Wetland 06 Water Monitoring Report Southwest Calgary Ring Road Project, Calgary Alberta

Prepared for:

KGL Constructors
18 Seven Chiefs Road SW
Calgary, Alberta T2W 3C4

Project No. 102604-01

February 26, 2019

Prepared by:

Hemmera Envirochem Inc.
322 11th Avenue SW, Suite 804
Calgary, AB T2R 0C5
T: 403.264.0671
F: 403.264.0670
hemmera.com

TABLE OF CONTENTS

LIST OF TABLES (WITHIN TEXT)

LIST OF FIGURES (WITHIN TEXT)

LIST OF APPENDICES

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
the Approval	*Water Act* Approval No.: 00388473-00-00
Ausenco	Ausenco Engineering Canada Inc.
CCME	Canadian Council of Ministers of the Environment
DO	Dissolved Oxygen
GOA	Government of Alberta
Hemmera	Hemmera Envirochem Inc.
KGL	KGL Constructors
Monitoring Plan	Long-Term Monitoring Plan
the Order	Ministerial Order 06/2018
the Project	Southwest Calgary Ring Road Project
SWCRR	Southwest Calgary Ring Road
TUC	Transportation Utility Corridor
TSS	Total Suspended Solids

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
km	Kilometre
m	Metre
mg/L	Milligrams per liter

1.0 BACKGROUND

Wetland 06 is located in the Weaselhead Natural Area, a natural environmental park that borders the west end of Glenmore Reservoir (**Figure 1**) within the City of Calgary. A small portion of Wetland 06 is located within the Transportation Utility Corridor (TUC) running north to south through the Weaselhead Natural Area. Wetland 06 is an historical oxbow channel to the Elbow River that is over 500 metres (m) in length with wetted widths that are generally less than 30 m. Wetland 06 collects surface water from several other wetlands (Wetland 07, 08, and 09, **Figure 1**) located upslope. Wetland 06 drains generally east through the Weaselhead Natural Area and eventually discharges into the Glenmore Reservoir, which provides approximately half of the city of Calgary's drinking water supply.

The TUC containing the western portion of Wetland 06 was incorporated into the proposed design of the Southwest Calgary Ring Road (SWCRR) Project (the Project). The SWCRR Project was awarded by Alberta Transportation to Mountain View Partnership, which in turn engaged KGL Constructors (KGL) to develop the Project. The scope of the Project encompasses the design and construction of approximately 31 kilometers (km) of new six and eight lane divided freeway, 14 interchanges, as well as three watercourse realignments and associated crossing structures. The Project corridor is located along the western limit of the City of Calgary south of Highway 8 and includes sections of Highways 8 and 22.

On August 11, 2017, the Project received *Water Act* Approval No.: 00388473-00-00 (the Approval) to impact twenty-four wetlands, including Wetland 06. Subsequently, an Environmental Appeal was filed (*Brockman and Tulick v. Director, South Saskatchewan Region, AEP*; Appeal No.: 17-047 and 17-050-R. 2017) affecting KGL's ability to impact the wetlands, as described in the Approval.

As a result of the Environmental Appeal, the Minister of Environment and Parks issued a Ministerial Order 06/2018 (the Order), on January 29, 2018, that amended the previously received Approval to include additional conditions to address water quality and quantity impacts to Wetland 06. In June 2018 a Long-Term Monitoring Plan (Monitoring Plan) developed by Hemmera Envirochem (Hemmera) on behalf of on behalf of KGL to fulfil requirements of the Order (see conditions 6.2 and 6.6) was approved by the Director of Alberta Environment and Parks.

The Monitoring Plan outlined the following obligations:

- The Monitoring Plan will come into effect as soon as approved by the Director and shall remain in effect for a period of five years after the road is officially opened to the public.
- Monitoring of the flow of water into Wetland 06 shall occur in the spring and fall of each year that the plan is in effect.
- Monitoring of water quality in Wetland 06 shall occur in the spring and fall of each year that the plan is in effect, including total dissolved solids, salts, dissolved metals, and other parameters consistent with a stormwater sampling program.
- The monitoring data shall be provided to the Director within one month from the date the data were collected.
- The results of the monitoring and analysis of the monitoring shall be provided to the Director in an annual report by March 31 of the year following the calendar year in which the data were collected.

2.0 INTRODUCTION

This monitoring report has been prepared by Hemmera on behalf of KGL. Monitoring of surface water flow and surface water quality in 2018 occurred with reference to the Project's Monitoring Plan (Hemmera 2018). Monitoring in 2018 represented Year 1 of the Monitoring Plan, which will remain in effect throughout construction, and for the first five years of operation of the SWCRR. The Monitoring Plan is presented in Appendix A.

The objective of the first year of monitoring was to establish long-term monitoring locations and collect initial surface water quality and surface water flow measurements from Wetland 06, and other waterbodies/drainages providing surface flow to Wetland 06. Additionally, surface water quality and surface water flow were monitored in a nearby reference wetland, located outside of the potential impact area of construction, to determine naturally occurring variation affecting wetlands in the Weaselhead Natural Area. Information gathered in 2018 will contribute to future data collected by Hemmera throughout the duration of the Monitoring Plan and will facilitate comparative analysis about the potential influences or lack thereof of the Project on surface water quality and flow in Wetland 06.

3.0 SITE DESCRIPTION

Several adjacent wetlands within the Weaselhead Natural Area contribute surface flow to Wetland 06 (see **Figure 1**). The Monitoring Plan identified two pathways in which Project-influenced water could potentially flow into Wetland 06.

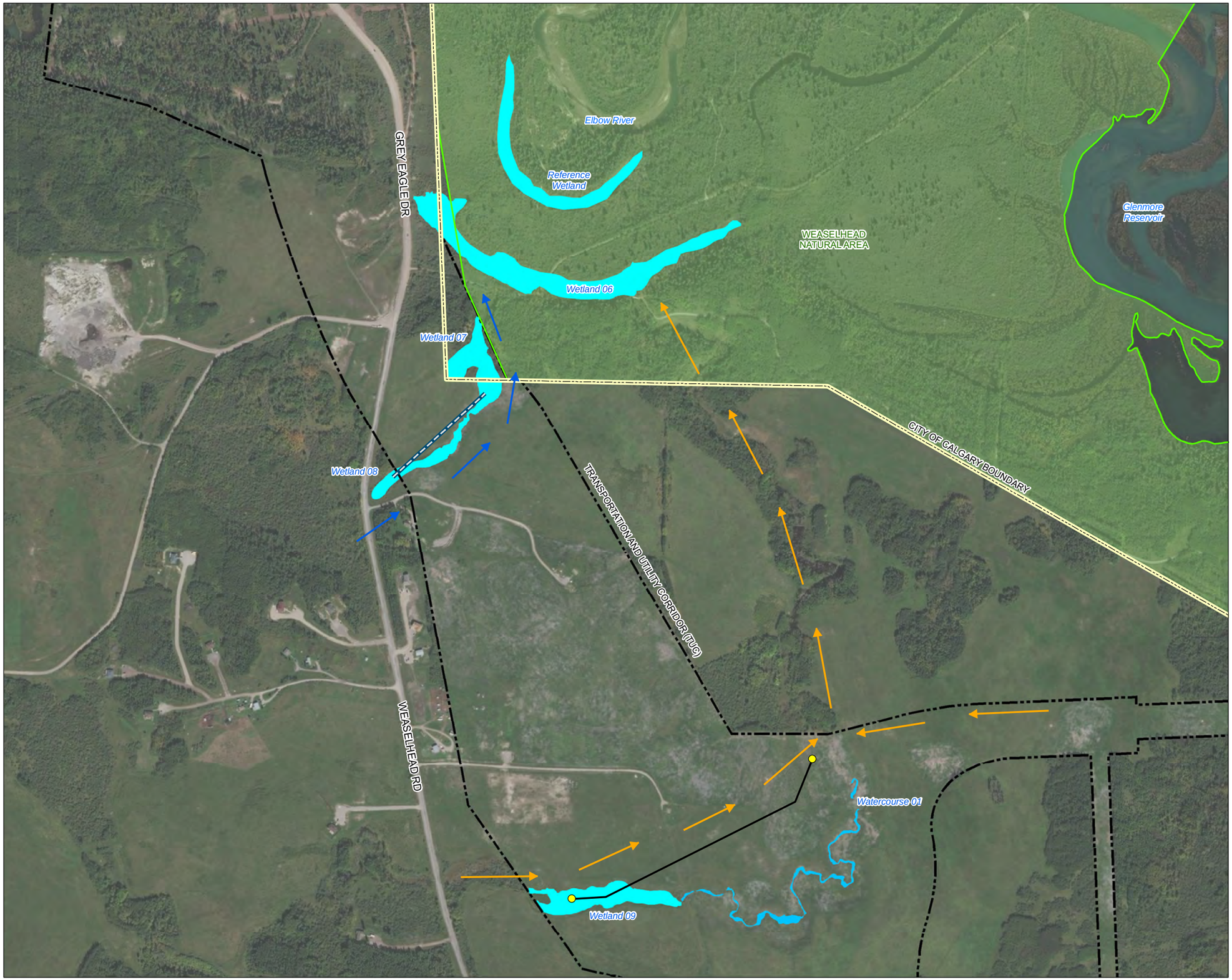
Pathway 1 - conveys flow from Wetland 08 and Wetland 07 which are located to the southwest of Wetland 06. This pathway is an undefined channel that diagonally bisects the Project footprint. From the west side of the TUC boundary, a bypass drainage culvert installed as part of the Project carries water from Wetland 08 and Wetland 07 northeast through the Project area. Water then flows past the east side of the TUC boundary and into a defined channel (approximately 400 m) which ultimately drains into Wetland 6.

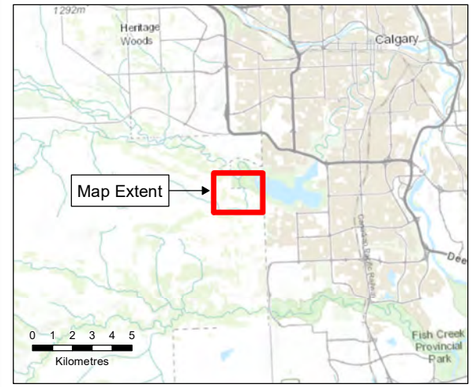
Pathway 2 - conveys flow from Wetland 09, located to the south of Wetland 06. This pathway originates as an undefined channel that flows east through Wetland 09 and through a bypass drainage system installed as part of the Project to maintain flow from Wetland 09 to Wetland 06. The drainage system outlets to a constructed riprap lined drainage ditch which flows north towards the eastern TUC boundary. In addition, a constructed drainage ditch channels water west where it converges with flows from the aforementioned constructed riprap lined drainage ditch. From the northern edge of the TUC water meanders north through a defined channel (approximately 1,000 m) eventually draining into Wetland 06.

Throughout the construction phase of the Project, surface run-off from the work area is managed through temporary erosion and sediment control (ESC) measures and redirected away from Wetland 06. During the operational phase of the Project, the natural flow of surface water (i.e., from the west side of the TUC) into Wetland 06 will be maintained via the bypass drainage systems described above. Further, during the operational phase, Project-impacted water will not be discharged into Wetland 06. All Project-impacted water in the vicinity of wetland 06 has been designed to flow northwest into a stormwater pond.

Wetland 06 Water Monitoring Report
Southwest Calgary Ring Road Project, Calgary AB

Wetland Locations





Legend

- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016
- Inset Basemap: ESRI World Topographic Map

N

1:7,500

0 100 200 300 400 500

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: Feb 26, 2019	Figure 1

Hemmera An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig1_102604_01_Wetland_Location_190226.mxd

4.0 METHODS

Site visits of Wetland 06 and surrounding wetlands in 2018 were conducted by a crew of two, led by a Qualified Environmental Professional (QEP) from Hemmera. During Year 1 two site visits were conducted, once during the summer and once during the fall in order to capture seasonal variability of the wetlands. The timing of each site visit was influenced by environmental conditions, including ambient air temperatures, snow/ice cover, and precipitation events. In order to reduce temporal variation no sampling was conducted within 72 hours of a substantial precipitation event.

Although the Monitoring Plan specifies a site visit in both spring and fall, a visit could not be conducted in spring in 2018 as the Monitoring Plan did not receive approval until June 2018. The initial visit was further delayed until early July by a series of precipitation events. Site visits were completed on the following dates:

- Summer –July 5, 2018; and
- Fall – October 11, 2018

4.1 Sample Locations

Locations for surface water quality and flow monitoring are provided in **Figure 2**. The sites were selected strategically for appropriate reference and comparison site considerations, in order to facilitate comparative analysis. Sampling sites in and near Wetland 06 are provided in an enhanced view in **Figure 3**. The suitability of sample locations was field verified as part of the Monitoring Plan in spring 2018; no changes to the original proposed locations were required throughout the duration of Year 1 monitoring.

4.1.1 Water Quality Monitoring

Surface water quality monitoring sites were established at eight locations (**Table 1**).

One surface water quality reference site (WQ-01) was established north of Wetland 06, in an adjacent wetland outside the TUC. This location was selected as the reference site as there are no identified or known pathways from the Project that could direct Project-affected water into the adjacent wetland.

Three surface water quality reference sites were located within the pathway of flow from Wetland 08 and Wetland 07 into Wetland 06 (i.e. Pathway 1). The three sample sites established along this pathway were; WQ-04a, WQ-04b, and WQ-02. Site WQ-04a was located upstream of any potential influences from the Project and was selected to serve as a background site for this pathway.

Four surface water quality reference sites were located along the pathway of flow from Wetland 09 to Wetland 06 (i.e. Pathway 2). The four sample sites selected along this pathway were WQ-05a, WQ-05b, WQ-05c, and WQ-03. Site WQ-05a was located upstream of any potential influences from the Project and was selected to serve as a background site for this pathway.

No supplementary water quality monitoring sites were required throughout Year 1 monitoring, as no abnormal site conditions or contaminant indicators were observed.

Wetland 06 Water Monitoring Report
Southwest Calgary Ring Road Project, Calgary AB

Water Flow and Quality Sampling Locations

Legend

- Water Flow Sample Location (Hemmera, 2018)
- Water Quality Sample Location (Hemmera, 2018)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016

N

1:7,500

0 100 200 300 400 500

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: Feb 26, 2019	Figure 2

Hemmera An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig2_102604_01_Sample_Locations_190226.mxd

Wetland 06 Water Monitoring Report
Southwest Calgary Ring Road Project, Calgary AB

Water Flow and Quality Sampling Location Details

Legend

- Water Flow Sample Location (Hemmera, 2018)
- Water Quality Sample Location (Hemmera, 2018)
- Transect Location (Hemmera, 2019)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016

N

1:3,000

0 25 50 75 100 125

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: Feb 26, 2019	Figure 3

Hemmera
An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig3_102604_01_Sample_Locations_Details_190225.mxd

Table 1 Surface Water Quality Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Site Description	Reference or Comparison Site
	Easting	Northing		
WQ-01	699168	5652375	Reference wetland to the north of Wetland 06	Reference
WQ-02	699186	5652164	West (upslope) side of Wetland 06	Comparison
WQ-03	699432	5652159	East (downslope) side of Wetland 06	Comparison
WQ-04a	698898	5651725	Wetland 08, upslope of SWCRR Project	Background
WQ-04b	699113	5651956	Wetland 07, downslope of SWCRR Project and Wetland 08	Comparison
WQ-05a	699060	5650929	Upslope of Wetland 09 and SWCRR Project	Background
WQ-5b	699788	5651289	Watercourse 01 downslope of Wetland 09 and SWCRR Project	Comparison
WQ-05c	700061	5651274	Catchment basin to the east of SWCRR Project and upslope of the confluence with Watercourse 01	Comparison

4.1.2 Water Flow Monitoring

Surface water flow monitoring sampling sites were established at four locations within Wetland 06 (**Table 2**). Sampling locations were selected based on the expectation they would provide conveyance of surface flow (inflow or outflow) year-round during normal surface flow conditions. Locations with defined channels were selected for monitoring sites, as monitoring the flow of undefined channels could result in reduced accuracy.

Three sampling locations were identified to measure surface water inflows into Wetland 06. Site FL-01 was located at the inflow of surface water from Wetland 07 and 08 along drainage Pathway 1. Site FL-02 was located where the surface water inflow was conveyed from Wetland 09 along drainage Pathway 2. Site FL-03 was located where the surface water inflow from the reference wetland drained into Wetland 06. One site was established to monitor surface water outflow from wetland 06; site FL-04 was located 75 m downstream of Wetland 06 at the Glenmore Pathway bridge crossing.

No supplementary surface water monitoring sites were required throughout Year 1 monitoring, as no additional inflow or outflow locations were identified during field sampling visits.

Table 2 Surface Water Flow Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Inflow or Outflow
	Easting	Northing	
FL-01	699156	5652166	Inflow
FL-02	699406	5652115	Inflow
FL-03	699075	5652326	Inflow
FL-04	699644	5652343	Outflow

4.2 Water Quality Monitoring

Surface water quality sampling was conducted from the banks of the sample sites provided in **Table 1** and described in **section 4.1.1**. Site conditions (e.g. weather) were recorded, and photos documenting current conditions were taken at each location. During the fall monitoring visit the water levels in the reference wetland were too low to facilitate surface water quality sampling; data was not collected from WQ-01 at this time.

Sampling was conducted following the shore sampling protocol provided by Canadian Council of Ministers of Environment (CCME) (2011). The crew wore unpowdered latex disposable gloves during sample collection. At each sampling site, the crew collected water samples using an extension pole to avoid site disturbance. The extension pole and clamp were rinsed upon arrival at each site, before samples were collected, in order to reduce contamination between sites. Laboratory protocols for sample bottle rinsing were followed by the crew; all rinsing of bottles or collection equipment was conducted slightly downslope of the sample site to prevent cross contamination.

Water samples were collected at approximately 60% depth and facing upstream if flow was present. Algae, sediment, organic matter, scum and film were avoided in order to ensure the sample was representative. All water samples were collected one at a time, capped immediately to prevent contamination and labelled with a water-proof marker to facilitate accurate future identification. After collection, samples were kept at approximately 4^{o}C within a cooler using ice packs. Before transport from site, all samples were packed and sealed as to prevent spillage and breakage. Samples were collected and delivered to a laboratory within the same day to allow sample analysis within appropriate holding times.

Maxxam Analytics, a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA) completed the analysis of water samples. A chain of custody form was completed, indicating the transfer of custody from the authorized crew member to the CALA laboratory.

Water quality parameters with a holding time of less than 7-days (i.e. biological oxygen demand, nitrate, nitrite, sulfate, total dissolved solids, and total suspended solids) were immediately analyzed in all samples. Samples collected from the reference wetland (WQ-01) and Wetland 06 (WQ-02 and WQ-03) were immediately analysed for the parameters listed in **Table 3**. These parameters are reflective of the City of Calgary Stormwater Management and Design Manual (2011) and likely to facilitate the detection of any potential impacts of the construction and operation phases of the Project. The remaining samples (WQ-04a, WQ-04b, WQ-05a, WQ-05b, and WQ-05c) were held by the CALA Laboratory and tested if exceedances in Wetland 06 samples were detected in water quality parameters under the Environmental Quality Guidelines for Alberta Surface Water (GOA) (Government of Alberta 2018). This testing protocol facilitated the potential determination of source Pathway of water quality exceedances in Wetland 06.

Table 3 Year 1 Water Quality Monitoring Parameters

Sediment & Physical	
• Total Suspended Solids (TSS) • Total Dissolved Solids (TDS) • Turbidity	• Conductivity (EC) • pH • Dissolved Oxygen (DO)
Nutrients and Others (mg/L)	
• Biochemical Oxygen Demand (BOD) • Chemical Oxygen Demand (COD) • Nitrate (NO_3) • Nitrite (NO_2)	• Total Kjelahl Nitrogen (TKN) • Ammonia-Nitrogen (NH_3-N) • Total Phosphorus (TP) • Dissolved Reactive Phosphorus (TDP) • Ortho-Phosphate

Dissolved Metals & Metals (mg/L)			
• Silver (Ag) • Aluminum (Al) • Arsenic (As) • Boron (B) • Barium (Ba) • Beryllium (Be) • Calcium (Ca) • Cadmium (Cd)	• Cobalt (Co) • Chromium (Cr) • Copper (Cu • Iron (Fe) • Potassium (K) • Lithium (Li) • Magnesium (Mg) • Manganese (Mn)	• Molybdenum (Mo) • Nickel (Ni) • Lead (P) • Lead (Pb) • Sulfur (S) • Antimony (Sb) • Selenium (Se) • Silicon (Si)	• Tin (Sn) • Strontium (Sr) • Sodium (Na) • Titanium (Ti) • Thallium (Tl) • Uranium (U) • Vanadium (V) • Zinc (Zn)

Major Ions & Salts	
• Sodium (Na^{2+}) • Potassium (K^{+}) • Potassium (K^{+})	• Calcium (Ca^{2+}) • Chloride (Cl^{-}) • Sulfate (SO^{4-})

In-situ measurements were also collected at all water quality sampling sites; sediment and physical parameters were recorded (i.e. TSS, TDS, Turbidity, conductivity, dissolved oxygen, pH and water temperature). Measurements were taken at approximately 60% water depth using a YSI water quality meter as per the manufacturer's instructions, following calibration.

Select water quality parameters were compared to surface water quality parameters collected from proximate sites in Wetland 06 in 2016 and 2017 by the Weaselhead / Glenmore Preservation Society and presented in their 2017 Environmental Monitoring Report (Porto 2018).

4.3 Water Flow Monitoring

Surface flow monitoring was conducted by the crew at the sample sites provided in **Table 2** and described in **Section 4.1.2**. Surface flow was determined using the velocity-area method (Government of Alberta 2009) and a HACH® velocity flow meter. During summer and fall monitoring visits the inflow channel from the reference wetland (FL-03) as well as the outflow channel (FL-04) were dry at the time of survey, inhibiting the measurement of water flow for these sampling sites. Following each seasonal monitoring visit, the inflows and outflow of Wetland 06 were used to calculate a modified water balance within the wetland.

During the summer field visit, the crew deployed a water level staff gauge in Wetland 06 and the reference wetland. The initial water depths were recorded; water level measurements were taken again during the fall monitoring visit.

Transect locations to measure wetted width during both field visits were established. Four transects were completed by the crew in both Wetland 06 and the reference wetland respectively (**Figure 3**). The location of each transect was recorded in reference to distinct local landmarks and using a global positioning system (GPS) device. Transect measurements of wetted widths of Wetland 06 were replicated by the crew during the fall sampling visit. There was no surface water present in the reference wetland during fall sampling, as a result the wetted width was not measured.

Wetted width and water depths of Wetland 06 and the reference wetland were compared and used to assess if the wetted perimeter of Wetland 06 was impacted by Project activities, by accounting for seasonal variability resulting from natural fluctuations.

5.0 RESULTS

5.1 Water Quality Monitoring

5.1.1 2018 Water Quality Results

Water quality parameters outlined in **Table 3** were collected from sampling sites located within Wetland 06, the inflow pathways from Wetlands 07 and 08, and Wetland 09, as well as the reference wetland. Water quality sampling results from WQ-01, WQ-02 and WQ-03 are summarized in **Table 4** and demonstrate the natural variability within Wetland 06 and the reference wetland during both summer and fall**.** Water quality samples could not be collected from sampling site WQ-05c as the proposed location was within the footprint of active construction and no longer contributed to the surface water flow along Pathway 2. Raw water quality data from all viable sampling sites are provided in **Appendix B.** Photographs taken at each sampling site are provided in **Appendix C.**

Water quality results were compared to the Environmental Quality Guidelines for Alberta Surface Water (GOA 2018) and the Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Fresh Water Organisms (CCME 1999). Two water quality parameters (pH and Dissolved Oxygen [DO]) exceeded the Environmental Quality Guidelines. No water quality exceedances were found for Nutrients, Dissolved Metals and Metals, Major Ions or Salts in any of the samples analysed.

pH: In-situ pH measured during summer sampling at site WQ-03 was recorded as 9.01 which exceeds the pH range provided by the AB SW Freshwater Aquatic Life (Long-term) of 6.5 to 9.0 (GOA 2014). During the same time period, the pH concentration measured at site WQ-02 was 8.25. During fall sampling, the pH had been reduced at site WQ-03 to 8.09 which is within the acceptable range of Freshwater Aquatic Life (Long-term) (GOA 2014). The pH measured at site WQ-02 remained unchanged between sampling visits.

Dissolved Oxygen: In-situ DO measured during fall sampling at site WQ-03 was recorded as 4.3 mg/L, which is below the Environmental Quality Guidelines (GOA 2018) for acceptable minimum DO concentration for early life stages of cold water biota of 9.5 mg/L. DO measured at site WQ-02 during fall sampling, as well as both samples collected from Wetland 06 during summer sampling were consistent with the Environmental Quality Guidelines DO concentration criteria.

During summer sampling, in-situ DO concentrations within the reference wetland were recorded as 2.2 mg/L; lower than recorded in Wetland 06 and below the Environmental Quality Guidelines (GOA 2018). fall DO concentrations measured in Wetland 06 (WQ-02, WQ-03) could not be directly compared to DO concentrations present in the reference wetland as it was dry during fall sampling.

Table 4 Summary of 2018 Water Quality Sampling Results

	CCME Guidelines (1999)		Summer (05/06/2018)			Fall (11/10/2018)		
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	WQ-01	WQ-02	WQ-03	WQ-01*	WQ-02	WQ-03
Sediment & Physical								
Total Suspended Solids (TSS) (mg/L)	Narr.	Narr.	18	17	3.5	-	9.7	25
Total Dissolved Solids (TDS) (mg/L)	N/A	N/A	530	470	270	-	490	390
Turbidity (NTU)	Narr.	Narr.	6.5	7	2.6	-	5.4	17
Conductivity (EC) (µS/cm)	N/A	N/A	950	850	500	-	850	710
pH	6.50 – 9.00	N/A	8.13	8.25	**9.1**	-	8.25	8.09
Dissolved Oxygen (mg/L)	Narr.	5.0	2.2	10	14	-	11	**4.3**
Nutrients and Others (mg/L)								
Biochemical Oxygen Demand (BOD)	N/A	N/A	3.2	<2.0	<2.0	-	<2.0	3.5
Chemical Oxygen Demand (COD)	N/A	N/A	36	35	27	-	15	37
Nitrate (NO3)	3.000	124.000	<0.044	<0.044	0.072	-	0.6	<0.044
Nitrite (NO2)	N/A	N/A	<0.033	<0.033	<0.033	-	<0.033	<0.033
Total Kjelahl Nitrogen (TKN)	N/A	N/A	1.5	0.81	0.86	-	0.44	0.9
Ammonia-Nitrogen (NH3-N)	N/A	N/A	0.043	0.045	0.024	-	<0.015	0.039
Ortho-Phosphate	N/A	N/A	0.008	0.0068	0.0085	-	0.0034	<0.003
Dissolved Metals & Metals (mg/L)								
Silver (Ag)	N/A	0.0075 mg/L	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001
Aluminum (Al)	0.100 mg/L	N/A	<0.003	<0.003	<0.003	-	0.0034	0.0034
Arsenic (As)	0.005 mg/L	N/A	0.0013	0.0021	0.0016	-	0.00061	0.0012
Boron (B)	1.500 mg/L	29.000mg/L	0.032	0.032	0.028	-	0.04	0.041
Berium (Ba)	N/A	N/A	0.23	0.13	0.069	-	0.11	0.21
Beryllium (Be)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001
Calcium (Ca)	N/A	N/A	97	80	30	-	73	52
Cadmium (Cd)	N/A	N/A	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002
Colbalt (Co)	N/A	N/A	0.00074	0.00041	<0.0003	-	<0.0003	<0.0003
Chromium (Cr)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001
Copper (Cu)	N/A	N/A	0.00021	0.00025	0.0004	-	0.00036	<0.0002
Iron (Fe)	0.30 mg/L	N/A	1	<0.06	<0.06	-	0.1	0.064
Potassium (K)	N/A	N/A	1.7	4.1	3.6	-	2.3	6.8
Lithium (Li)	N/A	N/A	<0.02	0.024	<0.02	-	0.026	<0.02
Magnesium (Mg)	N/A	N/A	49	49	35	-	53	43
Manganese (Mn)	N/A	N/A	0.44	0.12	0.0083	-	0.065	0.025
Molybdenum (Mo)	0.073 mg/L	N/A	0.00036	0.0038	0.0028	-	0.0019	0.0057
Nickel (Ni)	N/A	N/A	0.0011	0.0014	0.00098	-	0.00066	0.0014
Lead (P)	N/A	N/A	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002
Sulfur (S)	N/A	N/A	3	7.7	10	-	20	14
Antimony (Sb)	N/A	N/A	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006
Selenium (Se)	0.001 mg/L	N/A	<0.0002	0.0011	0.0006	-	0.0014	0.0004
Silicon (Si)	N/A	N/A	4.4	6	1.2	-	5.2	1.4
Tin (Sn)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001
Strontium (Sr)	N/A	N/A	0.63	0.85	0.37	-	0.74	0.52
Sodium (Na)	N/A	N/A	49	34	23	-	44	34
Titanium (Ti)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001
Thallium (Tl)	0.0008 mg/L	N/A	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002
Uranium (U)	0.015mg/L	0.033 mg/L	0.00044	0.0031	0.0023	-	0.0048	0.0083
Vanadium (V)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001
Zinc (Zn)	0.007 mg/L	0.037mg/L	<0.003	<0.003	<0.003	-	0.013	<0.003
Major Ions & Salts								
Chloride (Cl-)	120	640	12	41	51	-	12	29
Sulfate (SO4-)	N/A	N/A	6.6	24	34	-	59	40

Note: * WQ01 was dry during fall sampling visit.
(-) = null result.
Narr = Narrative guidelines.
N/A = CCME data regarding water quality limits for specified parameter is unavailable.

5.1.2 Comparison with Historic Measurements

Select surface water quality parameters (i.e. turbidity, temperature, pH, conductivity, DO, phosphate and chloride) collected at WQ-02 and WQ-03 were compared to data collected in 2016 and 2017 by the Weaselhead / Glenmore Preservation Society (Porto 2018) at two sampling sites in close proximity to WQ-02 and WQ-03. Water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 was collected prior to the initiation of construction activities on the Project. A comparison of surface water quality parameters is presented in **Table 5** and demonstrates the natural variability in water quality between sites and season in Wetland 06.

Chloride: Water quality sampling of Wetland 06 in 2018 measured higher chloride concentrations compared to previous water quality data collected by the Weaselhead / Glenmore Preservation Society. Samples collected during the summer site visit measured a Chloride concentration of 51 mg/L; a value higher than chloride measurements in previous years. Elevated chloride concentrations may result from a variety of sources including road salt runoff and herbicides (Kelly et al. 2012). As chloride has limited reactivity with the environment and is highly soluble in water, its residence time within a water body is greatly influenced by the rate of water flow; limited flow will result in a longer persistence time. The CCME guidelines for water quality recommend a maximum chloride concentration of 120 mg/L for the long-term protection of aquatic life (CCME 1999); the concentration of chloride with Wetland 06 remained below this limit. Although current concentrations of chloride are below CCME limits, this parameter will be closely monitored throughout subsequent monitoring years to detect any long-term trends.

Conductivity: In-situ water quality sampling of Wetland 06 in 2018 measured higher conductivity measurements compared to previous water quality data collected by the Weaselhead / Glenmore Preservation Society. Higher conductivity was recorded in both summer and fall at Sampling Site 1 (WQ-02). Conductivity in surface water is affected by the presence of a variety of inorganic cations and anions, including chloride. There are no CCME or Alberta Environmental Quality Guidelines specific to conductivity due to its high natural variability, however natural waters can vary between 50 μS/cm and 1,500 μS/cm (BC Ministry of Environment 2013). Variation in conductivity measured in Wetland 06 falls within this range.

Table 5 Surface Water Quality Parameters Collected from Wetland 06 Sites from 2016 to 2018

Surface Water Quality Parameters of Wetland 06							
		2016[1]		2017[1]		2018[2]	
		Summer	Fall	Summer	Fall	Summer	Fall
Sampling Site 1 (close proximity to WQ-02)	Turbidity (NTU)	30.8	0.8	20.0	18.7	6.5	5.4
	Temperature C	11.9	4.0	14.6	4.2	19.1	1.1
	pH	7.6	7.9	7.53	8.07	7.6	6.5
	Conductivity (µS/cm)	470	444	589	500	882	833
	DO (mg/L)	5.20	10.48	2.03	9.12	10.5	9.8
	Phosphate (mg/L)	0	0	0.01	0.01	0.0068	0.0034
	Chloride (mg/L)	2.88	5.26	3.68	5.25	41	12
Sampling Site 2 (close proximity to WQ-03)	Turbidity (NTU)	3.3	10.0	36.0	19.6	7	7
	Temperature C	12.2	4.1	10.7	2.4	20.6	0.5
	pH	8	8	7.95	8.15	8.9	6.8
	Conductivity (µS/cm)	469	449	523	491	509	688
	DO (mg/L)	5.3	5.1	2.65	9.99	14.4	5.8
	Phosphate (mg/L)	0.16	0.01	0	0	0.0085	0.0085
	Chloride (mg/L)	4.18	5.85	7.70	4.68	51	29

Note: [1] Porto 2018
[2] Data collected at WQ-02 and WQ-03 in 2018 as part of the Monitoring Plan.

5.2 Water Flow Monitoring

Surface water flow monitoring was conducted during the Summer and fall at three inflow sites and one outflow site located within Wetland 06 (**Table 2**). Information on channel width, channel depth, velocity and discharge was collected during each monitoring visit; the results are summarized in **Table 6**.

During the summer monitoring visit water levels were low, inhibiting the collection of data. The inflow channels at site FL-01 and site FL-02 had surface water present, but no measurable velocity within the channel. The inflow channel at site FL-03 and the outflow channel at site FL-04 were dry at the time of monitoring. There was not sufficient surface water or velocity during summer monitoring to calculate discharge at any of the sites.

Surface water levels were also low during the fall monitoring visit. Site FL-01 had increased water depth and velocity compared to the conditions present during summer monitoring but lacked sufficient velocity to calculate surface water discharge for the channel. Site FL-02 had surface water present, but no measurable velocity in the channel. The wetted width and depth of the channel at site FL-02 was reduced compared to summer measurements. The inflow channel at site FL-03 and the outflow channel at site FL-04 were dry at the time of monitoring.

Table 6 Summary of Surface Water Flow

Site	Inflow or Outflow	Channel Width (m)	Depth*(m)			Velocity* (m/sec)			Discharge (m3/sec)
			RMID	MID	LMID	RMID	MID	LMID	
Summer									
FL-01	Inflow	0.42	0.30	0.27	0.28	-	-	-	-
FL-02	Inflow	2.50	0.68	0.58	0.39	-	-	-	-
FL-03	Inflow	-	-	-	-	-	-	-	-
FL-04	Outflow	-	-	-	-	-	-	-	-
Fall									
FL-01	Inflow	0.49	0.07	0.07	0.07	0	0.15	0	-
FL-02	Inflow	1.15	0.14	0.23	0.28	-	-	-	-
FL-03	Inflow	-	-	-	-	-	-	-	-
FL-04	Outflow	-	-	-	-	-	-	-	-

Note: * RMID= right mid channel, MID= mid channel, LMID= left mid channel
(-) = null result

Wetted widths measured at four transects in Wetland 06 and four transects in the reference wetland are summarized in **Table 7.** In Wetland 06, wetted widths were longer in the summer than in the fall, indicating a reduction in the quantity of surface water within the wetland. The transect located at the eastern most extent of Wetland 06 (T1) showed the most significant reduction in wetted width between monitoring visits. The reference wetland was dry during the fall monitoring visit and wetted width transects could not be conducted.

Staff gauges were installed to measure water depths at Wetland 06 and the reference wetland. The greatest water depth was measured was 16.0 cm Wetland 06 during the summer site visit. During the fall site visit the water depth measured in Wetland 06 had been reduced to 10.0 cm. In the reference wetland a water depth of 11.0 cm was recorded during the summer monitoring visit; a water depth could not be recorded during the fall visit as the reference wetland was dry.

Table 7 Summary of Wetted Width Measurements

Site	Transect	Wetted Width(m)		Percent Change of Wetted Width (%)
		Summer	Fall	
Wetland 06	T1-1	28	1	96.4
	T1-2	26	22	15.4
	T1-3	52	51	1.9
	T1-4	37	35	5.4
Reference Wetland	T2-1	25	-	100.0
	T2-2	32	-	100.0
	T2-3	28	-	100.0
	T2-4	28	-	100.0

Note: (-) = wetland was dry during monitoring visit

6.0 SUMMARY

Monitoring effort conducted in 2018 represent Year 1 of the Wetland 06 monitoring program. This report presents the 2018 results which will be compared against in subsequent monitoring years. Year 1 of the monitoring program was completed according to the Monitoring Plan, with the exception of the early season monitoring visit being conducted in summer (i.e., July) rather than May as originally proposed.

During Year 1 of monitoring, the following key observations were noted:

- Water quality results show variation in water quality parameters among sampling locations within Wetland 06, as well between summer and fall sampling visits.
- The majority of surface water quality parameters measured were consistent with CCME criteria for the protection of aquatic life. Two parameters, pH and DO, were found in exceedance of CCME criteria within Wetland 06.
- Chloride and conductivity concentrations measured in Wetland 06 in 2018 were higher than historic measurements taken in 2016 and 2017.
- Inflow and outflow channel measurements found limited to no surface water flow into or out of Wetland 06 during the two monitoring visits.
- Smaller wetted widths were recorded during the fall site visit at all transects in Wetland 06 indicating a reduction in surface water quantity. During the fall site visit the reference wetland was dry.

7.0 RECOMMENDATIONS

Based on the results of the Year 1 (2018) monitoring program, the following recommendations are suggested for monitoring in 2019:

- Monitoring of water quality and quantity should be continued in 2019 using similar methods and effort as employed in 2018 and outlined in the Monitoring Plan. In Year 2, the early-season monitoring visits will occur in May, as specified in the Monitoring Plan.
- Water quality monitoring efforts will continue in Year 2 to better facilitate detection of any changes to surface water quality as a result of SWCRR Project impacts.
    - Increased diligence should be taken in regard to water quality parameters which were in exceedance of CCME guidance during the Year 1 monitoring period; subsequent years of monitoring will provide greater understanding if exceedances were the result of natural variation within the wetlands or part of an ongoing change in environmental conditions.
    - Trends in changing water quality parameters noted in Wetland 06 when compared to historical data (i.e. conductivity and chloride) should be similarly investigated throughout subsequent monitoring to detect any long-term trends.
- If appropriate, an alternative water quality sampling site should be established in 2019 along Pathway 2 to replace sampling site WQ-05c which is located within the footprint of active construction and is no longer a viable site for documenting surface water flow or collecting water quality samples.
- Water flow monitoring will continue in Year 2 to determine if surface water quantity within Wetland 06 has been influenced by activities related to the SWCRR Project.
    - During Year 2 of monitoring, the initial site visit should be conducted earlier in the year to capture higher periods of flow within the Project area. Wetter conditions would enable calculations of velocity and discharge at all inflow and outflow locations.
    - The staff gauges used to measure water depth within Wetland 06 and the reference wetland should be relocated to an area that maintains surface water throughout the year.

8.0 CLOSURE

The results of Year 1 monitoring provide initial results of the surface water conditions of Wetland 06 following the initiation of construction phase of the SWCRR; Year 1 results will be compared against in subsequent monitoring years. This report addresses water quality and quantity impacts to Wetland 06, fulfilling the requirements of the Order which amended the initial *Water Act* Approval received by the Project No.: 00388473-00-00.

Report prepared by:
Hemmera Envirochem Inc.

Jessica Eaton, B.Sc. BIT
Biologist

Report reviewed by:
Hemmera Envirochem Inc.

Kirsten Norris, B.Sc., M.Sc., P.Biol.
Senior Fisheries Biologist

9.0 REFERENCES

British Columbia Ministry of Environment. 2013. Water Quality Assessment and Objects for Coldstream Creek. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/thomp-ok-wqos/technical_coldstream_wqo_jan_2016.pdf.

Canadian Council of Ministers of the Environment. 2011. Protocols Manual for Water Quality Sampling in Canada. Available at: https://www.ccme.ca/files/Resources/water/water_quality/protocols_document_e_final_101.pdf

City of Calgary. 2011. Stormwater Management and Design Manual. Water Resources Division. Available at: https://www.calgary.ca/UEP/Water/Documents/Water-Documents/Stormwater%20Source%20Control%20Practices%20Handbook%20-%20November%202007.pdf?noredirect=1

Government of Alberta. 2009. Water Measurement Guidebook. Available at: https://open.alberta.ca/dataset/4abef720-89a2-4040-af1d-c75d31050fda/resource/b890c99d-e51e-4376-9993-7aa01051d396/download/wur-watermeasurementguidebook-2009.pdf

Government of Alberta. 2014. Environmental Quality Guidelines for Alberta Surface Waters. Alberta Environment and Sustainable Resource Development, Water Policy Branch, Policy Division. Edmonton, 48 pp.

Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. 58 pp.

Hemmera. 2018. Wetland 06 Water Monitoring Plan, Southwest Calgary Ring Road Project, Calgary, Alberta. Prepared for KGL Constructors.

Kelly, W.R,, Panno, S.V., Hackley, K. 2012. The Sources, Distribution, and Trends of Chloride in the Waters of Illinois. Prairie Research Institute, University of Illinois. Champaign, USA.

Porto, Cassiano. 2018. Weaselhead/Glenmore Park SWCRR Impact Study 2016-2023 Environmental Monitoring Report 2017: Part 1 – Noise, birds, vegetation, water quality and aquatic invertebrates.

APPENDIX A
Monitoring Plan

Wetland 06 Water Monitoring Plan
Southwest Calgary Ring Road Project
Calgary, Alberta

Prepared for:

KGL Constructors
18 Steven Chiefs Road SW
Calgary, Alberta T2W 3C4

Project No. 102604-01

Prepared by:

Hemmera Envirochem Inc.
322 11th Avenue SW, Suite 804
Calgary, AB T2R 0C5
T: 403.264.0671
F: 403.264.0670
hemmera.com

June 2018

TABLE OF CONTENTS

LIST OF TABLES (WITHIN TEXT)

LIST OF FIGURES (WITHIN TEXT)

LIST OF APPENDICES

FIGURES (APPENDED)

1.0 INTRODUCTION

The Southwest Calgary Ring Road (SWCRR) Project (the Project) includes the design and construction of approximately 31 kilometers of new six and eight lane divided freeway, 14 interchanges, as well as three watercourse realignments and associated crossing structures. The Project corridor is located along the western limit of the City of Calgary south of Highway 8 and includes sections of Highways 8 and 22. The Project has been awarded by Alberta Transportation to Mountain View Partnership, which in turn has engaged KGL Constructors (KGL) to develop the Project.

On August 11, 2017, the Project received *Water Act* Approval No.: 00388473-00-00 (the Approval) to impact twenty-four (24) wetlands, including Wetland 06. Subsequently, an Environmental Appeal was filed (*Brockman and Tulick v. Director, South Saskatchewan Region, AEP*; Appeal Nos.: 17-047 and 17-050-R. 2017) affecting KGL's ability to impact the wetlands, as described in the Approval.

As a result of the Environmental Appeal, the Minister of Environment and Parks issued a Ministerial Order 06/2018 (the Order), on January 29, 2018, that amended the previously received Approval to include conditions to address water quality and quantity impacts to Wetland 06 (see conditions 6.2 to 6.6). To address these conditions, KGL Constructors retained Hemmera Envirochem Inc. (Hemmera) to develop a monitoring plan (the Plan) that includes:

- monitoring of the flow of water flow into Wetland 06 in the spring and fall of each year that the plan is in effect;
- monitoring of the water quality in Wetland 06 in the spring and fall of each year that the plan is in effect, including total dissolved solids, salts, dissolved metals, and other parameters consistent with a stormwater sampling program;
- the monitoring data shall be provided to the Director within one month from the date the data were collected;
- the results of the monitoring and an analysis of the monitoring shall be provided to the Director in an annual report by March 31 of the year following the calendar year in which the data were collected; and
- the monitoring plan shall come into effect as soon as the Director approves the plan and shall remain in effect for a period of five years after the road is officially opened to the public.

1.1 Monitoring Objectives

Wetlands consist of land that has been saturated for sufficient time to promote the formation of water altered soils, growth of water tolerant vegetation, and various kinds of biological activity, adapted to wet environments (ESRD 2013). They play an important role on the landscape and are ecologically and economically significant by maintaining water quality and supply in watersheds, providing flood protection and erosion control, as well as providing habitat for various fish and wildlife species. Wetland health is reflective of numerous physical, chemical, and biological components. We acknowledge that there are numerous indicators of wetland health; however, the monitoring plan has been developed specifically to reflect requirements of the Order. As a result, monitoring elements of this Plan were prioritized to surface water quality and flow exclusively.

The objectives of the Plan include:

- monitoring surface water quality in Wetland 06 and flow into Wetland 06,
- monitoring surface water flow out of Wetland 06,
- monitoring surface water quality in waterbodies/drainages that provide surface water flow into Wetland 06, and
- monitoring surface water quality in an adjacent reference wetland.

It is expected that by monitoring Wetland 06 as well as other nearby wetlands and waterbodies, the Plan will result in a suitable comparative analysis about the potential influences or lack thereof of the Project on surface water quality and flow in Wetland 06.

2.0 DESCRIPTION OF WETLAND 06

Wetland 06 is located in the Weaselhead Natural Area, a natural environmental park that borders the west end of Glenmore Reservoir (**Figure 1**) within the City of Calgary. A small portion of Wetland 06 is located within the Transportation Utility Corridor (TUC). Wetland 06 is a historical oxbow channel to the Elbow River that is over 500 m in length with wetted widths that are generally less than 30 m. A pedestrian/bike bridge associated with the Glenmore Reservoir Regional Pathway network crosses Wetland 06. Wetland 06 drains generally east through the Weaselhead Natural Area and eventually discharges into the Glenmore Reservoir, which provides approximately half of the City of Calgary's drinking water supply.

Wetlands 07, 08, and 09 are located upslope of Wetland 06 and are the source of surface water flow into Wetland 06 (**Figure 1**). Wetland 08 and 07 are located to the southwest of Wetland 06. Surface flow from Wetland 08 and 07 are conveyed into Wetland 06 by an undefined channel that becomes defined downstream of the TUC near Wetland 06 as the slope gradient increases. A bypass drainage culvert will be installed during the construction phase of the Project to convey water from Wetland 07 and 08 through the Project area. Wetland 09 is located south of Wetland 06. Surface flow from Wetland 09 is conveyed by an undefined channel first flowing easterly through the Project and then northerly from the TUC boundary through a defined channel to Wetland 06. A bypass drainage system has been installed as part of the Project to maintain flow from Wetland 09 to Wetland 06.

During the construction phase of the Project, surface run-off from the work area will be managed through temporary erosion and sediment control (ESC) measures and will be redirected away from Wetland 06. During the operational phase of the Project, the natural flow of surface water (i.e., from the west side of the TUC) into Wetland 06 will be maintained via the bypass drainage systems described above. Further, during the operational phase, Project-impacted water will not be discharged into Wetland 06. All Project-impacted water in the vicinity of Wetland 06 has been designed to flow north into a stormwater pond.

3.0 MONITORING SCHEDULE

The monitoring schedule, including field sampling visits, seasonal data summaries, and annual reports is provided in **Table 1.** Field sampling visits to monitor surface water quality and flow will occur during the spring and fall of each year of the Plan. Additional details on sampling frequency are provided in **Section 4.2.**

Following each season of monitoring, data summaries (i.e., surface water quality and flow) will be made publicly available by KGL within one month of the seasonal field sampling visits. The annual report will be made publicly available by March 31 of the year following the field sampling visits.

Table 1 Monitoring Schedule

Task	Monitoring Year[a]											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Water Quality Monitoring[b]												
2. Water Flow Monitoring[b]												
3. Seasonal Data Summary[c]												
4. Annual Report[d]												

[a] Plan year includes construction phase and first five years of the operational phase.

[b] Surface water quality and flow field sampling visits are proposed in May and October of each year of the Plan; however, annual variability in ambient air temperature, snow/ice cover, and precipitation events may impact the exact date of sampling.

[c] Surface water quality and flow data summaries will be made publicly available within one month of each seasonal monitoring visit.

[d]The Annual Report will be made publicly available by March 31 of the year following the field sampling visits (e.g., the 2018 Annual Report will be posted by March 30, 2019).

4.0 METHODOLOGY

4.1 Sample locations

The locations for surface water quality and flow monitoring are provided in **Figure 2.** The sites have been selected strategically for appropriate reference and comparison site considerations, in order to allow for a comparative analysis. An enhanced view of the sampling sites in and near Wetland 06 is provided in **Figure 3**. Suitability of these locations has been field verified during a reconnaissance survey in early spring 2018, however, the locations of these sites are subject to change pending potential subsequent annual and seasonal variability in site conditions.

4.1.1 Surface Water Quality

Surface water quality will be monitored at eight site locations (**Table 2**).

One surface water quality reference site (WQ-01) is identified for the Plan. The reference site is located north of Wetland 06 in an adjacent wetland that is outside the TUC. This site was selected as there are no identified or known pathways from the Project that could potentially direct Project-effected water into the adjacent wetland.

Based on a desktop assessment and a field reconnaissance, Hemmera identified two pathways in which Project-influenced water could potentially flow into Wetland 06 (see **Figure 1**). The two identified pathways are described below. For each of the respective pathways, comparison samples will be collected from a series of sample sites (i.e., background vs. comparison) (see **Figure 2**).

- Pathway 1 is an undefined channel that diagonally bisects the Project footprint. From the west side of the TUC boundary, water flows northeast through Wetland 08 into Wetland 07 where it then flows past the east side of the TUC boundary and then into a defined channel (approximately 400 m) that ultimately drains into Wetland 06 (see **Figure 1**). The sample sites associated with Pathway 1 are; WQ-04a, WQ-04b, and WQ-02 (see **Figure 2**). WQ-04a has been selected as a background site, as it is located upstream of potential influences from the Project.
- Pathway 2 is an undefined channel that flows east through Wetland 09 where it then enters a recently construction stormwater drainage system (see **Figure 1**). The drainage system outlets into a constructed riprap lined drainage ditch that flows north towards the eastern TUC boundary. In addition, a constructed drainage ditches channels water west where it converges with flows in the aforementioned constructed riprap lined drainage ditch. From the eastern TUC water meanders north through a defined channel (approximately 1,000 m) that eventually drains into Wetland 06 (see **Figure 1**). The samples sites associated with Pathway 2 are; WQ-05a, WQ-05b, WQ-05c, and WQ-03 (see **Figure 2**).

Surface water quality monitoring sites are subject to change due to seasonality and site conditions. Additional or alternative surface water quality monitoring sites may be identified if field crews observe abnormal site conditions or contaminant indicators, more information is provided in **Section 4.3.**

Table 2 Surface Water Quality Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Site Description	Reference or Comparison Site
	Easting	Northing		
WQ-01	699168	5652375	Reference wetland to the north of Wetland 06	Reference
WQ-02	699186	5652164	West (upslope) side of Wetland 06	Comparison
WQ-03	699432	5652159	East (downslope) side of Wetland 06	Comparison
WQ-04a	698898	5651725	Wetland 08, upslope of SWCRR Project	Background
WQ-04b	699113	5651956	Wetland 07, downslope of SWCRR Project and Wetland 08	Comparison
WQ-05a	699060	5650929	Upslope of Wetland 09 and SWCRR Project	Background
WQ-5b	699788	5651289	Watercourse 01 downslope of Wetland 09 and SWCRR Project	Comparison
WQ-05c	700061	5651274	Catchment basin to the east of SWCRR Project and upslope of the confluence with Watercourse 01	Comparison

4.1.2 Surface Water Flow

Surface water flow will be monitored at four locations around Wetland 06 (**Table 3**). Each of these locations are expected to provide conveyance of surface flow (inflow or outflow) year-round during normal surface flow conditions. Given the higher than average snowfall and later than normal lowland melt in 2018, sampling locations for surface water flow may need to be reconsidered in subsequent sampling visits.

Surface water inflows have been identified at FL-01, FL-02, and FL-03. The sampling location FL-01 occurs where surface water inflow is associated with drainage from Wetland 07 and 08. Site FL-02 is where the surface water inflow is conveyed from Wetland 09. Site FL-03 is where the surface water inflow associated with drainage from the reference wetland to the north of Wetland 06. Surface water outflow monitoring will occur at FL-04 at the Glenmore Pathway bridge crossing approximately 75 m downslope from Wetland 06.

Table 3 Surface Water Flow Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Inflow or Outflow
	Easting	Northing	
FL-01	699156	5652166	Inflow
FL-02	699406	5652115	Inflow
FL-03	699075	5652326	Inflow
FL-04	699644	5652343	Outlfow

Surface flow in undefined channels (i.e., lacking defined bed and banks) may be present at the surface water flow monitoring locations pending flow conditions during each field sampling visit and are expected be influenced by natural events (e.g., precipitation levels) within and between monitoring years. Monitoring flow in waterbodies lacking defined bed and banks can also have reduced accuracy as compared to a defined channel. Therefore, field crews may be required to adjust the surface water flow monitoring sites

during each field sampling visit to a location where channel characteristics are most appropriate for flow measurements. If additional surface water inflow or outflow locations are identified during the field sampling visits due to variability in hydrological connectivity, contingency surface water flow monitoring sites will be added.

4.2 Frequency of sampling

Surface water quality and flow monitoring will occur twice annually, once in the spring and once in the fall. The spring field sampling visit is proposed to occur in May and the fall field sampling visit is proposed to occur in October of each year of the Plan. The exact timing of the spring and fall field sampling visits are dependent on environmental conditions including ambient air temperatures, snow/ice cover, and precipitation events. Sampling will not occur during or within 72 hours of a substantial precipitation event to reduce any temporal variation (short-term pulse response) associated with extreme disturbances resulting in water and flow sampling that is more representative of the wetland conditions.

4.3 Water Quality Monitoring

Surface water quality samples will be taken from the banks of at the sample sites provided in **Tables 2** and discussed in **Section 4.1.1**. Site conditions (e.g., weather) will be recorded y the field crew. At each sampling site, five photos will be taken in a north, south, east, west, and ground direction.

Discrete profile lake water sampling and composite integrated water sampling methodologies (Alberta Environment 2006) have been determined to be inappropriate sampling methodologies for this Plan as water depths at the sampling sites are not deep enough to require spatial characterization over a horizontal or depth profile. The protocol provided by Canadian Council of Ministers of the Environment (CCME) (2011) for shore sampling will be followed and is summarized below. A certified Canadian Association for Laboratory Accreditation (CALA) laboratory will complete the laboratory analysis of water samples.

Samples will be labeled using a water-proof marker for accurate identification by the field crews and the laboratory. A chain of custody form will be completed, and any transfers of custody will be noted on the form by the authorized personnel including transfer to the CALA laboratory. Field crews will wear unpowdered latex or polyethylene disposable gloves and refrain from smoking or eating while collecting water samples (Alberta Government 2006).

An extension pole will be used to collect a “grab sample” from each sampling site and to avoid disturbing the site during collection of the water samples (CCME 2011). At each sampling location, the extension pole and clamp will be rinsed prior to collecting the water samples to reduce possible contamination between sites. Laboratory protocols for sample bottle rinsing will be followed and any rinsing of sample bottles or collection equipment will be completed slightly downslope of the sampling location to prevent cross contamination.

Water samples will be collected facing upstream if flow is present (CCME 2011). Water bottles will be uncapped immediately prior to filling. Water samples will be collected one at a time ensuring the lid is immediately capped once the bottle is filled. Water samples will be collected at approximately 60% water depth to avoid surface scum and film, and to collect a representative water sample. Algae, sediment, and organic matter will be avoided in the water sample.

Laboratory protocols for preservatives, storage, and transportation of water samples will be followed. Water samples will be kept in coolers containing enough ice packs or warm water bottles to keep the samples at approximately 4°C. All water samples will be sealed and packed in the coolers as to prevent spillage or breakage. Water samples will be delivered to the laboratory as soon as possible after collection, preferably the same day and hold times will be followed so analysis will occur within the appropriate hold periods.

Water sample parameters to be monitored during the Plan include those identified as potential sources or indicators of sources of pollutants or contaminants that may result from the construction and operations phases of the Project. Previous studies have shown sediment transport and deposition pose the greatest risk to the construction phase of highway projects, resulting from excavation and earthworks (Barrett et. al., 1995). Eroded soil can also transport nutrients, ions, and metals (Barrett et. al., 1995). During the operations phase of highway projects, sedimentation remains a concern along with transportation of pollutants from vehicles operating on the highway through run-off (Barrett et. al., 1995).

Water samples will be collected at all eight sampling (**Table 2**) for the parameters provided in **Table 4**. All samples collected from Wetland 06 and the reference wetland (i.e., WQ-01, WQ-02, and WQ-03) will be submitted for analysis for all parameters immediately after collection, with regular turn around time of 7-days requested. For remaining sample locations (i.e., WQ-04a,b; WQ-05a,b,c), all samples will be submitted, however, only those samples which have a holding time of less than 7 days will be immediately analysed (i.e., biological oxygen demand, nitrate, nitrite, sulfate, total dissolved solids, and total suspended solids. Samples not immediately analysed will be kept at the laboratory, pending the results from WQ-01 to WQ-03, and will be stored at the laboratory in accordance with CALA standards. If an exceedance value is identified at WQ- 01, WQ-02, or WQ-03, additional laboratory analysis for the exceedance parameter(s) will be conducted for the remaining sample sites (i.e., WQ-04a,b; WQ-05a,b,c), to determine if the exceedance is Project related or generated offsite.

The parameters provided in **Table 4** are reflective of those included in the City of Calgary Stormwater Management and Design Manual (2011). Project activities associated with the construction and operations phase of the Project are unlikely to have effects on microbiological indicators; as such they have been excluded from the Plan.

Table 4 Water Quality Parameters Monitored During the Plan

Sediment & Physical	
• Total Suspended Solids (TSS) • Total Dissolved Solids (TDS) • Turbidity	• Conductivity (EC) • pH • Dissolved Oxygen (DO)
Nutrients and Others (mg/L)	
• Biochemical Oxygen Demand (BOD) • Chemical Oxygen Demand (COD) • Nitrate (NO_3) • Nitrite (NO_2)	• Total Kjelahl Nitrogen (TKN) • Ammonia-Nitrogen (NH_3-N) • Total Phosphorus (TP) • Dissolved Reactive Phosphorus (TDP) • Ortho-Phosphate

Dissolved Metals & Metals (mg/L)			
• Silver (Ag)	• Cobalt (Co)	• Molybdenum (Mo)	• Tin (Sn)
• Aluminum (Al)	• Chromium (Cr)	• Nickel (Ni)	• Strontium (Sr)
• Arsenic (As)	• Copper (Cu	• Lead (P)	• Sodium (Na)
• Boron (B)	• Iron (Fe)	• Lead (Pb)	• Titanium (Ti)
• Barium (Ba)	• Potassium (K)	• Sulfur (S)	• Thallium (Tl)
• Beryllium (Be)	• Lithium (Li)	• Antimony (Sb)	• Uranium (U)
• Calcium (Ca)	• Magnesium (Mg)	• Selenium (Se)	• Vanadium (V)
• Cadmium (Cd)	• Manganese (Mn)	• Silicon (Si)	• Zinc (Zn)
Major Ions& Salts			
• Sodium (Na^{2+})		• Calcium (Ca^{2+})	
• Potassium (K^{+})		• Chloride (Cl^{-})	
• Potassium (K^{+})		• Sulfate (SO^{4-})	

Sediment and physical parameters provided in the first section of **Table 4** (i.e., TSS, TDS, turbidity, conductivity, dissolved oxygen, and pH) will be measured at all water quality monitoring sites listed in **Table 2**. In addition, water temperature, conductivity, pH, and dissolved oxygen which will be measured in-situ at all water quality monitoring sites provided in **Table 2.** These measurements will be taken below the water surface at approximately 60% water depth. Manufacturers instructions for calibration and measuring parameters will be followed.

In-situ measurements will be used as field indicators for any supplemental water quality sampling, if required. Field crews may collect additional water samples for analysis at the existing water sampling locations or at additional locations not included in **Table 2** if abnormal site conditions are observed or in-situ measurements indicate potential water quality abnormalities. Field indicators of potential hydrocarbons (e.g., oil sheen, odor) will be noted by field crews and a potential observation will trigger further water quality analysis for hydrocarbons.

4.4 Water Flow Monitoring

The proposed locations for surface water flow monitoring have been discussed in **Section 4.1**. Surface flow will be measured at each monitoring site using a HACH® velocity flow meter (or comparable model) and using the velocity-area method (Government of Alberta 2009). Using the surface water inflows and outflows of Wetland 06, a modified water balance will be completed. The sum of all surface water inflow and sum of all outflows will be compared for each seasonal sampling visit and between years of the Plan.

In addition to flow monitoring, field crews will deploy a water level staff gauge in both Wetland 06 and the reference wetland. Water depths will be recorded during each field sampling visit. Wetted widths will also be measured at four transects across Wetland 06 and the reference wetland. Transect locations will be recorded using a global positioning system (GPS) devise and natural landmarks will be recorded for replicability in the transect location from each seasonal field sampling visit during the Plan.

A comparison of the wetted widths and water depths of Wetland 06 and the reference wetland will be used to assess if the wetted perimeter of Wetland 06 is being reduced while accounting for natural fluctuations resulting in annual variability through comparison to the reference wetland.

4.5 Reporting

Surface water quality and flow results for each monitoring field visit will be made publicly available by KGL within one month of the seasonal field sampling event. The annual report, incorporating both seasonal field sampling visits will be made publicly available by KGL by March 31 of the year following the seasonal field sampling visits.

The annual report will include analysis of the surface water quality and flow results for both seasonal field visits. Surface water quality results will be compared relative the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta 2014). Select surface water quality parameters (i.e., turbidity, temperature, pH, conductivity, dissolved oxygen, phosphate, and chloride) will also be compared to water quality parameters collected by the Weaselhead /Glenmore Park Preservation Society in 2016 within Wetland 06 as part of a baseline conditions environmental monitoring study (Porto 2017). This study will provide baseline conditions (i.e., prior to construction activities on the Project) in Wetland 06 with the limitation that not all water quality parameters measured in this Plan were included in the 2016 baseline study.

The annual report will also compare wetted width measurements and water depths in Wetland 06 versus the reference wetland to the north. Any change in wetted width or water depth recorded during prescribed sampling times (i.e., May and October) will be compared in the reference wetland to identify if changes in the wetland are due to Project effects or natural environmental conditions (e.g., drought). Following the first annual report, subsequent annual reports will also include a trend analysis through comparison of surface water quality and flow between years of the Plan.

5.0 CLOSURE

This Monitoring Plan has been developed to meet the monitoring requirements described in Condition 6.2 and other additional monitoring components that will enable identification of potential impacts to the surface water quality and flow of Wetland 06. Alternatively, the Plan may also identify and inform on other potential impacts that are not related to the Project.

In developing this Plan, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This Plan was developed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale, but with specific reference to the Order. The Plan presented herein should be considered within the context of the scope of work and project terms of reference; further, the Plan is time sensitive and should considered valid only during the timeline included in this Plan. This Plan is based upon the applicable guidelines, regulations, and legislation existing at the time the Plan was produced.

Prepared by:
Hemmera Envirochem Inc.

per: Caitlin Gifford B.Sc., P.Biol.
Aquatic Biologist

Greg Eisler, B.Sc., P.Biol., R.P.Bio.
Senior Aquatic Biologist

6.0 REFERENCES

Environment and Sustainable Resource Development (ESRD) 2013. Alberta Wetland Policy. Prepared by ESRD, September 2013. ISBN: 978-4601-1286-1.

Barrett, Michael E., Jospeh F. Malina, Randall J. harbeneau, and George H. Ward. 1995. Effects of Highway Construction and Operation on Water Quality and Quantity in an Ephemeral Stream in the Austin, Texas Area. Available at: https://repositories.lib.utexas.edu/bitstream/handle/2152/6739/crwr_onlinereport95-7.pdf.

Canadian Council of Ministers of the Environment. 2011. Protocols Manual for Water Quality Sampling in Canada. Available at: https://www.ccme.ca/files/Resources/water/water_quality/protocols_document_e_final_101.pdf

City of Calgary. 2011. Stormwater Management and Design Manual. Water Resources Division. Available at: www.calgary.ca/_layouts/cocis/DirectDownload.aspx?target=http%3a%2f%2fwww.calgary.ca%2fPDA%2fpd%2fDocuments%2furban_development%2fbulletins%2f2011-stormwater-management-and-Design.pdf&noredirect=1&sf=1

Government of Alberta. 2009. Water Measurement Guidebook. Available at: http://aep.alberta.ca/water/reports-data/water-use-reporting-system/documents/WUR-WaterMeasurementGuidebook-2009.pdf

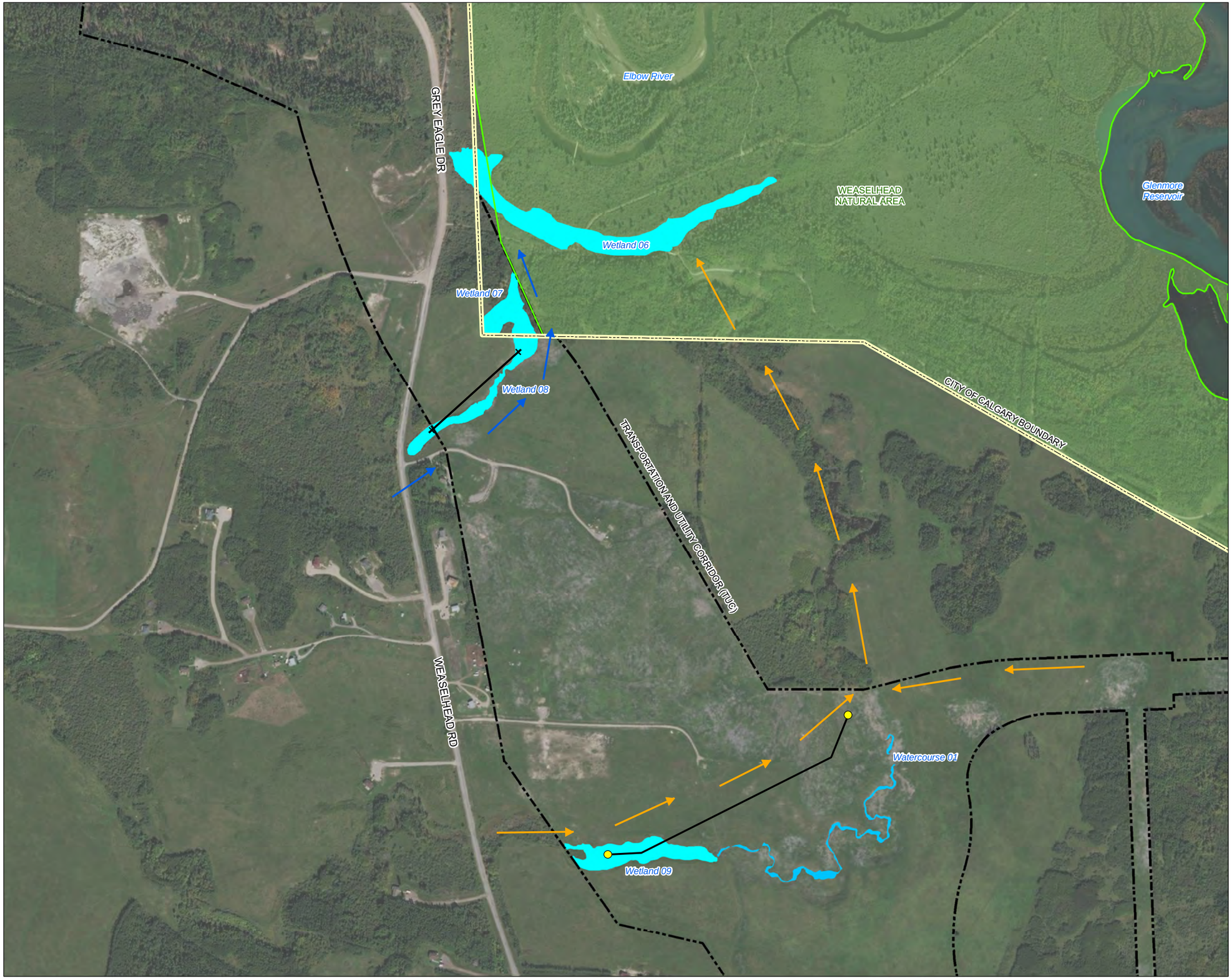
Government of Alberta. 2014. Environmental Quality Guidelines for Alberta Surface Waters. Alberta Environment and Sustainable Resource Development, Water Policy Branch, Policy Division. Edmonton, 48 pp.

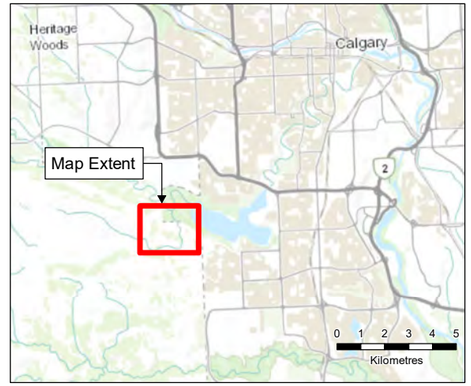
Porto, Cassiano. 2017. Weaselhead/Glenmore Park SWCRR Impact Study Environmental Monitoring Report 2016: baseline conditions. Wetland Monitoring Component.

FIGURES

2018 Wetland Monitoring Program
Weaselhead Rd, Calgary AB

Wetland Locations





Legend

- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016
- Inset Basemap: ESRI World Topographic Map

N

1:7,500

0 100 200 300 400 500

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: May 17, 2018	Figure 1

Hemmera
An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig1_102604_01_Wetland_Location_180517.mxd

2018 Wetland Monitoring Program
Weaselhead Rd, Calgary AB

Water Flow and Quality Sampling Locations

Legend

- Water Flow Sample Location (Hemmera, 2018)
- Water Quality Sample Location (Hemmera, 2018)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016

N

1:7,500

0 100 200 300 400 500

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: May 17, 2018	Figure 2

Hemmera
An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig2_102604_01_Sample_Locations_185517.mxd

2018 Wetland Monitoring Program
Weaselhead Rd, Calgary AB

Water Flow and Quality Sampling Location Details

Legend

- Water Flow Sample Location (Hemmera, 2018)
- Water Quality Sample Location (Hemmera, 2018)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016

N

1:3,000

0 25 50 75 100 125

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01	Production Date: May 17, 2018	Figure 3

Hemmera
An Ausenco Company

KGL

Path: S:\Geomatics\Projects\102604\01\mxd\Fig3_102604_01_Sample_Locations_Details_180517.mxd

APPENDIX B
Raw Water Quality Data

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your P.O. #: 102604-01
Your Project #: SWCRR
Your C.O.C. #: 557638-01-01

Attention: Jarrett Yaremko

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2018/07/16
Report #: R2589414
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B854903
Received: 2018/07/05, 18:41

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	N/A	2018/07/07	AB SOP-00005	SM 22 2320 B m
Biochemical Oxygen Demand	6	2018/07/06	2018/07/11	AB SOP-00017	SM 22 5210B m
Cadmium - low level CCME - Dissolved	3	N/A	2018/07/07	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry	3	N/A	2018/07/11	AB SOP-00020	SM 22-4500-Cl-E m
Chemical Oxygen Demand	3	N/A	2018/07/06	AB SOP-00016	SM 22 5220D m
Oxygen (Dissolved, winkler) (1)	6	N/A	2018/07/09	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	3	N/A	2018/07/07	AB SOP-00005	SM 22 2510 B m
Hardness	3	N/A	2018/07/06	AB WI-00065	Auto Calc
Elements by ICP - Dissolved (2)	3	N/A	2018/07/06	AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS - Dissolved (2)	3	N/A	2018/07/06	AB SOP-00043	EPA 6020b R2 m
Ion Balance	3	N/A	2018/07/06	AB WI-00065	Auto Calc
Sum of cations, anions	3	N/A	2018/07/06	AB WI-00065	Auto Calc
Ammonia-N (Total)	3	N/A	2018/07/09	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	6	N/A	2018/07/08	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	6	N/A	2018/07/08	AB WI-00065	Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	1	N/A	2018/07/07	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	5	N/A	2018/07/08	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	3	N/A	2018/07/07	AB SOP-00005	SM 22 4500-H+B m
Orthophosphate by Konelab	6	N/A	2018/07/06	AB SOP-00025	SM 23 4500-P A,F m
Sulphate by Automated Colourimetry	3	N/A	2018/07/11	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Filt. Residue)	3	2018/07/11	2018/07/11	AB SOP-00065	SM 22 2540 C m
Total Dissolved Solids (Calculated)	1	N/A	2018/07/11	AB WI-00065	Auto Calc
Total Dissolved Solids (Calculated)	2	N/A	2018/07/12	AB WI-00065	Auto Calc
Total Kjeldahl Nitrogen	3	2018/07/12	2018/07/13	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved)	1	2018/07/10	2018/07/12	AB SOP-00024	SM 22 4500-P A,B,F m
Phosphorus -P (Total, Dissolved)	2	2018/07/12	2018/07/12	AB SOP-00024	SM 22 4500-P A,B,F m
Total Phosphorus	3	2018/07/12	2018/07/12	AB SOP-00024	SM 22 4500-P A,B,F m
Total Suspended Solids (NFR)	3	2018/07/11	2018/07/11	AB SOP-00061	SM 23 2540 D m
Turbidity	6	N/A	2018/07/07	CAL SOP-00081	SM 22 2130 B m

Remarks:

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your P.O. #: 102604-01
Your Project #: SWCRR
Your C.O.C. #: 557638-01-01

Attention: Jarrett Yaremko

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2018/07/16
Report #: R2589414
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B854903
Received: 2018/07/05, 18:41

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

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

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

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

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

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

(1) The APHA Standard Method requires dissolved oxygen to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory dissolved oxygen analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(2) Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Maxxam endeavours to analyze samples as soon as possible after receipt.

Encryption Key

Maxxam
16 Jul 2018 12:01:58

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Leanne Cameron, C.E.T., Senior Project Manager
Email: LCameron@maxxam.ca
Phone# (780)577-7103

==========

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

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		TU5603		TU5604		TU5605		
Sampling Date		2018/07/05 11:50		2018/07/05 13:40		2018/07/05 14:30		
COC Number		557638-01-01		557638-01-01		557638-01-01		
	UNITS	WQ1	QC Batch	WQ2	QC Batch	WQ3	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	11	9051910	9.5	9051910	5.4	N/A	9051910
Cation Sum	meq/L	11	9051910	9.6	9051910	5.4	N/A	9051910
Hardness (CaCO3)	mg/L	440	9052193	400	9052193	220	0.50	9052193
Ion Balance (% Difference)	%	1.1	9052205	0.73	9052205	0.50	N/A	9052205
Dissolved Nitrate (NO3)	mg/L	<0.044	9051607	<0.044	9051607	0.072	0.044	9051607
Nitrate plus Nitrite (N)	mg/L	<0.014	9052211	<0.014	9052211	0.016	0.014	9052211
Dissolved Nitrite (NO2)	mg/L	<0.033	9051607	<0.033	9051607	<0.033	0.033	9051607
Calculated Total Dissolved Solids	mg/L	530	9052224	470	9052224	270	10	9052224
Misc. Inorganics								
Conductivity	uS/cm	950	9054115	850	9054115	500	2.0	9054115
pH	pH	8.13	9054113	8.25	9054113	9.10	N/A	9054113
Low Level Elements								
Dissolved Cadmium (Cd)	mg/L	<0.000020	9052165	<0.000020	9052165	<0.000020	0.000020	9052165
Anions								
Alkalinity (PP as CaCO3)	mg/L	<1.0	9054112	<1.0	9054112	17	1.0	9054112
Alkalinity (Total as CaCO3)	mg/L	520	9054112	390	9054112	160	1.0	9054112
Bicarbonate (HCO3)	mg/L	630	9054112	480	9054112	150	1.0	9054112
Carbonate (CO3)	mg/L	<1.0	9054112	<1.0	9054112	21	1.0	9054112
Hydroxide (OH)	mg/L	<1.0	9054112	<1.0	9054112	<1.0	1.0	9054112
Dissolved Sulphate (SO4)	mg/L	6.6	9059448	24	9058678	34	1.0	9059448
Dissolved Chloride (Cl)	mg/L	12	9059447	41	9058677	51	1.0	9059447
Nutrients								
Dissolved Nitrite (N)	mg/L	<0.010	9053546	<0.010	9053546	<0.010	0.010	9053546
Dissolved Nitrate (N)	mg/L	<0.010	9053546	<0.010	9053546	0.016	0.010	9053546
Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	9052764	<0.0030	9052764	<0.0030	0.0030	9052764
Dissolved Antimony (Sb)	mg/L	<0.00060	9052764	<0.00060	9052764	<0.00060	0.00060	9052764
Dissolved Arsenic (As)	mg/L	0.0013	9052764	0.0021	9052764	0.0016	0.00020	9052764
Dissolved Barium (Ba)	mg/L	0.23	9053299	0.13	9053299	0.069	0.010	9053299
Dissolved Beryllium (Be)	mg/L	<0.0010	9052764	<0.0010	9052764	<0.0010	0.0010	9052764
Dissolved Boron (B)	mg/L	0.032	9053299	0.052	9053299	0.028	0.020	9053299

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		TU5603		TU5604		TU5605		
Sampling Date		2018/07/05 11:50		2018/07/05 13:40		2018/07/05 14:30		
COC Number		557638-01-01		557638-01-01		557638-01-01		
	UNITS	WQ1	QC Batch	WQ2	QC Batch	WQ3	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	97	9053299	80	9053299	30	0.30	9053299
Dissolved Chromium (Cr)	mg/L	<0.0010	9052764	<0.0010	9052764	<0.0010	0.0010	9052764
Dissolved Cobalt (Co)	mg/L	0.00074	9052764	0.00041	9052764	<0.00030	0.00030	9052764
Dissolved Copper (Cu)	mg/L	0.00021	9052764	0.00025	9052764	0.00040	0.00020	9052764
Dissolved Iron (Fe)	mg/L	1.0	9053299	<0.060	9053299	<0.060	0.060	9053299
Dissolved Lead (Pb)	mg/L	<0.00020	9052764	<0.00020	9052764	<0.00020	0.00020	9052764
Dissolved Lithium (Li)	mg/L	<0.020	9053299	0.024	9053299	<0.020	0.020	9053299
Dissolved Magnesium (Mg)	mg/L	49	9053299	49	9053299	35	0.20	9053299
Dissolved Manganese (Mn)	mg/L	0.44	9053299	0.12	9053299	0.0083	0.0040	9053299
Dissolved Molybdenum (Mo)	mg/L	0.00036	9052764	0.0038	9052764	0.0028	0.00020	9052764
Dissolved Nickel (Ni)	mg/L	0.0011	9052764	0.0014	9052764	0.00098	0.00050	9052764
Dissolved Phosphorus (P)	mg/L	<0.10	9053299	<0.10	9053299	<0.10	0.10	9053299
Dissolved Potassium (K)	mg/L	1.7	9053299	4.1	9053299	2.3	0.30	9053299
Dissolved Selenium (Se)	mg/L	<0.00020	9052764	0.0011	9052764	0.00060	0.00020	9052764
Dissolved Silicon (Si)	mg/L	4.4	9053299	6.0	9053299	1.2	0.10	9053299
Dissolved Silver (Ag)	mg/L	<0.00010	9052764	<0.00010	9052764	<0.00010	0.00010	9052764
Dissolved Sodium (Na)	mg/L	49	9053299	34	9053299	23	0.50	9053299
Dissolved Strontium (Sr)	mg/L	0.63	9053299	0.85	9053299	0.37	0.020	9053299
Dissolved Sulphur (S)	mg/L	3.0	9053299	7.7	9053299	10	0.20	9053299
Dissolved Thallium (Tl)	mg/L	<0.00020	9052764	<0.00020	9052764	<0.00020	0.00020	9052764
Dissolved Tin (Sn)	mg/L	<0.0010	9052764	<0.0010	9052764	<0.0010	0.0010	9052764
Dissolved Titanium (Ti)	mg/L	<0.0010	9052764	<0.0010	9052764	<0.0010	0.0010	9052764
Dissolved Uranium (U)	mg/L	0.00044	9052764	0.0031	9052764	0.0023	0.00010	9052764
Dissolved Vanadium (V)	mg/L	<0.0010	9052764	<0.0010	9052764	0.0010	0.0010	9052764
Dissolved Zinc (Zn)	mg/L	<0.0030	9052764	<0.0030	9052764	<0.0030	0.0030	9052764

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TU5603		TU5604		TU5605		
Sampling Date		2018/07/05 11:50		2018/07/05 13:40		2018/07/05 14:30		
COC Number		557638-01-01		557638-01-01		557638-01-01		
	UNITS	WQ1	QC Batch	WQ2	QC Batch	WQ3	RDL	QC Batch
Demand Parameters								
Biochemical Oxygen Demand	mg/L	3.2	9052747	<2.0	9052747	<2.0	2.0	9052747
Total Chemical Oxygen Demand	mg/L	36	9052652	35	9052652	27	5.0	9052652
Misc. Inorganics								
Dissolved Oxygen (O2)	mg/L	2.2	9055731	10	9055731	14	0.10	9055731
Total Dissolved Solids	mg/L	530	9058410	480	9058410	290	10	9058410
Total Suspended Solids	mg/L	18	9058674	17	9058674	3.5	1.0	9058674
Nutrients								
Total Ammonia (N)	mg/L	0.043	9055638	0.045	9055638	0.024	0.015	9055638
Orthophosphate (P)	mg/L	0.0080 (1)	9053625	0.0068	9053625	0.0085	0.0030	9053625
Dissolved Phosphorus (P)	mg/L	<0.0030	9059914	0.029	9056919	0.0093	0.0030	9059914
Total Phosphorus (P)	mg/L	0.093	9059885	0.060	9059885	0.024	0.0030	9059885
Total Total Kjeldahl Nitrogen	mg/L	1.5	9060533	0.81	9060533	0.86	0.050	9060555
Physical Properties								
Turbidity	NTU	6.5	9054470	7.0	9054470	2.6	0.10	9054470

RDL = Reportable Detection Limit
(1) Orthophosphate greater than dissolved phosphate. Results within acceptable limits of precision.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		TU5606	TU5607	TU5608		
Sampling Date		2018/07/05 15:30	2018/07/05 16:10	2018/07/05 11:50		
COC Number		557638-01-01	557638-01-01	557638-01-01		
	UNITS	WQ4B	WQ5B	WQ4	RDL	QC Batch
Calculated Parameters						
Dissolved Nitrate (NO3)	mg/L	0.068	1.9	3.2	0.044	9051607
Nitrate plus Nitrite (N)	mg/L	0.015	0.44	0.71	0.014	9052211
Dissolved Nitrite (NO2)	mg/L	<0.033	<0.033	<0.033	0.033	9051607
Demand Parameters						
Biochemical Oxygen Demand	mg/L	<2.0	<2.0	<2.0	2.0	9052747
Misc. Inorganics						
Dissolved Oxygen (O2)	mg/L	11	11	1.5	0.10	9055731
Nutrients						
Orthophosphate (P)	mg/L	0.0065	0.0083	0.0066 (1)	0.0030	9053625
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	<0.010	0.010	9053546
Dissolved Nitrate (N)	mg/L	0.015	0.44	0.71	0.010	9053546
Physical Properties						
Turbidity	NTU	13	2.2	<0.10	0.10	9054470

RDL = Reportable Detection Limit
(1) Matrix Spike exceeds acceptance limits due to matrix interference. Reanalysis yields similar results.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

GENERAL COMMENTS

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

Package 1	18.7°C
Package 2	18.3°C

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9052652	JM0	Matrix Spike	Total Chemical Oxygen Demand	2018/07/06		103	%	80 - 120
9052652	JM0	Spiked Blank	Total Chemical Oxygen Demand	2018/07/06		101	%	80 - 120
9052652	JM0	Method Blank	Total Chemical Oxygen Demand	2018/07/06	<5.0		mg/L	
9052652	JM0	RPD	Total Chemical Oxygen Demand	2018/07/06	NC		%	20
9052747	XLI	Spiked Blank	Biochemical Oxygen Demand	2018/07/11		90	%	85 - 115
9052747	XLI	Method Blank	Biochemical Oxygen Demand	2018/07/11	<2.0		mg/L	
9052747	XLI	RPD	Biochemical Oxygen Demand	2018/07/11	NC		%	20
9052764	PC5	Matrix Spike	Dissolved Aluminum (Al)	2018/07/06		NC	%	80 - 120
			Dissolved Antimony (Sb)	2018/07/06		95	%	80 - 120
			Dissolved Arsenic (As)	2018/07/06		100	%	80 - 120
			Dissolved Beryllium (Be)	2018/07/06		99	%	80 - 120
			Dissolved Chromium (Cr)	2018/07/06		97	%	80 - 120
			Dissolved Cobalt (Co)	2018/07/06		96	%	80 - 120
			Dissolved Copper (Cu)	2018/07/06		94	%	80 - 120
			Dissolved Lead (Pb)	2018/07/06		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/07/06		103	%	80 - 120
			Dissolved Nickel (Ni)	2018/07/06		95	%	80 - 120
			Dissolved Selenium (Se)	2018/07/06		100	%	80 - 120
			Dissolved Silver (Ag)	2018/07/06		74 (1)	%	80 - 120
			Dissolved Thallium (Tl)	2018/07/06		92	%	80 - 120
			Dissolved Tin (Sn)	2018/07/06		99	%	80 - 120
			Dissolved Titanium (Ti)	2018/07/06		103	%	80 - 120
			Dissolved Uranium (U)	2018/07/06		NC	%	80 - 120
			Dissolved Vanadium (V)	2018/07/06		100	%	80 - 120
			Dissolved Zinc (Zn)	2018/07/06		92	%	80 - 120
9052764	PC5	Spiked Blank	Dissolved Aluminum (Al)	2018/07/06		80	%	80 - 120
			Dissolved Antimony (Sb)	2018/07/06		95	%	80 - 120
			Dissolved Arsenic (As)	2018/07/06		100	%	80 - 120
			Dissolved Beryllium (Be)	2018/07/06		97	%	80 - 120
			Dissolved Chromium (Cr)	2018/07/06		99	%	80 - 120
			Dissolved Cobalt (Co)	2018/07/06		100	%	80 - 120
			Dissolved Copper (Cu)	2018/07/06		100	%	80 - 120
			Dissolved Lead (Pb)	2018/07/06		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/07/06		98	%	80 - 120
			Dissolved Nickel (Ni)	2018/07/06		97	%	80 - 120
			Dissolved Selenium (Se)	2018/07/06		97	%	80 - 120
			Dissolved Silver (Ag)	2018/07/06		96	%	80 - 120
			Dissolved Thallium (Tl)	2018/07/06		95	%	80 - 120
			Dissolved Tin (Sn)	2018/07/06		96	%	80 - 120
			Dissolved Titanium (Ti)	2018/07/06		94	%	80 - 120
			Dissolved Uranium (U)	2018/07/06		89	%	80 - 120
			Dissolved Vanadium (V)	2018/07/06		98	%	80 - 120
			Dissolved Zinc (Zn)	2018/07/06		96	%	80 - 120
9052764	PC5	Method Blank	Dissolved Aluminum (Al)	2018/07/06	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2018/07/06	<0.00060		mg/L	
			Dissolved Arsenic (As)	2018/07/06	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2018/07/06	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2018/07/06	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2018/07/06	<0.00030		mg/L	
			Dissolved Copper (Cu)	2018/07/06	<0.00020		mg/L	
			Dissolved Lead (Pb)	2018/07/06	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2018/07/06	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2018/07/06	<0.00050		mg/L	
			Dissolved Selenium (Se)	2018/07/06	<0.00020		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Silver (Ag)	2018/07/06	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2018/07/06	<0.00020		mg/L	
			Dissolved Tin (Sn)	2018/07/06	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2018/07/06	<0.0010		mg/L	
			Dissolved Uranium (U)	2018/07/06	<0.00010		mg/L	
			Dissolved Vanadium (V)	2018/07/06	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2018/07/06	<0.0030		mg/L	
9052764	PC5	RPD	Dissolved Aluminum (Al)	2018/07/06	2.1		%	20
			Dissolved Antimony (Sb)	2018/07/06	NC		%	20
			Dissolved Arsenic (As)	2018/07/06	13		%	20
			Dissolved Beryllium (Be)	2018/07/06	NC		%	20
			Dissolved Chromium (Cr)	2018/07/06	NC		%	20
			Dissolved Cobalt (Co)	2018/07/06	0.57		%	20
			Dissolved Copper (Cu)	2018/07/06	0.11		%	20
			Dissolved Lead (Pb)	2018/07/06	3.1		%	20
			Dissolved Molybdenum (Mo)	2018/07/06	0.24		%	20
			Dissolved Nickel (Ni)	2018/07/06	0.021		%	20
			Dissolved Selenium (Se)	2018/07/06	2.5		%	20
			Dissolved Silver (Ag)	2018/07/06	NC		%	20
			Dissolved Thallium (Tl)	2018/07/06	NC		%	20
			Dissolved Tin (Sn)	2018/07/06	5.2		%	20
			Dissolved Titanium (Ti)	2018/07/06	13		%	20
			Dissolved Uranium (U)	2018/07/06	1.3		%	20
			Dissolved Vanadium (V)	2018/07/06	1.5		%	20
			Dissolved Zinc (Zn)	2018/07/06	2.1		%	20
9053299	FM0	Matrix Spike	Dissolved Barium (Ba)	2018/07/06		89	%	80 - 120
			Dissolved Boron (B)	2018/07/06		88	%	80 - 120
			Dissolved Calcium (Ca)	2018/07/06		NC	%	80 - 120
			Dissolved Iron (Fe)	2018/07/06		88	%	80 - 120
			Dissolved Lithium (Li)	2018/07/06		91	%	80 - 120
			Dissolved Magnesium (Mg)	2018/07/06		NC	%	80 - 120
			Dissolved Manganese (Mn)	2018/07/06		85	%	80 - 120
			Dissolved Phosphorus (P)	2018/07/06		106	%	80 - 120
			Dissolved Potassium (K)	2018/07/06		93	%	80 - 120
			Dissolved Silicon (Si)	2018/07/06		82	%	80 - 120
			Dissolved Sodium (Na)	2018/07/06		NC	%	80 - 120
			Dissolved Strontium (Sr)	2018/07/06		NC	%	80 - 120
9053299	FM0	Spiked Blank	Dissolved Barium (Ba)	2018/07/06		93	%	80 - 120
			Dissolved Boron (B)	2018/07/06		96	%	80 - 120
			Dissolved Calcium (Ca)	2018/07/06		100	%	80 - 120
			Dissolved Iron (Fe)	2018/07/06		98	%	80 - 120
			Dissolved Lithium (Li)	2018/07/06		93	%	80 - 120
			Dissolved Magnesium (Mg)	2018/07/06		99	%	80 - 120
			Dissolved Manganese (Mn)	2018/07/06		100	%	80 - 120
			Dissolved Phosphorus (P)	2018/07/06		96	%	80 - 120
			Dissolved Potassium (K)	2018/07/06		95	%	80 - 120
			Dissolved Silicon (Si)	2018/07/06		91	%	80 - 120
			Dissolved Sodium (Na)	2018/07/06		94	%	80 - 120
			Dissolved Strontium (Sr)	2018/07/06		95	%	80 - 120
9053299	FM0	Method Blank	Dissolved Barium (Ba)	2018/07/06	<0.010		mg/L	
			Dissolved Boron (B)	2018/07/06	<0.020		mg/L	
			Dissolved Calcium (Ca)	2018/07/06	<0.30		mg/L	
			Dissolved Iron (Fe)	2018/07/06	<0.060		mg/L	
			Dissolved Lithium (Li)	2018/07/06	<0.020		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Magnesium (Mg)	2018/07/06	<0.20		mg/L	
			Dissolved Manganese (Mn)	2018/07/06	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2018/07/06	<0.10		mg/L	
			Dissolved Potassium (K)	2018/07/06	<0.30		mg/L	
			Dissolved Silicon (Si)	2018/07/06	<0.10		mg/L	
			Dissolved Sodium (Na)	2018/07/06	<0.50		mg/L	
			Dissolved Strontium (Sr)	2018/07/06	<0.020		mg/L	
			Dissolved Sulphur (S)	2018/07/06	<0.20		mg/L	
9053299	FM0	RPD	Dissolved Iron (Fe)	2018/07/06	NC		%	20
			Dissolved Manganese (Mn)	2018/07/06	0.38		%	20
9053546	KD9	Matrix Spike	Dissolved Nitrite (N)	2018/07/07		101	%	80 - 120
			Dissolved Nitrate (N)	2018/07/07		101	%	80 - 120
9053546	KD9	Spiked Blank	Dissolved Nitrite (N)	2018/07/07		100	%	80 - 120
			Dissolved Nitrate (N)	2018/07/07		100	%	80 - 120
9053546	KD9	Method Blank	Dissolved Nitrite (N)	2018/07/07	<0.010		mg/L	
			Dissolved Nitrate (N)	2018/07/07	<0.010		mg/L	
9053546	KD9	RPD	Dissolved Nitrite (N)	2018/07/07	NC		%	20
			Dissolved Nitrate (N)	2018/07/07	NC		%	20
9053625	JLD	Matrix Spike [TU5608-01]	Orthophosphate (P)	2018/07/06		74 (1)	%	80 - 120
9053625	JLD	Spiked Blank	Orthophosphate (P)	2018/07/06		101	%	80 - 120
9053625	JLD	Method Blank	Orthophosphate (P)	2018/07/06	<0.0030		mg/L	
9053625	JLD	RPD [TU5608-01]	Orthophosphate (P)	2018/07/06	9.1		%	20
9054112	KD9	Spiked Blank	Alkalinity (Total as CaCO3)	2018/07/07		95	%	80 - 120
9054112	KD9	Method Blank	Alkalinity (PP as CaCO3)	2018/07/07	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2018/07/07	<1.0		mg/L	
			Bicarbonate (HCO3)	2018/07/07	<1.0		mg/L	
			Carbonate (CO3)	2018/07/07	<1.0		mg/L	
			Hydroxide (OH)	2018/07/07	<1.0		mg/L	
9054112	KD9	RPD	Alkalinity (PP as CaCO3)	2018/07/07	NC		%	20
			Alkalinity (Total as CaCO3)	2018/07/07	0.14		%	20
			Bicarbonate (HCO3)	2018/07/07	0.14		%	20
			Carbonate (CO3)	2018/07/07	NC		%	20
			Hydroxide (OH)	2018/07/07	NC		%	20
9054113	KD9	Spiked Blank	pH	2018/07/07		100	%	97 - 103
9054115	KD9	Spiked Blank	Conductivity	2018/07/07		99	%	90 - 110
9054115	KD9	Method Blank	Conductivity	2018/07/07	<2.0		uS/cm	
9054115	KD9	RPD	Conductivity	2018/07/07	0.36		%	10
9054470	AP1	Spiked Blank	Turbidity	2018/07/07		100	%	80 - 120
9054470	AP1	Method Blank	Turbidity	2018/07/07	<0.10		NTU	
9054470	AP1	RPD	Turbidity	2018/07/07	0.69		%	20
9055638	JLD	Matrix Spike	Total Ammonia (N)	2018/07/09		105	%	80 - 120
9055638	JLD	Spiked Blank	Total Ammonia (N)	2018/07/09		103	%	80 - 120
9055638	JLD	Method Blank	Total Ammonia (N)	2018/07/09	<0.015		mg/L	
9055638	JLD	RPD	Total Ammonia (N)	2018/07/09	NC		%	20
9055731	AP1	Spiked Blank	Dissolved Oxygen (O2)	2018/07/09		95	%	80 - 120
9055731	AP1	RPD [TU5603-09]	Dissolved Oxygen (O2)	2018/07/09	0		%	20
9056919	JLD	Matrix Spike [TU5604-04]	Dissolved Phosphorus (P)	2018/07/12		101	%	80 - 120
9056919	JLD	QC Standard	Dissolved Phosphorus (P)	2018/07/12		92	%	80 - 120
9056919	JLD	Spiked Blank	Dissolved Phosphorus (P)	2018/07/12		98	%	80 - 120
9056919	JLD	Method Blank	Dissolved Phosphorus (P)	2018/07/12	<0.0030		mg/L	
9056919	JLD	RPD [TU5604-04]	Dissolved Phosphorus (P)	2018/07/12	2.7		%	20
9058410	AP1	Matrix Spike	Total Dissolved Solids	2018/07/11		NC	%	80 - 120
9058410	AP1	Spiked Blank	Total Dissolved Solids	2018/07/11		95	%	80 - 120
9058410	AP1	Method Blank	Total Dissolved Solids	2018/07/11	<10		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9058410	AP1	RPD	Total Dissolved Solids	2018/07/11	7.0		%	20
9058674	AP1	Matrix Spike	Total Suspended Solids	2018/07/11		100	%	80 - 120
9058674	AP1	Spiked Blank	Total Suspended Solids	2018/07/11		98	%	80 - 120
9058674	AP1	Method Blank	Total Suspended Solids	2018/07/11	<1.0		mg/L	
9058674	AP1	RPD	Total Suspended Solids	2018/07/11	1.6		%	20
9058677	YQI	Matrix Spike	Dissolved Chloride (Cl)	2018/07/11		NC	%	80 - 120
9058677	YQI	Spiked Blank	Dissolved Chloride (Cl)	2018/07/11		107	%	80 - 120
9058677	YQI	Method Blank	Dissolved Chloride (Cl)	2018/07/11	<1.0		mg/L	
9058677	YQI	RPD	Dissolved Chloride (Cl)	2018/07/11	7.7		%	20
9058678	YQI	Matrix Spike	Dissolved Sulphate (SO4)	2018/07/11		NC	%	80 - 120
9058678	YQI	Spiked Blank	Dissolved Sulphate (SO4)	2018/07/11		100	%	80 - 120
9058678	YQI	Method Blank	Dissolved Sulphate (SO4)	2018/07/11	<1.0		mg/L	
9058678	YQI	RPD	Dissolved Sulphate (SO4)	2018/07/11	1.9		%	20
9059447	YQI	Matrix Spike	Dissolved Chloride (Cl)	2018/07/11		109	%	80 - 120
9059447	YQI	Spiked Blank	Dissolved Chloride (Cl)	2018/07/11		99	%	80 - 120
9059447	YQI	Method Blank	Dissolved Chloride (Cl)	2018/07/11	<1.0		mg/L	
9059447	YQI	RPD	Dissolved Chloride (Cl)	2018/07/11	4.0		%	20
9059448	YQI	Matrix Spike	Dissolved Sulphate (SO4)	2018/07/11		106	%	80 - 120
9059448	YQI	Spiked Blank	Dissolved Sulphate (SO4)	2018/07/11		96	%	80 - 120
9059448	YQI	Method Blank	Dissolved Sulphate (SO4)	2018/07/11	<1.0		mg/L	
9059448	YQI	RPD	Dissolved Sulphate (SO4)	2018/07/11	NC		%	20
9059885	JLD	Matrix Spike	Total Phosphorus (P)	2018/07/12		95	%	80 - 120
9059885	JLD	QC Standard	Total Phosphorus (P)	2018/07/12		92	%	80 - 120
9059885	JLD	Spiked Blank	Total Phosphorus (P)	2018/07/12		94	%	80 - 120
9059885	JLD	Method Blank	Total Phosphorus (P)	2018/07/12	<0.0030		mg/L	
9059885	JLD	RPD	Total Phosphorus (P)	2018/07/12	6.4		%	20
9059914	JLD	Matrix Spike [TU5605-04]	Dissolved Phosphorus (P)	2018/07/12		97	%	80 - 120
9059914	JLD	QC Standard	Dissolved Phosphorus (P)	2018/07/12		91	%	80 - 120
9059914	JLD	Spiked Blank	Dissolved Phosphorus (P)	2018/07/12		92	%	80 - 120
9059914	JLD	Method Blank	Dissolved Phosphorus (P)	2018/07/12	<0.0030		mg/L	
9059914	JLD	RPD [TU5605-04]	Dissolved Phosphorus (P)	2018/07/12	16		%	20
9060533	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2018/07/16		76 (1)	%	80 - 120
9060533	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2018/07/13		103	%	80 - 120
9060533	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2018/07/13		94	%	80 - 120
9060533	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2018/07/13	<0.050		mg/L	
9060533	JLD	RPD	Total Total Kjeldahl Nitrogen	2018/07/16	0.85		%	20
9060555	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2018/07/13		NC	%	80 - 120
9060555	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2018/07/13		85	%	80 - 120
9060555	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2018/07/13		100	%	80 - 120
9060555	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2018/07/13	<0.050		mg/L	
9060555	JLD	RPD	Total Total Kjeldahl Nitrogen	2018/07/13	0.93		%	20

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

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

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

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

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

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

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

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

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

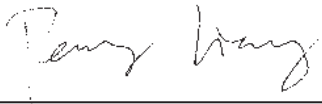
Maxxam Job #: B854903
Report Date: 2018/07/16

HEMMERA ENVIROCHEM INC.
Client Project #: SWCRR
Your P.O. #: 102604-01

VALIDATION SIGNATURE PAGE

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

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



Harry (Peng) Liang, Senior Analyst

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

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:	Laboratory Use Only:
Company Name: #10658 HEMMERA ENVIROCHEM INC.	Company Name:	Quotation #:	Maxxam Job #: / Bottle Order #: 557638
Attention: Jarrett Yaremko	Attention:	P.O. #:	
Address: SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5	Address:	Project:	COC #: C#557638-01-01 / Project Manager: Leanne Cameron
Tel: (403) 264-0671 Fax:	Tel: Fax:	Project Name:	
Email: jyaremko@hemmera.com	Email:	Site #:	
		Sampled By:	

Regulatory Criteria:
- ☐ ATI
- ☐ CCME
- ☐ Other

Special Instructions:

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☐
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (If applies to entire submission) ☐
Date Required:
Rush Confirmation Number: (call lab for #)

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Routine Water & Diss. Regulated Metals	Orthophosphate by Konelab	Total Suspended Solids (NFR)	Total Dissolved Solids (Filt. Residue)	Turbidity	Total Kjeldahl Nitrogen	Ammonia-N (Total)	Total Phosphorus	Chemical Oxygen Demand	Phosphorus -P (Total, Dissolved)	# of Bottles	Comments
1		WQ1		1150	W		X											Call if hits on 1,2,3
2		WQ2		1340	W		X											
3		WQ3		1430	W		X											
4		~~WQ4a~~			W													
5		WQ4b		1530	W		X	X			X							Just nitrate from routine
6		~~WQ5a~~			W													
7		WQ5b	20180705	1610	W		X	X			X							Just nitrate from routine.
8		~~WQ5c~~			W													
9																		
10																		

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
	2018 07 05	1841		2018/07/05	1844		☐	21, 20, 15 / 18, 19, 18	☐ Yes ☑ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

05-Jul-18 18:41
Leanne Cameron
B854903
IL4 INS-0069

Maxxam Analytics International Corporation

Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:	Laboratory Use Only:
Company Name: #10658 HEMMERA ENVIROCHEM INC.	Company Name:	Quotation #:	Maxxam Job #: / Bottle Order #: 557638
Attention: ~~Jarrett Yaremko~~ Cameron Davis	Attention:	P.O. #: 102664-01	
Address: SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5	Address:	Project:	COC #: C#557638-01-02 / Project Manager: Leanne Cameron
Tel: (403) 264-0671 ext 314 Fax:	Tel: Fax:	Project Name: SWCEP	
Email: jyaremko@hemmera.com, cdavis@hemmera.com	Email:	Site #:	
		Sampled By:	

Regulatory Criteria:
- ☐ ATI
- ☐ CCME
- ☐ Other

Special Instructions:

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☐
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Biochemical Oxygen Demand	Oxygen (Dissolved, winkler)	# of Bottles	Comments
1		WQ1	2018 07 05	1150	W		X	X		Call on hrs for 1, 2, 3
2		WQ2	2018 07 05	1340	W		X	X		
3		WQ3	2018 07 05	1430	W		X	X		
4		~~WQ4~~			W					
5		WQ6	2018 07 05	1530	W		X	X		
6		~~WQ5~~	2018 07 05		W					
7		WQ56	2018 07 04	1610	W		X	X		
8		~~WQ5C~~	20		W					
9										
10										

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
	18 07 05	1841	JOSH KOWALSKI	2018/07/05	18:41	

Laboratory Use Only: Time Sensitive ☐ | Temperature (°C) on Receipt 21, 20, 15 | Custody Seal Intact on Cooler? ☐ Yes ☐ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

18, 19, 18
ice yes

05-Jul-18 18:41
Leanne Cameron
B854903

IL4 INS-0069

Maxxam Analytics International Corporation

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your P.O. #: 102604-01
Your Project #: SWLRR
Your C.O.C. #: 567842-01-01

Attention: Cam Davis

HEMMERA ENVIROCHEM INC.
SUITE 302, 322-11TH AVENUE
CALGARY, AB
CANADA T2R 0C5

Report Date: 2018/10/19
Report #: R2637258
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888854
Received: 2018/10/11, 15:11

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	N/A	2018/10/13	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	5	2018/10/12	2018/10/17	AB SOP-00017	SM 22 5210B m
Cadmium - low level CCME - Dissolved	2	N/A	2018/10/16	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry	2	N/A	2018/10/17	AB SOP-00020	SM 22-4500-Cl-E m
Chemical Oxygen Demand	2	N/A	2018/10/15	AB SOP-00016	SM 22 5220D m
Oxygen (Dissolved, winkler) (1)	5	N/A	2018/10/12	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	2	N/A	2018/10/13	AB SOP-00005	SM 23 2510 B m
Hardness	2	N/A	2018/10/15	AB WI-00065	Auto Calc
Elements by ICP - Dissolved (2)	2	N/A	2018/10/13	AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS - Dissolved (2)	2	N/A	2018/10/15	AB SOP-00043	EPA 6020b R2 m
Ion Balance	2	N/A	2018/10/12	AB WI-00065	Auto Calc
Sum of cations, anions	2	N/A	2018/10/15	AB WI-00065	Auto Calc
Ammonia-N (Total)	1	N/A	2018/10/12	AB SOP-00007	SM 23 4500 NH3 A G m
Ammonia-N (Total)	1	N/A	2018/10/16	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	2	N/A	2018/10/14	AB WI-00065	Auto Calc
Nitrate and Nitrite	3	N/A	2018/10/16	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	2	N/A	2018/10/14	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	3	N/A	2018/10/16	AB WI-00065	Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2018/10/13	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	3	N/A	2018/10/15	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	2	N/A	2018/10/13	AB SOP-00005	SM 23 4500-H+B m
Orthophosphate by Konelab (4)	5	N/A	2018/10/12	AB SOP-00025	SM 23 4500-P A,F m
Sulphate by Automated Colourimetry	2	N/A	2018/10/17	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Filt. Residue)	2	2018/10/15	2018/10/15	AB SOP-00065	SM 22 2540 C m
Total Dissolved Solids (Calculated)	2	N/A	2018/10/17	AB WI-00065	Auto Calc
Total Kjeldahl Nitrogen	1	2018/10/17	2018/10/18	AB SOP-00008	EPA 351.1 R1978 m
Total Kjeldahl Nitrogen	1	2018/10/18	2018/10/18	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved) (5)	2	2018/10/17	2018/10/17	AB SOP-00024	SM 22 4500-P A,B,F m
Total Phosphorus	1	2018/10/16	2018/10/16	AB SOP-00024	SM 22 4500-P A,B,F m
Total Phosphorus	1	2018/10/17	2018/10/17	AB SOP-00024	SM 22 4500-P A,B,F m

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your P.O. #: 102604-01
Your Project #: SWLRR
Your C.O.C. #: 567842-01-01

Attention: Cam Davis

HEMMERA ENVIROCHEM INC.
SUITE 302, 322-11TH AVENUE
CALGARY, AB
CANADA T2R 0C5

Report Date: 2018/10/19
Report #: R2637258
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888854
Received: 2018/10/11, 15:11

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Total Suspended Solids (NFR)	2	2018/10/15	2018/10/16	AB SOP-00061	SM 23 2540 D m
Turbidity	5	N/A	2018/10/14	CAL SOP-00081	SM 22 2130 B m

Remarks:

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

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

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

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

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

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

(1) The APHA Standard Method requires dissolved oxygen to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory dissolved oxygen analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Maxxam endeavours to analyze samples as soon as possible after receipt.
(4) Orthophosphate > Total Phosphorus Imbalance: When applicable, Orthophosphate, Total Phosphorus and dissolved Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) Dissolved Phosphorus > Total Phosphorus Imbalance: When applicable, Dissolved Phosphorus and Total Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.

Your P.O. #: 102604-01
Your Project #: SWLRR
Your C.O.C. #: 567842-01-01

Attention: Cam Davis

HEMMERA ENVIROCHEM INC.
SUITE 302, 322-11TH AVENUE
CALGARY, AB
CANADA T2R 0C5

Report Date: 2018/10/19
Report #: R2637258
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888854
Received: 2018/10/11, 15:11

Encryption Key

Maxxam
19 Oct 2018 11:34:28

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Leanne Cameron, C.E.T., Senior Project Manager
Email: LCameron@maxxam.ca
Phone# (780)577-7103
==========
This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		UN3686		UN3687		
Sampling Date		2018/10/11 11:50		2018/10/11 11:00		
COC Number		567842-01-01		567842-01-01		
	UNITS	WQ2	QC Batch	WQ3	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	9.9	9180406	7.9	N/A	9180406
Cation Sum	meq/L	10	9180406	7.8	N/A	9180406
Hardness (CaCO3)	mg/L	400	9180399	310	0.50	9180399
Ion Balance (% Difference)	%	0.84	9180402	0.50	N/A	9180402
Dissolved Nitrate (NO3)	mg/L	0.60	9180409	<0.044	0.044	9180409
Nitrate plus Nitrite (N)	mg/L	0.14	9180415	<0.014	0.014	9180415
Dissolved Nitrite (NO2)	mg/L	<0.033	9180409	<0.033	0.033	9180409
Calculated Total Dissolved Solids	mg/L	490	9180435	390	10	9180435
Misc. Inorganics						
Conductivity	uS/cm	850	9182741	710	2.0	9182741
pH	pH	8.25	9182740	8.09	N/A	9182740
Low Level Elements						
Dissolved Cadmium (Cd)	mg/L	<0.000020	9179268	<0.000020	0.000020	9180858
Anions						
Alkalinity (PP as CaCO3)	mg/L	<1.0	9182739	<1.0	1.0	9182739
Alkalinity (Total as CaCO3)	mg/L	410	9182739	310	1.0	9182739
Bicarbonate (HCO3)	mg/L	510	9182739	380	1.0	9182739
Carbonate (CO3)	mg/L	<1.0	9182739	<1.0	1.0	9182739
Hydroxide (OH)	mg/L	<1.0	9182739	<1.0	1.0	9182739
Dissolved Sulphate (SO4)	mg/L	59	9188517	40	1.0	9188517
Dissolved Chloride (Cl)	mg/L	12	9188512	29	1.0	9188512
Nutrients						
Dissolved Nitrite (N)	mg/L	<0.010	9182891	<0.010	0.010	9182891
Dissolved Nitrate (N)	mg/L	0.14	9182891	<0.010	0.010	9182891
Elements						
Dissolved Aluminum (Al)	mg/L	0.0034	9183598	0.0034	0.0030	9183598
Dissolved Antimony (Sb)	mg/L	<0.00060	9183598	<0.00060	0.00060	9183598
Dissolved Arsenic (As)	mg/L	0.00061	9183598	0.0012	0.00020	9183598
Dissolved Barium (Ba)	mg/L	0.11	9183251	0.21	0.010	9183251
Dissolved Beryllium (Be)	mg/L	<0.0010	9183598	<0.0010	0.0010	9183598
Dissolved Boron (B)	mg/L	0.040	9183251	0.041	0.020	9183251

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		UN3686		UN3687		
Sampling Date		2018/10/11 11:50		2018/10/11 11:00		
COC Number		567842-01-01		567842-01-01		
	UNITS	WQ2	QC Batch	WQ3	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	73	9183251	52	0.30	9183251
Dissolved Chromium (Cr)	mg/L	<0.0010	9183598	<0.0010	0.0010	9183598
Dissolved Cobalt (Co)	mg/L	<0.00030	9183598	<0.00030	0.00030	9183598
Dissolved Copper (Cu)	mg/L	0.00036	9183598	<0.00020	0.00020	9183598
Dissolved Iron (Fe)	mg/L	0.10	9183251	0.064	0.060	9183251
Dissolved Lead (Pb)	mg/L	<0.00020	9183598	<0.00020	0.00020	9183598
Dissolved Lithium (Li)	mg/L	0.026	9183251	<0.020	0.020	9183251
Dissolved Magnesium (Mg)	mg/L	53	9183251	43	0.20	9183251
Dissolved Manganese (Mn)	mg/L	0.065	9183251	0.025	0.0040	9183251
Dissolved Molybdenum (Mo)	mg/L	0.0019	9183598	0.0057	0.00020	9183598
Dissolved Nickel (Ni)	mg/L	0.00066	9183598	0.0014	0.00050	9183598
Dissolved Phosphorus (P)	mg/L	<0.10	9183251	<0.10	0.10	9183251
Dissolved Potassium (K)	mg/L	3.6	9183251	6.8	0.30	9183251
Dissolved Selenium (Se)	mg/L	0.0014	9183598	0.00040	0.00020	9183598
Dissolved Silicon (Si)	mg/L	5.2	9183251	1.4	0.10	9183251
Dissolved Silver (Ag)	mg/L	<0.00010	9183598	<0.00010	0.00010	9183598
Dissolved Sodium (Na)	mg/L	44	9183251	34	0.50	9183251
Dissolved Strontium (Sr)	mg/L	0.74	9183251	0.52	0.020	9183251
Dissolved Sulphur (S)	mg/L	20	9183251	14	0.20	9183251
Dissolved Thallium (Tl)	mg/L	<0.00020	9183598	<0.00020	0.00020	9183598
Dissolved Tin (Sn)	mg/L	<0.0010	9183598	<0.0010	0.0010	9183598
Dissolved Titanium (Ti)	mg/L	<0.0010	9183598	<0.0010	0.0010	9183598
Dissolved Uranium (U)	mg/L	0.0048	9183598	0.0083	0.00010	9183598
Dissolved Vanadium (V)	mg/L	<0.0010	9183598	<0.0010	0.0010	9183598
Dissolved Zinc (Zn)	mg/L	0.013	9183598	<0.0030	0.0030	9183598
RDL = Reportable Detection Limit						

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UN3686		UN3687			UN3688	UN3689		
Sampling Date		2018/10/11 11:50		2018/10/11 11:00			2018/10/11 12:18	2018/10/11 14:00		
COC Number		567842-01-01		567842-01-01			567842-01-01	567842-01-01		
	UNITS	WQ2	QC Batch	WQ3	RDL	QC Batch	WQ4B	WQ4A	RDL	QC Batch
Calculated Parameters										
Dissolved Nitrate (NO3)	mg/L						1.3	3.4	0.044	9183517
Nitrate plus Nitrite (N)	mg/L						0.30	0.76	0.014	9183518
Dissolved Nitrite (NO2)	mg/L						<0.033	<0.033	0.033	9183517
Demand Parameters										
Biochemical Oxygen Demand	mg/L	<2.0	9181544	3.5	2.0	9181544	<2.0	<2.0	2.0	9181544
Total Chemical Oxygen Demand	mg/L	15	9183847	37	5.0	9183847				
Misc. Inorganics										
Dissolved Oxygen (O2)	mg/L	11	9182517	4.3	0.10	9182517	9.3	1.9	0.10	9182517
Total Dissolved Solids	mg/L	460	9184223	390	10	9184224				
Total Suspended Solids	mg/L	9.7	9185613	25	1.0	9185613				
Nutrients										
Total Ammonia (N)	mg/L	<0.015	9181454	0.039	0.015	9185627				
Orthophosphate (P)	mg/L	0.0034	9181945	<0.0030	0.0030	9181945	0.0031	<0.0030	0.0030	9181945
Dissolved Phosphorus (P)	mg/L	0.0045	9187349	0.0085	0.0030	9187349				
Total Phosphorus (P)	mg/L	0.021	9187350	0.080	0.0030	9185622				
Total Total Kjeldahl Nitrogen	mg/L	0.44	9187770	0.90	0.050	9189439				
Dissolved Nitrite (N)	mg/L						<0.010	<0.010	0.010	9184473
Dissolved Nitrate (N)	mg/L						0.30	0.76	0.010	9184473
Physical Properties										
Turbidity	NTU	5.4	9183607	17	0.10	9183607	0.83	0.84	0.10	9183607
RDL = Reportable Detection Limit										

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UN3690		
Sampling Date		2018/10/11 13:15		
COC Number		567842-01-01		
	UNITS	WQ5B	RDL	QC Batch
Calculated Parameters				
Dissolved Nitrate (NO3)	mg/L	22	0.044	9183517
Nitrate plus Nitrite (N)	mg/L	5.0	0.014	9183518
Dissolved Nitrite (NO2)	mg/L	0.14	0.033	9183517
Demand Parameters				
Biochemical Oxygen Demand	mg/L	<2.0	2.0	9181544
Misc. Inorganics				
Dissolved Oxygen (O2)	mg/L	13	0.10	9182517
Nutrients				
Orthophosphate (P)	mg/L	<0.0030	0.0030	9181945
Dissolved Nitrite (N)	mg/L	0.043	0.010	9184473
Dissolved Nitrate (N)	mg/L	4.9	0.010	9184473
Physical Properties				
Turbidity	NTU	23	0.10	9183607
RDL = Reportable Detection Limit				

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

GENERAL COMMENTS

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

Package 1	6.0°C
Package 2	7.0°C

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9181454	JLD	Matrix Spike	Total Ammonia (N)	2018/10/12		101	%	80 - 120
9181454	JLD	Spiked Blank	Total Ammonia (N)	2018/10/12		101	%	80 - 120
9181454	JLD	Method Blank	Total Ammonia (N)	2018/10/12	<0.015		mg/L	
9181454	JLD	RPD	Total Ammonia (N)	2018/10/12	0.39		%	20
9181544	AP1	Spiked Blank	Biochemical Oxygen Demand	2018/10/17		100	%	85 - 115
9181544	AP1	Method Blank	Biochemical Oxygen Demand	2018/10/17	<2.0		mg/L	
9181544	AP1	RPD	Biochemical Oxygen Demand	2018/10/17	8.3		%	20
9181945	JLD	Matrix Spike	Orthophosphate (P)	2018/10/12		99	%	80 - 120
9181945	JLD	Spiked Blank	Orthophosphate (P)	2018/10/12		100	%	80 - 120
9181945	JLD	Method Blank	Orthophosphate (P)	2018/10/12	<0.0030		mg/L	
9181945	JLD	RPD	Orthophosphate (P)	2018/10/12	NC		%	20
9182517	JM0	Spiked Blank	Dissolved Oxygen (O2)	2018/10/12		91	%	80 - 120
9182517	JM0	RPD [UN3686-07]	Dissolved Oxygen (O2)	2018/10/12	0		%	20
9182739	KD9	Spiked Blank	Alkalinity (Total as CaCO3)	2018/10/13		97	%	80 - 120
9182739	KD9	Method Blank	Alkalinity (PP as CaCO3)	2018/10/13	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2018/10/13	<1.0		mg/L	
			Bicarbonate (HCO3)	2018/10/13	<1.0		mg/L	
			Carbonate (CO3)	2018/10/13	<1.0		mg/L	
			Hydroxide (OH)	2018/10/13	<1.0		mg/L	
9182739	KD9	RPD	Alkalinity (PP as CaCO3)	2018/10/13	NC		%	20
			Alkalinity (Total as CaCO3)	2018/10/13	0.61		%	20
			Bicarbonate (HCO3)	2018/10/13	0.61		%	20
			Carbonate (CO3)	2018/10/13	NC		%	20
			Hydroxide (OH)	2018/10/13	NC		%	20
9182740	KD9	Spiked Blank	pH	2018/10/13		101	%	97 - 103
9182740	KD9	RPD	pH	2018/10/13	0.39		%	N/A
9182741	KD9	Spiked Blank	Conductivity	2018/10/13		101	%	90 - 110
9182741	KD9	Method Blank	Conductivity	2018/10/13	<2.0		uS/cm	
9182741	KD9	RPD	Conductivity	2018/10/13	0.19		%	10
9182891	KD9	Matrix Spike	Dissolved Nitrite (N)	2018/10/13		105	%	80 - 120
			Dissolved Nitrate (N)	2018/10/13		104	%	80 - 120
9182891	KD9	Spiked Blank	Dissolved Nitrite (N)	2018/10/13		104	%	80 - 120
			Dissolved Nitrate (N)	2018/10/13		104	%	80 - 120
9182891	KD9	Method Blank	Dissolved Nitrite (N)	2018/10/13	<0.010		mg/L	
			Dissolved Nitrate (N)	2018/10/13	<0.010		mg/L	
9182891	KD9	RPD	Dissolved Nitrite (N)	2018/10/13	NC		%	20
			Dissolved Nitrate (N)	2018/10/13	NC		%	20
9183251	FM0	Matrix Spike	Dissolved Barium (Ba)	2018/10/13		95	%	80 - 120
			Dissolved Boron (B)	2018/10/13		95	%	80 - 120
			Dissolved Calcium (Ca)	2018/10/13		NC	%	80 - 120
			Dissolved Iron (Fe)	2018/10/13		98	%	80 - 120
			Dissolved Lithium (Li)	2018/10/13		95	%	80 - 120
			Dissolved Magnesium (Mg)	2018/10/13		93	%	80 - 120
			Dissolved Manganese (Mn)	2018/10/13		96	%	80 - 120
			Dissolved Phosphorus (P)	2018/10/13		102	%	80 - 120
			Dissolved Potassium (K)	2018/10/13		96	%	80 - 120
			Dissolved Silicon (Si)	2018/10/13		97	%	80 - 120
			Dissolved Sodium (Na)	2018/10/13		NC	%	80 - 120
			Dissolved Strontium (Sr)	2018/10/13		91	%	80 - 120
			Dissolved Sulphur (S)	2018/10/13		86	%	80 - 120
9183251	FM0	Spiked Blank	Dissolved Barium (Ba)	2018/10/13		99	%	80 - 120
			Dissolved Boron (B)	2018/10/13		98	%	80 - 120
			Dissolved Calcium (Ca)	2018/10/13		99	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Iron (Fe)	2018/10/13		104	%	80 - 120
			Dissolved Lithium (Li)	2018/10/13		96	%	80 - 120
			Dissolved Magnesium (Mg)	2018/10/13		101	%	80 - 120
			Dissolved Manganese (Mn)	2018/10/13		101	%	80 - 120
			Dissolved Phosphorus (P)	2018/10/13		99	%	80 - 120
			Dissolved Potassium (K)	2018/10/13		96	%	80 - 120
			Dissolved Silicon (Si)	2018/10/13		102	%	80 - 120
			Dissolved Sodium (Na)	2018/10/13		99	%	80 - 120
			Dissolved Strontium (Sr)	2018/10/13		96	%	80 - 120
			Dissolved Sulphur (S)	2018/10/13		97	%	80 - 120
9183251	FM0	Method Blank	Dissolved Barium (Ba)	2018/10/13	<0.010		mg/L	
			Dissolved Boron (B)	2018/10/13	<0.020		mg/L	
			Dissolved Calcium (Ca)	2018/10/13	<0.30		mg/L	
			Dissolved Iron (Fe)	2018/10/13	<0.060		mg/L	
			Dissolved Lithium (Li)	2018/10/13	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2018/10/13	<0.20		mg/L	
			Dissolved Manganese (Mn)	2018/10/13	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2018/10/13	<0.10		mg/L	
			Dissolved Potassium (K)	2018/10/13	<0.30		mg/L	
			Dissolved Silicon (Si)	2018/10/13	<0.10		mg/L	
			Dissolved Sodium (Na)	2018/10/13	<0.50		mg/L	
			Dissolved Strontium (Sr)	2018/10/13	<0.020		mg/L	
			Dissolved Sulphur (S)	2018/10/13	<0.20		mg/L	
9183251	FM0	RPD	Dissolved Barium (Ba)	2018/10/13	0.36		%	20
			Dissolved Boron (B)	2018/10/13	7.8		%	20
			Dissolved Calcium (Ca)	2018/10/13	0.77		%	20
			Dissolved Iron (Fe)	2018/10/13	6.9		%	20
			Dissolved Lithium (Li)	2018/10/13	NC		%	20
			Dissolved Magnesium (Mg)	2018/10/13	0.17		%	20
			Dissolved Manganese (Mn)	2018/10/13	NC		%	20
			Dissolved Phosphorus (P)	2018/10/13	NC		%	20
			Dissolved Potassium (K)	2018/10/13	0.86		%	20
			Dissolved Silicon (Si)	2018/10/13	0.77		%	20
			Dissolved Sodium (Na)	2018/10/13	0.11		%	20
			Dissolved Strontium (Sr)	2018/10/13	0.30		%	20
			Dissolved Sulphur (S)	2018/10/13	0.073		%	20
9183598	LQ1	Matrix Spike	Dissolved Aluminum (Al)	2018/10/15		NC	%	80 - 120
			Dissolved Antimony (Sb)	2018/10/15		106	%	80 - 120
			Dissolved Arsenic (As)	2018/10/15		101	%	80 - 120
			Dissolved Beryllium (Be)	2018/10/15		103	%	80 - 120
			Dissolved Chromium (Cr)	2018/10/15		104	%	80 - 120
			Dissolved Cobalt (Co)	2018/10/15		106	%	80 - 120
			Dissolved Copper (Cu)	2018/10/15		103	%	80 - 120
			Dissolved Lead (Pb)	2018/10/15		101	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/10/15		106	%	80 - 120
			Dissolved Nickel (Ni)	2018/10/15		102	%	80 - 120
			Dissolved Selenium (Se)	2018/10/15		99	%	80 - 120
			Dissolved Silver (Ag)	2018/10/15		102	%	80 - 120
			Dissolved Thallium (Tl)	2018/10/15		101	%	80 - 120
			Dissolved Tin (Sn)	2018/10/15		103	%	80 - 120
			Dissolved Titanium (Ti)	2018/10/15		98	%	80 - 120
			Dissolved Uranium (U)	2018/10/15		103	%	80 - 120
			Dissolved Vanadium (V)	2018/10/15		106	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Zinc (Zn)	2018/10/15		99	%	80 - 120
9183598	LQ1	Spiked Blank	Dissolved Aluminum (Al)	2018/10/15		100	%	80 - 120
			Dissolved Antimony (Sb)	2018/10/15		104	%	80 - 120
			Dissolved Arsenic (As)	2018/10/15		103	%	80 - 120
			Dissolved Beryllium (Be)	2018/10/15		98	%	80 - 120
			Dissolved Chromium (Cr)	2018/10/15		101	%	80 - 120
			Dissolved Cobalt (Co)	2018/10/15		102	%	80 - 120
			Dissolved Copper (Cu)	2018/10/15		102	%	80 - 120
			Dissolved Lead (Pb)	2018/10/15		100	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/10/15		103	%	80 - 120
			Dissolved Nickel (Ni)	2018/10/15		102	%	80 - 120
			Dissolved Selenium (Se)	2018/10/15		98	%	80 - 120
			Dissolved Silver (Ag)	2018/10/15		101	%	80 - 120
			Dissolved Thallium (Tl)	2018/10/15		98	%	80 - 120
			Dissolved Tin (Sn)	2018/10/15		102	%	80 - 120
			Dissolved Titanium (Ti)	2018/10/15		102	%	80 - 120
			Dissolved Uranium (U)	2018/10/15		98	%	80 - 120
			Dissolved Vanadium (V)	2018/10/15		104	%	80 - 120
			Dissolved Zinc (Zn)	2018/10/15		99	%	80 - 120
9183598	LQ1	Method Blank	Dissolved Aluminum (Al)	2018/10/15	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2018/10/15	<0.00060		mg/L	
			Dissolved Arsenic (As)	2018/10/15	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2018/10/15	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2018/10/15	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2018/10/15	<0.00030		mg/L	
			Dissolved Copper (Cu)	2018/10/15	<0.00020		mg/L	
			Dissolved Lead (Pb)	2018/10/15	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2018/10/15	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2018/10/15	<0.00050		mg/L	
			Dissolved Selenium (Se)	2018/10/15	<0.00020		mg/L	
			Dissolved Silver (Ag)	2018/10/15	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2018/10/15	<0.00020		mg/L	
			Dissolved Tin (Sn)	2018/10/15	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2018/10/15	<0.0010		mg/L	
			Dissolved Uranium (U)	2018/10/15	<0.00010		mg/L	
			Dissolved Vanadium (V)	2018/10/15	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2018/10/15	<0.0030		mg/L	
9183598	LQ1	RPD	Dissolved Aluminum (Al)	2018/10/15	1.0		%	20
			Dissolved Antimony (Sb)	2018/10/15	NC		%	20
			Dissolved Arsenic (As)	2018/10/15	6.4		%	20
			Dissolved Beryllium (Be)	2018/10/15	NC		%	20
			Dissolved Chromium (Cr)	2018/10/15	NC		%	20
			Dissolved Cobalt (Co)	2018/10/15	17		%	20
			Dissolved Copper (Cu)	2018/10/15	11		%	20
			Dissolved Lead (Pb)	2018/10/15	NC		%	20
			Dissolved Molybdenum (Mo)	2018/10/15	8.3		%	20
			Dissolved Nickel (Ni)	2018/10/15	6.7		%	20
			Dissolved Selenium (Se)	2018/10/15	NC		%	20
			Dissolved Silver (Ag)	2018/10/15	NC		%	20
			Dissolved Thallium (Tl)	2018/10/15	NC		%	20
			Dissolved Tin (Sn)	2018/10/15	NC		%	20
			Dissolved Titanium (Ti)	2018/10/15	NC		%	20
			Dissolved Uranium (U)	2018/10/15	NC		%	20

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Vanadium (V)	2018/10/15	NC		%	20
			Dissolved Zinc (Zn)	2018/10/15	3.5		%	20
9183607	KHB	Spiked Blank	Turbidity	2018/10/14		99	%	80 - 120
9183607	KHB	Method Blank	Turbidity	2018/10/14	<0.10		NTU	
9183607	KHB	RPD	Turbidity	2018/10/14	6.4		%	20
9183847	JM0	Matrix Spike	Total Chemical Oxygen Demand	2018/10/15		106	%	80 - 120
9183847	JM0	Spiked Blank	Total Chemical Oxygen Demand	2018/10/15		103	%	80 - 120
9183847	JM0	Method Blank	Total Chemical Oxygen Demand	2018/10/15	<5.0		mg/L	
9183847	JM0	RPD	Total Chemical Oxygen Demand	2018/10/15	4.4		%	20
9184223	HE1	Matrix Spike	Total Dissolved Solids	2018/10/15		NC	%	80 - 120
9184223	HE1	Spiked Blank	Total Dissolved Solids	2018/10/15		91	%	80 - 120
9184223	HE1	Method Blank	Total Dissolved Solids	2018/10/15	<10		mg/L	
9184223	HE1	RPD	Total Dissolved Solids	2018/10/15	11		%	20
9184224	HE1	Matrix Spike	Total Dissolved Solids	2018/10/15		90	%	80 - 120
9184224	HE1	Spiked Blank	Total Dissolved Solids	2018/10/15		99	%	80 - 120
9184224	HE1	Method Blank	Total Dissolved Solids	2018/10/15	<10		mg/L	
9184224	HE1	RPD	Total Dissolved Solids	2018/10/15	2.7		%	20
9184473	SSO	Matrix Spike [UN3689-01]	Dissolved Nitrite (N)	2018/10/15		102	%	80 - 120
			Dissolved Nitrate (N)	2018/10/15		100	%	80 - 120
9184473	SSO	Spiked Blank	Dissolved Nitrite (N)	2018/10/15		101	%	80 - 120
			Dissolved Nitrate (N)	2018/10/15		100	%	80 - 120
9184473	SSO	Method Blank	Dissolved Nitrite (N)	2018/10/15	<0.010		mg/L	
			Dissolved Nitrate (N)	2018/10/15	<0.010		mg/L	
9184473	SSO	RPD [UN3689-01]	Dissolved Nitrite (N)	2018/10/15	NC		%	20
			Dissolved Nitrate (N)	2018/10/15	0.34		%	20
9185613	AP1	Matrix Spike	Total Suspended Solids	2018/10/16		93	%	80 - 120
9185613	AP1	Spiked Blank	Total Suspended Solids	2018/10/16		95	%	80 - 120
9185613	AP1	Method Blank	Total Suspended Solids	2018/10/16	<1.0		mg/L	
9185613	AP1	RPD	Total Suspended Solids	2018/10/16	0.96		%	20
9185622	JLD	Matrix Spike	Total Phosphorus (P)	2018/10/16		94	%	80 - 120
9185622	JLD	QC Standard	Total Phosphorus (P)	2018/10/16		82	%	80 - 120
9185622	JLD	Spiked Blank	Total Phosphorus (P)	2018/10/16		102	%	80 - 120
9185622	JLD	Method Blank	Total Phosphorus (P)	2018/10/16	<0.0030		mg/L	
9185622	JLD	RPD	Total Phosphorus (P)	2018/10/16	NC		%	20
9185627	JLD	Matrix Spike	Total Ammonia (N)	2018/10/16		NC	%	80 - 120
9185627	JLD	Spiked Blank	Total Ammonia (N)	2018/10/16		104	%	80 - 120
9185627	JLD	Method Blank	Total Ammonia (N)	2018/10/16	<0.015		mg/L	
9185627	JLD	RPD	Total Ammonia (N)	2018/10/16	2.7		%	20
9187349	JLD	Matrix Spike	Dissolved Phosphorus (P)	2018/10/17		96	%	80 - 120
9187349	JLD	QC Standard	Dissolved Phosphorus (P)	2018/10/17		91	%	80 - 120
9187349	JLD	Spiked Blank	Dissolved Phosphorus (P)	2018/10/17		99	%	80 - 120
9187349	JLD	Method Blank	Dissolved Phosphorus (P)	2018/10/17	<0.0030		mg/L	
9187349	JLD	RPD	Dissolved Phosphorus (P)	2018/10/17	9.3		%	20
9187350	JLD	Matrix Spike	Total Phosphorus (P)	2018/10/17		101	%	80 - 120
9187350	JLD	QC Standard	Total Phosphorus (P)	2018/10/17		85	%	80 - 120
9187350	JLD	Spiked Blank	Total Phosphorus (P)	2018/10/17		91	%	80 - 120
9187350	JLD	Method Blank	Total Phosphorus (P)	2018/10/17	<0.0030		mg/L	
9187350	JLD	RPD	Total Phosphorus (P)	2018/10/17	0.35		%	20
9187770	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2018/10/18		83	%	80 - 120
9187770	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2018/10/18		87	%	80 - 120
9187770	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2018/10/18		87	%	80 - 120
9187770	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2018/10/18	<0.050		mg/L	
9187770	JLD	RPD	Total Total Kjeldahl Nitrogen	2018/10/18	5.7		%	20

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9188512	GK1	Matrix Spike	Dissolved Chloride (Cl)	2018/10/17		NC	%	80 - 120
9188512	GK1	Spiked Blank	Dissolved Chloride (Cl)	2018/10/17		101	%	80 - 120
9188512	GK1	Method Blank	Dissolved Chloride (Cl)	2018/10/17	<1.0		mg/L	
9188512	GK1	RPD	Dissolved Chloride (Cl)	2018/10/17	0.16		%	20
9188517	GK1	Matrix Spike	Dissolved Sulphate (SO4)	2018/10/17		NC	%	80 - 120
9188517	GK1	Spiked Blank	Dissolved Sulphate (SO4)	2018/10/17		104	%	80 - 120
9188517	GK1	Method Blank	Dissolved Sulphate (SO4)	2018/10/17	<1.0		mg/L	
9188517	GK1	RPD	Dissolved Sulphate (SO4)	2018/10/17	0.36		%	20
9189439	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2018/10/18		101	%	80 - 120
9189439	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2018/10/18		98	%	80 - 120
9189439	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2018/10/18		99	%	80 - 120
9189439	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2018/10/18	<0.050		mg/L	
9189439	JLD	RPD	Total Total Kjeldahl Nitrogen	2018/10/18	12		%	20

N/A = Not Applicable

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

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

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

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

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

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

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

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B888854
Report Date: 2018/10/19

HEMMERA ENVIROCHEM INC.
Client Project #: SWLRR
Your P.O. #: 102604-01
Sampler Initials: CD

VALIDATION SIGNATURE PAGE

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

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

Harry (Peng) Liang, Senior Analyst

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

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.maxxam.ca

408

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10658 HEMMERA ENVIROCHEM INC.	Company Name:	SAME	Quotation #:	B61187	Maxxam Job #:	Bottle Order #: 567842
Attention:	Cam Davis	Attention:		P.O. #:	102609-01		
Address:	SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5	Address:		Project:			
Tel:	(403) 264-0671 Fax:	Tel:	Fax:	Project Name:	SWCRR	COC #: C#567842-01-01	Project Manager: Leanne Cameron
Email:	cdavis@hemmera.com	Email:		Site #:			
				Sampled By:	CD, KN		

Regulatory Criteria:
- [ ] ATI
- [ ] CCME
- [ ] Other

Special Instructions:

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

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

Job Specific Rush TAT (if applies to entire submission) [ ]
Date Required:
Rush Confirmation Number: *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Routine Water & Diss. Regulated Metals	Orthophosphate by Konelab	Total Suspended Solids (NFR)	Total Dissolved Solids (Filt. Residue)	Turbidity	Total Kjeldahl Nitrogen	Ammonia-N (Total)	Total Phosphorus	Chemical Oxygen Demand	Phosphorus -P (Total. Dissolved)	# of Bottles	Comments
1		WQ2	18/10/11	1150	W		X	X	X	X	X	X	X	X	X	X		Call if any hits
2		WQ3	18/10/11	1100	W		X	X	X	X	X	X	X	X	X	X		Call if any hits
3		WQ4B	18/10/11	1218	W		X	X			X							Just nitrate from Routine
4		WQ4A	18/10/11	1400	W		X	X			X							Just nitrate from Routine
5		WQ5B	18/10/11	1315	W		X	X			X							Just nitrate from routine
6					W													
7					W													
8					W													
9																		
10																		

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
	18/10/11	1511	ADRIAN VILLAMAYOR	2018/10/11	15:11		[ ]	6/6/6 6/7/8 ice no	[ ] Yes [X] No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

11-Oct-18 15:11
Leanne Cameron
B888854

TL8 INS-0032

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.maxxam.ca

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10658 HEMMERA ENVIROCHEM INC.	Company Name:		Quotation #:	B61187	Maxxam Job #:	Bottle Order #:
Attention:	Cam Davis	Attention:		P.O. #:	10266v01		567842
Address:	SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5	Address:		Project:		COC #:	Project Manager:
Tel:	(403) 264-0671 Fax:	Tel:	Fax:	Project Name:	SWCRA	C#567842-01-02	Leanne Cameron
Email:	cdavis@hemmera.com	Email:		Site #:			
				Sampled By:	CD, KN		

Regulatory Criteria:
- ☐ ATI
- ☐ CCME
- ☐ Other

Special Instructions:

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Biochemical Oxygen Demand	Oxygen (Dissolved, winkler)	# of Bottles	Comments
1		WQ2	18/10/11	1150	W		X	X		Call on Lots
2		WQ3	18/10/11	1100	W		X	X		Call on Lots
3		WQ4B	18/10/11	1218	W		X	X		
4		WQ4A	18/10/11	1400	W		X	X		
5		WQ5B	18/10/11	1315	W		X	X		
6					W					
7					W					
8					W					
9										
10										

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (ºC) on Receipt	Custody Seal Intact on Cooler?
Amie	18/10/11	1510	Jellamayor ARDRIN VILLAMAYOR	2018/10/11	15:10		☐	6/6/6 6/7/8	☐ Yes ☑ No

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

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

** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

1 cooler

11-Oct-18 15:11
Leanne Cameron
B888854

TL8 INS-0032

Maxxam Analytics International Corporation o/a Maxxam Analytics

APPENDIX C
Photo Log

Photo 1 Site WQ-01 looking southwest. Photo taken on May 16, 2018

Photo 2 Site WQ-01 looking northeast. Photo taken on May 16, 2018

Photo 1 Site WQ-02 looking north. Photo taken on July 5, 2018

Photo 2 Site WQ-02 looking west. Photo taken on July 5, 2018

Photo 1 Site WQ-03 looking north. Photo taken on July 5, 2018

Photo 2 Site WQ-03 looking west. Photo taken on July 5, 2018

Photo 1 Site WQ-04a looking west. Photo taken on July 5, 2018

Photo 2 Site WQ-04a looking east. Photo taken on July 5, 2018

Photo 1 Site WQ-04b looking north. Photo taken on July 5, 2018

Photo 2 Site WQ-04b looking south. Photo taken on July 5, 2018

Photo 1 Site WQ-05a looking west. Photo taken on July 5, 2018

Photo 2 Site WQ-05a looking east. Photo taken on July 5, 2018

Photo 1 Site WQ-05b looking north. Photo taken on July 5, 2018

Photo 2 Site WQ-05b looking south. Photo taken on July 5, 2018

Photo 1 Site WQ-01 looking east. Photo taken on october 11, 2018

Photo 2 Site WQ-01 looking west. Photo taken on October 11, 2018

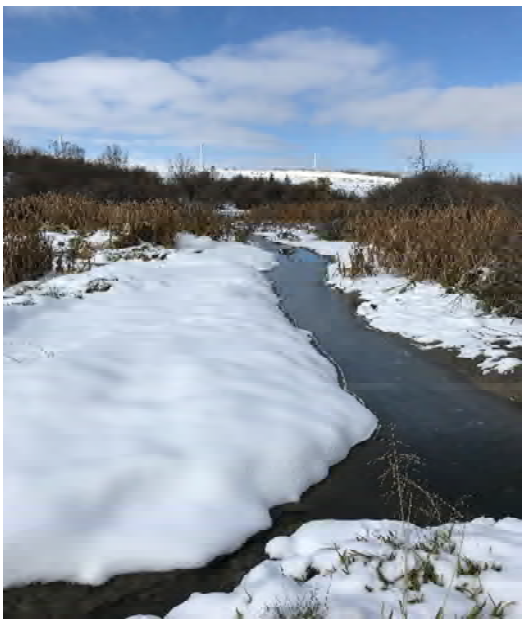


Photo 1 Site WQ-02 looking west. Photo taken on October 11, 2018

Photo 2 Site WQ-02 looking east. Photo taken on October 11, 2018

Photo 1 Site WQ-03 looking east. Photo taken on October 11, 2018

Photo 2 Site WQ-03 looking north. Photo taken on October 11, 2018

Photo 1 Site WQ-04a looking east. Photo taken on October 11, 2018

Photo 2 Site WQ-04a looking west. Photo taken on October 11, 2018

Photo 1 Site WQ-04b looking north. Photo taken on October 11, 2018

Photo 2 Site WQ-04b looking east. Photo taken on October 11, 2018

Photo 1 Site WQ-05a looking west. Photo taken on October 11, 2018

Photo 2 Site WQ-05a looking east. Photo taken on October 11, 2018

Photo 1 Site WQ-05b looking north. Photo taken on October 11, 2018

Photo 2 Site WQ-05b looking east. Photo taken on October 11, 2018