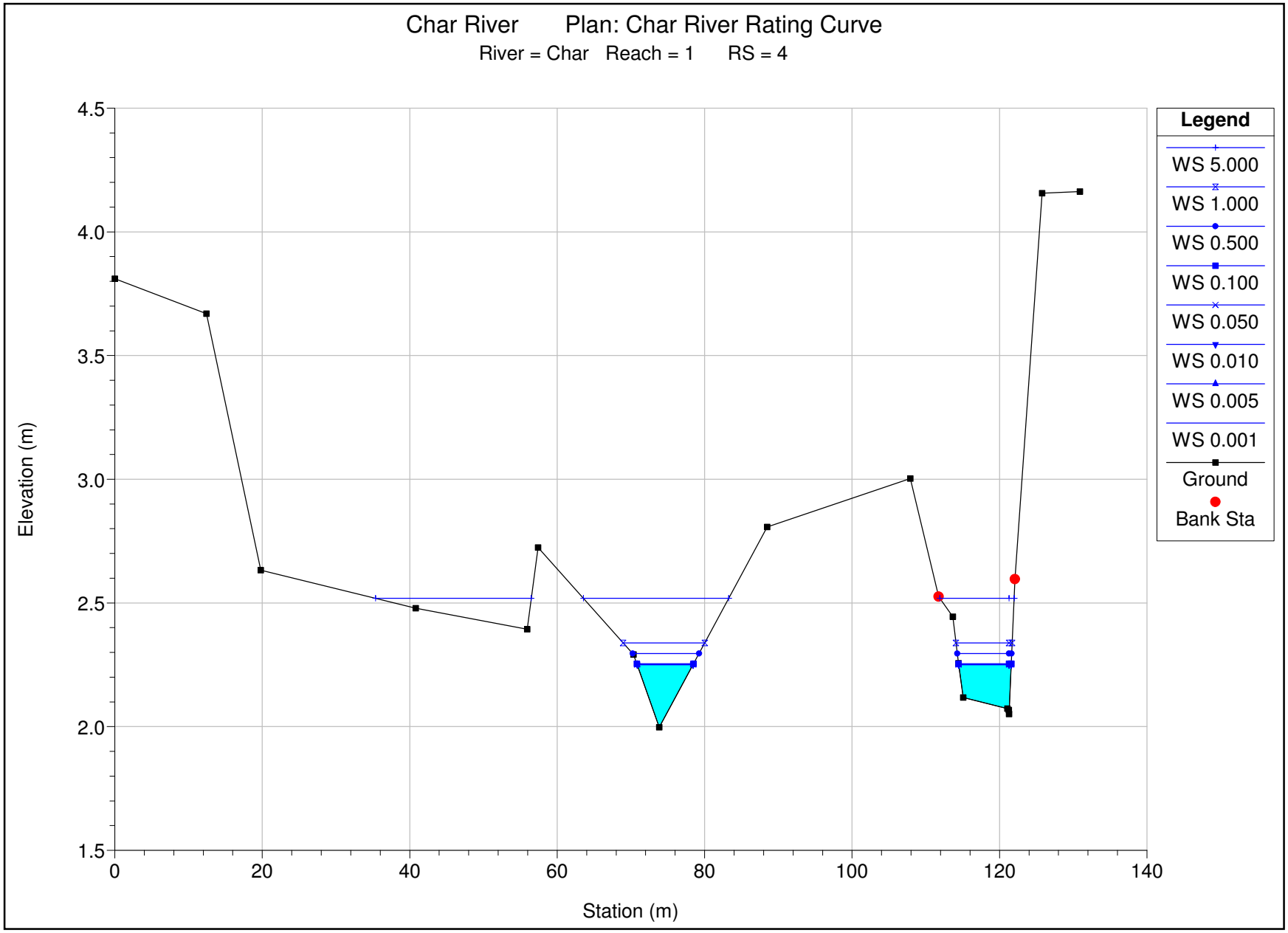
River = Char Reach = 1 RS = 9
Elevation (m)
Station (m)
13
12
11
10
9
8
7
6
0
10
20
30
40
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta

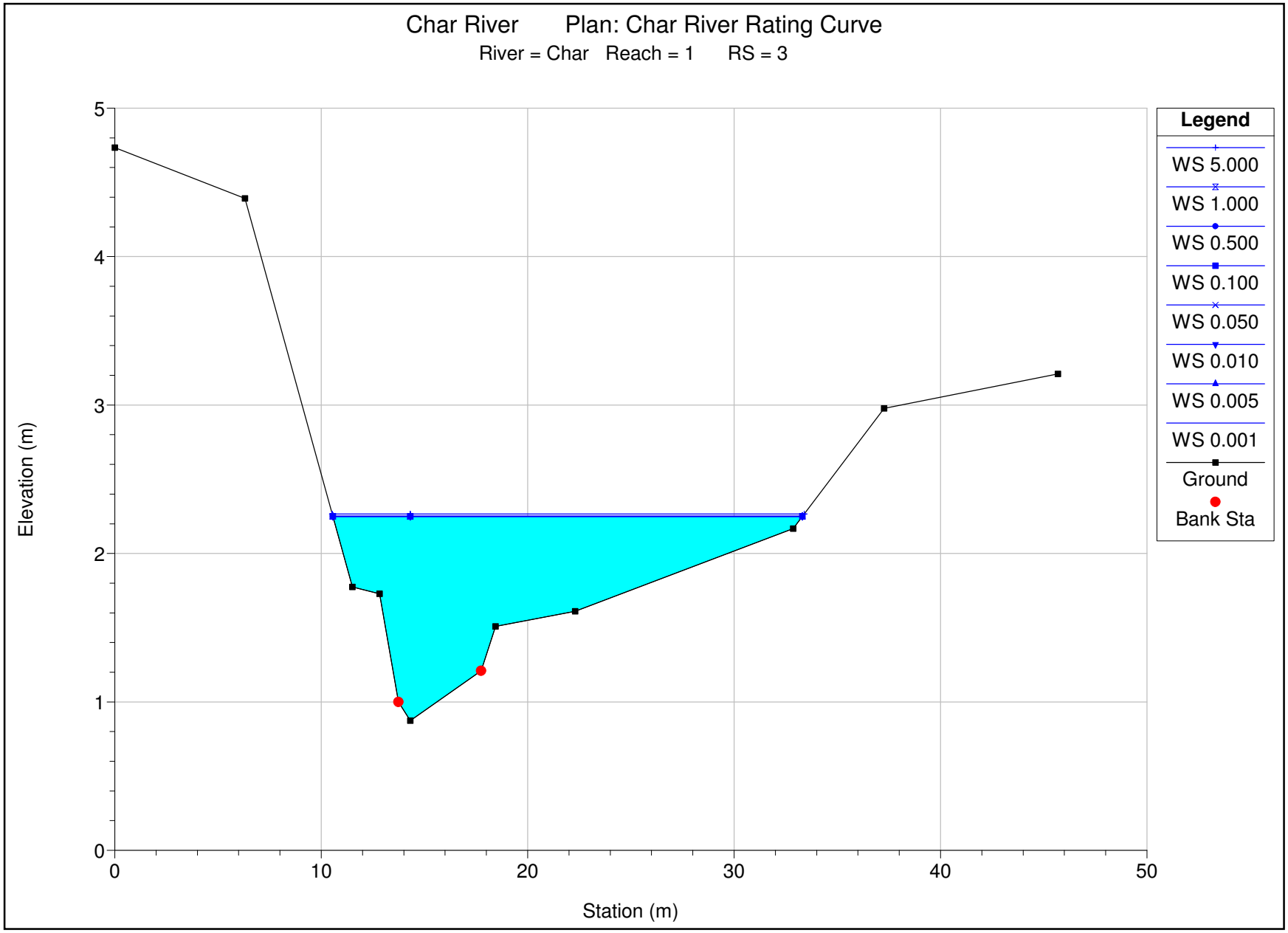

Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 8
Elevation (m)
Station (m)
10
9
8
7
6
5
4
0
20
40
60
80
100
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta

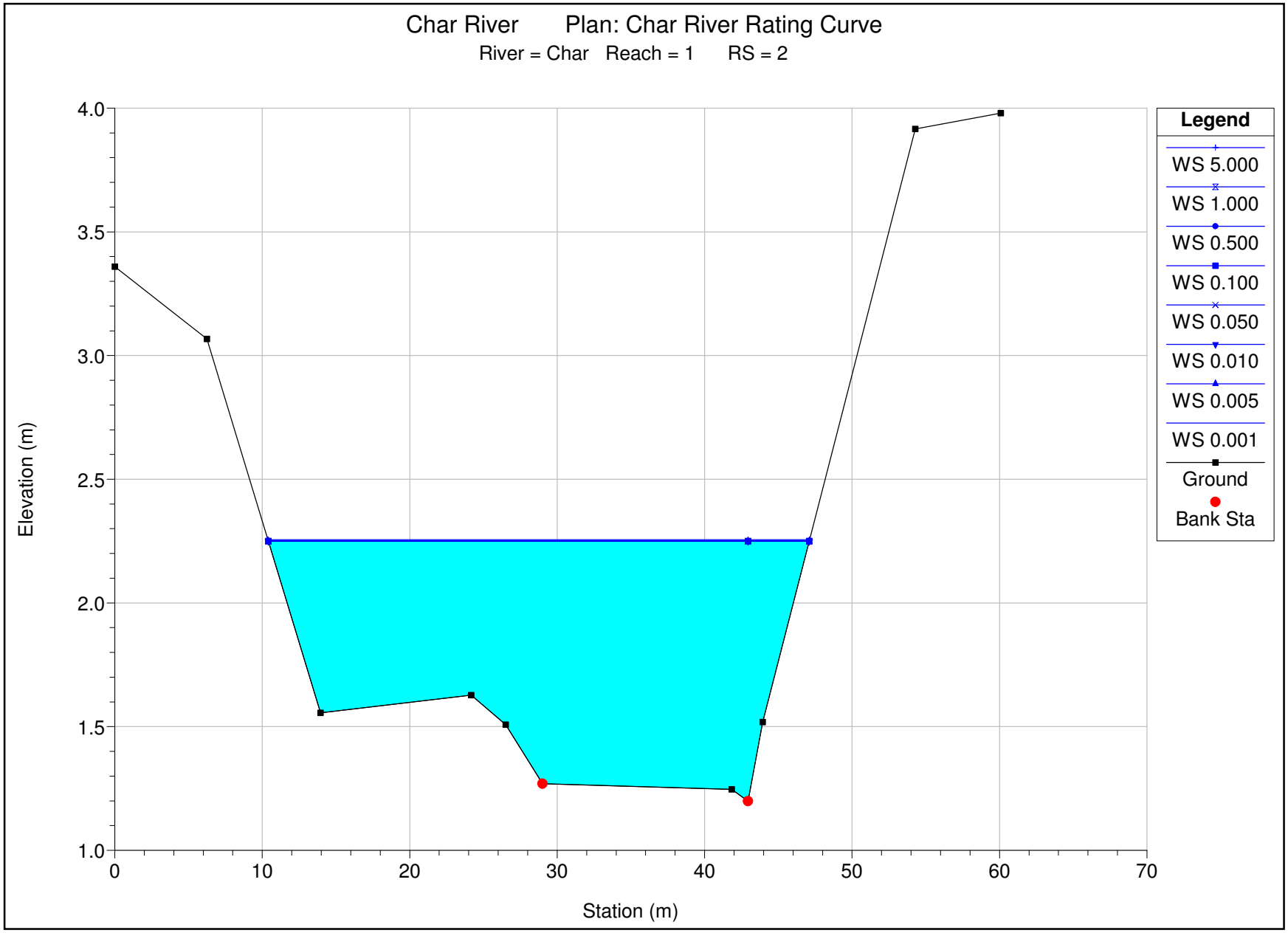

Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 7
Elevation (m)
Station (m)
8
7
6
5
4
3
0
20
40
60
80
100
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 6
Elevation (m)
Station (m)
7
6
5
4
3
2
0
10
20
30
40
50
60
70
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 5
Elevation (m)
Station (m)
8
7
6
5
4
3
2
0
20
40
60
80
100
120
140
160
180
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 4
Elevation (m)
Station (m)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
0
20
40
60
80
100
120
140
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta


Char River Plan: Char River Rating Curve
River = Char Reach = 1 RS = 3
Elevation (m)
Station (m)
0
1
2
3
4
5
0
10
20
30
40
50
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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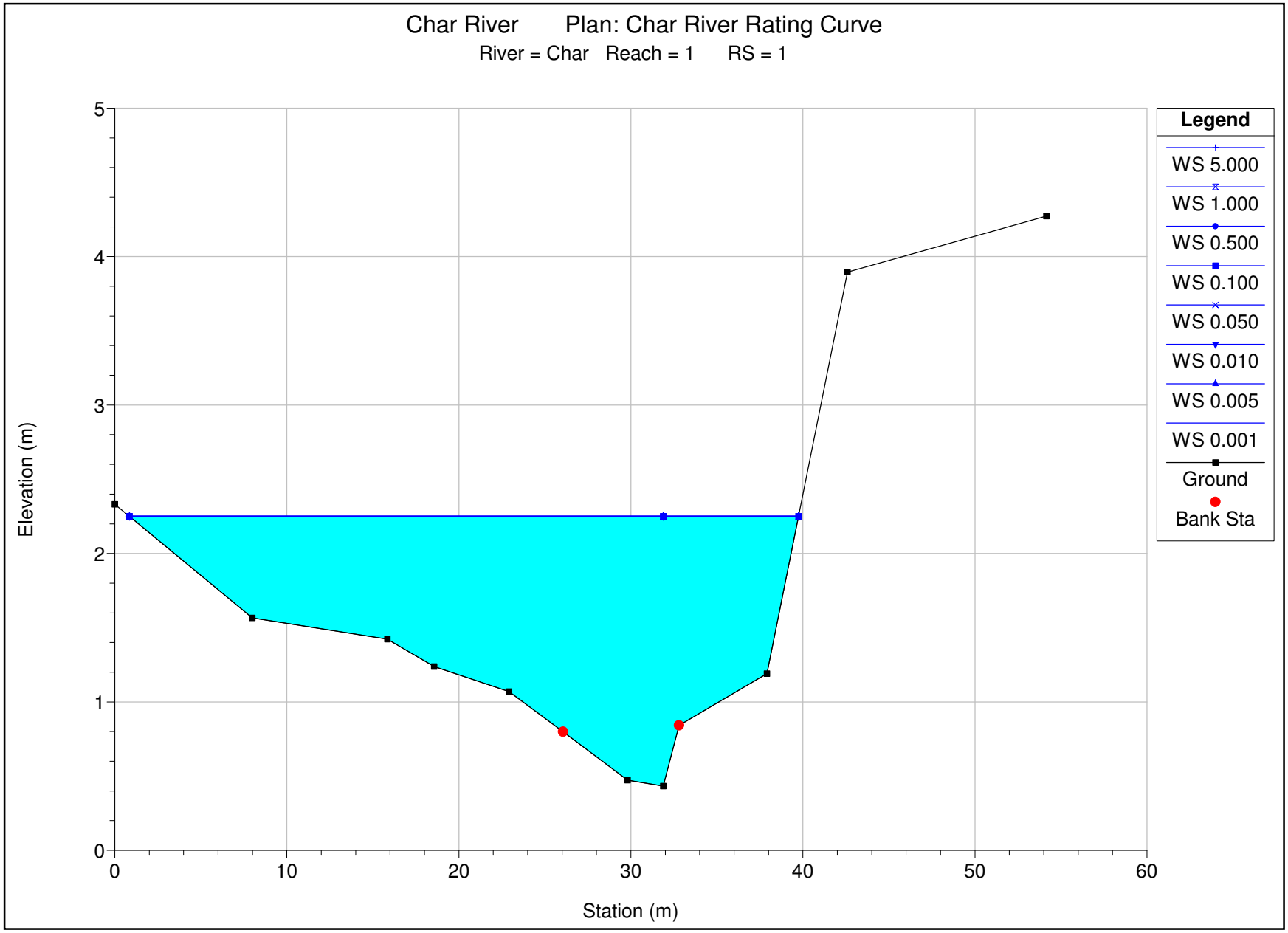
River = Char Reach = 1 RS = 2
Elevation (m)
Station (m)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
10
20
30
40
50
60
70
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta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River = Char Reach = 1 RS = 1
Elevation (m)
Station (m)
0
1
2
3
4
5
0
10
20
30
40
50
60
Legend
WS 5.000
WS 1.000
WS 0.500
WS 0.100
WS 0.050
WS 0.010
WS 0.005
WS 0.001
Ground
Bank Sta

Appendix C – Char River Water Pumped to Nipissar Lake 2015

Char River Water Pumped to Nipissar Lake

Water Licence No. 3AM-GRA1015

GRA-6

Date	Time	Flow Meter Reading (m^3)	Daily Volume Pumped (m^3)	Total Volume Pumped (m^3)	Nipissar Lake Elevations (inches)	Nipissar Lake Elevations (m)	Change in Elevation* (inches)	Change in Elevation* (m)
18-Jun-15	11:40 AM	7	-	-				
19-Jun-15	9:05 AM	2651	2644	2644	123.875	3.146425		
20-Jun-15	7:45 AM	5427	2776	5420				
21-Jun-15	8:00 AM	8399	2972	8392				
22-Jun-15	8:30 AM	11367	2968	11360				
23-Jun-15	8:30 AM	14338	2971	14331				
24-Jun-15	8:45 AM	17250	2912	17243				
25-Jun-15	8:30 AM	20100	2850	20093				
26-Jun-15	9:30 AM	22117	2017	22110	122.5	3.115	1.375	0.031425
27-Jun-15	8:30 AM	24785	2668	24778				
28-Jun-15	9:45 AM	27909	3124	27902				
29-Jun-15	8:45 AM	29857	1948	29850				
30-Jun-15	9:30 AM	32388	2531	32381				
01-Jul-15	9:27 AM	35422	3034	35415				
02-Jul-15	8:55 AM	38373	2951	38366				
03-Jul-15	9:14 AM	41440	3067	41433				
04-Jul-15	9:50 AM	44545	3105	44538				
05-Jul-15	9:39 AM	47555	3010	47548				
06-Jul-15	9:03 AM	50498	2943	50491				
07-Jul-15	8:40 AM	53456	2958	53449	121.8125	3.0940375	2.0625	0.0523875
08-Jul-15	7:15 AM	56399	2943	56392				
09-Jul-15	9:30 AM	59430	3031	59423				
10-Jul-15	8:40 AM	62265	2835	62258				
11-Jul-15	8:00 AM	65177	2912	65170				
12-Jul-15	8:30 AM	68242	3065	68235				
13-Jul-15	8:45 AM	71221	2979	71214				
14-Jul-15	9:12 AM	74155	2934	74148				
15-Jul-15	9:30 AM	77054	2899	77047				
16-Jul-15	8:30 AM	79782	2728	79775				
17-Jul-15	8:30 AM	82560	2778	82553				
18-Jul-15	8:50 AM	85443	2883	85436				
19-Jul-15	8:55 AM	88343	2900	88336				
20-Jul-15	8:45 AM	91105	2762	91098	119	3.0226	4.875	0.123825
21-Jul-15	9:15 AM	94100	2995	94093				
22-Jul-15	9:24 AM	97093	2993	97086				
23-Jul-15	8:45 AM	100028	2935	100021				
24-Jul-15	9:15 AM	102463	2435	102456				
25-Jul-15	8:30 AM	105848	3385	105841				
26-Jul-15	8:45 AM	108779	2931	108772				
27-Jul-15	9:13 AM	111764	2985	111757	119.375	3.032125	4.5	0.1143

28-Jul-15								
29-Jul-15	9:30 AM	117609	5845	117602				
30-Jul-15	1:53 PM	121007	3398	121000				
31-Jul-15	9:30 AM	123371	2364	123364				
01-Aug-15	7:45 AM	126016	2645	126009				
02-Aug-15	7:45 AM	128880	2864	128873				
03-Aug-15	7:45 AM	131766	2886	131759				
04-Aug-15	8:30 AM	134796	3030	134789				
05-Aug-15	9:15 AM	137481	2685	137474				
06-Aug-15	10:15 AM	140815	3334	140808				
07-Aug-15								
08-Aug-15	8:15 AM	146307	5492	146300				
09-Aug-15	9:00 AM	149293	2986	149286				
10-Aug-15	9:00 AM	152211	2918	152204	116	2.9464	7.875	0.200025
11-Aug-15	9:11 AM	155111	2900	155104				
12-Aug-15	8:45 AM	157952	2841	157945				
13-Aug-15	8:35 AM	160865	2913	160858				
14-Aug-15	11:15 AM	164003	3138	163996				
15-Aug-15	9:00 AM	166860	2857	166853				
16-Aug-15	8:07 AM	169386	2526	169379				
17-Aug-15	9:30 AM	172412	3026	172405	115.25	2.92735	8.625	0.219075
18-Aug-15	9:00 AM	175233	2821	175226				
19-Aug-15	9:08 AM	178103	2870	178096				
20-Aug-15	2:50 PM	181668	3565	181661				
21-Aug-15	9:00 AM	183875	2207	183868				
22-Aug-15								
23-Aug-15								
24-Aug-15	9:30 AM	192316	8441	192309				
25-Aug-15	8:45 AM	195029	2713	195022				
26-Aug-15	9:15 AM	197817	2788	197810				
27-Aug-15	9:00 AM	200671	2854	200664				
28-Aug-15	9:30 AM	203919	3248	203912				
29-Aug-15	9:20 AM	206359	2440	206352				
30-Aug-15	8:45 AM	209126	2767	209119				
31-Aug-15	8:54 AM	211990	2864	211983				
01-Sep-15	9:05 AM	214821	2831	214814				
02-Sep-15	8:45 AM	217639	2818	217632				
03-Sep-15								
04-Sep-15								
05-Sep-15								
06-Sep-15								
07-Sep-15								
08-Sep-15								
09-Sep-15					115	2.921	8.875	0.225425
10-Sep-15								
11-Sep-15	2:19 PM	243644	26005	243637				
12-Sep-15								
13-Sep-15								
14-Sep-15								
15-Sep-15								
16-Sep-15								

17-Sep-15								
18-Sep-15								
19-Sep-15								
20-Sep-15								
21-Sep-15								
22-Sep-15								
23-Sep-15								
24-Sep-15								
25-Sep-15					113.25	2.87655	10.625	0.269875

*from first reading

Last day of pumping

Appendix C – Summary of Water Chemistry Analysis 2014

Summary of Water Chemistry Analysis

Parameters	Units	Detection Limit	24-Jun-14		07-Oct-14		Guidelines for Canadian Drinking Water Quality
			Nipissar Lake	Char River	Char River	Lower Landing Lake	
Miscellaneous Parameters							
Ammonia, Total (as N)	mg/L	0.010	<0.010	<0.010	<0.010	0.037	None required
Biochemical Oxygen Demand	mg/L	6.0			<6.0	<6.0	
Phosphorus (P)-Total	mg/L	0.010	0.02	0.013	<0.010	<0.010	
Total Kjeldahl Nitrogen	mg/L	0.20			0.27	0.27	
Fecal Coliforms	MPN/100mL	3	<3	<3	<3	<3	
Total Suspended Solids	mg/L	5	8	<5.0			
Alkalinity							
Alkalinity, Total (as CaCO3)	mg/L	20	41	20	25	23	
Bicarbonate (HCO3)	mg/L	24	50	25	30	28	
Carbonate (CO3)	mg/L	12	<12	<12	<12	<12	
Hydroxide (OH)	mg/L	6.8	<6.8	<6.8	<6.8	<6.8	
Chloride by Ion Chromatography							
Chloride	mg/L	0.50	30.5	15.7	22.4	24.2	AO: ≤ 250 mg/L
Conductivity							
Conductivity	umhos/cm	20	210	104	150	151	
Hardness Calculated							
Hardness (as CaCO3)	mg/L	0.30	54.9	24.3	35.7	32.1	None required
Nitrate as N by Ion Chromatography							
Nitrate-N	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	
Nitrate+Nitrite							
Nitrate and Nitrite as N	mg/L	0.071	<0.071	<0.071	<0.071	<0.071	10 mg/L as nitrate-nitrogen
Nitrite as N by Ion Chromatography							
Nitrite-N	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	
Sulfate by Ion Chromatography							
Sulfate	mg/L	0.50	11	4.75	8.99	7.89	AO: ≤ 500 mg/L
TDS Calculated							
TDS (Calculated)	mg/L	5.0	105	50.3	73.8	73.8	AO: < 500 mg/L
Total Metals by ICP-MS							
Aluminum (Al)-Total	mg/L	0.02	0.075	<0.020	<0.020	0.020	OG: <0.1 mg/L (conventional); <0.2 mg/L (other treatment types)
Antimony (Sb)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	MAC: 0.006 mg/L
Arsenic (As)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	MAC: 0.010 mg/L
Barium (Ba)-Total	mg/L	0.0005	0.01444	0.0102	0.0149	0.0134	MAC: 1.0 mg/L
Beryllium (Be)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	
Bismuth (Bi)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	
Boron (B)-Total	mg/L	0.03	0.037	<0.030	<0.030	<0.030	MAC: 5 mg/L
Cadmuim (Cd)-Total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	MAC: 0.005 mg/L
Calcium (Ca)-Total	mg/L	0.2	16.6	7.3	10.2	8.62	None required
Cesium (Cs)- Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	
Chromium (Cr)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	MAC: 0.05 mg/L
Cobalt (Co)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	
Copper (Cu)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	AO: ≤ 1.0 mg/L
Iron (Fe)-Total	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	AO: ≤ 0.3 mg/L
Lead (Pb)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	MAC: 0.010 mg/L
Lithium (Li)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	

Magnesium (Mg)-Total	mg/L	0.05	3.24	1.47	2.49	2.58	None required
Manganese (Mn)-Total	mg/L	0.001	0.006	0.0043	0.0054	0.0039	AO: ≤ 0.05 mg/L
Molybdenum (Mo)-Total	mg/L	0.0005	0.00067	<0.00050	<0.00050	0.00055	
Nickel (Ni)- Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	
Phosphorus (P)-Total	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	
Potassium (K)-Total	mg/L	0.1	1.86	1.03	1.60	1.59	
Rubidium (Rb)-Total	mg/L	0.0005	0.00164	0.00144	0.00203	0.00195	
Selenium (Se)-Total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	MAC: 0.01 mg/L
Silicon (Si)-Total	mg/L	0.3	<0.30	<0.30	<0.30	<0.30	
Silver(Ag)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	None required
Sodium(Na)-Total	mg/L	0.05	16.6	7.98	13.4	15.2	AO: ≤ 200 mg/L
Strontium(Sr)-Total	mg/L	0.0005	0.0826	0.0426	0.0547	0.0514	
Tellurium(Te)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	
Thallium(Tl)-Total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	
Thorium(Th)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	
Tin(Sn)-Total	mg/L	0.0006	<0.00060	<0.00060	<0.00060	<0.00060	
Titanium(Ti)-Total	mg/L	0.001	0.0029	<0.0010	<0.0010	<0.0010	
Tungsten(W)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	
Uranium(U)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	MAC: 0.02 mg/L
Vanadium(V)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	
Zinc(Zn)-Total	mg/L	0.02	<0.020	<0.020	<0.020	<0.020	AO: ≤ 5.0 mg/L
Zirconium(Zr)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	
pH							
pH	pH Units	0.1	7.77	7.46	7.63	7.62	6.5-8.5

MAC - Maximum acceptable concentrations (health based)
AO - Aesthetic objectives (based on aesthetic considerations)
OG - Operational guidance values (based on operational considerations)

Appendix E – Summary of Hydrocarbon Contamination Analysis 2014

Summary of Hydrocarbon Contamination Analysis

Parameters	Units	Detection Limit	07-Oct-14			Guidelines for Canadian Drinking Water Quality
			Nipissar Lake	Char River	Lower Landing Lake	
BTX plus F1 by GCMS						
Benzene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	MAC: 0.005 mg/L
Toluene	mg/L	0.0010	<0.0010	<0.0010	<0.0010	AO: ≤ 0.024 mg/L [1]
Ethylbenzene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	AO: ≤ 0.0024 mg/L [2]
o-Xylene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	
m+p-Xylenes	mg/L	0.00050	<0.00050	<0.00050	<0.00050	
F1 (C6-C10)	mg/L	0.10	<0.10	<0.10	<0.10	
CCME Total Hydrocarbons						
F1-BTEX	mg/L	0.10	<0.10	<0.10	<0.10	
F2-Naphth	mg/L	0.25	<0.25	<0.25	<0.25	
F3-PAH	mg/L	0.25	<.025	<.025	<.025	
Total Hydrocarbons (C6-C50)	mg/L	0.44	<0.44	<0.44	<0.44	
F2-F4 PHC Method						
F2 (C10-C16)	mg/L	0.25	<0.25	<0.25	<0.25	
F3 (C16-C34)	mg/L	0.25	<0.25	<0.25	<0.25	
F4 (C34-C50)	mg/L	0.25	<0.25	<0.25	<0.25	
Sum of Xylene Isomer Concentrations						
Xylenes (Total)	mg/L	0.0015	<0.0015	<0.0015	<0.0015	AO: ≤ 0.3 mg/L [3]
Polyaromatic Hydrocarbons (PAHs)						
1-Methyl Napthalene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
2-Methyl Naphthalene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Acenaphthene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Acenaphthylene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Anthracene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Acridine	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Benzo(a)anthracene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Benzo(a)pyrene	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050	MAC: 0.00001 mg/L
Benzo(b&j)fluoranthene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Benzo(g,h,i)perylene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Benzo(k)fluoranthene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Chrysene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Dibenzo(a,h)anthracene	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050	
Fluoranthene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Fluorene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
Indeno(1,2,3-cd)pyrene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Naphthalene	mg/L	0.000050	0.000061	<0.000050	<0.000050	
Phenanthrene	mg/L	0.000050	<0.000050	<0.000050	<0.000050	
Pyrene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	
Quinoline	mg/L	0.000020	<0.000020	<0.000020	<0.000020	
B(a)P Total Potency Equivalent	mg/L	0.000030	<0.000030	<0.000030	<0.000030	

MAC - Maximum acceptable concentrations (health based)
AO - Aesthetic objectives (based on aesthetic considerations)
OG - Operational guidance values (based on operational considerations)

[1] AO based on odour

[2] AO based on odour; levels above the AO would render drinking water unpalatable

[3] AO based on taste and odour; levels above the AO would render water unpalatable

Appendix F – Certificate of Analysis June 24, 2014

Nunavut - Community & Government Services
- Rankin Inlet
ATTN: MEGAN LUSTY
PO BOX 490
BAG 002
Rankin Inlet NU X0C 0G0

Date Received: 25-JUN-14
Report Date: 04-JUL-14 09:28 (MT)
Version: FINAL

Client Phone: 867-645-8176

Certificate of Analysis

Lab Work Order #: L1476895

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

Barb Bayer
General Manager, Winnipeg

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1476895-1 NIPISSOR LAKE							
Sampled By: MEGAN LUSTY on 24-JUN-14 @ 10:45							
Matrix: WATER							
Miscellaneous Parameters							
Ammonia, Total (as N)	<0.010		0.010	mg/L		30-JUN-14	R2876966
Fecal Coliforms	<3		3	MPN/100mL		02-JUL-14	R2878375
Phosphorus (P)-Total	0.020		0.010	mg/L		02-JUL-14	R2877002
Total Suspended Solids	8.0		5.0	mg/L		27-JUN-14	R2875948
Routine Soluble + Metal scan							
Alkalinity							
Alkalinity, Total (as CaCO3)	41		20	mg/L		30-JUN-14	R2876471
Bicarbonate (HCO3)	50		24	mg/L		30-JUN-14	R2876471
Carbonate (CO3)	<12		12	mg/L		30-JUN-14	R2876471
Hydroxide (OH)	<6.8		6.8	mg/L		30-JUN-14	R2876471
Chloride by Ion Chromatography							
Chloride	30.5		0.50	mg/L		26-JUN-14	R2875938
Conductivity							
Conductivity	210		20	umhos/cm		30-JUN-14	R2876471
Hardness Calculated							
Hardness (as CaCO3)	54.9		0.30	mg/L		02-JUL-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		26-JUN-14	R2875938
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		30-JUN-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		26-JUN-14	R2875938
Sulfate by Ion Chromatography							
Sulfate	11.0		0.50	mg/L		26-JUN-14	R2875938
TDS calculated							
TDS (Calculated)	105		5.0	mg/L		02-JUL-14	
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.075		0.020	mg/L	30-JUN-14	30-JUN-14	R2876428
Antimony (Sb)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Arsenic (As)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Barium (Ba)-Total	0.0144		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Bismuth (Bi)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Boron (B)-Total	0.037		0.030	mg/L	30-JUN-14	30-JUN-14	R2876428
Cadmium (Cd)-Total	<0.00020		0.00020	mg/L	30-JUN-14	30-JUN-14	R2876428
Calcium (Ca)-Total	16.6		0.20	mg/L	30-JUN-14	30-JUN-14	R2876428
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Chromium (Cr)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Cobalt (Co)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Copper (Cu)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Iron (Fe)-Total	<0.10		0.10	mg/L	30-JUN-14	30-JUN-14	R2876428
Lead (Pb)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Lithium (Li)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Magnesium (Mg)-Total	3.24		0.050	mg/L	30-JUN-14	30-JUN-14	R2876428
Manganese (Mn)-Total	0.0060		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Molybdenum (Mo)-Total	0.00067		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Phosphorus (P)-Total	<0.50		0.50	mg/L	30-JUN-14	30-JUN-14	R2876428
Potassium (K)-Total	1.86		0.10	mg/L	30-JUN-14	30-JUN-14	R2876428
Rubidium (Rb)-Total	0.00164		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Selenium (Se)-Total	<0.0050		0.0050	mg/L	30-JUN-14	30-JUN-14	R2876428
Silicon (Si)-Total	<0.30		0.30	mg/L	30-JUN-14	30-JUN-14	R2876428

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1476895-1 NIPISSOR LAKE							
Sampled By: MEGAN LUSTY on 24-JUN-14 @ 10:45							
Matrix: WATER							
Total Metals by ICP-MS							
Silver (Ag)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Sodium (Na)-Total	16.6		0.050	mg/L	30-JUN-14	30-JUN-14	R2876428
Strontium (Sr)-Total	0.0826		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	30-JUN-14	30-JUN-14	R2876428
Thorium (Th)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Tin (Sn)-Total	<0.00060		0.00060	mg/L	30-JUN-14	30-JUN-14	R2876428
Titanium (Ti)-Total	0.0029		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Tungsten (W)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Uranium (U)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Vanadium (V)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Zinc (Zn)-Total	<0.020		0.020	mg/L	30-JUN-14	30-JUN-14	R2876428
Zirconium (Zr)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
pH							
pH	7.77		0.10	pH units		30-JUN-14	R2876471
L1476895-2 CHAR RIVER							
Sampled By: MEGAN LUSTY on 24-JUN-14 @ 10:15							
Matrix: WATER							
Miscellaneous Parameters							
Ammonia, Total (as N)	<0.010		0.010	mg/L		30-JUN-14	R2876966
Fecal Coliforms	<3		3	MPN/100mL		02-JUL-14	R2878375
Phosphorus (P)-Total	0.013		0.010	mg/L		02-JUL-14	R2877002
Total Suspended Solids	<5.0		5.0	mg/L		27-JUN-14	R2875948
Routine Soluble + Metal scan							
Alkalinity							
Alkalinity, Total (as CaCO3)	20		20	mg/L		30-JUN-14	R2876471
Bicarbonate (HCO3)	25		24	mg/L		30-JUN-14	R2876471
Carbonate (CO3)	<12		12	mg/L		30-JUN-14	R2876471
Hydroxide (OH)	<6.8		6.8	mg/L		30-JUN-14	R2876471
Chloride by Ion Chromatography							
Chloride	15.7		0.50	mg/L		26-JUN-14	R2875938
Conductivity							
Conductivity	104		20	umhos/cm		30-JUN-14	R2876471
Hardness Calculated							
Hardness (as CaCO3)	24.3		0.30	mg/L		02-JUL-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		26-JUN-14	R2875938
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		30-JUN-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		26-JUN-14	R2875938
Sulfate by Ion Chromatography							
Sulfate	4.75		0.50	mg/L		26-JUN-14	R2875938
TDS calculated							
TDS (Calculated)	50.3		5.0	mg/L		02-JUL-14	
Total Metals by ICP-MS							
Aluminum (Al)-Total	<0.020		0.020	mg/L	30-JUN-14	30-JUN-14	R2876428
Antimony (Sb)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Arsenic (As)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Barium (Ba)-Total	0.0102		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1476895-2 CHAR RIVER							
Sampled By: MEGAN LUSTY on 24-JUN-14 @ 10:15							
Matrix: WATER							
Total Metals by ICP-MS							
Bismuth (Bi)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Boron (B)-Total	<0.030		0.030	mg/L	30-JUN-14	30-JUN-14	R2876428
Cadmium (Cd)-Total	<0.00020		0.00020	mg/L	30-JUN-14	30-JUN-14	R2876428
Calcium (Ca)-Total	7.30		0.20	mg/L	30-JUN-14	30-JUN-14	R2876428
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Chromium (Cr)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Cobalt (Co)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Copper (Cu)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Iron (Fe)-Total	<0.10		0.10	mg/L	30-JUN-14	30-JUN-14	R2876428
Lead (Pb)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Lithium (Li)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Magnesium (Mg)-Total	1.47		0.050	mg/L	30-JUN-14	30-JUN-14	R2876428
Manganese (Mn)-Total	0.0043		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Molybdenum (Mo)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Phosphorus (P)-Total	<0.50		0.50	mg/L	30-JUN-14	30-JUN-14	R2876428
Potassium (K)-Total	1.03		0.10	mg/L	30-JUN-14	30-JUN-14	R2876428
Rubidium (Rb)-Total	0.00144		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Selenium (Se)-Total	<0.0050		0.0050	mg/L	30-JUN-14	30-JUN-14	R2876428
Silicon (Si)-Total	<0.30		0.30	mg/L	30-JUN-14	30-JUN-14	R2876428
Silver (Ag)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Sodium (Na)-Total	7.98		0.050	mg/L	30-JUN-14	30-JUN-14	R2876428
Strontium (Sr)-Total	0.0426		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	30-JUN-14	30-JUN-14	R2876428
Thorium (Th)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Tin (Sn)-Total	<0.00060		0.00060	mg/L	30-JUN-14	30-JUN-14	R2876428
Titanium (Ti)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
Tungsten (W)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Uranium (U)-Total	<0.00050		0.00050	mg/L	30-JUN-14	30-JUN-14	R2876428
Vanadium (V)-Total	<0.0020		0.0020	mg/L	30-JUN-14	30-JUN-14	R2876428
Zinc (Zn)-Total	<0.020		0.020	mg/L	30-JUN-14	30-JUN-14	R2876428
Zirconium (Zr)-Total	<0.0010		0.0010	mg/L	30-JUN-14	30-JUN-14	R2876428
pH							
pH	7.46		0.10	pH units		30-JUN-14	R2876471

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-WP	Water	Alkalinity	APHA 2320B
Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.			
CL-IC-WP	Water	Chloride by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
ETL-HARDNESS-TOT-WP	Water	Hardness Calculated	HARDNESS CALCULATED
ETL-SOLIDS-CALC-WP	Water	TDS calculated	CALCULATION
FC-MPN-WP	Water	Fecal Coliform	APHA 9221E
The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.			
IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E
MET-T-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-T
This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).			
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PH-WP	Water	pH	APHA 4500H
The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.			
SO4-IC-WP	Water	Sulfate by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
SOLIDS-TOTSUS-WP	Water	Total Suspended Solids	APHA 2540 D (modified)
Total suspended solids in aquesous matrices is determined gravimetrically after drying the residue at 103 105°C.			

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

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

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

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

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

L1476895-COFC

10-026474

Page 1 of 1

Report To		Service Requested: (Rush subject to availability)
Company: GN-CGS	Standard: ✓ Other (specify):	✓ Regular (Standard Turnaround Times))
Contact: Megan Lusty	Select: PDF ✓ Excel ✓ Digital Fax	Priority, Date Req'd: _____ (Surcharges apply)
Address: P.O. Box 490, Rankin Inlet, NU X0C 0G0	Email 1: mlusty@gov.nu.ca	Emergency (1 Business Day) - 100% Surcharge
	Email 2:	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: Fax:		
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #:	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** **Sampler:** Megan Lusty	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Routine	Nutrients	Fecal Coliforms	BOD	TSS	Number of Containers
1	Nipissor Lake	24-06-14	10:15 AM	Water	✓	✓P	✓P	✓	✓	4
2	Char River	24-06-14	10:15 AM	Water	✓	✓P	✓P	✓	✓	4

Special Instructions / Regulations / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Megan Lusty	June 24/14	11:00 AM	LD	June 25/14	2:40	17.5°C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

Appendix G– Certificate of Analysis October 7, 2014

Nunavut - Community & Government Services
- Rankin Inlet
ATTN: MEGAN LUSTY
BAG 002
BOX 490
Rankin Inlet NU X0C 0G0

Date Received: 07-OCT-14
Report Date: 14-OCT-14 15:12 (MT)
Version: FINAL

Client Phone: 867-645-8176

Certificate of Analysis

Lab Work Order #: L1529266

Project P.O. #: NOT SUBMITTED
Job Reference: 3AM - GRA1015
C of C Numbers:
Legal Site Desc:

Barb Bayer
General Manager, Winnipeg

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-1 LOWER LANDING LAKE							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 09:50							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
Toluene	<0.0010		0.0010	mg/L		08-OCT-14	R2976408
Ethyl benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
o-Xylene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
m+p-Xylenes	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
F1 (C6-C10)	<0.10		0.10	mg/L		08-OCT-14	R2976408
Surrogate: 4-Bromofluorobenzene (SS)	100.7		70-130	%		08-OCT-14	R2976408
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		09-OCT-14	
F2-Naphth	<0.25		0.25	mg/L		09-OCT-14	
F3-PAH	<0.25		0.25	mg/L		09-OCT-14	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		09-OCT-14	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F3 (C16-C34)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F4 (C34-C50)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
Surrogate: 2-Bromobenzotrifluoride	113.8		60-140	%	08-OCT-14	08-OCT-14	R2978314
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		09-OCT-14	
Miscellaneous Parameters							
Ammonia, Total (as N)	0.037		0.010	mg/L		09-OCT-14	R2978517
Biochemical Oxygen Demand	<6.0		6.0	mg/L		08-OCT-14	R2983575
Fecal Coliforms	<3		3	MPN/100mL		11-OCT-14	R2984771
Phosphorus (P)-Total	<0.010		0.010	mg/L		09-OCT-14	R2978911
Total Kjeldahl Nitrogen	0.27		0.20	mg/L	08-OCT-14	09-OCT-14	R2979096
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Acridine	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(a)anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Chrysene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluoranthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluorene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Naphthalene	<0.000050		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Phenanthrene	<0.000050		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Quinoline	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acenaphthene d10	90.5		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acridine d9	93.9		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Chrysene d12	77.9		40-130	%	08-OCT-14	09-OCT-14	R2978719

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-1 LOWER LANDING LAKE							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 09:50							
Matrix: WATER							
Polyaromatic Hydrocarbons (PAHs)							
Surrogate: Naphthalene d8	90.0		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Phenanthrene d10	89.8		40-130	%	08-OCT-14	09-OCT-14	R2978719
Routine Soluble + Metal scan							
Alkalinity							
Alkalinity, Total (as CaCO3)	23		20	mg/L		08-OCT-14	R2978494
Bicarbonate (HCO3)	28		24	mg/L		08-OCT-14	R2978494
Carbonate (CO3)	<12		12	mg/L		08-OCT-14	R2978494
Hydroxide (OH)	<6.8		6.8	mg/L		08-OCT-14	R2978494
Chloride by Ion Chromatography							
Chloride	24.2		0.50	mg/L		08-OCT-14	R2978909
Conductivity							
Conductivity	151		20	umhos/cm		08-OCT-14	R2978494
Hardness Calculated							
Hardness (as CaCO3)	32.1		0.30	mg/L		09-OCT-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-OCT-14	R2978909
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		09-OCT-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-OCT-14	R2978909
Sulfate by Ion Chromatography							
Sulfate	7.89		0.50	mg/L		08-OCT-14	R2978909
TDS calculated							
TDS (Calculated)	73.8		5.0	mg/L		09-OCT-14	
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.020		0.020	mg/L	08-OCT-14	08-OCT-14	R2978241
Antimony (Sb)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Arsenic (As)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Barium (Ba)-Total	0.0134		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Bismuth (Bi)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Boron (B)-Total	<0.030		0.030	mg/L	08-OCT-14	08-OCT-14	R2978241
Cadmium (Cd)-Total	<0.00020		0.00020	mg/L	08-OCT-14	08-OCT-14	R2978241
Calcium (Ca)-Total	8.62		0.20	mg/L	08-OCT-14	08-OCT-14	R2978241
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Chromium (Cr)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Cobalt (Co)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Copper (Cu)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Iron (Fe)-Total	<0.10		0.10	mg/L	08-OCT-14	08-OCT-14	R2978241
Lead (Pb)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Lithium (Li)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Magnesium (Mg)-Total	2.58		0.050	mg/L	08-OCT-14	08-OCT-14	R2978241
Manganese (Mn)-Total	0.0039		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Molybdenum (Mo)-Total	0.00055		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Phosphorus (P)-Total	<0.50		0.50	mg/L	08-OCT-14	08-OCT-14	R2978241
Potassium (K)-Total	1.59		0.10	mg/L	08-OCT-14	08-OCT-14	R2978241
Rubidium (Rb)-Total	0.00195		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Selenium (Se)-Total	<0.0050		0.0050	mg/L	08-OCT-14	08-OCT-14	R2978241
Silicon (Si)-Total	<0.30		0.30	mg/L	08-OCT-14	08-OCT-14	R2978241
Silver (Ag)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Sodium (Na)-Total	15.2		0.050	mg/L	08-OCT-14	08-OCT-14	R2978241

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-1 LOWER LANDING LAKE							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 09:50							
Matrix: WATER							
Total Metals by ICP-MS							
Strontium (Sr)-Total	0.0514		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	08-OCT-14	08-OCT-14	R2978241
Thorium (Th)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Tin (Sn)-Total	<0.00060		0.00060	mg/L	08-OCT-14	08-OCT-14	R2978241
Titanium (Ti)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Tungsten (W)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Uranium (U)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Vanadium (V)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Zinc (Zn)-Total	<0.020		0.020	mg/L	08-OCT-14	08-OCT-14	R2978241
Zirconium (Zr)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
pH							
pH	7.62		0.10	pH units		08-OCT-14	R2978494
L1529266-2 NIPISSAR LAKE							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 10:25							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
Toluene	<0.0010		0.0010	mg/L		08-OCT-14	R2976408
Ethyl benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
o-Xylene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
m+p-Xylenes	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
F1 (C6-C10)	<0.10		0.10	mg/L		08-OCT-14	R2976408
Surrogate: 4-Bromofluorobenzene (SS)	102.3		70-130	%		08-OCT-14	R2976408
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		09-OCT-14	
F2-Naphth	<0.25		0.25	mg/L		09-OCT-14	
F3-PAH	<0.25		0.25	mg/L		09-OCT-14	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		09-OCT-14	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F3 (C16-C34)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F4 (C34-C50)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
Surrogate: 2-Bromobenzotrifluoride	93.4		60-140	%	08-OCT-14	08-OCT-14	R2978314
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		09-OCT-14	
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Acridine	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(a)anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Chrysene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-2 NIPISSAR LAKE							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 10:25							
Matrix: WATER							
Polyaromatic Hydrocarbons (PAHs)							
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluoranthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluorene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Naphthalene	0.000061		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Phenanthrene	<0.000050		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Quinoline	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acenaphthene d10	89.9		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acridine d9	99.0		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Chrysene d12	82.4		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Naphthalene d8	88.5		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Phenanthrene d10	93.4		40-130	%	08-OCT-14	09-OCT-14	R2978719
L1529266-3 CHAR RIVER							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 10:10							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
Toluene	<0.0010		0.0010	mg/L		08-OCT-14	R2976408
Ethyl benzene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
o-Xylene	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
m+p-Xylenes	<0.00050		0.00050	mg/L		08-OCT-14	R2976408
F1 (C6-C10)	<0.10		0.10	mg/L		08-OCT-14	R2976408
Surrogate: 4-Bromofluorobenzene (SS)	103.6		70-130	%		08-OCT-14	R2976408
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		09-OCT-14	
F2-Naphth	<0.25		0.25	mg/L		09-OCT-14	
F3-PAH	<0.25		0.25	mg/L		09-OCT-14	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		09-OCT-14	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F3 (C16-C34)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
F4 (C34-C50)	<0.25		0.25	mg/L	08-OCT-14	08-OCT-14	R2978314
Surrogate: 2-Bromobenzotrifluoride	95.4		60-140	%	08-OCT-14	08-OCT-14	R2978314
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		09-OCT-14	
Miscellaneous Parameters							
Ammonia, Total (as N)	<0.010		0.010	mg/L		09-OCT-14	R2978517
Biochemical Oxygen Demand	<6.0		6.0	mg/L		08-OCT-14	R2983575
Fecal Coliforms	<3		3	MPN/100mL		11-OCT-14	R2984771
Phosphorus (P)-Total	<0.010		0.010	mg/L		09-OCT-14	R2978911
Total Kjeldahl Nitrogen	0.27		0.20	mg/L	08-OCT-14	09-OCT-14	R2979096
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Acenaphthylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Acridine	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-3 CHAR RIVER							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 10:10							
Matrix: WATER							
Polyaromatic Hydrocarbons (PAHs)							
Benzo(a)anthracene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Chrysene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluoranthene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Fluorene	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Naphthalene	<0.000050		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Phenanthrene	<0.000050		0.000050	mg/L	08-OCT-14	09-OCT-14	R2978719
Pyrene	<0.000010		0.000010	mg/L	08-OCT-14	09-OCT-14	R2978719
Quinoline	<0.000020		0.000020	mg/L	08-OCT-14	09-OCT-14	R2978719
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acenaphthene d10	82.7		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Acridine d9	90.8		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Chrysene d12	74.1		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Naphthalene d8	82.5		40-130	%	08-OCT-14	09-OCT-14	R2978719
Surrogate: Phenanthrene d10	85.6		40-130	%	08-OCT-14	09-OCT-14	R2978719
Routine Soluble + Metal scan							
Alkalinity							
Alkalinity, Total (as CaCO3)	25		20	mg/L		08-OCT-14	R2978494
Bicarbonate (HCO3)	30		24	mg/L		08-OCT-14	R2978494
Carbonate (CO3)	<12		12	mg/L		08-OCT-14	R2978494
Hydroxide (OH)	<6.8		6.8	mg/L		08-OCT-14	R2978494
Chloride by Ion Chromatography							
Chloride	22.4		0.50	mg/L		08-OCT-14	R2978909
Conductivity							
Conductivity	150		20	umhos/cm		08-OCT-14	R2978494
Hardness Calculated							
Hardness (as CaCO3)	35.7		0.30	mg/L		09-OCT-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-OCT-14	R2978909
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		09-OCT-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-OCT-14	R2978909
Sulfate by Ion Chromatography							
Sulfate	8.99		0.50	mg/L		08-OCT-14	R2978909
TDS calculated							
TDS (Calculated)	73.8		5.0	mg/L		09-OCT-14	
Total Metals by ICP-MS							
Aluminum (Al)-Total	<0.020		0.020	mg/L	08-OCT-14	08-OCT-14	R2978241
Antimony (Sb)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Arsenic (As)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Barium (Ba)-Total	0.0149		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Bismuth (Bi)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Boron (B)-Total	<0.030		0.030	mg/L	08-OCT-14	08-OCT-14	R2978241
Cadmium (Cd)-Total	<0.00020		0.00020	mg/L	08-OCT-14	08-OCT-14	R2978241
Calcium (Ca)-Total	10.2		0.20	mg/L	08-OCT-14	08-OCT-14	R2978241

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1529266-3 CHAR RIVER							
Sampled By: MEGAN LUSTY on 07-OCT-14 @ 10:10							
Matrix: WATER							
Total Metals by ICP-MS							
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Chromium (Cr)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Cobalt (Co)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Copper (Cu)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Iron (Fe)-Total	<0.10		0.10	mg/L	08-OCT-14	08-OCT-14	R2978241
Lead (Pb)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Lithium (Li)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Magnesium (Mg)-Total	2.49		0.050	mg/L	08-OCT-14	08-OCT-14	R2978241
Manganese (Mn)-Total	0.0054		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Molybdenum (Mo)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Phosphorus (P)-Total	<0.50		0.50	mg/L	08-OCT-14	08-OCT-14	R2978241
Potassium (K)-Total	1.60		0.10	mg/L	08-OCT-14	08-OCT-14	R2978241
Rubidium (Rb)-Total	0.00203		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Selenium (Se)-Total	<0.0050		0.0050	mg/L	08-OCT-14	08-OCT-14	R2978241
Silicon (Si)-Total	<0.30		0.30	mg/L	08-OCT-14	08-OCT-14	R2978241
Silver (Ag)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Sodium (Na)-Total	13.4		0.050	mg/L	08-OCT-14	08-OCT-14	R2978241
Strontium (Sr)-Total	0.0547		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	08-OCT-14	08-OCT-14	R2978241
Thorium (Th)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Tin (Sn)-Total	<0.00060		0.00060	mg/L	08-OCT-14	08-OCT-14	R2978241
Titanium (Ti)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
Tungsten (W)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Uranium (U)-Total	<0.00050		0.00050	mg/L	08-OCT-14	08-OCT-14	R2978241
Vanadium (V)-Total	<0.0020		0.0020	mg/L	08-OCT-14	08-OCT-14	R2978241
Zinc (Zn)-Total	<0.020		0.020	mg/L	08-OCT-14	08-OCT-14	R2978241
Zirconium (Zr)-Total	<0.0010		0.0010	mg/L	08-OCT-14	08-OCT-14	R2978241
pH							
pH	7.63		0.10	pH units		08-OCT-14	R2978494

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-WP	Water	Alkalinity	APHA 2320B

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B

The sample is incubated for 5 days at 20 degrees Celcius. Comparison of dissolved oxygen content at the beginning and end of incubation provides a measure of biochemical oxygen demand. If carbonaceous BOD is requested, TCMP is added to the sample to chemically inhibit nitrogenous oxygen demand. If soluble BOD is requested, the sample is filtered prior to analysis. Surface waters have a DL of 1 mg/L. Effluents are diluted according to their history and will have a sample DL of 6 mg/L or greater, depending on the dilutions used.

BTEXS+F1-HSMS-WP	Water	BTX plus F1 by GCMS	EPA 8260C / EPA 5021A

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

CL-IC-WP	Water	Chloride by Ion Chromatography	EPA 300.1 (Modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

EC-WP	Water	Conductivity	APHA 2510B

Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.

ETL-HARDNESS-TOT-WP	Water	Hardness Calculated	HARDNESS CALCULATED
ETL-SOLIDS-CALC-WP	Water	TDS calculated	CALCULATION
F1-F4-CALC-WP	Water	CCME Total Hydrocarbons	CCME CWS-PHC DEC-2000 - PUB# 1310-L

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F2-F4-FID-WP	Water	F2-F4 PHC method	CWS (CCME)

Petroleum Hydrocarbons (F2-F4) in Water Method is adapted from US EPA Method 3511: Organic Compounds in Water by Micro-extraction" (Nov 2002) with instrumental analysis as per the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method" (CCMS, Dec 2000) Water samples (in their entirety) are extracted using hexane prior to capillary column gas chromatography with flame ionization detection (GC/FID).

FC-MPN-WP	Water	Fecal Coliform	APHA 9221E

The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.

IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E
MET-T-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-T

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen	Quickchem method 10-107-06-2-E Lachat
Samples are digested with a sulphuric acid solution, cooled, diluted with water, and analyzed for ammonia. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulphate through this digestion process. Analysis is performed by Flow Injection Analysis (FIA). The pH of the digested sample is raised to a known, basic pH by neutralization with a concentrated buffer solution. This neutralization converts the ammonium cation to ammonia. The ammonia produced is heated with saliclyate and hypochlorite to produce blue colour which is proportional to the ammonia concentration.			
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F
Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.			
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PAH,PANH-WP	Water	Polyaromatic Hydrocarbons (PAHs)	EPA SW 846/8270-GC/MS
Water is spiked with a surrogate spike mix and extracted using solvent extraction techniques. Analysis is performed by GC/MS in the selected ion monitoring (SIM) mode.			
PH-WP	Water	pH	APHA 4500H
The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.			
SO4-IC-WP	Water	Sulfate by Ion Chromatography	EPA 300.1 (Modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
XYLENES-SUM-CALC-WP	Water	Sum of Xylene Isomer Concentrations	CALCULATED RESULT
Total xylenes represents the sum of o-xylene and m&p-xylene.			

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

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

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

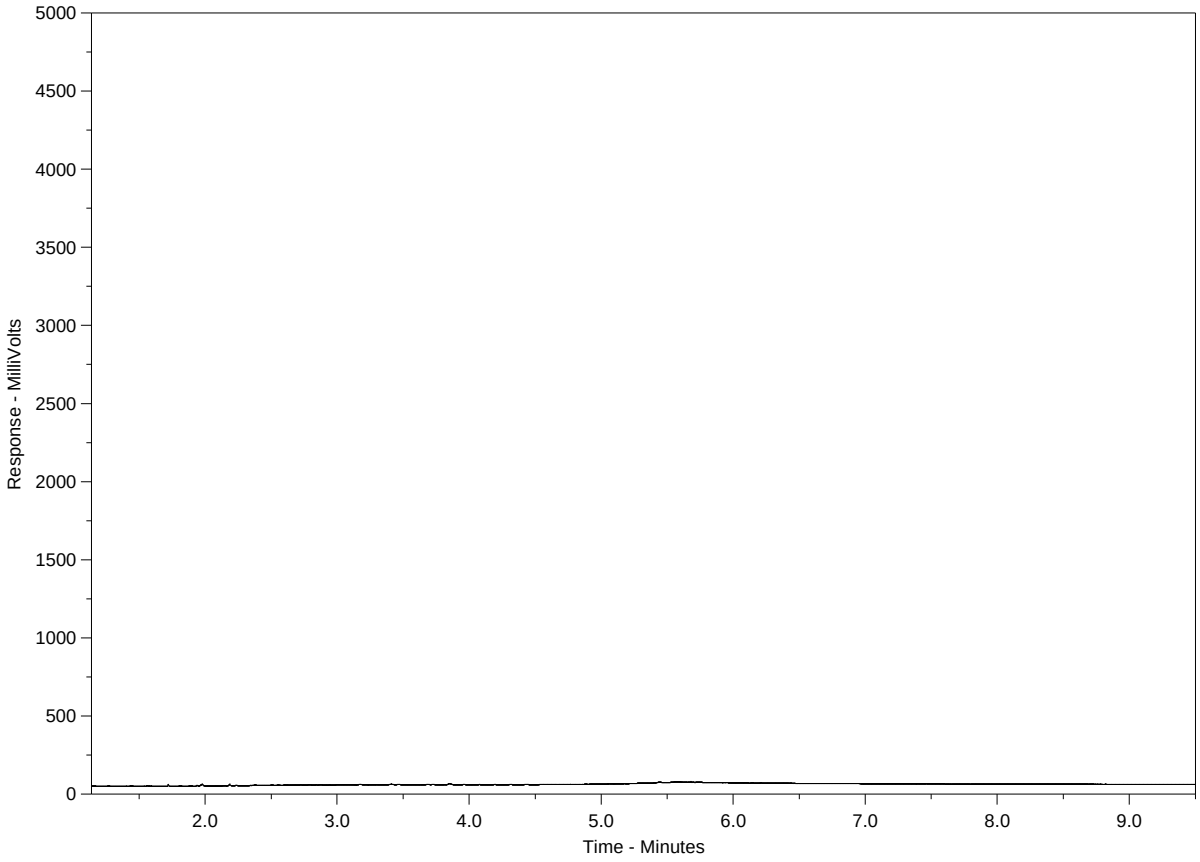
GLOSSARY OF REPORT TERMS

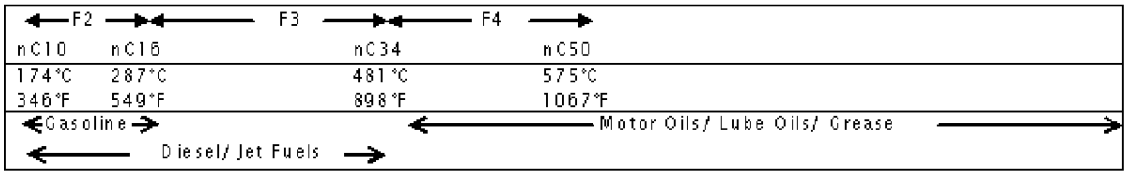
Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

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

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1529266-1
Client Sample ID: LOWER LANDING LAKE





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

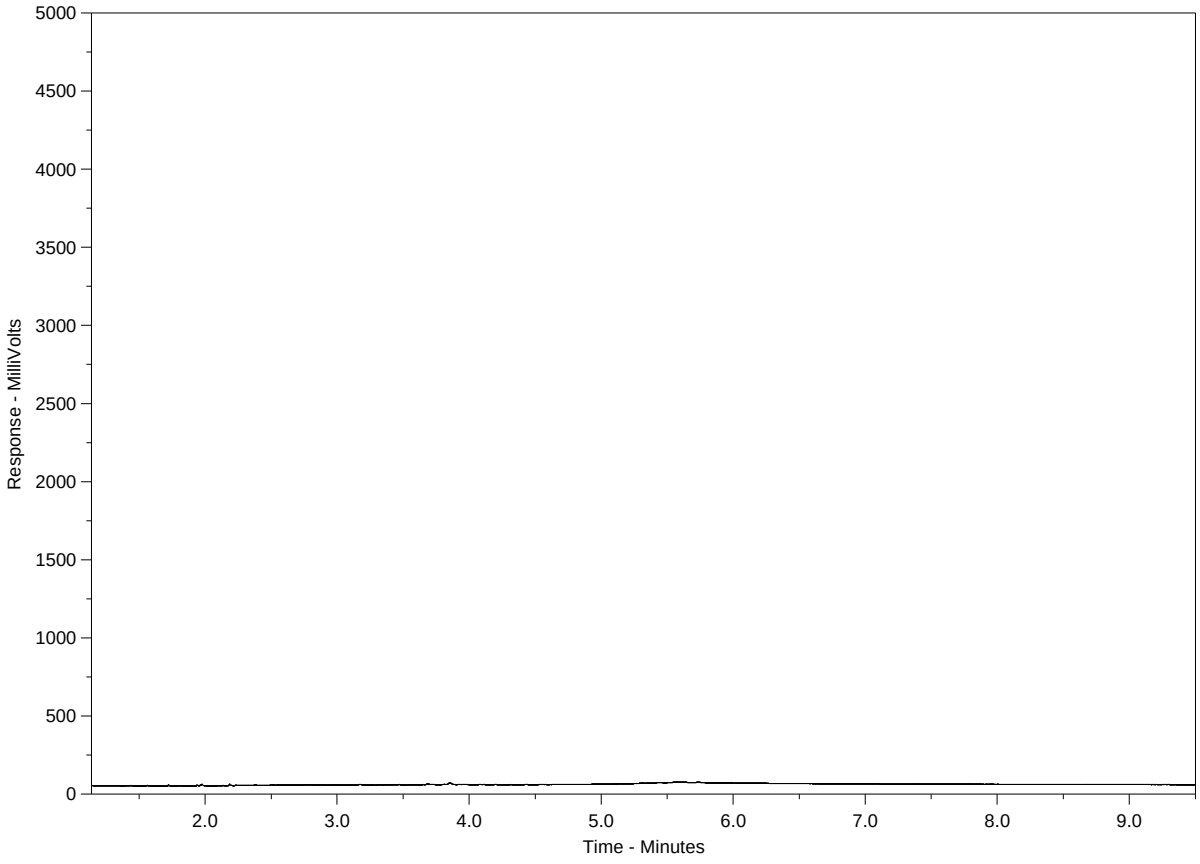
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

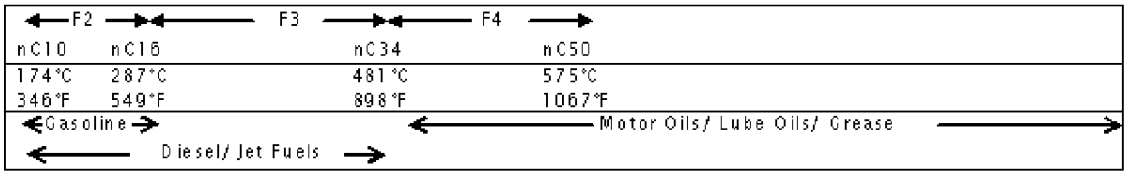
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1529266-2
Client Sample ID: NIPISSAR LAKE





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

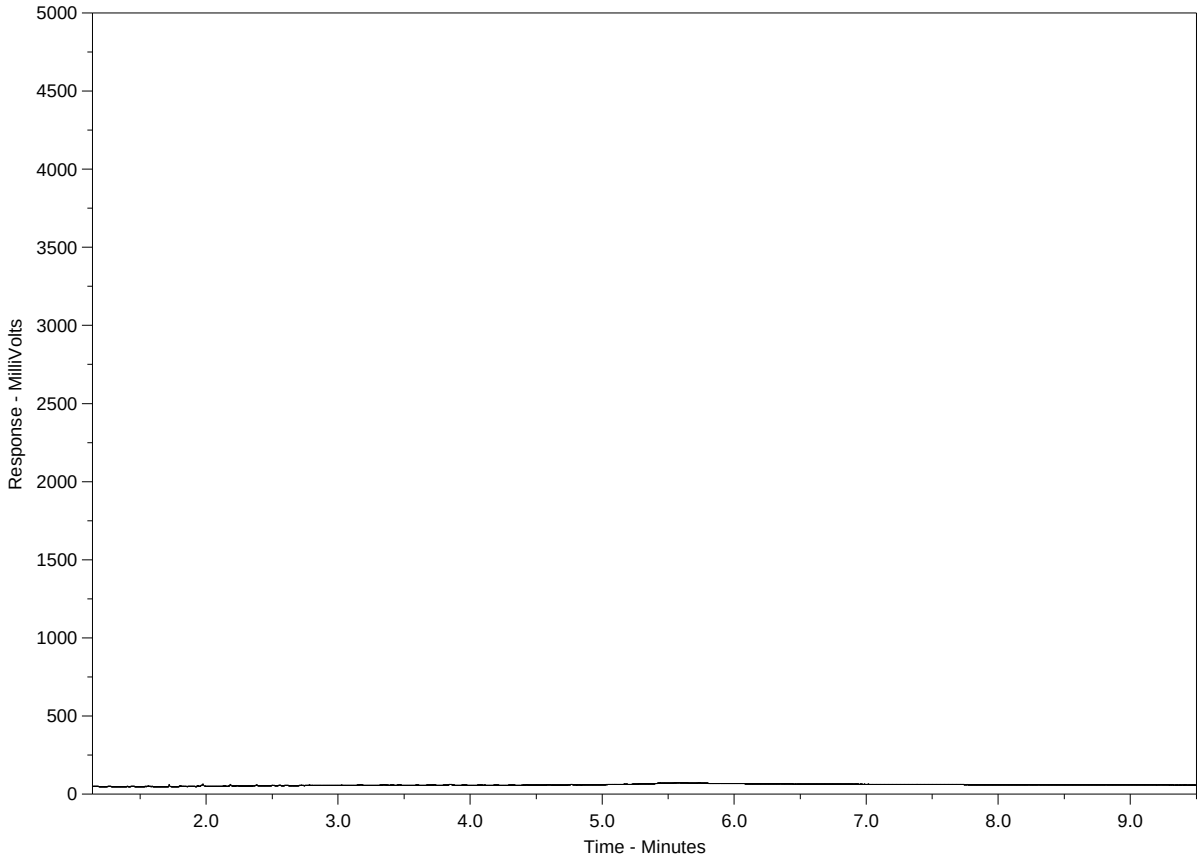
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

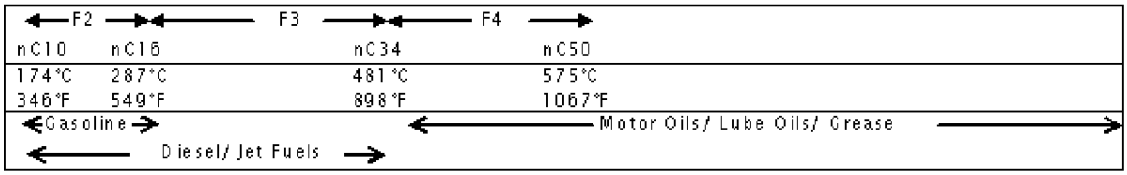
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1529266-3
Client Sample ID: CHAR RIVER





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

10- 313239

L1529266-COFC

ALS Environmental

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: GN-CGS	Standard: ✓ Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact: Megan Lusty	Select: PDF ✓ Excel Digital Fax ✓	✓ Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: P.O. Box 490 Rankin Inlet, Nu X0C 0G0	Email 1: mlusty@gov.nu.ca	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 867-645-8176 Fax: 867-645-8196		
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	Analysis Request
Copy of Invoice with Report? (circle) Yes or No	Job #: 2AM-GRA1015	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	ALS Contact: Craig Riddel Sampler: Megan Lusty	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PAH	BTEX,F	F2-F4	BOD	Routine	Total Metals	Total Nutrients	Bacteria	Number of Containers
	Lower Loading Lake	07-10-14	9:50AM	water	✓	✓P	✓P	✓	✓	✓P	✓P	✓P	11
	Nipissar Lake	07-10-14	10:25AM	water	✓	✓P	✓P						6
	Chur River	07-10-14	10:10AM	water	✓	✓P	✓P	✓	✓	✓P	✓P	✓P	11

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Megan Lusty	07-10-14	10:35am		7-10-14	4:25	3 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

Appendix H – Summary of Water Chemistry Analysis 2015

Summary of Water Chemistry Analysis 2015

Parameters	Units	Detection Limit	24-Jun-14		07-Oct-14		24-Jun-15			Guidelines for Canadian Drinking Water Quality
			Nipissar Lake GRA-1	Char River GRA-6	Char River GRA-6	Lower Landing Lake GRA-7	Nipissar Lake GRA-1	Char River GRA-6	Lower Landing Lake GRA-7	
Miscellaneous Parameters										
Ammonia, Total (as N)	mg/L	0.010	<0.010	<0.010	<0.010	0.037	0.087	<0.010	0.12	None required
Biochemical Oxygen Demand	mg/L	6.0			<6.0	<6.0	2.9	<2.0	<2.0	
Phosphorus (P)-Total	mg/L	0.010	0.02	0.013	<0.010	<0.010	0.014	<0.010	0.01	
Total Kjeldahl Nitrogen	mg/L	0.20			0.27	0.27				
Fecal Coliforms	MPN/100mL	3	<3	<3	<3	<3	<3	<3	<3	
Total Suspended Solids	mg/L	5	8	<5.0			<5.0	<5.0	<5.0	
Alkalinity										
Alkalinity, Total (as CaCO3)	mg/L	20	41	20	25.0	23	29.6	15.6	13.5	
Bicarbonate (HCO3)	mg/L	24	50	25	30.0	28	36.1	19	16.5	
Carbonate (CO3)	mg/L	12	<12	<12	<12	<12	<0.60	<0.60	<0.60	
Hydroxide (OH)	mg/L	6.8	<6.8	<6.8	<6.8	<6.8	<0.34	<0.34	<0.34	
Chloride by Ion Chromatography										
Chloride	mg/L	0.50	30.5	15.7	22.4	24.2	20.7	13.2	11.4	AO: ≤ 250 mg/L
Conductivity										
Conductivity	umhos/cm	20	210	104.0	150	151	19	88.7	77.1	
Hardness Calculated										
Hardness (as CaCO3)	mg/L	0.30	54.9	24.3	35.7	32.1	40.8	23	19.6	None required
Nitrate as N by Ion Chromatography										
Nitrate-N	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	<0.020	<0.020	<0.020	
Nitrate+Nitrite										
Nitrate and Nitrite as N	mg/L	0.071	<0.071	<0.071	<0.071	<0.071	<0.070	<0.070	<0.070	10 mg/L as nitrate-nitrogen
Nitrite as N by Ion Chromatography										
Nitrite-N	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	
Sulfate by Ion Chromatography										
Sulfate	mg/L	0.50	11	4.75	8.99	7.89	10.9	4.42	3.99	AO: ≤ 500 mg/L
TDS Calculated										
TDS (Calculated)	mg/L	5.0	105	50.3	73.8	73.8				AO: < 500 mg/L
Total Metals by ICP-MS										
Aluminum (Al)-Total	mg/L	0.02	0.075	<0.020	<0.020	0.020	0.0491	0.015	0.014	OG: <0.1 mg/L (conventional); <0.2 mg/L (other treatment types)
Antimony (Sb)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				MAC: 0.006 mg/L
Arsenic (As)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	0.00048	0.00023	0.00021	MAC: 0.010 mg/L
Barium (Ba)-Total	mg/L	0.0005	0.01444	0.0102	0.0149	0.0134				MAC: 1.0 mg/L
Beryllium (Be)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				
Bismuth (Bi)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050				
Boron (B)-Total	mg/L	0.03	0.037	<0.030	<0.030	<0.030				MAC: 5 mg/L
Cadmuim (Cd)-Total	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.000010	<0.000010	<0.000010	MAC: 0.005 mg/L
Calcium (Ca)-Total	mg/L	0.2	16.6	7.3	10.2	8.62	11.8	6.71	5.68	None required
Cesium (Cs)- Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050				
Chromium (Cr)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	MAC: 0.05 mg/L
Cobalt (Co)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	
Copper (Cu)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	0.00085	0.00075	0.00068	AO: ≤ 1.0 mg/L
Iron (Fe)-Total	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	AO: ≤ 0.3 mg/L
Lead (Pb)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.000090	<0.000090	<0.000090	MAC: 0.010 mg/L
Lithium (Li)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020				
Magnesium (Mg)-Total	mg/L	0.05	3.24	1.47	2.49	2.58	2.72	1.52	1.32	None required
Manganese (Mn)-Total	mg/L	0.001	0.006	0.0043	0.0054	0.0039	0.031	0.00304	0.00312	AO: ≤ 0.05 mg/L
Molybdenum (Mo)-Total	mg/L	0.0005	0.00067	<0.00050	<0.00050	0.00055				
Nickel (Ni)- Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	
Phosphorus (P)-Total	mg/L	0.5	<0.50	<0.50	<0.50	<0.50	0.014	<0.010	0.01	
Potassium (K)-Total	mg/L	0.1	1.86	1.03	1.60	1.59	1.57	1.17	1.02	
Rubidium (Rb)-Total	mg/L	0.0005	0.00164	0.00144	0.00203	0.00195				
Selenium (Se)-Total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050				MAC: 0.01 mg/L
Silicon (Si)-Total	mg/L	0.3	<0.30	<0.30	<0.30	<0.30				
Silver(Ag)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				None required

Sodium(Na)-Total	mg/L	0.05	16.6	7.98	13.4	15.2	13.1	7.86	6.71	AO: ≤ 200 mg/L
Strontium(Sr)-Total	mg/L	0.0005	0.0826	0.0426	0.0547	0.0514				
Tellurium(Te)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				
Thallium(Tl)-Total	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050				
Thorium(Th)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				
Tin(Sn)-Total	mg/L	0.0006	<0.00060	<0.00060	<0.00060	<0.00060				
Titanium(Ti)-Total	mg/L	0.001	0.0029	<0.0010	<0.0010	<0.0010				
Tungsten(W)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020				
Uranium(U)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050				MAC: 0.02 mg/L
Vanadium(V)-Total	mg/L	0.002	<0.0020	<0.0020	<0.0020	<0.0020				
Zinc(Zn)-Total	mg/L	0.02	<0.020	<0.020	<0.020	<0.020	<0.0020	<0.0020	<0.0020	AO: ≤ 5.0 mg/L
Zirconium(Zr)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010				
pH										
pH	pH Units	0.1	7.77	7.46	7.63	7.62	7.63	7.43	7.35	6.5-8.5

MAC - Maximum acceptable concentrations (health based)

AO - Aesthetic objectives (based on aesthetic considerations)

OG - Operational guidance values (based on operational considerations)

Appendix I – Summary of Hydrocarbon Contamination Analysis 2015

Summary of Hydrocarbon Contamination Analysis 2015

Parameters	Units	Detection Limit	07-Oct-14			24-Jun-15			Guidelines for Canadian Drinking Water Quality
			Nipissar Lake GRA-1	Char River GRA-6	Lower Landing Lake GRA-7	Nipissar Lake GRA-1	Char River GRA-6	Lower Landing Lake GRA-7	
BTX plus F1 by GCMS									
Benzene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	MAC: 0.005 mg/L
Toluene	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	AO: ≤ 0.024 mg/L [1]
Ethylbenzene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	AO: ≤ 0.0024 mg/L [2]
o-Xylene	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
m+p-Xylenes	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00071	<0.00050	
F1 (C6-C10)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
CCME Total Hydrocarbons									
F1-BTEX	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
F2-Naphth	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	
F3-PAH	mg/L	0.25	<.025	<.025	<0.25	<0.25	<0.25	<0.25	
Total Hydrocarbons (C6-C50)	mg/L	0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	
F2-F4 PHC Method									
F2 (C10-C16)	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	
F3 (C16-C34)	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	
F4 (C34-C50)	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	
Sum of Xylene Isomer Concentrations									
Xylenes (Total)	mg/L	0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	AO: ≤ 0.3 mg/L [3]
Polyaromatic Hydrocarbons (PAHs)									
1-Methyl Napthalene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
2-Methyl Naphthalene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Acenaphthene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Acenaphthylene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Anthracene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	
Acridine	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000010	<0.000020	
Benzo(a)anthracene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Benzo(a)pyrene	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	MAC: 0.00001 mg/L
Benzo(b&j)fluoranthene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Benzo(g,h,i)perylene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Benzo(k)fluoranthene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Chrysene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.0000020	<0.000020	
Dibenzo(a,h)anthracene	mg/L	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Fluoranthene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Fluorene	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
Indeno(1,2,3-cd)pyrene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	
Naphthalene	mg/L	0.000050	0.000061	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Phenanthrene	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Pyrene	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Quinoline	mg/L	0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
B(a)P Total Potency Equivalent	mg/L	0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	

MAC - Maximum acceptable concentrations (health based)
AO - Aesthetic objectives (based on aesthetic considerations)
OG - Operational guidance values (based on operational considerations)

[1] AO based on odour

[2] AO based on odour; levels above the AO would render drinking water unpalatable

[3] AO based on taste and odour; levels above the AO would render water unpalatable

Appendix J – Certificate of Analysis June 24, 2015

Nunavut - Community & Government Services - Rankin Inlet
ATTN: BLAINE CHISLETT
PO Box 490
Rankin Inlet NU X0C 0G0

Date Received: 25-JUN-15
Report Date: 17-JUL-15 11:45 (MT)
Version: FINAL

Client Phone: 867-645-8172

Certificate of Analysis

Lab Work Order #: L1633161

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

Hua Wo
Chemistry Laboratory Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-1 GRA-6							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:00							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		08-JUL-15	R3221017
Toluene	<0.0010		0.0010	mg/L		08-JUL-15	R3221017
Ethyl benzene	<0.00050		0.00050	mg/L		08-JUL-15	R3221017
o-Xylene	<0.00050		0.00050	mg/L		08-JUL-15	R3221017
m+p-Xylenes	0.00071		0.00050	mg/L		08-JUL-15	R3221017
F1 (C6-C10)	<0.10		0.10	mg/L		08-JUL-15	R3221017
Surrogate: 4-Bromofluorobenzene (SS)	90.2		70-130	%		08-JUL-15	R3221017
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		08-JUL-15	
F2-Naphth	<0.25		0.25	mg/L		08-JUL-15	
F3-PAH	<0.25		0.25	mg/L		08-JUL-15	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		08-JUL-15	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F3 (C16-C34)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F4 (C34-C50)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
Surrogate: 2-Bromobenzotrifluoride	98.8		60-140	%	02-JUL-15	02-JUL-15	R3219951
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		08-JUL-15	
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Acenaphthene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Acenaphthylene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Anthracene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Acridine	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(a)anthracene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Chrysene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Fluoranthene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Fluorene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Naphthalene	<0.000050		0.000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Phenanthrene	<0.000050		0.000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Pyrene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Quinoline	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	07-JUL-15	07-JUL-15	R3221586
Surrogate: Acenaphthene d10	92.1		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Acridine d9	105.0		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Chrysene d12	96.1		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Naphthalene d8	81.2		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Phenanthrene d10	95.1		40-130	%	07-JUL-15	07-JUL-15	R3221586
Nunavut WW Group 1							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	19.0		1.2	mg/L		13-JUL-15	
Alkalinity, Carbonate							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-1 GRA-6							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:00							
Matrix: WATER							
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		13-JUL-15	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		13-JUL-15	
Ammonia by colour							
Ammonia, Total (as N)	<0.010		0.010	mg/L		30-JUN-15	R3218142
Biochemical Oxygen Demand (BOD)							
Biochemical Oxygen Demand	<2.0		2.0	mg/L		26-JUN-15	R3222093
Carbonaceous BOD							
BOD Carbonaceous	<2.0		2.0	mg/L		26-JUN-15	R3222093
Chloride in Water by IC							
Chloride (Cl)	13.2		0.50	mg/L		26-JUN-15	R3218414
Conductivity							
Conductivity	88.7		1.0	umhos/cm		09-JUL-15	R3224268
Fecal Coliform							
Fecal Coliforms	<3	MBHT	3	MPN/100mL		25-JUN-15	R3218195
Hardness Calculated							
Hardness (as CaCO3)	23.0		0.30	mg/L		07-JUL-15	
Mercury Total							
Mercury (Hg)-Total	<0.000020		0.000020	mg/L	06-JUL-15	06-JUL-15	R3221292
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-15	R3218414
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.070		0.070	mg/L		02-JUL-15	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-15	R3218414
Oil and Grease, Total							
Oil and Grease, Total	<2.0		2.0	mg/L	03-JUL-15	03-JUL-15	R3220114
Phenol (4AAP)							
Phenols (4AAP)	<0.0010		0.0010	mg/L		07-JUL-15	R3221471
Phosphorus, Total							
Phosphorus (P)-Total	<0.010		0.010	mg/L		01-JUL-15	R3218033
Sulfate in Water by IC							
Sulfate (SO4)	4.42		0.30	mg/L		26-JUN-15	R3218414
Total Alkalinity as CaCO3							
Alkalinity, Total (as CaCO3)	15.6		1.0	mg/L		09-JUL-15	R3224268
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.0154		0.0050	mg/L	06-JUL-15	06-JUL-15	R3220699
Arsenic (As)-Total	0.00023		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Cadmium (Cd)-Total	<0.000010		0.000010	mg/L	06-JUL-15	06-JUL-15	R3220699
Calcium (Ca)-Total	6.71		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Chromium (Cr)-Total	<0.0010		0.0010	mg/L	06-JUL-15	06-JUL-15	R3220699
Cobalt (Co)-Total	<0.00020		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Copper (Cu)-Total	0.00075		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Iron (Fe)-Total	<0.10		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Lead (Pb)-Total	<0.000090		0.000090	mg/L	06-JUL-15	06-JUL-15	R3220699
Magnesium (Mg)-Total	1.52		0.010	mg/L	06-JUL-15	06-JUL-15	R3220699
Manganese (Mn)-Total	0.00304		0.00030	mg/L	06-JUL-15	06-JUL-15	R3220699
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Potassium (K)-Total	1.17		0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Sodium (Na)-Total	7.86		0.030	mg/L	06-JUL-15	06-JUL-15	R3220699
Zinc (Zn)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Total Organic Carbon							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-1 GRA-6							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:00							
Matrix: WATER							
Total Organic Carbon							
Total Organic Carbon	4.6		1.0	mg/L		17-JUL-15	R3227602
Total Suspended Solids							
Total Suspended Solids	<5.0		5.0	mg/L		30-JUN-15	R3218516
pH							
pH	7.43		0.10	pH units		09-JUL-15	R3224268
L1633161-2 GRA-7							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:30							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
Toluene	<0.0010		0.0010	mg/L		06-JUL-15	R3221017
Ethyl benzene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
o-Xylene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
m+p-Xylenes	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
F1 (C6-C10)	<0.10		0.10	mg/L		06-JUL-15	R3221017
Surrogate: 4-Bromofluorobenzene (SS)	88.6		70-130	%		06-JUL-15	R3221017
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		08-JUL-15	
F2-Naphth	<0.25		0.25	mg/L		08-JUL-15	
F3-PAH	<0.25		0.25	mg/L		08-JUL-15	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		08-JUL-15	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F3 (C16-C34)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F4 (C34-C50)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
Surrogate: 2-Bromobenzotrifluoride	101.1		60-140	%	02-JUL-15	02-JUL-15	R3219951
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		07-JUL-15	
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Acenaphthene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Acenaphthylene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Anthracene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Acridine	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(a)anthracene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Chrysene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Fluoranthene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Fluorene	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Naphthalene	<0.000050		0.000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Phenanthrene	<0.000050		0.000050	mg/L	07-JUL-15	07-JUL-15	R3221586
Pyrene	<0.000010		0.000010	mg/L	07-JUL-15	07-JUL-15	R3221586
Quinoline	<0.000020		0.000020	mg/L	07-JUL-15	07-JUL-15	R3221586

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-2 GRA-7							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:30							
Matrix: WATER							
Polyaromatic Hydrocarbons (PAHs)							
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	07-JUL-15	07-JUL-15	R3221586
Surrogate: Acenaphthene d10	85.2		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Acridine d9	99.3		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Chrysene d12	92.1		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Naphthalene d8	77.2		40-130	%	07-JUL-15	07-JUL-15	R3221586
Surrogate: Phenanthrene d10	88.2		40-130	%	07-JUL-15	07-JUL-15	R3221586
Nunavut WW Group 1							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	16.5		1.2	mg/L		13-JUL-15	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		13-JUL-15	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		13-JUL-15	
Ammonia by colour							
Ammonia, Total (as N)	0.12	DLA	0.10	mg/L		30-JUN-15	R3218142
Biochemical Oxygen Demand (BOD)							
Biochemical Oxygen Demand	<2.0		2.0	mg/L		26-JUN-15	R3222093
Carbonaceous BOD							
BOD Carbonaceous	<2.0		2.0	mg/L		26-JUN-15	R3222093
Chloride in Water by IC							
Chloride (Cl)	11.4		0.50	mg/L		26-JUN-15	R3218414
Conductivity							
Conductivity	77.1		1.0	umhos/cm		09-JUL-15	R3224268
Fecal Coliform							
Fecal Coliforms	<3	MBHT	3	MPN/100mL		25-JUN-15	R3218195
Hardness Calculated							
Hardness (as CaCO3)	19.6		0.30	mg/L		07-JUL-15	
Mercury Total							
Mercury (Hg)-Total	<0.000020		0.000020	mg/L	06-JUL-15	06-JUL-15	R3221292
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-15	R3218414
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.070		0.070	mg/L		02-JUL-15	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-15	R3218414
Oil and Grease, Total							
Oil and Grease, Total	<2.0		2.0	mg/L	03-JUL-15	03-JUL-15	R3219907
Phenol (4AAP)							
Phenols (4AAP)	<0.0010		0.0010	mg/L		07-JUL-15	R3221471
Phosphorus, Total							
Phosphorus (P)-Total	0.010		0.010	mg/L		01-JUL-15	R3218033
Sulfate in Water by IC							
Sulfate (SO4)	3.99		0.30	mg/L		26-JUN-15	R3218414
Total Alkalinity as CaCO3							
Alkalinity, Total (as CaCO3)	13.5		1.0	mg/L		09-JUL-15	R3224268
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.0139		0.0050	mg/L	06-JUL-15	06-JUL-15	R3220699
Arsenic (As)-Total	0.00021		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Cadmium (Cd)-Total	<0.000010		0.000010	mg/L	06-JUL-15	06-JUL-15	R3220699
Calcium (Ca)-Total	5.68		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Chromium (Cr)-Total	<0.0010		0.0010	mg/L	06-JUL-15	06-JUL-15	R3220699
Cobalt (Co)-Total	<0.00020		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-2 GRA-7							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:30							
Matrix: WATER							
Total Metals by ICP-MS							
Copper (Cu)-Total	0.00068		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Iron (Fe)-Total	<0.10		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Lead (Pb)-Total	<0.000090		0.000090	mg/L	06-JUL-15	06-JUL-15	R3220699
Magnesium (Mg)-Total	1.32		0.010	mg/L	06-JUL-15	06-JUL-15	R3220699
Manganese (Mn)-Total	0.00312		0.00030	mg/L	06-JUL-15	06-JUL-15	R3220699
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Potassium (K)-Total	1.02		0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Sodium (Na)-Total	6.71		0.030	mg/L	06-JUL-15	06-JUL-15	R3220699
Zinc (Zn)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Total Organic Carbon							
Total Organic Carbon	4.1		1.0	mg/L		17-JUL-15	R3227602
Total Suspended Solids							
Total Suspended Solids	<5.0		5.0	mg/L		30-JUN-15	R3218516
pH							
pH	7.35		0.10	pH units		09-JUL-15	R3224268
L1633161-3 GRA-1							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:55							
Matrix: WATER							
BTEX plus F1-F4							
BTX plus F1 by GCMS							
Benzene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
Toluene	<0.0010		0.0010	mg/L		06-JUL-15	R3221017
Ethyl benzene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
o-Xylene	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
m+p-Xylenes	<0.00050		0.00050	mg/L		06-JUL-15	R3221017
F1 (C6-C10)	<0.10		0.10	mg/L		06-JUL-15	R3221017
Surrogate: 4-Bromofluorobenzene (SS)	90.4		70-130	%		06-JUL-15	R3221017
CCME Total Hydrocarbons							
F1-BTEX	<0.10		0.10	mg/L		07-JUL-15	
Total Hydrocarbons (C6-C50)	<0.44		0.44	mg/L		07-JUL-15	
F2-F4 PHC method							
F2 (C10-C16)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F3 (C16-C34)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
F4 (C34-C50)	<0.25		0.25	mg/L	02-JUL-15	02-JUL-15	R3219951
Surrogate: 2-Bromobenzotrifluoride	98.9		60-140	%	02-JUL-15	02-JUL-15	R3219951
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.0015		0.0015	mg/L		07-JUL-15	
Nunavut WW Group 1							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	36.1		1.2	mg/L		13-JUL-15	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		13-JUL-15	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		13-JUL-15	
Ammonia by colour							
Ammonia, Total (as N)	0.087		0.010	mg/L		30-JUN-15	R3218142
Biochemical Oxygen Demand (BOD)							
Biochemical Oxygen Demand	2.9		1.0	mg/L		26-JUN-15	R3222093
Carbonaceous BOD							
BOD Carbonaceous	2.5		1.0	mg/L		26-JUN-15	R3222093
Chloride in Water by IC							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-3 GRA-1							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 09:55							
Matrix: WATER							
Chloride in Water by IC							
Chloride (Cl)	20.7		0.50	mg/L		26-JUN-15	R3218414
Conductivity							
Conductivity	149		1.0	umhos/cm		09-JUL-15	R3224268
Fecal Coliform							
Fecal Coliforms	<3	MBHT	3	MPN/100mL		25-JUN-15	R3218195
Hardness Calculated							
Hardness (as CaCO3)	40.8		0.30	mg/L		07-JUL-15	
Mercury Total							
Mercury (Hg)-Total	<0.000020		0.000020	mg/L	06-JUL-15	06-JUL-15	R3221292
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-15	R3218414
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.070		0.070	mg/L		02-JUL-15	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-15	R3218414
Oil and Grease, Total							
Oil and Grease, Total	<2.0		2.0	mg/L	03-JUL-15	03-JUL-15	R3219907
Phenol (4AAP)							
Phenols (4AAP)	<0.0010		0.0010	mg/L		07-JUL-15	R3221471
Phosphorus, Total							
Phosphorus (P)-Total	0.014		0.010	mg/L		01-JUL-15	R3218033
Sulfate in Water by IC							
Sulfate (SO4)	10.9		0.30	mg/L		26-JUN-15	R3218414
Total Alkalinity as CaCO3							
Alkalinity, Total (as CaCO3)	29.6		1.0	mg/L		09-JUL-15	R3224268
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.0491		0.0050	mg/L	06-JUL-15	06-JUL-15	R3220699
Arsenic (As)-Total	0.00048		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Cadmium (Cd)-Total	<0.000010		0.000010	mg/L	06-JUL-15	06-JUL-15	R3220699
Calcium (Ca)-Total	11.8		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Chromium (Cr)-Total	<0.0010		0.0010	mg/L	06-JUL-15	06-JUL-15	R3220699
Cobalt (Co)-Total	<0.00020		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Copper (Cu)-Total	0.00085		0.00020	mg/L	06-JUL-15	06-JUL-15	R3220699
Iron (Fe)-Total	<0.10		0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Lead (Pb)-Total	<0.000090		0.000090	mg/L	06-JUL-15	06-JUL-15	R3220699
Magnesium (Mg)-Total	2.72		0.010	mg/L	06-JUL-15	06-JUL-15	R3220699
Manganese (Mn)-Total	0.0310		0.00030	mg/L	06-JUL-15	06-JUL-15	R3220699
Nickel (Ni)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Potassium (K)-Total	1.57		0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Sodium (Na)-Total	13.1		0.030	mg/L	06-JUL-15	06-JUL-15	R3220699
Zinc (Zn)-Total	<0.0020		0.0020	mg/L	06-JUL-15	06-JUL-15	R3220699
Total Organic Carbon							
Total Organic Carbon	4.1		1.0	mg/L		17-JUL-15	R3227602
Total Suspended Solids							
Total Suspended Solids	<5.0		5.0	mg/L		30-JUN-15	R3218516
pH							
pH	7.63		0.10	pH units		09-JUL-15	R3224268
L1633161-4 GRA-3							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 10:20							
Matrix: WASTEWATER							
Nunavut WW Group 1							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-4 GRA-3							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 10:20							
Matrix: WASTEWATER							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	412		1.2	mg/L		13-JUL-15	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		13-JUL-15	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		13-JUL-15	
Ammonia by colour							
Ammonia, Total (as N)	9.4	DLA	1.0	mg/L		02-JUL-15	R3218855
Biochemical Oxygen Demand (BOD)							
Biochemical Oxygen Demand	520	DLA	300	mg/L		26-JUN-15	R3222093
Carbonaceous BOD							
BOD Carbonaceous	390	DLA	300	mg/L		26-JUN-15	R3222093
Chloride in Water by IC							
Chloride (Cl)	45.6		0.50	mg/L		26-JUN-15	R3218414
Conductivity							
Conductivity	861		1.0	umhos/cm		09-JUL-15	R3224268
Fecal Coliform							
Fecal Coliforms	>110000	MBHT	3	MPN/100mL		25-JUN-15	R3218195
Hardness Calculated							
Hardness (as CaCO3)	332		0.30	mg/L		07-JUL-15	
Mercury Total							
Mercury (Hg)-Total	<0.00040	DLM	0.00040	mg/L	06-JUL-15	06-JUL-15	R3221292
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-15	R3218414
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.070		0.070	mg/L		02-JUL-15	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-15	R3218414
Oil and Grease, Total							
Oil and Grease, Total	896	DLM	8.0	mg/L	03-JUL-15	03-JUL-15	R3219907
Phenol (4AAP)							
Phenols (4AAP)	0.027	DLA	0.010	mg/L		07-JUL-15	R3221471
Phosphorus, Total							
Phosphorus (P)-Total	20.0	DLA	0.20	mg/L		01-JUL-15	R3218033
Sulfate in Water by IC							
Sulfate (SO4)	17.4		0.30	mg/L		26-JUN-15	R3218414
Total Alkalinity as CaCO3							
Alkalinity, Total (as CaCO3)	337		1.0	mg/L		09-JUL-15	R3224268
Total Metals by ICP-MS							
Aluminum (Al)-Total	8.83	DLM	0.50	mg/L	06-JUL-15	06-JUL-15	R3220699
Arsenic (As)-Total	<0.020	DLM	0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Cadmium (Cd)-Total	0.0023	DLM	0.0010	mg/L	06-JUL-15	06-JUL-15	R3220699
Calcium (Ca)-Total	106	DLM	10	mg/L	06-JUL-15	06-JUL-15	R3220699
Chromium (Cr)-Total	<0.10	DLM	0.10	mg/L	06-JUL-15	06-JUL-15	R3220699
Cobalt (Co)-Total	<0.020	DLM	0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Copper (Cu)-Total	2.81	DLM	0.020	mg/L	06-JUL-15	06-JUL-15	R3220699
Iron (Fe)-Total	<10	DLM	10	mg/L	06-JUL-15	06-JUL-15	R3220699
Lead (Pb)-Total	0.0785	DLM	0.0090	mg/L	06-JUL-15	06-JUL-15	R3220699
Magnesium (Mg)-Total	16.3	DLM	1.0	mg/L	06-JUL-15	06-JUL-15	R3220699
Manganese (Mn)-Total	0.363	DLM	0.030	mg/L	06-JUL-15	06-JUL-15	R3220699
Nickel (Ni)-Total	<0.20	DLM	0.20	mg/L	06-JUL-15	06-JUL-15	R3220699
Potassium (K)-Total	16.9	DLM	2.0	mg/L	06-JUL-15	06-JUL-15	R3220699
Sodium (Na)-Total	35.2	DLM	3.0	mg/L	06-JUL-15	06-JUL-15	R3220699

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1633161-4 GRA-3							
Sampled By: MEGAN LUSTY on 24-JUN-15 @ 10:20							
Matrix: WASTEWATER							
Total Metals by ICP-MS							
Zinc (Zn)-Total	3.26	DLM	0.20	mg/L	06-JUL-15	06-JUL-15	R3220699
Total Organic Carbon							
Total Organic Carbon	387		1.0	mg/L		17-JUL-15	R3227602
Total Suspended Solids							
Total Suspended Solids	11300		5.0	mg/L		30-JUN-15	R3218516
pH							
pH	5.61		0.10	pH units		09-JUL-15	R3224268

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MBHT	The APHA 30 hour hold time was exceeded for microbiological testing. Samples processed within 48 hours from time of sampling may be valid in some cases (refer to Health Canada guidance).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-CO3CO3-CALC-WP	Water	Alkalinity, Carbonate	CALCULATION

The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by carbonate is calculated and reported as mg CO3 2-/L.

ALK-HCO3HCO3-CALC-WP	Water	Alkalinity, Bicarbonate	CALCULATION

The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by bicarbonate is calculated and reported as mg HCO3-/L

ALK-OHOH-CALC-WP	Water	Alkalinity, Hydroxide	CALCULATION

The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by hydroxide is calculated and reported as mg OH-/L.

ALK-TITR-WP	Water	Total Alkalinity as CaCO3	APHA 2320B

The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

BOD-CBOD-WP	Water	Carbonaceous BOD	APHA 5210 B

Samples are diluted and seeded, have TCMP added to inhibit nitrogenous demands, and then are incubated in airtight bottles at 20°C for 5 days. Dissolved oxygen is measured initially and after incubation, and results are computed from the difference between initial and final DO.

BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B

Samples are diluted and seeded and then incubated in airtight bottles at 20°C for 5 days. Dissolved oxygen is measured initially and after incubation, and results are computed from the difference between initial and final DO.

BTEXS+F1-HSMS-WP	Water	BTX plus F1 by GCMS	EPA 8260C / EPA 5021A

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

C-TOT-ORG-WP	Water	Total Organic Carbon	APHA 5310 B-INSTRUMENTAL-WP

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

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

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

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

EC-WP	Water	Conductivity	APHA 2510B

Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.

ETL-HARDNESS-TOT-WP	Water	Hardness Calculated	HARDNESS CALCULATED
F1-F4-CALC-WP	Water	CCME Total Hydrocarbons	CCME CWS-PHC, Pub #1310, Dec 2001-L

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F2-F4-FID-WP	Water	F2-F4 PHC method	CWS (CCME)

Petroleum Hydrocarbons (F2-F4) in Water Method is adapted from US EPA Method 3511: Organic Compounds in Water by Micro-extraction" (Nov 2002) with instrumental analysis as per the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method" (CCMS, Dec 2000) Water samples (in their entirety) are extracted using hexane prior to capillary column gas chromatography with flame ionization detection (GC/FID).

FC-MPN-WP	Water	Fecal Coliform	APHA 9221E

The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.

HG-T-CVAF-WP	Water	Mercury Total	EPA245.7 V2.0

Mercury in filtered and unfiltered waters is oxidized with Bromine monochloride and analyzed by cold-vapour atomic fluorescence spectrometry.

MET-T-L-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-TL

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-N-WP	Water	Nitrite in Water by IC	EPA 300.1 (mod)

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

NO3-IC-N-WP	Water	Nitrate in Water by IC	EPA 300.1 (mod)

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

OGG-TOT-WT	Water	Oil and Grease, Total	APHA 5520 B

Sample is extracted with hexane, extract is then evaporated and the residue is weighed to determine total oil and grease.

P-T-COL-WP	Water	Phosphorus, Total	APHA 4500 P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PAH,PANH-WP	Water	Polyaromatic Hydrocarbons (PAHs)	EPA SW 846/8270-GC/MS

Water is spiked with a surrogate spike mix and extracted using solvent extraction techniques. Analysis is performed by GC/MS in the selected ion monitoring (SIM) mode.

PH-WP	Water	pH	APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
reference electrode.			
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.			
SO4-IC-N-WP	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
SOLIDS-TOTSUS-WP	Water	Total Suspended Solids	APHA 2540 D (modified)
Total suspended solids in aquesous matrices is determined gravimetrically after drying the residue at 103 105°C.			
XYLENES-SUM-CALC-WP	Water	Sum of Xylene Isomer Concentrations	CALCULATED RESULT
Total xylenes represents the sum of o-xylene and m&p-xylene.			

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

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

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

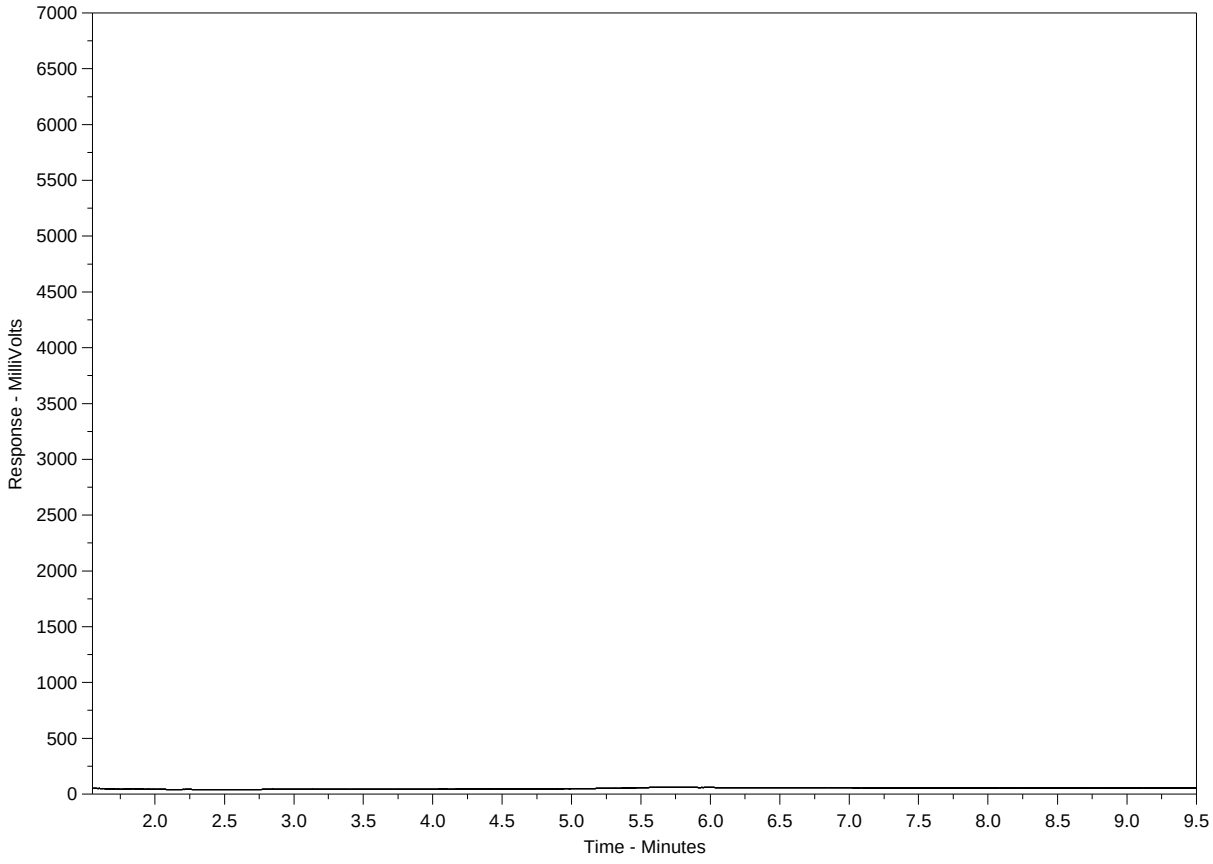
GLOSSARY OF REPORT TERMS

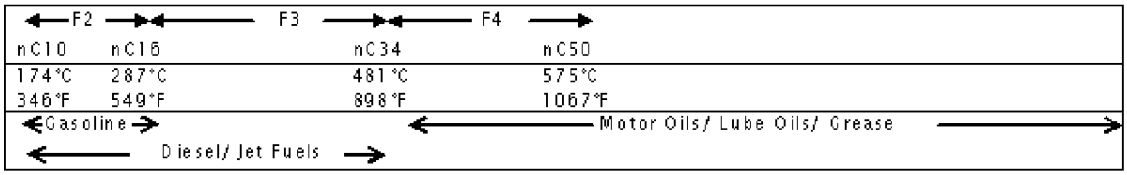
Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

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

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1633161-1
Client Sample ID: GRA-6





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

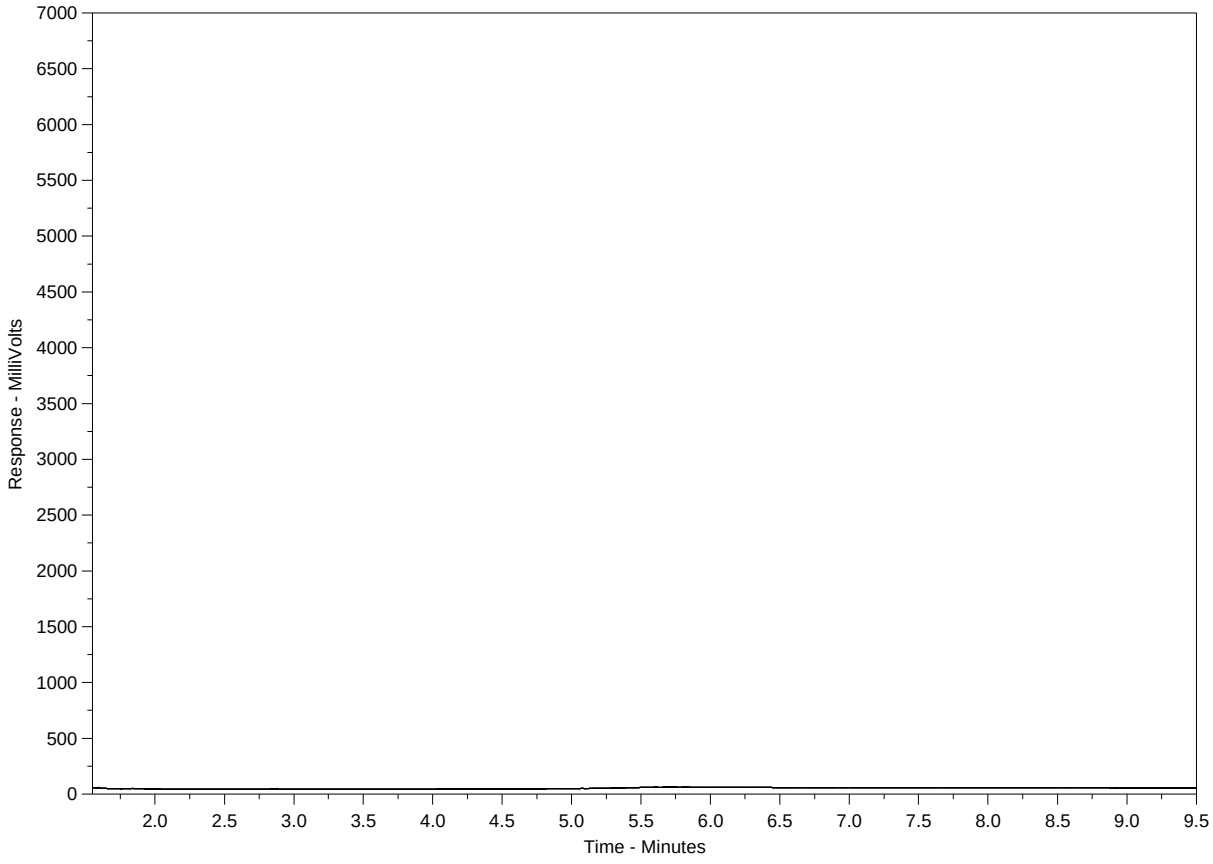
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

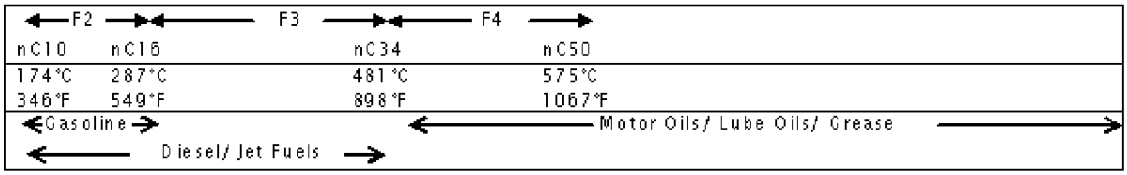
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1633161-2
Client Sample ID: GRA-7





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

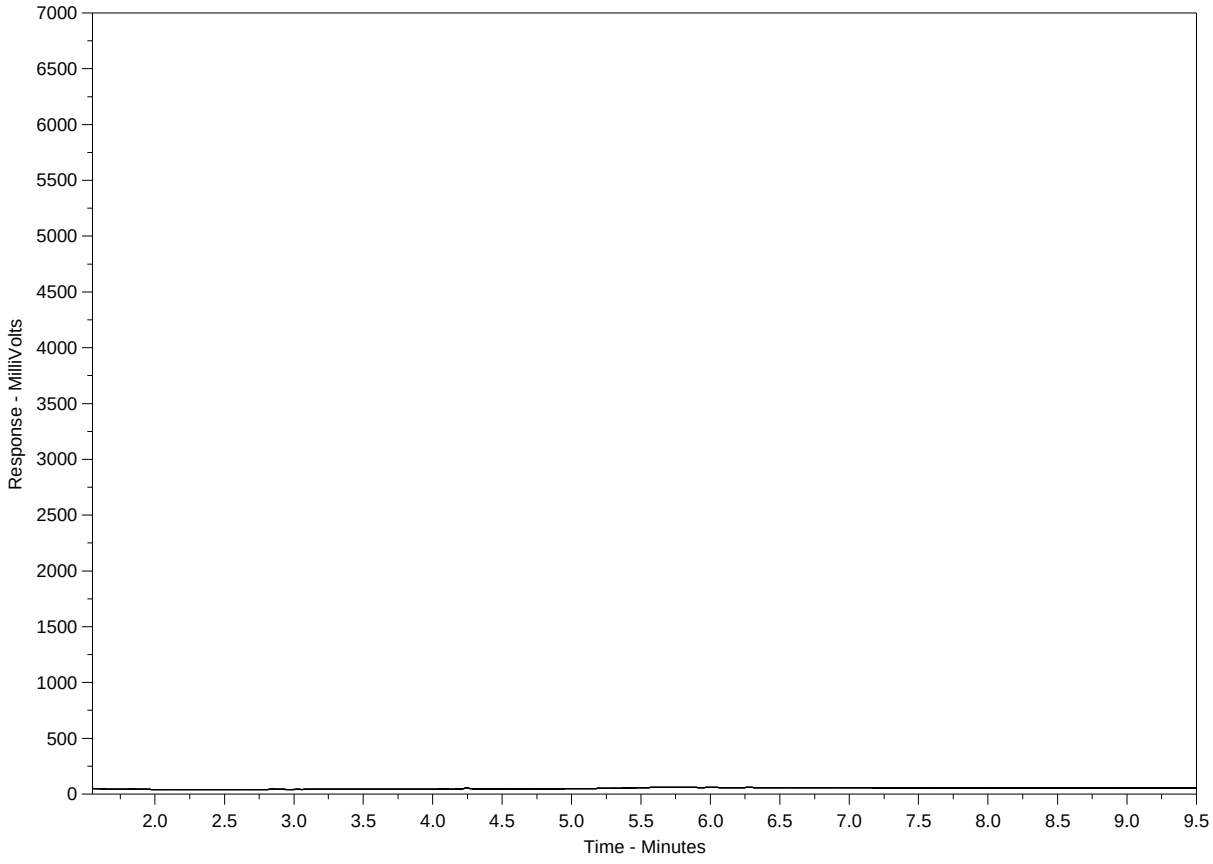
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

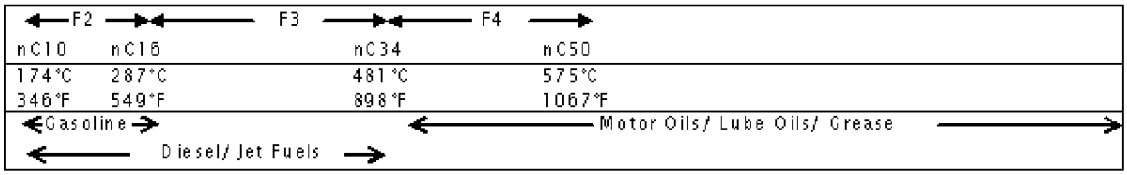
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1633161-3
Client Sample ID: GRA-1





The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

2 Coolers

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1633161-COFC

COC Number: 14 - 454492

Page 1 of 1

Copy

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Government of Nunavut - CGS Rankin Inlet	Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3pm)
Contact:	Blaise Chisholm / Megan Lusty	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 business days if received by 3pm)
Address:	P.O. Box 490 Rankin Inlet, NU X0C0G0	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 business days if received by 3pm)
		Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency if received by 10am -- contact ALS for surcharge.
Phone:	867-645-8176	Email 1 or Fax		Specify Date Required for E2,E or P:
		Email 2		

Invoice To		Invoice Distribution	
	Same as Report To ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
	Copy of Invoice with Report ☐ Yes ☐ No		
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	W8133	Approver ID:	Cost Center:
Job #:		GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: Craig Riddell

Sampler: Megan Lusty

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

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Routine	BOD	Phenols	Total Metals	Total Nutrients	Oil & Grease x2	Bacteria	Total Metals	BTX, F1 x3	F2-F4 x2	PAH			Number of Containers
	GRA-6	24-06-15	9:00AM	Water	✓	✓	P	P	P	P	P	P	P	P	P			15
	GRA-7	24-06-15	9:30AM	Water	✓	✓	P	P	P	P	P	P	P	P	P			15
	GRA-1	24-06-15	9:55AM	Water	✓	✓	P	P	P	P	P	P	P	P	P			15
	GRA-3	24-06-15	10:20AM	Wastewater	✓	✓	P	P	P	P	P	P						9

Drinking Water (DW) Samples' (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No	NUNAVUT - WW - GRP1 - WP
Are samples for human drinking water use? ☐ Yes ☑ No	BTX, F1-F4
	PAH

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐		
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☐					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
14					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	24-06-15	10:40 AM		25 JUN 15	17:20			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0328a v08 Front(3 October 2013

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

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

Appendix K – Certificate of Analysis June 30, 2015

Nunavut - Community & Government Services - Rankin Inlet
ATTN: MEGAN LUSTY
Bag 002
Rankin Inlet NU X0C 0G0

Date Received: 30-JUN-15
Report Date: 08-JUL-15 14:28 (MT)
Version: FINAL

Client Phone: 867-645-8176

Certificate of Analysis

Lab Work Order #: L1635013

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

Barb Bayer, B.Sc.
General Manager, Winnipeg

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1635013-1 GRA-1							
Sampled By: MARIA K on 26-JUN-15 @ 13:25							
Matrix: WATER							
Polyaromatic Hydrocarbons (PAHs)							
1-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
2-Methyl Naphthalene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Acenaphthene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Acenaphthylene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Anthracene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Acridine	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Benzo(a)anthracene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	07-JUL-15	08-JUL-15	R3221586
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Chrysene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	07-JUL-15	08-JUL-15	R3221586
Fluoranthene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Fluorene	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Naphthalene	<0.000050		0.000050	mg/L	07-JUL-15	08-JUL-15	R3221586
Phenanthrene	<0.000050		0.000050	mg/L	07-JUL-15	08-JUL-15	R3221586
Pyrene	<0.000010		0.000010	mg/L	07-JUL-15	08-JUL-15	R3221586
Quinoline	<0.000020		0.000020	mg/L	07-JUL-15	08-JUL-15	R3221586
B(a)P Total Potency Equivalent	<0.000030		0.000030	mg/L	07-JUL-15	08-JUL-15	R3221586
Surrogate: Acenaphthene d10	93.8		40-130	%	07-JUL-15	08-JUL-15	R3221586
Surrogate: Acridine d9	107.8		40-130	%	07-JUL-15	08-JUL-15	R3221586
Surrogate: Chrysene d12	99.4		40-130	%	07-JUL-15	08-JUL-15	R3221586
Surrogate: Naphthalene d8	84.2		40-130	%	07-JUL-15	08-JUL-15	R3221586
Surrogate: Phenanthrene d10	95.2		40-130	%	07-JUL-15	08-JUL-15	R3221586

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PAH,PANH-WP	Water	Polyaromatic Hydrocarbons (PAHs)	EPA SW 846/8270-GC/MS

Water is spiked with a surrogate spike mix and extracted using solvent extraction techniques. Analysis is performed by GC/MS in the selected ion monitoring (SIM) mode.

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

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

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

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

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1635013-COFC

COC Number: 14 - 453317

Page 1 of 1

Report To		Report Format /		Turnaround Time (TAT) (Rush Turnaround Time (TAT) is not available for all tests)	
Company:	GN-CGS	Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	R ☑	Regular (Standard TAT if received by 3pm)
Contact:	Megan Lusty	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐	Priority (2-4 business days if received by 3pm)
Address:	P.O. Box 490 Rankin Inlet, NU X0C 0G0	☐ Criteria on Report - provide details below if box checked		E ☐	Emergency (1-2 business days if received by 3pm)
		Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐	Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Phone:	(867) 645-8176	Email 1 or Fax	MLusty@gov.nu.ca	Specify Date Required for E2,E or P:	
		Email 2			

Invoice To	Same as Report To	☑ Yes ☐ No	Invoice Distribution		
	Copy of Invoice with Report	☐ Yes ☐ No	Select Invoice Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	
Company:			Email 1 or Fax		
Contact:			Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	W8133	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)	ALS Contact:	Sampler:
	Craig Ruddel	Maria Kasduk

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

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PAH	Number of Containers
	GRA-1	26-06-12	1:25 pm	water	P	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No	
Are samples for human drinking water use? ☐ Yes ☑ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐		SIF Observations	Yes	☐	No	☐
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes	☐	No	☐
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Maria Kasduk	26-06-15	1:25pm	EE	6/30-12	11:26			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v06 Front05 October 2010

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

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

Appendix L – Guidelines for Canadian Drinking Water Quality, Summary Table, October 2014

Guidelines for Canadian Drinking Water Quality
Summary Table

Prepared by the

Federal-Provincial-Territorial Committee on Drinking Water

of the

Federal-Provincial-Territorial Committee on Health and the Environment

October 2014

This document may be cited as follows:

Health Canada (2014). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

The document was prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment.

Any questions or comments on this document may be directed to:

Water and Air Quality Bureau
Healthy Environments and Consumer Safety Branch
Health Canada
269 Laurier Avenue West, Address Locator 4903D
Ottawa, Ontario
Canada K1A 0K9

Tel.: 613-948-2566
Fax: 613-952-2574
E-mail: water_eau@hc-sc.gc.ca

Other documents for the Guidelines for Canadian Drinking Water Quality can be found on the following web page:
www.healthcanada.gc.ca/waterquality

Table of Contents

Introduction

The Guidelines for Canadian Drinking Water Quality are established by the Federal-Provincial-Territorial Committee on Drinking Water (CDW) and published by Health Canada. This summary table is updated regularly and published on Health Canada's website (www.healthcanada.gc.ca/waterquality). It supersedes all previous electronic and printed versions, including the 6th edition of the Guidelines for Canadian Drinking Water Quality (1996).

Each guideline was established based on current, published scientific research related to health effects, aesthetic effects, and operational considerations. Health-based guidelines are established on the basis of comprehensive review of the known health effects associated with each contaminant, on exposure levels and on the availability of treatment and analytical technologies. Aesthetic effects (e.g., taste, odour) are taken into account when these play a role in determining whether consumers will consider the water drinkable. Operational considerations are factored in when the presence of a substance may interfere with or impair a treatment process or technology (e.g., turbidity interfering with chlorination or UV disinfection) or adversely affect drinking water infrastructure (e.g., corrosion of pipes).

The Federal-Provincial-Territorial Committee on Drinking Water establishes the *Guidelines for Canadian Drinking Water Quality* specifically for contaminants that meet all of the following criteria:

1. Exposure to the contaminant could lead to adverse health effects in humans;
2. The contaminant is frequently detected or could be expected to be found in a large number of drinking water supplies throughout Canada; and
3. The contaminant is detected, or could be expected to be detected, in drinking water at a level that is of possible human health significance.

If a contaminant of interest does not meet all these criteria, CDW may choose not to establish a numerical guideline or develop a Guideline Technical Document. In that case, a Guidance Document may be developed.

Older guidelines are systematically reviewed in order to assess the need to update them; in the tables, guidelines that have been reaffirmed include both the original approval and reaffirmation year indicated after the name of the parameter.

Science-based documents published as part of the Guidelines for Canadian Drinking Water Quality (i.e., Guideline Technical Documents, Guidance Documents) are developed through a documented process which includes a literature review, internal and external peer-reviews, public consultations and Federal-Provincial-Territorial approval processes. For more information on specific guidelines, please refer to the guideline technical document or guidance document for the parameter of concern, available on the Health Canada website (www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/index-eng.php).

Membership of the Federal-Provincial-Territorial Committee on Drinking Water

Jurisdictional representatives

Alberta	Department of Environment and Sustainable Resource Development	Dr. Donald Reid
British Columbia	Ministry of Health	Mr. David Fishwick
Manitoba	Manitoba Conservation and Water Stewardship	Ms. Kim Philip
New Brunswick	Department of Health	Mr. Kevin Gould
Newfoundland and Labrador	Department of Environment and Conservation	Mr. Haseen Kahn
Northwest Territories	Department of Health and Social Services	Mr. Duane Fleming
Nova Scotia	Department of Environment	Ms. Angelina Polegato
Nunavut Territory	Department of Health and Social Services	Ms. Wanda Joy
Ontario	Ministry of the Environment and Climate Change	Dr. Satish Deshpande
Prince Edward Island	Department of Environment, Labour and Justice	Mr. George Somers
Québec	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques	Ms. Caroline Robert
Saskatchewan	Water Security Agency	Mr. Sam Ferris
Yukon Territory	Department of Health and Social Services	Ms. Patricia Brooks
Canada	Health Canada	Dr. John Cooper

Liaison officers

Federal-Provincial-Territorial Committee on Health and the Environment (CHE)	Mr. Gary O'Toole
Environment Canada/Canadian Council of Ministers of the Environment	Dr. Doug Spry

Committee coordinator

Health Canada (Water and Air Quality Bureau)	Ms. Anne Vézina

Tables

Table 1. Microbiological Parameters

In general, the highest priority guidelines are those dealing with microbiological contaminants, such as bacteria, protozoa and viruses. As a result of challenges with routine analysis of harmful microorganisms that could potentially be present in inadequately treated drinking water, the microbiological guidelines focus on indicators (*E.coli*, total coliforms) and treatment goals. The use of a multi-barrier approach that includes source water protection, adequate treatment, including disinfection, and a well maintained distribution system can reduce microorganisms to levels that have not been associated with illness, as well as meet the guidelines outlined below.

Parameter (approval)	Guideline	Common sources	Health considerations	Applying the guideline
Enteric protozoa: *Giardia* and *Cryptosporidium* (2012)	Treatment goal: Minimum 3 log removal and/or inactivation of cysts and oocysts	Human and animal faeces	*Giardia* and *Cryptosporidium* are commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea). Less common health effects vary. *Giardia* infections may include prolonged gastrointestinal upset, malaise and malabsorption. *Cryptosporidium* infections, in immunocompromised individuals, can occur outside the gastrointestinal tract including in the lungs, middle ear, and pancreas.	Monitoring for *Cryptosporidium* and *Giardia* in source waters will provide valuable information for a risk-based assessment of treatment requirements. Depending on the source water quality, a greater log removal and/or inactivation may be required.
Enteric viruses (2011)	Treatment goal: Minimum 4 log reduction (removal and/or inactivation) of enteric viruses	Human faeces	Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); less common health effects can include respiratory symptoms, central nervous system infections, liver infections and muscular syndromes.	Routine monitoring for viruses is not practical; characterize source water to determine if greater than a 4 log removal or inactivation is necessary.
Escherichia coli (*E. coli*) (2012)	MAC: None detectable per 100 mL	Human and animal faeces	The presence of *E. coli* indicates recent faecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses; pathogens in human and animal faeces pose the most immediate danger to public health.	*E. coli* is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. *E. coli* monitoring should be used, in conjunction with other indicators, as part of a multi-barrier approach to producing drinking water of an acceptable quality.

Parameter (approval)	Guideline	Common sources	Health considerations	Applying the guideline
Total coliforms (2012)	MAC of none detectable/100 mL in water leaving a treatment plant and in non-disinfected groundwater leaving the well	Human and animal faeces; naturally occurring in water, soil and vegetation	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	Total coliforms should be monitored in the distribution system because they are used to indicate changes in water quality. In water leaving a treatment plant, total coliforms should be measured in conjunction with other indicators to assess water quality; the presence of total coliforms indicates a serious breach in treatment. In a distribution and storage system, detection of total coliforms can indicate regrowth of the bacteria in biofilms or intrusion of untreated water. In non-disinfected groundwater, the presence of total coliforms may indicate that the system is vulnerable to contamination, or it may be a sign of bacterial regrowth.
Turbidity (2012)	Treatment limits for individual filters or units: - Conventional and direct filtration: ≤ 0.3 NTU[1] - slow sand and diatomaceous earth filtration: ≤ 1.0 NTU[2] - membrane filtration: ≤ 0.1 NTU[3]	Naturally occurring particles: *Inorganic*: clays, silts, metal precipitates *Organic*: decomposed plant & animal debris, microorganisms	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	Guidelines apply to individual filter turbidity for systems using surface water or groundwater under the direct influence of surface water. The decision to exempt a waterworks from filtration should be made by the appropriate authority based on site-specific considerations, including historical and ongoing monitoring data. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less. For systems that use groundwater, turbidity should generally be below 1.0 NTU.

[1] in at least 95% of measurements either per filter cycle or per month; never to exceed 1.0 NTU.
[2] in at least 95% of measurements either per filter cycle or per month; never to exceed 3.0 NTU.
[3] in at least 99% of measurements per operational filter period or per month. Measurements greater than 0.1 NTU for a period greater than 15 minutes from an individual membrane unit should immediately trigger an investigation of the membrane unit integrity.

Table 2. Chemical and Physical Parameters

Guidelines for chemical and physical parameters are:

1. health based and listed as maximum acceptable concentrations (MAC);
2. based on aesthetic considerations and listed as aesthetic objectives (AO); or
3. established based on operational considerations and listed as operational guidance values (OG).

In general, the highest priority guidelines are those dealing with microbiological contaminants. Any measure taken to reduce concentrations of chemical contaminants should not compromise the effectiveness of disinfection.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
T	Aluminum (1998)		OG: < 0.1 (conventional treatment); < 0.2 (other treatment types)	Aluminum salts used as coagulants in drinking water treatment; naturally occurring	There is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans.	The operational guideline applies to treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum found in groundwater. For treatment plants using aluminum-based coagulants, monthly samples should be taken of the water leaving the plant; the OGs are based on a running annual average of monthly samples.
I	Ammonia (2013)	None required		Naturally occurring; released from agricultural or industrial wastes; added as part of chloramination for drinking water disinfection	Levels of ammonia, either naturally present in the source water or added as part of a disinfection strategy, can affect water quality in the distribution system (e.g., nitrification) and should be monitored.	Guideline value not necessary as it is produced in the body and efficiently metabolized in healthy people; no adverse effects at levels found in drinking water. To help prevent nitrification, limit excess free ammonia entering the distribution system to below 0.1 mg/L, and preferably below 0.05 mg/L, measured as nitrogen. Nitrification can lead to the formation of nitrite/nitrate, decreased chloramine residual and increased bacterial count.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Antimony (1997)	0.006		Naturally occurring (erosion); soil runoff; industrial effluents; leaching from plumbing materials and solder	**Health basis of MAC:** Microscopic changes in organs and tissues (thymus, kidney, liver, spleen, thyroid)	MAC takes into consideration analytical achievability; plumbing should be thoroughly flushed before water is used for consumption.
I	Arsenic (2006)	0.010 ALARA		Naturally occurring (erosion and weathering of soils, minerals, ores); releases from mining; industrial effluent	**Health basis of MAC:** Cancer (lung, bladder, liver, skin) (classified as human carcinogen) **Other:** Skin, vascular and neurological effects (numbness and tingling of extremities)	MAC based on treatment achievability; elevated levels associated with certain groundwaters; levels should be kept as low as reasonably achievable.
I	Asbestos (1989, 2005)	None required		Naturally occurring (erosion of asbestos minerals and ores); decay of asbestos-cement pipes		Guideline value not necessary; no evidence of adverse health effects from exposure through drinking water.
P	Atrazine (1993)	0.005		Leaching and/or runoff from agricultural use	**Health basis of MAC:** Developmental effects (reduced body weight of offspring) **Other:** Potential increased risk of ovarian cancer or lymphomas (classified as possible carcinogen)	MAC applies to sum of atrazine and its *N*-dealkylated metabolites - diethylatrazine, deisopropylatrazine, hydroxyatrazine, diaminochlorotriazine; Persistent in source waters.
P	Azinphos-methyl (1989, 2005)	0.02		Leaching and/or runoff from agricultural use	**Health basis of MAC:** Neurological effects (plasma cholinesterase)	All uses were phased out by 2012.
I	Barium (1990)	1.0		Naturally occurring; releases or spills from industrial uses	**Health basis of MAC:** Increases in blood pressure, cardiovascular disease	
O	Benzene (2009)	0.005		Releases or spills from industrial uses	**Health basis of MAC:** Bone marrow (red and white blood cell) changes and cancer (classified as human carcinogen) **Other:** Blood system and immunological responses	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	Benzo[*a*]pyrene (1988, 2005)	0.000 01		Leaching from liners in water distribution systems	**Health basis of MAC:** Stomach tumours (classified as probable carcinogen)	

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Boron (1990)	5		Naturally occurring; leaching or runoff from industrial use	**Health basis of MAC:** Reproductive effects (testicular atrophy, spermatogenesis) **Other:** Limited evidence of reduced sexual function in men	MAC based on treatment achievability.
DBP	Bromate (1998)	0.01		By-product of drinking water disinfection with ozone; possible contaminant in hypochlorite solution	**Health basis of MAC:** Renal cell tumours (classified as probable carcinogen)	MAC based on analytical and treatment achievability.
P	Bromoxynil (1989, 2005)	0.005		Leaching or runoff from agricultural use	**Health basis of MAC:** Reduced liver to body weight ratios	
I	Cadmium (1986, 2005)	0.005		Leaching from galvanized pipes, solders or black polyethylene pipes; industrial and municipal waste	**Health basis of MAC:** Kidney damage and softening of bone	
I	Calcium (1987, 2005)	None required		Naturally occurring (erosion and weathering of soils, minerals, ores)		Guideline value not necessary, as there is no evidence of adverse health effects from calcium in drinking water; calcium contributes to hardness.
P	Carbaryl (1991, 2005)	0.09		Leaching or runoff from agricultural use	**Health basis of MAC:** Decreased kidney function (may be rapidly reversible after exposure ceases)	
P	Carbofuran (1991, 2005)	0.09		Leaching or runoff from agricultural use	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition) and growth suppression	
O	Carbon tetrachloride (2010)	0.002		Industrial effluents and leaching from hazardous waste sites	**Health basis of MAC:** Liver toxicity **Other:** Kidney damage; liver tumours (classified as probable carcinogen)	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
D	Chloramines (1995)	3.0		Monochloramine is used as a secondary disinfectant; formed in presence of both chlorine and ammonia	**Health basis of MAC:** Reduced body weight gain **Other:** immunotoxicity effects	MAC is for total chloramines based on health effects associated with monochloramine and analytical achievability.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
DBP	Chlorate (2008)	1		By-product of drinking water disinfection with chlorine dioxide; possible contaminant in hypochlorite solution	**Health basis of MAC:** Thyroid gland effects (colloid depletion)	As chlorate is difficult to remove once formed, its formation should be controlled by respecting the maximum feed dose of 1.2 mg/L of chlorine dioxide and managing /monitoring formation in hypochlorite solutions.
I	Chloride (1979, 2005)		AO: ≤ 250	Naturally occurring (seawater intrusion); dissolved salt deposits, highway salt, industrial effluents, oil well operations, sewage, irrigation drainage, refuse leachates		Based on taste and potential for corrosion in the distribution system.
D	Chlorine (2009)	None required		Used as drinking water disinfectant	Guideline value not necessary due to low toxicity at concentrations found in drinking water	Free chlorine concentrations in most Canadian drinking water distribution systems range from 0.04 to 2.0 mg/L.
D	Chlorine dioxide (2008)	None required		Used as drinking water disinfectant (primary disinfection only)	A guideline for chlorine dioxide is not required because of its rapid reduction to chlorite in drinking water	A maximum feed dose of 1.2 mg/L of chlorine dioxide should not be exceeded to control the formation of chlorite and chlorate.
DBP	Chlorite (2008)	1		By-product of drinking water disinfection with chlorine dioxide	**Health basis of MAC:** Neurobehavioural effects (lowered auditory startle amplitude, decreased exploratory activity), decreased absolute brain weight, altered liver weights	Chlorite formation should be controlled by respecting the maximum feed dose of 1.2 mg/L of chlorine dioxide and managing /monitoring formation in hypochlorite solutions.
P	Chlorpyrifos (1986)	0.09		Leaching and/or runoff from agricultural or other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Not expected to leach significantly into groundwater.
I	Chromium (1986)	0.05		Naturally occurring (erosion of minerals); releases or spills from industrial uses	**Health basis of MAC:** Enlarged liver, irritation of the skin, respiratory and gastrointestinal tracts from chromium (VI) **Other:** Chromium (III) is an essential element	MAC is protective of health effects from chromium (VI).

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
T	Colour (1979, 2005)		AO: ≤ 15 TCU	Naturally occurring organic substances, metals; industrial wastes		May interfere with disinfection; removal is important to ensure effective treatment.
I	Copper (1992)		AO: ≤ 1.0	Naturally occurring; leaching from copper piping	Copper is an essential element in human metabolism. Adverse health effects occur at levels much higher than the aesthetic objective	Based on taste, staining of laundry and plumbing fixtures; plumbing should be thoroughly flushed before water is used for consumption.
I	Cyanide (1991)	0.2		Industrial and mining effluents; release from organic compounds	**Health basis of MAC:** No clinical or other changes at the highest dose tested	Health effects from cyanide are acute; at low levels of exposure, it can be detoxified to a certain extent in the human body.
O	Cyanobacterial toxins—Microcystin-LR (2000)	0.0015		Naturally occurring (released from blooms of blue-green algae)	**Health basis of MAC:** Liver effects (enzyme inhibitor) **Other:** Classified as possible carcinogen	MAC is protective of total microcystins; avoid algaecides like copper sulphate, as they may cause toxin release into water.
P	Diazinon (1986, 2005)	0.02		Runoff from agricultural or other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Not expected to leach significantly into groundwater.
P	Dicamba (1987, 2005)	0.12		Leaching or runoff from agricultural or other uses	**Health basis of MAC:** Liver effects (vacuolization, necrosis, fatty deposits and liver weight changes)	Readily leaches into groundwater.
O	1,2-Dichlorobenzene[2] (1987)	0.2	AO: ≤ 0.003	Releases or spills from industrial effluents	**Health basis of MAC:** Increased blood cholesterol, protein and glucose levels	AO based on odour; levels above the AO would render drinking water unpalatable.
O	1,4-Dichlorobenzene[2] (1987)	0.005	AO: ≤ 0.001	Releases or spills from industrial effluents; use of urinal deodorants	**Health basis of MAC:** Benign liver tumours and adrenal gland tumours (classified as probable carcinogen)	AO based on odour; levels above the AO would render drinking water unpalatable.
O	1,2-Dichloroethane (2014)	0.005		Releases or spills from industrial effluents; leachate from waste disposal	**Health basis of MAC:** Cancer of the mammary gland (classified as probable carcinogen)	The MAC is protective of both cancer and non-cancer effects and takes into consideration all exposures from drinking water, which include ingestion as well as inhalation and dermal absorption during showering and bathing.
O	1,1-Dichloroethylene (1994)	0.014		Releases or spills from industrial effluents	**Health basis of MAC:** Liver effects (fatty changes)	

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Dichloromethane (2011)	0.05		Industrial and municipal wastewater discharges	**Health basis of MAC:** Liver effects (liver foci and areas of cellular alteration). **Other:** Classified as probable carcinogen	The MAC is protective of both cancer and non-cancer effects and takes into consideration all exposures from drinking water, which include ingestion as well as inhalation and dermal absorption during showering and bathing.
O	2,4-Dichlorophenol (1987, 2005)	0.9	AO: ≤ 0.0003	By-product of drinking water disinfection with chlorine; releases from industrial effluents	**Health basis of MAC:** Liver effects (cellular changes)	AO based on odour; levels above the AO would render drinking water unpalatable.
P	2,4-Dichlorophenoxy acetic acid (2,4-D) (1991)	0.1		Leaching and/or runoff from use as a weed controller; releases from industrial effluents	**Health basis of MAC:** Kidney effects (tubular cell pigmentation)	
P	Diclofop-methyl (1987, 2005)	0.009		Leaching and/or runoff from use as a weed controller; added directly to water to control aquatic weeds	**Health basis of MAC:** Liver effects (enlargement and enzyme changes)	Low potential for groundwater contamination.
P	Dimethoate (1986, 2005)	0.02		Leaching and/or runoff from residential, agricultural and forestry use	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	
P	Diquat (1986, 2005)	0.07		Leaching and/or runoff from agricultural use; added directly to water to control aquatic weeds	**Health basis of MAC:** Cataract formation	Unlikely to leach into groundwater.
P	Diuron (1987, 2005)	0.15		Leaching and/or runoff from use in controlling vegetation	**Health basis of MAC:** Weight loss, increased liver weight and blood effects	High potential to leach into groundwater.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Ethylbenzene (2014)	0.14	AO: 0.0016	Emissions, effluents or spills from petroleum and chemical industries	**Health basis of MAC:** Effects on the liver and pituitary gland. **Other:** Tumour formation at various sites in animals, including kidney, lung, liver and testes.	MAC is protective of both cancer and non-cancer health effects. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
I	Fluoride (2010)	1.5		Naturally occurring (rock and soil erosion); may be added to promote dental health	**Health basis of MAC:** Moderate dental fluorosis (based on cosmetic effect, not health)	Beneficial in preventing dental caries.
DBP	Formaldehyde (1997)	None required		By-product of disinfection with ozone; releases from industrial effluents		Guideline value not necessary, as levels in drinking water are below the level at which adverse health effects may occur.
P	Glyphosate (1987, 2005)	0.28		Leaching and/or runoff from various uses in weed control	**Health basis of MAC:** Reduced body weight gain	Not expected to migrate to groundwater
DBP	Haloacetic acids – Total (HAAs)[3] (2008)	0.08 ALARA		By-product of drinking water disinfection with chlorine	**Health basis of MAC:** Liver cancer (DCA); DCA is classified as probably carcinogenic to humans **Other:** Other organ cancers (DCA, DBA, TCA); liver and other organ effects (body, kidney and testes weights) (MCA)	Refers to the total of monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA) and dibromoacetic acid (DBA); MAC is based on ability to achieve HAA levels in distribution systems without compromising disinfection; precursor removal limits formation.
T	Hardness (1979)	None required		Naturally occurring (sedimentary rock erosion and seepage, runoff from soils); levels generally higher in groundwater	Although hardness may have significant aesthetic effects, a guideline has not been established because public acceptance of hardness may vary considerably according to the local conditions; major contributors to hardness (calcium and magnesium) are not of direct public health concern	Hardness levels between 80 and 100 mg/L (as $CaCO_3$) provide acceptable balance between corrosion and incrustation; where a water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Iron (1978, 2005)		AO: ≤ 0.3	Naturally occurring (erosion and weathering of rocks and minerals); acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries		Based on taste and staining of laundry and plumbing fixtures; no evidence exists of dietary iron toxicity in the general population.
I	Lead (1992)	0.010		Leaching from plumbing (pipes, solder, brass fittings and lead service lines)	**Health basis of MAC:** Biochemical and neurobehavioural effects (intellectual development, behaviour) in infants and young children (under 6 years) **Other:** Anaemia, central nervous system effects; in pregnant women, can affect the unborn child; in infants and children under 6 years, can affect intellectual development, behaviour, size and hearing; classified as probably carcinogenic to humans	Because the MAC is based on chronic effects, it is intended to apply to average concentrations in water consumed for extended periods. Exposure to lead should nevertheless be kept to a minimum; plumbing should be thoroughly flushed before water is used for consumption; most significant contribution is generally from lead service line entering the building.
I	Magnesium (1978)	None required		Naturally occurring (erosion and weathering of rocks and minerals)		Guideline value not necessary, as there is no evidence of adverse health effects from magnesium in drinking water.
P	Malathion (1986, 2005)	0.19		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Not expected to leach into groundwater.
I	Manganese (1987)		AO: ≤ 0.05	Naturally occurring (erosion and weathering of rocks and minerals)		Based on taste and staining of laundry and plumbing fixtures.
I	Mercury (1986)	0.001		Releases or spills from industrial effluents; waste disposal; irrigation or drainage of areas where agricultural pesticides are used	**Health basis of MAC:** Irreversible neurological symptoms	Applies to all forms of mercury; mercury generally not found in drinking water, as it binds to sediments and soil.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
P	2-Methyl-4-chlorophenoxyacetic acid (MCPA) (2010)	0.1		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Kidney effects (increased absolute and relative weights, urinary bilirubin, crystals and pH) **Other:** Systemic, liver, testicular, reproductive/developmental and nervous system effects	Can potentially leach into groundwater.
O	Methyl tertiary-butyl ether (MTBE) (2006)		AO: ≤ 0.015	Spills from gasoline refineries, filling stations and gasoline-powered boats; seepage into groundwater from leaking storage tanks	There exist too many uncertainties and limitations in the MTBE database to develop a health based guideline.	AO based on odour; levels above the AO would render water unpalatable; as the AO is lower than levels associated with potential toxicological effects, it is considered protective of human health.
P	Metolachlor (1986)	0.05		Leaching and/or runoff from agricultural or other uses	**Health basis of MAC:** Liver lesions and nasal cavity tumours	Readily binds to organic matter in soil; little leaching expected in soils with high organic and clay content
P	Metribuzin (1986, 2005)	0.08		Leaching and/or runoff from agricultural use	**Health basis of MAC:** Liver effects (increased incidence and severity of mucopolysaccharide droplets)	Leaching into groundwater depends on the organic matter content of the soil.
O	Monochlorobenzene (1987)	0.08	AO: ≤ 0.03	Releases or spills from industrial effluents	**Health basis of MAC:** Reduced survival and body weight gain	AO based on odour threshold.
I	Nitrate (2013)	45 as nitrate; 10 as nitrate-nitrogen		Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system	**Health basis of MAC:** Methaemoglobinaemia (blue baby syndrome) and effects on thyroid gland function in bottle-fed infants **Other:** Classified as possible carcinogen under conditions that result in endogenous nitrosation	Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrate in the distribution system. Homeowners with a well should test concentration of nitrate in their water supply.
I	Nitrilotriacetic acid (NTA) (1990)	0.4		Sewage contamination	**Health basis of MAC:** Kidney effects (nephritis and nephrosis) **Other:** Classified as possible carcinogen	

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Nitrite (2013)	3 as nitrite; 1 as nitrite-nitrogen		Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system	**Health basis of MAC:** Methaemoglobinaemia (blue baby syndrome) in bottle-fed infants less than 6 months of age **Other:** Classified as possible carcinogen under conditions that result in endogenous nitrosation	Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrite in the distribution system. Homeowners with a well should test concentration of nitrite in their water supply.
DBP	*N*-Nitroso dimethylamine (NDMA) (2010)	0.000 04		By-product of drinking water disinfection with chlorine or chloramines; industrial and sewage treatment plant effluents	**Health basis of MAC:** Liver cancer (classified as probable carcinogen)	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.; levels should be kept low by preventing formation during treatment.
A	Odour (1979, 2005)		Inoffensive	Biological or industrial sources		Important to provide drinking water with no offensive odour, as consumers may seek alternative sources that are less safe.
P	Paraquat (1986, 2005)	0.01 as paraquat dichloride; 0.007 as paraquat ion		Leaching and/or runoff from agricultural and other uses; added directly to water to control aquatic weeds	**Health basis of MAC:** Various effects on body weight, spleen, testes, liver, lungs, kidney, thyroid, heart and adrenal gland	Entry into drinking water unlikely from crop applications (clay binding); however, may persist in water for several days if directly applied to water.
O	Pentachlorophenol (1987, 2005)	0.06	AO: $\leq$ 0.03	By-product of drinking water disinfection with chlorine; industrial effluents	**Health basis of MAC:** Reduced body weight, changes in clinical parameters, histological changes in kidney and liver, reproductive effects (decreased neonatal survival and growth)	AO based on odour; levels above the AO would render drinking water unpalatable.
T	pH (1979)		6.5–8.5[4]	Not applicable		pH can influence the formation of disinfection by-products and effectiveness of treatment.
P	Phorate (1986, 2005)	0.002		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Some potential to leach into groundwater.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
P	Picloram (1988, 2005)	0.19		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Changes in body and liver weights and clinical chemistry parameters **Other:** Kidney effects (liver to body weight ratios and histopathology)	Significant potential to leach into groundwater.
I	Selenium (2014)	0.05		Naturally occurring (erosion and weathering of rocks and soils)and release from coal ash from coal-fired power plants and mining, refining of copper and other metals.	**Health basis of MAC:** chronic selenosis symptoms in humans following exposure to high levels **Other:** Hair loss, tooth decay, weakened nails and nervous system disturbances at extremely high levels of exposure	Selenium is an essential nutrient. Most exposure is from food; little information on toxicity of selenium from drinking water. Selenium can be found in non-leaded brass alloy where it is added to replace lead.
I	Silver (1986, 2005)	None required		Naturally occurring (erosion and weathering of rocks and soils)		Guideline value not required as drinking water contributes negligibly to an individual's daily intake.
P	Simazine (1986)	0.01		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Body weight changes and effects on serum and thyroid gland	Extent of leaching decreases with increasing organic matter and clay content.
I	Sodium (1979)		AO: ≤ 200	Naturally occurring (erosion and weathering of salt deposits and contact with igneous rock, seawater intrusion); sewage and industrial effluents; sodium-based water softeners		Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.
I	Sulphate (1994)		AO: ≤ 500	Industrial wastes	High levels (above 500 mg/L) can cause physiological effects such as diarrhoea or dehydration	Based on taste; it is recommended that health authorities be notified of drinking water sources containing sulphate concentrations above 500 mg/L.
I	Sulphide (1992)		AO: ≤ 0.05	Can occur in the distribution system from the reduction of sulphates by sulphate-reducing bacteria; industrial wastes		Based on taste and odour; levels above the AO would render water unpalatable.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
A	Taste (1979, 2005)		Inoffensive	Biological or industrial sources		Important to provide drinking water with no offensive taste, as consumers may seek alternative sources that are less safe.
T	Temperature (1979, 2005)		AO: ≤ 15°C	Not applicable		Temperature indirectly affects health and aesthetics through impacts on disinfection, corrosion control and formation of biofilms in the distribution system.
P	Terbufos (1987, 2005)	0.001		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Based on analytical achievability.
O	Tetrachloroethylene (1995)	0.03		Industrial effluents or spills	**Health basis of MAC:** Increased liver and kidney weights **Other:** Classified as possible carcinogen; limited evidence of an increased risk of spontaneous abortion	Readily leaches into groundwater; MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	2,3,4,6-Tetrachlorophenol (1986, 2005)	0.1	AO: ≤ 0.001	By-product of drinking water disinfection with chlorine; industrial effluents and use of pesticides	**Health basis of MAC:** Developmental effects (embryotoxicity)	AO based on odour; levels above the AO would render drinking water unpalatable.
O	Toluene (2014)	0.06	AO: 0.024	Emissions, effluents or spills from petroleum and chemical industries	**Health basis of MAC:** Adverse neurological effects, including vibration thresholds, colour discrimination, auditory thresholds, attention, memory and psychomotor functions **Other:** Insufficient information to determine whether toluene is carcinogenic to humans.	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
A	Total dissolved solids (TDS) (1991)		AO: ≤ 500	Naturally occurring; sewage, urban and agricultural runoff, industrial wastewater		Based on taste; TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances; TDS is composed of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Trichloroethylene (2005)	0.005		Industrial effluents and spills from improper disposal	**Health basis of MAC:** Developmental effects (heart malformations) **Other:** Classified as probable carcinogen	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	2,4,6-Trichlorophenol (1987, 2005)	0.005	AO: ≤ 0.002	By-product of drinking water disinfection with chlorine; industrial effluents and spills	**Health basis of MAC:** Liver cancer (classified as probable carcinogen)	AO based on odour; levels above the AO would render drinking water unpalatable.
P	Trifluralin (1989, 2005)	0.045		Runoff from agricultural uses	**Health basis of MAC:** Changes in liver and spleen weights and in serum chemistry	Unlikely to leach into groundwater.
DBP	Trihalomethanes[3] (THMs) (2006)	0.1		By-product of drinking water disinfection with chlorine; industrial effluents	**Health basis of MAC:** Liver effects (fatty cysts) (chloroform classified as possible carcinogen) **Other:** Kidney and colorectal cancers	Refers to the total of chlorodibromomethane, chloroform, bromodichloromethane and bromoform; MAC based on health effects of chloroform. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. Utilities should make every effort to maintain concentrations as low as reasonably achievable without compromising the effectiveness of disinfection. Recommended strategy is precursor removal. The separate MAC for BDCM was rescinded in April 2009.
I	Uranium (1999)	0.02		Naturally occurring (erosion and weathering of rocks and soils); mill tailings; emissions from nuclear industry and combustion of coal and other fuels; phosphate fertilizers	**Health basis of MAC:** Kidney effects (various lesions); may be rapidly reversible after exposure ceases	Based on treatment achievability; MAC based on chemical effects, as uranium is only weakly radioactive; uranium is rapidly eliminated from the body.

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Vinyl chloride (2013)	0.002 ALARA		Industrial effluents; degradation product from organic solvents in groundwater; leaching from polyvinyl chloride pipes	**Health basis of MAC:** Liver cancer (classified as human carcinogen) **Other:** Raynaud's disease, effects on bone, circulatory system, thyroid, spleen, central nervous system	Based on analytical achievability. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. Leaching from polyvinyl chloride pipe is not expected to be significant.
O	Xylenes (total) (2014)	0.09	AO: 0.02	Emissions, effluents or spills from petroleum and chemical industries	**Health basis of MAC:** Adverse neuromuscular effects **Other:** Insufficient information to determine whether xylenes are carcinogenic to humans.	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
I	Zinc (1979, 2005)		AO: ≤ 5.0	Naturally occurring; industrial and domestic emissions; leaching may occur from galvanized pipes, hot water tanks and brass fittings		AO based on taste; water with zinc levels above the AO tends to be opalescent and develops a greasy film when boiled; plumbing should be thoroughly flushed before water is consumed.

[1] Parameter types: A – Acceptability; D – Disinfectant; DBP – Disinfection by-product; P – Pesticide; I – Inorganic chemical; O – Organic chemical; Γ – Treatment related parameter.
[2] In cases where total dichlorobenzenes are measured and concentrations exceed the most stringent value (0.005 mg/L), the concentrations of the individual isomers should be established.
[3] Expressed as a locational running annual average of quarterly samples.
[4] No units.

Table 3. Radiological Parameters

Guidelines for radiological parameters focus on routine operational conditions of existing and new water supplies and do not apply in the event of contamination during an emergency involving a large release of radionuclides into the environment. Maximum acceptable concentrations (MACs) have been established for the most commonly detected natural and artificial radionuclides in Canadian drinking water sources, using internationally accepted equations and principles and based solely on health considerations.

The MACs are based on exposure solely to a specific radionuclide. The radiological effects of two or more radionuclides in the same drinking water source are considered to be additive. Thus, the sum of the ratios of the observed concentration to the MAC for each contributing radionuclide should not exceed 1.

Water samples may be initially analysed for the presence of radioactivity using gross alpha and gross beta screening rather than measurements of individual radionuclides. If screening levels are exceeded (0.5 Bq/L for gross alpha and 1.0 Bq/L for gross beta), then concentrations of specific radionuclides should be analysed. A guideline for radon is not deemed necessary and has not been established. Information on radon is presented because of its significance for indoor air quality in certain situations.

Parameter (approval)	MAC (Bq/L)	Common sources	Health basis of MAC	Comments
Cesium-137 (2009)	10	Nuclear weapons fallout and emissions from nuclear reactors	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Iodine-131 (2009)	6	Sewage effluent	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Lead-210 (2009)	0.2	Naturally occurring (decay product of radon)	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	Corresponds to total lead concentration of 7×10^{-8} µg/L
Radium-226 (2009)	0.5	Naturally occurring	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Radon (2009)	None required	Naturally occurring (leaching from radium-bearing rocks and soils; decay product of radium-226)	Health risk from ingestion considered negligible due to high volatility	Mainly a groundwater concern; if concentrations in drinking water exceed 2000 Bq/L actions should be taken to reduce release into indoor air (e.g. proper venting of drinking water supply)
Strontium-90 (2009)	5	Nuclear weapons fallout	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Tritium (2009)	7000	Naturally occurring (cosmogenic radiation); releases from nuclear reactors	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	Not removed by drinking water treatment
Uranium (1999)	N/A		MAC based on chemical properties	See information provided in Table 2

Table 4. Guidance Documents

In certain situations, the Federal-Provincial-Territorial Committee on Drinking Water may choose to develop guidance documents for contaminants that do not meet the criteria for guideline development and for specific issues for which operational or management guidance is warranted. These documents are offered as information for drinking water authorities and help provide guidance relating to contaminants, drinking water management issues or emergency situations.

Parameter/subject (approval)	Comments
Chloral hydrate in drinking water (2008)	Exposure levels in Canada far below concentration that would cause health effects; levels above 0.2 mg/L may indicate a concern for health effects and should be investigated.
Controlling corrosion in drinking water distribution systems (2009)	Addresses strategies to deal with leaching of lead from materials in the distribution system; sampling protocols can be used to assess corrosion and the effectiveness of remediation/control measures to reduce lead levels in drinking water; corrective measures are outlined to address lead sources.
Heterotrophic plate count (HPC) (2012)	A useful operational tool for monitoring general bacteriological water quality through the treatment process and in the distribution system. HPC results are not an indicator of water safety and should not be used as an indicator of potential adverse human health effects.
Issuing and rescinding boil water advisories (2009)	Summarizes factors for consideration when responsible authorities issue or rescind boil water advisories.
Issuing and rescinding drinking water avoidance advisories in emergency situations (2009)	Summarizes factors for consideration when responsible authorities issue or rescind drinking water avoidance advisories in emergency situations.
Potassium from water softeners (2008)	Not a concern for general population; those with kidney disease or other conditions, such as heart disease, coronary artery disease, hypertension or diabetes, and those who are taking medications that interfere with normal body potassium handling should avoid the consumption of water treated by water softeners using potassium chloride.
Use of the microbiological drinking water guidelines (2013)	Provides an overview of the microbiological considerations to ensure drinking water quality, integrating key content of the relevant guideline technical documents and guidance documents to illustrate how they fit into the multi-barrier approach.
Waterborne bacterial pathogens (2013)	Originate from human or animal faeces or may be naturally occurring in the environment. Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); some pathogens may infect wounds, lungs, skin, eyes, central nervous system or liver. Document provides information on these pathogens and treatment options, and recommends using the multi-barrier approach to reduce their levels.

Table 5. Archived Documents

The Federal-Provincial-Territorial Committee on Drinking Water has established a science-based process to systematically review older guidelines and archive those that are no longer required. Guidelines are archived for parameters that are no longer found in Canadian drinking water supplies at levels that could pose a risk to human health, including pesticides that are no longer registered for use in Canada and for mixtures of contaminants that are addressed individually. To obtain a copy of an archived document, please contact water_eau@hc-sc.gc.ca.

Parameter	Type
Aldicarb	Pesticide
Aldrin + dieldrin	Pesticide
Bendiocarb	Pesticide
Cyanazine	Pesticide
Dinoseb	Pesticide
Gasoline and its organic constituents	Organic chemical
Methoxychlor	Pesticide
Parathion	Pesticide

Acronyms

A	acceptability (parameter type)
ALARA	as low as reasonably achievable
AO	aesthetic objective
CDW	Committee on Drinking Water (FPT)
D	disinfectant (parameter type)
DBP	disinfectant by-product (parameter type)
HPC	heterotrophic plate count
I	inorganic chemical (parameter type)
MAC	maximum acceptable concentration
NTU	nephelometric turbidity units
O	organic chemical (parameter type)
OG	operational guidance value
P	pesticide (parameter type)
T	treatment-related (parameter type)
TCU	true colour units

Appendix M – AANDC Memorandum on Nipissar Lake, Lower Landing Lake and Char River Water Chemistry Data, October 23, 2014

Your file - Votre reference
3AM-GRA1015

October 23, 2014

Our file - Notre reference
IQALUIT-# 866823

Phyllis Beaulieu
Manager of Licensing
Nunavut Water Board
Gjoa Haven, NU X0E 1J0

Re: Aboriginal Affairs and Northern Development Canada's Technical Review of additional information submitted as per the public hearing proceedings which took place on Sept 25, 2014 by the Government of Nunavut, Department of Community and Government Services (GN-CGS) for the Seasonal Replenishment of Nipissar Lake.

Dear Ms. Beaulieu:

Thank you for your email of October 10, 2014 concerning the above mentioned application. A memorandum is provided for the Board's consideration. Comments and recommendations have been provided pursuant to Aboriginal Affairs and Northern Development Canada's mandated responsibilities under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Department of Indian Affairs and Northern Development Act*.

Please do not hesitate to contact me by telephone at 867-975-4282 or email at ian.parsons@aandc-aadnc.gc.ca for further information.

Sincerely,

Ian Parsons
Regional Coordinator
Water Resources Division
Resource Management Directorate
Aboriginal Affairs and Northern Development Canada
Iqaluit, NU X0A 0H0

Encl.

c.c.: Murray Ball, Manager of Water Resources, AANDC Nunavut
Erik Allain, Manager of Field Operations, AANDC Nunavut

Canada

Memorandum

To: Phyllis Beaulieu, Nunavut Water Board

From: Ian Parsons, Aboriginal Affairs and Northern Development Canada

CC: Murray Ball (AANDC), Erik Allain (AANDC), Megan Porter (NWB) and Robin Ikkutisluk (NWB)

Date: October 23, 2014

Re: Water Licence Application, #3AM-GRA1015

Licensee:	Government of Nunavut, Dept. of Community and Government Services
Project:	Seasonal Replenishment of Nipissar Lake
Region:	Kivalliq

Comments:

A. Background

On July 7, 2014, the Nunavut Water Board (NWB) provided notification that a Public Hearing would take place on September 25-26, 2014 for the amendment application, allowing for the seasonal replenishment of Nipissar Lake.

The Licensee asked the NWB to keep the Public Hearing open in order to provide sufficient time to response to concerns raised by DFO at the Public Hearing; the NWB approved this request and also advised that the licensee provide water chemistry data on Nippissar Lake, Lower Landing Lake and Char River by October 10, 2014.

On October 10, 2014 after receiving all applicable documentation from the Licensee the NWB distributed the documents for review. The NWB advised interested parties that they had until October 24, 2014 to response to the additional information.

B. Results of review

On behalf of Aboriginal Affairs and Northern Development Canada (AANDC), the following comments and recommendations are provided:

1.	**Nipissar Lake, Lower Landing Lake and Char River Water Chemistry data** **Comment:** The licensee has provided water chemistry data for Nipissar Lake, Lower Landing Lake and Char River, this data was collected over two different time periods. On June 24, 2014 water chemistry results were reported on Nipissar Lake and Char River and on Oct 7, 2014 water chemistry results were reported on Char River and Lower Landing Lake. The water chemistry results indicate that there is no significant difference between the three different waterbodies on any of the parameters tested and that all three waterbodies have water chemistry that meets the

	guideline for drinking water standards in Canada. **Recommendation:** At this time AANDC is satisfied that the water chemistry of all three waterbodies is of similar quality as well as being suitable for drinking and poses no risk to the residents of Rankin Inlet.

Prepared by Ian Parsons