Yukon Government

Mount Nansen Water Treatment

Environmental Management and Technical Data Report

Prepared for:
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Energy, Mines and Resources
Assessment and Abandoned Mines

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1. Introduction

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1. Introduction

The Mount Nansen (MN) Site (the Site) is an abandoned gold and silver mine, located approximately 60 km west of Carmacks, Yukon. The Site is within the Traditional Territory of the Little Salmon Carmacks First Nation. In 1999, the owner, BYG Natural Resources Inc., terminated operations. Following shutdown, BYG appointed a receiver to the Site, who later abandoned the property that same year. Through the Devolution Transfer Agreement, the Government of Yukon became responsible for the Site in 2003, along with associated remediation (Yukon, 2017). The main components of the Site include an open pit and adjacent waste rock piles, a mill complex, a tailings storage facility (TSF), a tailings dam seepage collection pond, and a seepage collection pond dam. Discharge from the seepage collection pond is controlled and pumped over the seepage collection pond dam and into Dome Creek. Discharge from the seepage collection pond represents the point of discharge for the Site.

Water quality in the tailings seepage collection pond is elevated in TSS, sulphate, metals, cyanide and cyanide degradation products (*e.g.*, ammonia and nitrate). Concentrations have generally been declining over time or have remained stable. Exceptions this include TSS, iron and arsenic, which have more recently increased following denitrification and a change in redox within the impoundment. These processes are attributed to the continued decline in cyanide and associated cyanide degradation products, including nitrate and ammonia. Construction and operation of a water treatment plant (WTP) is proposed as a mitigation measure to reduce concentrations of TSS, arsenic and iron in controlled discharges to Dome Creek to acceptable levels.

The proposed WTP is a modular, flow-through, engineered treatment system with a maximum capacity of 360 m^3/d. The treatment process oxidizes the ferrous iron (Fe^{2+}) naturally present in the influent water via aeration to form ferric oxyhydroxide precipitates. The ferric oxyhydroxide formation is a common method for TSS and dissolved metal removal. Enhanced coagulation and settling technology will be employed for solid/liquid separation of precipitates and TSS. Solids generated from the WTP sedimentation and clarification process will be thickened with polymer and dewatered using Geotube® technology. Geotubes® are a simple, low maintenance and cost-effective dewatering solution which reduce the volume of resulting solids that must be stored and managed. Treatments solids will be contained within the Geotubes and will be deposited in a dedicated management area within the footprint of the TSF. Solids will be kept physically stable and will be stored above the water table so that effects to existing water quality remain negligible. This document outlines proposed water treatment to improve water

quality of the discharge from the seepage collections pond, thereby improving downstream water quality in Dome Creek and Victoria Creek, and improving the health of the downstream aquatic receiving environment. The proposed water treatment is an interim mitigation measure for the care and maintenance period until the closure plan is implemented. The treatment process is designed to remove total suspended solids (TSS) and total iron (T-Fe) and is also expected to be beneficial for the removal of other total metals including arsenic, cadmium, and zinc. Removal of manganese is not proposed at this time as current total manganese (T-Mn) concentrations in lower Dome Creek are below water quality guidelines. Further environmental monitoring following WTP implementation, as per the Aquatic Environmental Effects Management Plan (AEMP), will inform whether the guideline is protective and if manganese removal is required.

2. Conceptual Design

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2. Conceptual Design

The following sections contain information pertaining to the design of the proposed water treatment plant (WTP) at the Site, including influent criteria (Section 2.1), the conceptual approach for treatment (Section 2.2), an evaluation of the best available technology (Section 2.3), effluent criteria (Section 2.4), and a description of the proposed treatment process (Section 2.5).

2.1 Influent Criteria

The discharge pipe from the TSF seepage collection pond (SEEP) represents the point of discharge for the Site. A summary of current water quality is provided in Table 2-1 for key parameters of interest. Average and maximum concentrations are summarized over a 1-year period, from October 2015 through October 2016. From a regulatory perspective, effluent discharge limits from current water licences (WL) for quartz mines in the Yukon and the Environment Canada Metal Mining Effluent Regulations (MMER, 2002) are included in the table to provide context. It is important to note that discharge limits take into account factors associated with the receiving environment and are back-calculated as necessary to ensure that water quality objectives are met. As a result, discharge limits are mine specific. The historic and expired WL limits for the Site are also provided for reference.

Table 2-1:
Comparison of current seepage collection pond water quality observations (October 2015 to October 2016) to existing Yukon Water Licence limits and MMER discharge limits for parameters of interest.

Proponent	**Alexco**	**Alexco**	**Elsa**	**Minto**	**Strata Gold**	**BYG**	**Mount Nansen**		**MMER Discharge Limits**	
Project	Brewery Creek	Keno Hill	Keno Hill	Minto	Dublin Gulch	Mt. Nansen	Seepage Pond Discharge (Oct/'15 to Oct/'16)			
License	QZ96-007	QZ09-092	QZ12-057	QZ14-031	QZ14-041	QZ94-004				
Date	Apr-05	Aug-10	Feb-14	Aug-15	Dec-15	1997	Mean	Max	Mean	Max
Arsenic	0.5	0.1	0.5	0.015*	0.053	0.15*	0.07	0.13	0.5	1
Iron	1	NA	NA	3.3*	6.4	1	13.4	19.6	NA	NA
Manganese	2	NA	NA	NA	7.7	0.5	6.1	6.9	NA	NA
Zinc	0.5	0.5	0.5	0.09*	0.23	0.3	0.06	0.12	0.5	1
TSS	50	25	25	15	15	50	34	61	15	30

Notes: Concentrations as mg/L. *denotes metal values as dissolved.

Historic daily flows measured from the point of discharge to Dome Creek between 2014 and 2016 are shown in Figure 2-1. Flows are stable and typically range from 2 to 3 L/s. Periodic spikes have been shown to be the result of pond management activity and are not considered to be representative of natural variability (Tetra Tech EBA, 2015).

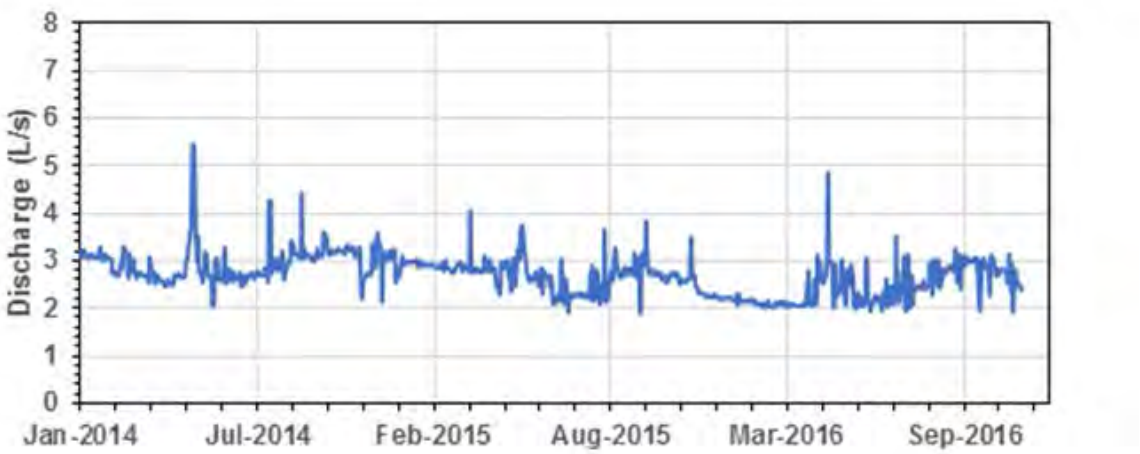


Figure 2-1: Historic daily discharge (L/s) from the Tailings Storage Facility seepage collection pond (2014 - 2016).

Comparison of existing TSF seepage water quality to Yukon WL examples and MMER limits suggests that T-Fe and TSS are unlikely to meet regulatory requirements. It is important to note that current T-Fe concentrations do not meet the historic WL for Mount Nansen. Based on these considerations, it is unlikely that SEEP water quality would be authorized for discharge under a current WL. Water treatment is proposed as a short-term mitigation solution commensurate with the duration of a care and maintenance water use license.

Total manganese (T-Mn) is also a parameter of concern, is elevated in the seepage collection pond, and exceeds the historic WUL for Mount Nansen. Water treatment has not been specifically designed for T-Mn removal. Concentrations of T-Mn in lower Dome Creek remain below water quality guidelines (Appendix 6D of the MN CMPP). Further, Mn is not included in MMER limits. Following WTP implementation, water quality and environmental effects monitoring will inform further decision-making as it pertains to water quality objectives in Dome Creek and water treatment plant performance, as specified in the Aquatic Effects Monitoring Program (Appendix 7B of the MN CMPP).

2.2 Conceptual Approach

SEEP T-Fe and TSS are the primary target parameters for treatment (Table 2-1). Although the mineralogy and elemental composition of suspended particles have not been specifically examined, the mass of TSS measured in seepage samples represents Fe oxidation products and is equal in the mass of measured T-Fe as Fe-oxides (as FeOOH stoichiometry). Based on these considerations, treatment measures designed to target Fe will also implicitly target TSS.

The Design Case outlined above includes treatment for TSS and T-Fe. The decision to proceed with the Design Case will be confirmed through the care and maintenance water use licensing approval process and will include consideration of the following:

- Water quality and associated effects assessment;
- Water balance and water quality modeling;
- Site-specific bench study results (*e.g.*, expected removal of TSS and T-Fe as per the Design Case); and
- Adaptive water management plan.

2.3 Best Available Technology Evaluation

The feasibility of any technology for the treatment of SEEP discharge is framed by the following site-specific considerations for the Site:

- Year-round treatment, with seepage water pump back to the TSF to be avoided under normal operations;
- No creation of additional water storage areas;
- Technology demonstrated in northern climates;
- Self-contained, semi-portable, containerized treatment technology;
- Limited storage capacity and footprint;
- Temporary treatment;
- Principle parameters of concern include total suspended solids (TSS) and total iron (T-Fe);
- Secondary parameters of concern include total arsenic (As), cadmium (Cd), manganese (Mn), and zinc (Zn).

A treatment alternatives analysis considered both passive and active treatment options. Unlike passive treatment systems, active treatment systems can be engineered to

accommodate a wide spectrum of influent characteristics, contaminant loadings, flow rates, and climate conditions (MEND, 2014). Given the site-specific criteria outlined above, passive treatment technologies were determined to be ill-suited for treatment at the Site for the following reasons:

- Not optimal for cold climate;
- Not self-contained and portable;
- Larger footprint required;
- Less reliable performance; and
- Typically a long-term or permanent treatment solution (*i.e.*, not temporary).

Key variables to be considered when selecting the appropriate active treatment technology include flow rate, influent composition (*e.g.*, pH, acidity, alkalinity, iron, sulphate, aluminum), target parameters, and performance criteria (INAP, 2014). Additional considerations include seasonality in flow; reagent consumption; volume and characteristics of treatment products (*e.g.*, sludge); available surface area; system longevity and maintenance needs; site accessibility and remoteness; availability of utilities; design, capital, and operation and maintenance costs; and climate impacts on system effectiveness (EPA, 2014; MEND, 2014).

Available technologies for treatment of iron include precipitation, chemical oxidation, aeration, and ion exchange. Each are briefly described below:

- Precipitation and chemical oxidation employ the use of reagents, which can be expensive and significantly increase operating costs. Reagent selection is site-specific and dependent on influent quality, reagent costs, reagent availability, handling requirements, reaction kinetics, buffering capacity, product solubility, reagent residuals, and desired sludge characteristics. Reagents require storage, handling, and management, particularly if hazardous or toxic.
- Aeration is a common method of converting soluble Fe^{2+} to its insoluble oxide phase with dissolved oxygen as per the following reaction:

  $$Fe^{2+} + ¼O_2 + 2OH^- + ½H_2O \leftrightarrow Fe(OH)_{3(s)}$$

  Although aeration requires equipment (*e.g.,* blowers, diffusers) which can add to initial capital costs, it does not require the use of reagents, which can significantly reduce operating expenses over the long-term.
- Ion exchange involves the adsorption of ions in solution onto the surface of a solid resin and replacement in the solution by an equivalent quantity of ions of similar

charge from the solid material surface. Ion exchange capacity loss is experienced year over year, resulting in increased operational costs associated with resin replacement. Management and disposal of spent regenerant is required, and regenerant equipment can add significant capital and operating costs. In addition, removal efficiency of ion exchange columns is highly dependent on the selected resin and the influent chemistry (MEND, 2014).

Based on the influent and effluent criteria and site-specific considerations for the Site, aeration was identified as the best available technology for the treatment of seepage collection pond waters. It is a simple yet effective technology for the treatment of Fe and has the advantage of not requiring reagents. Aeration is expected to also have the added benefit of removing additional parameters, including As, Cd and Zn through sorption and co-precipitation.

Iron precipitates generated as part of the oxidation process must be removed from the treatment stream through solid/liquid separation. This can be accomplished by traditional coagulation, flocculation and clarification, ultrafiltration/microfiltration, and enhanced coagulation and settling technologies. Each are briefly described below:

- Conventional clarification achieves TSS removal via gravity settling/sedimentation. Clarifiers may contain tube settlers or plate settlers ("lamella") to increase surface area, decrease specific overflow rate, and promote settling. Coagulants and/or flocculants may be added to aid precipitation, settling and flocculation processes.
- Ultrafiltration (UF) and microfiltration (MF) are membrane-based technologies that achieve TSS removal via size exclusion. UF and MF are effective for the treatment of low turbidity effluents characterized by fine and colloidal-size particles.
- Enhanced coagulation and settling technologies are variations on conventional clarification methods that can offer advantages with respect to footprint and performance. Veolia's Actiflo® technology, for example, can employ a combination of chemical precipitation, microsand-enhanced sedimentation and flocculation, and lamella clarification.

Enhanced coagulation and settling technology was identified as the best available solid/liquid separation technology for the Site due to its compact design, portability, and performance advantages.

Based on the above, a traditional flow-through engineered treatment system is proposed. More specifically, the Mini Actiflo® treatment system by Veolia Water Technologies Canada (Veolia) meets all the criteria listed above and has been selected as a suitable

analogue for water treatment that may be applied at the Site. In this regard, Veolia (the Vendor) has been engaged to provide pre-feasibility information in support of scoping and defining water treatment requirements and costs. Justification for selecting the Mini Actiflo® as the water treatment analogue for the Site include the following:

- Demonstrated performance in northern climates for parameters of concern, including Brucejack, CanTung, Faro, and Minto;
- Relatively simple technology;
- T-Fe and TSS treatment methods do not require the use of hazardous or toxic reagents;
- Semi-portable, containerized technology;
- Treatment technology is a reasonably suitable analogue for other flow-through, settling water treatment technologies;
- Off-the-shelf, readily transportable technology with minimal site-specific considerations; and
- Regulatory information requirements are readily available from Veolia, including treatment methods, process diagrams, *etc.*

2.3.1 Treatment Analogues in Northern Climates

As mentioned above, Veolia Actiflo® technology has been implemented in several northern environments including the Brucejack Mine (BC), CanTung Mine (NWT), Faro Mine Complex (YT), and Minto Mine (YT). The Faro Mine Complex WTP increases pH and removes TSS and total metals, including iron. The process uses aeration and hydrated lime to achieve ferric iron oxyhydroxide precipitation. Performance data collected in July and August 2016 demonstrate high removal efficiencies for TSS and iron (Table 2-2).

Table 2-2:
Treatment performance at Faro Mine Complex[1].

	Influent (average value)	Effluent (average value)	Removal
Units	mg/L	mg/L	%
TSS	**19.8**	**1.21**	**94**
T-Fe	**18.8**	**0.008**	**>99**
D-Fe	**13.8**	**0.020**	**>99**

Note:
[1] *Rainey, D. (2017).*

The Minto WTP uses Actiflo® technology in conjunction with sulfide precipitation, filtration, reverse osmosis, and pH adjustment. Performance data collected in 2015 also show a substantial reduction in TSS and total iron concentrations (Table 2-3). This example demonstrates low total iron can be achieved in effluent, even when influent values are low.

Table 2-3:
Treatment performance at Minto Mine[1].

	Influent (average value)	Effluent (average value)	Removal
Units	mg/L	mg/L	%
TSS	**8.3**	**1.8**	**78**
T-Fe	**0.2**	**0.1**	**50**

Note:
[1] *Capstone (2016).*

Based on this best available technology evaluation and performance data from other northern sites employing similar treatment processes, the Mini Actiflo® will be used as an analogue for treatment at the Site herein.

2.4 Effluent Criteria

The predicted WTP effluent quality is based on water quality modelling (Section 2.4.1) and bench scale test work (Section 2.4.2). Expected treatment performance of the WTP is summarized in Section 2.4.3.

2.4.1 Modelling Assumptions

The WTP is designed to oxidize and remove iron through aeration, precipitation and flocculation. Naturally occurring ferrous iron is used as a coagulant in this regard and is beneficial for the removal of other metals, including arsenic. These processes are naturally occurring downstream of seepage collection pond discharge (SEEP) to Dome Creek. The WTP is designed to facilitate these naturally occurring reactions in a controlled and highly efficient manner.

Site observations indicate that D-Fe readily oxidizes in the oxygenated, neutral drainage environment, as is to be expected. Comparison of winter water quality observations between SEEP and DC-U provide insight on the natural transformation of D-Fe and associated attenuation processes on other parameters of interest. Indeed, these processes are most evident when other surface inputs to Dome Creek are frozen and negligible, namely the Dome Creek Diversion Channel (*e.g.*, when SEEP flow is equal DC-U flow). As such, maximum observed concentrations at DC-U during winter months (December through April) provide a conservative approximation of WTP performance (*e.g.*, WTP

performance is expected to be more efficient than natural occurring attenuation processes within this 100m reach of Dome Creek). Specifically, maximum observed winter concentrations at DC-U are used as a proxy for maximum WTP effluent concentrations, as summarized in Table 2-4. These concentrations were used as constraints in the site water balance and water quality model as not to exceed maximum concentrations for WTP discharge (Appendix 7A).

2.4.2 Bench Scale Test Work

Bench scale test work was undertaken by Veolia to validate the treatment process proposed for the removal of TSS and T-Fe at the Site. Specifically, the objectives of the bench study were to:

- Quantify Fe oxidation reaction times;
- Determine optimum flocculant and dosing rate;
- Quantify removal efficiency; and
- Produce a sufficient quantity of solids for characterization.

Sample collection and shipment was conducted in a manner to minimize potential exposure to oxygen and associated oxidation. This involved filling five 1000 L water totes to maximum capacity with seepage collection pond discharge, and maintaining the temperature of the collected water to avoid freezing and/or high temperatures.

Details of the bench study are included in the Veolia bench scale test report (Appendix A). The bench test results for primary (highlighted in blue) and secondary parameters of interest are summarized in Table 2-4, and are used to support the assumptions of the model, as described in Section 2.4.1. Parameters of interest are defined through a water quality screening process as specified in Section 2.4 of the Surface Water Quality Existing Conditions Report (Appendix 6D of the MN CMPP).

Small variations in WTP influent chemistry can be managed through process optimization such that treatment effectiveness is maintained. For example, an increase in influent TSS concentration may require additional polymer and/or sand in the Actiflo to prevent degradation of effluent TSS and particulate metal removal. If an increase in influent metals concentration is observed over time, additional treatment components may be required (*e.g.*, pH adjustment).

The bench test results indicate that treatment of SEEP waters is feasible at the Site. Indeed, bench test results typically met or improved upon modeling assumptions as expected and as described above and provide confidence that model assumptions and associated estimates are reasonably appropriate to support the evaluation of project effects on water

quality following implementation of water treatment. Bench test results should be viewed with caution, however, as they are not meant to imply a performance guarantee. Further evaluation of WTP performance will be required through commissioning and field-scale implementation before performance can be confirmed with respect to parameters other than TSS and T-Fe.

In addition to TSS and T-Fe, the water treatment process is also expected to be beneficial for the removal of secondary parameters of interest including aluminum, arsenic, cadmium, and zinc with some benefit to manganese. The bench study was conducted with a finite volume of water and with specific objectives in mind, including the generation of sludge for characterization. As a result, the bench study was not optimized for all parameters of interest. As a result, WTP performance should not be inferred from the comparison of influent and effluent values reported in Table 2-4.

Table 2-4:
Water quality results from seepage collection pond discharge, modelled effluent, and bench test influent and effluent.

Parameter	SEEP from 22-Feb-17[1]	Model Assumption Effluent[2]	Bench Test Influent	Bench Test Effluent
Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**
TSS	45.3	<15	33	<4
Sulfate	697	900	696	744
Dissolved Metals				
Al	0.0140	0.07	<0.01	<0.01
As	0.0640	0.05	0.0039	0.003
Cd	0.000341	0.0004	<0.0002	<0.0005
Fe	18.3	0.1	0.04	<0.05
Mn	5.97	9.5	5.88	6.34
Zn	0.0432	0.06	0.020	0.03
Total Metals				
As	0.0962	0.05	0.0975	0.004
Cd	0.000444	0.0004	0.0005	<0.0005
Fe	20.5	0.5	13.4	0.52
Mn	6.14	9.5	6.21	7.19
Zn	0.0404	0.06	0.039	0.029

Notes:
[1] *Data provided by Environmental Dynamics Inc. (EDI) and included in Appendix D.*
[2] *Represents maximum effluent water quality values assumed in the model. Effluent is set equal to influent where influent is less than the maximum value. Total and dissolved metal values are assumed equal except for iron.*

2.4.3 Expected Treatment Performance

Treated effluent can be expected to achieve T-Fe concentrations of <0.5 mg/L (AWWA, 1990), and TSS concentrations of <15 mg/L, as per MMER (Table 2-1). Targets for both T-Fe and TSS are conservative, with Fe target concentrations less than half of the historic Mount Nansen Operating Water Licence (QZ94-004), and TSS target concentrations less than MMER limits. This TSS MMER limit represents mean TSS concentration, which when treated as an upper bound, further adds conservatism. These limits are achievable with the Mini-Actiflo® system for treatment as supported by bench test results (Table 2-4). Historic and target concentrations and flows for parameters of concern are summarized in Table 2-5 below.

Table 2-5:
Historic and target concentrations and flows for the parameters of concern.

Parameter	Units	Historic Influent Minimum	Historic Influent Maximum	Target Concentration After Treatment	Comparative Discharge Concentration Standard
Total Suspended Solids (TSS)	mg/L	21	47	< 15	15 [A] 50 [B]
Total Iron	mg/L	6.6	20	< 0.5	1.0 [B]
Total Arsenic	mg/L	0.04	0.13	0.05	0.500 [A] 0.15 (dissolved) [B]
Daily Flow	L/s	2	5.4	-	-

Notes:
[A] *MMER maximum authorized monthly mean concentration standards (Schedule 4) are used as a guide only and do not legally apply to the Site.*
[B] *Historic Mount Nansen Operating Water Licence (QZ94-004). Expired December 31, 2001.*

Bench test results show reductions of both TSS and T-Fe concentrations; however, the concentration of T-Fe in the bench scale effluent (0.52 mg/L) slightly exceeds the target concentration and modelling assumption effluent (both 0.50 mg/L). The concentration of D-Fe in the bench test effluent is not considered representative of expected treatment performance, as D-Fe concentrations in the bench scale influent are heavily influenced by depletion of ferrous iron through oxidation associated with sample bottling and travel time from Mount Nansen to Veolia's laboratory in Montreal (approximately one to two weeks). Therefore, the D-Fe concentration in the bench scale influent (0.04 mg/L) is not representative of expected SEEP water quality (18.3 mg/L).

With respect to water quality downstream of the WTP, the impact of SEEP treatment on Dome Creek water quality will likely vary seasonally and the full benefits of treatment may require several years of implementation before water quality improvements are realized. During winter low-flow periods when the seepage discharge represents the dominant flow in lower Dome Creek, the release of treated flows can be expected to promote significant

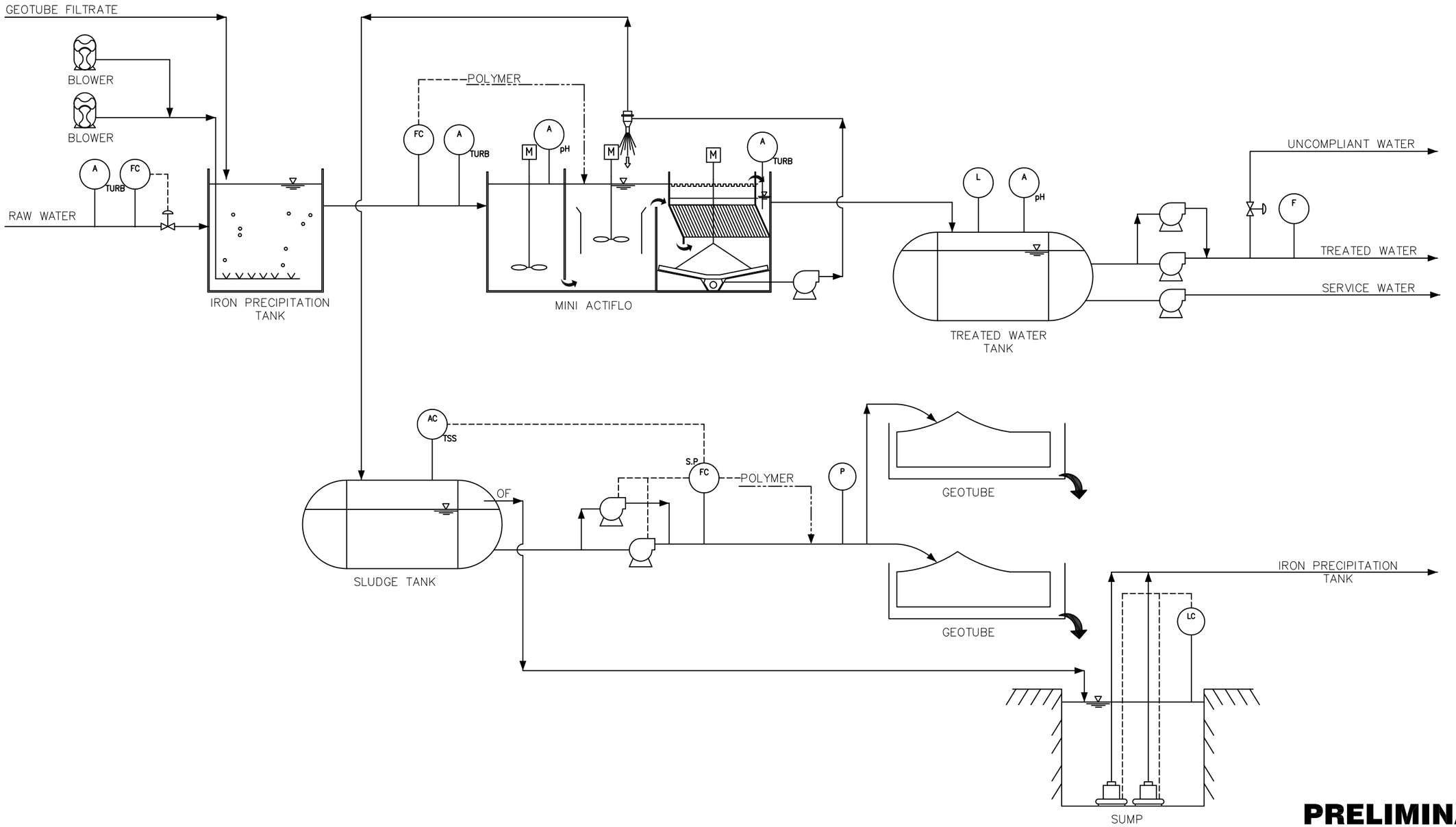
improvements in water quality. During other times of the year when significant flows are evident in the TSF diversion, treatment of seepage flows may offer limited benefit to water quality in lower Dome Creek due to upstream effects. This relates to the relatively high flows and elevated concentrations of Fe in the diversion flow. Implementation of a treatment system can also be expected to reduce settlement of Fe oxides particles on downstream substrates. In this regard, the accumulation of Fe oxide precipitates within Dome Creek downstream of historic SEEP discharges and associated artifacts on surface water quality may take years to recover. Note, however, that continued improvement of water quality in the downstream environment is expected following WTP implementation. Monitoring and management plans developed for the Mount Nansen Care and Maintenance Project Proposal (MN CM PP) include performance monitoring of the WTP (MN CM PP Appendix 7E), aquatic effects monitoring program (MN CM PP Appendix 7B) and the adaptive management plan (MN CM PP Appendix 7C). These plans are designed to ensure that significant project effects to surface water quality and the aquatic environment do not occur.

2.5 Treatment Description

For the purposes of managing Fe and TSS in water discharged from the seepage collection pond, a modular, flow-through, engineered treatment system is proposed. The WTP has a maximum capacity of 360 m^3/d, with the normal flow rate expected to be in the range of 173 m^3/d to 260 m^3/d.

The treatment process oxidizes the ferrous iron (Fe^{2+}) naturally present in the influent water via aeration to form ferric oxyhydroxide precipitate for dissolved metal removal. The ferric oxyhydroxide formation is a common method for TSS and dissolved metal removal. This process occurs naturally in the seepage collection pond and Dome Creek (Appendix C). The reaction will be conducted at the influent pH (pH 7 to 8), and therefore, pH adjustment is not required for Fe removal. Enhanced coagulation and settling technology will be employed for solid/liquid separation of precipitates and TSS. A Mini Actiflo® unit from Veolia Water Technologies is an analogue for the proposed solid/liquid separation process. Microsand and anionic polymer will be added in the Mini Actiflo® to aid with particle formation (flocculation) and for efficient TSS removal (clarification). Slurry generated from the sedimentation and clarification process will be thickened with cationic polymer and dewatered using Geotube® technology (J. Dallaire, personal communication, March 15, 2017).

The proposed treatment system consists of two main treatment chains: 1) water treatment (composing iron precipitation, decantation, and clarification); and 2) solids dewatering (involving thickening and dewatering of solids). Both treatment chains are illustrated in the process flow diagram (PFD) (Figure 2-2) and general arrangement (Figure 2-3), and described in the following sections.



PRELIMINARY

REV	DESCRIPTION	DATE	REV'D	CHKD	APV'D	ECN
B	FOR INFORMATION	2017-03-17	D.M.	J.D.	--	--
A	PRELIMINARY	2017-01-13	D.M.	J.D.	--	--

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DESIGNER	D.M.	DATE 2017-01-13
CHECKER	--	DATE --
ENGINEER	J.D.	DATE 2017-01-13
SCALE:	NONE	

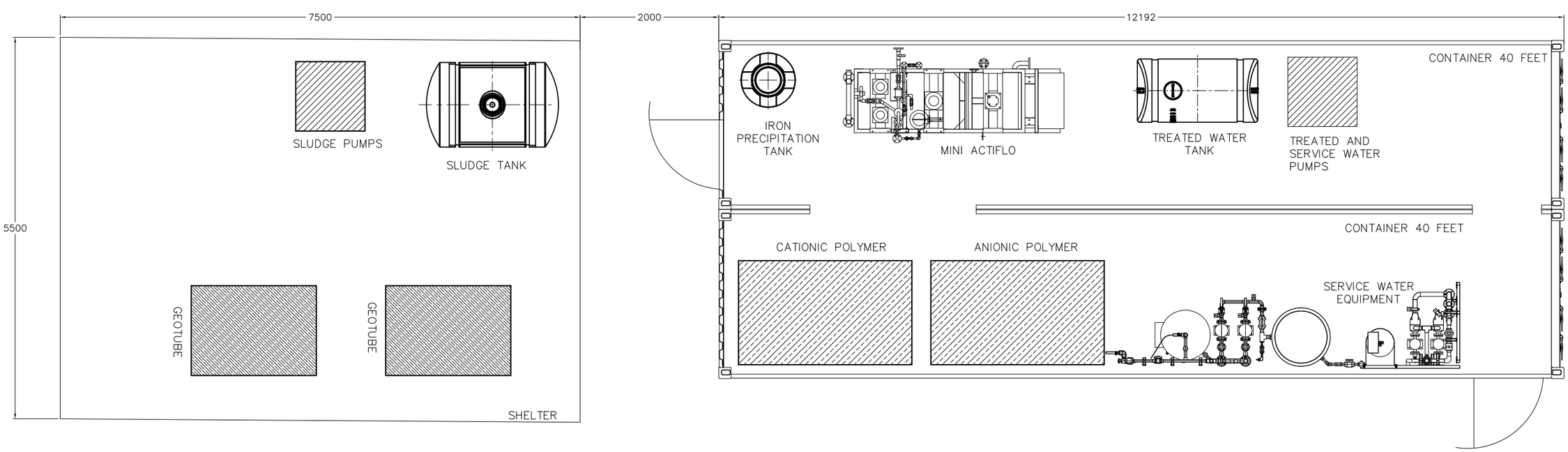
TITLE: WATER TREATMENT PROCESS FLOW DIAGRAM MOUNT NANSEN MINE

CLIENT: LORAX ENVIRONMENTAL FIGURE 2-2

VEOLIA WATER TECHNOLOGIES CANADA INC. 4105 Sartelon, Saint-Laurent, Qc, Canada. Tel: (514) 334-7230

PROJECT	DRAWING	INTERNAL	SHEET	REV
TIH125128 – PF001			1 OF 1	B

STD: "D" 22x34 | REF: | BAR = 1" AT PLOT SCALE



PRELIMINARY

REV	DESCRIPTION	DATE	REV'D	CHKD	APV'D	ECN
A	PRELIMINARY	2017-03-24	D.M.	J.D.	--	--

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DESIGNER	D.M.	DATE 2017-03-24
CHECKER	--	DATE --
ENGINEER	J.D.	DATE 2017-03-24
SCALE:	1/30	

TITLE: WATER TREATMENT
GENERAL ARRANGEMENT
MOUNT NANSEN MINE

CLIENT: LORAX ENVIRONMENTAL
FIGURE 2-3

VEOLIA
VEOLIA WATER TECHNOLOGIES CANADA INC., 4105 Sartelon, Saint-Laurent, Qc, Canada. Tel: (614) 334-7230

PROJECT	DRAWING	INTERNAL	SHEET	REV
TIH126128 – LA001			1 OF 1	A

STD: "D" 22x34 | REF: | BAR = 1" AT PLOT SCALE

2.5.1 Metal Precipitation and Clarification

The first treatment step is designed to precipitate ferrous iron present in influent water. Influent water is pumped into an Iron Precipitation Tank where the formation of ferric hydroxide is induced by aeration (using blowers). A recycle slurry stream is also mixed in this tank (J. Dallaire, personal communication, March 15, 2017).

Water from the Iron Precipitation Tank flows by gravity into the Mini Actiflo® unit. The Mini Actiflo® is designed to remove suspended solids present in the influent as well as those produced in the precipitation step. The Mini Actiflo® employs sand-ballasted settling, which is a high-rate flocculation/sedimentation process that utilizes microsand as a seed for floc formation. The microsand provides surface area that enhances flocculation and acts as a ballast or weight. The resulting floc settles rapidly, allowing for compact clarifier designs with high overflow rates and short retention times. The high TSS concentration maintained in the Mini Actiflo® due to the use of microsand also permits the unit to perform well under rapidly changing flow rates without impacting final effluent quality (J. Dallaire, personal communication, March 15, 2017).

The Mini Actiflo® unit consists of a coagulation chamber, maturation chamber, and a settling chamber. The coagulation chamber provides retention time and allows mixing to complete the chemical reactions initiated in the Iron Precipitation Tank. The water then flows into the maturation chamber where anionic polymeric flocculant and microsand are added to initiate floc formation. A mixer provides ideal conditions for bridging between the microsand and the destabilized suspended solids. A ferric hydroxide floc forms, which acts as both a bridge to tie colloidal particles together and as an active surface which can form complexes with many metals, providing further metal removal. The fully-formed ballasted floc then enters the settling chamber. The settling chamber is used for solid-liquid separation and is equipped with lamella plate settlers to provide rapid and effective removal of the sand/slurry floc. Scrapers force the slurry collected at the bottom of the clarifier into a center cone, from which it is continuously withdrawn and pumped to a hydrocyclone, where sand and slurry are separated by centrifugal force. After the hydrocyclone separation, the higher density microsand is discharged from the bottom of the cyclone and re-injected into the process for re-use. The hydrocyclone overflow is directed to the Sludge Tank. Part of the slurry in the Sludge Tank will be recycled to the Iron Precipitation Tank, while another portion will report to the solids dewatering chain. The recirculation of solids reduces the potential of scaling, increases the reagent efficiency, and promotes solids growth (J. Dallaire, personal communication, March 15, 2017).

Clarified water exits the Mini Actiflo® via a series of collection troughs or weirs and reports to the Treated Water Tank prior to final discharge. Part of the treated water is used as service water for polymer production (J. Dallaire, personal communication, March 15, 2017).

2.5.2 Sludge Dewatering

Slurry generated from the sedimentation and clarification process will be thickened with cationic polymer and dewatered using Geotube® technology. Geotubes® are a simple, low maintenance and cost effective dewatering solution, which reduce the volume of resulting solids that must be stored and managed. A Geotube® is a geotextile container made from specially designed, dual filament, polypropylene fabric. As the slurry is pumped into the Geotube®, it is mixed with polymer to help the solids separate from the liquid. Filtered effluent flows through the material of the Geotube® container, while the fabric liner keeps the solids trapped inside. The filtrate will collect in a sump and be recirculated as WTP influent, while the remaining solids inside the Geotube® retain up to 100% of contaminants (Bishop, 2017). The use of two Geotubes® will be necessary for the continuous withdrawal of solids. One Geotube® will be used as described above (in "filling" mode) while the other will be in "drying" mode to optimize the dryness of the solids (J. Dallaire, personal communication, March 21, 2017).

2.5.3 Capacity and Retention Times

The maximum operating capacity of the WTP is 360 m^3/d (4.2 L/s); however the influent flow rate is generally expected to be in the range of 173 m^3/d to 260 m^3/d (2 to 3 L/s) (J. Dallaire, personal communication, March 15, 2017). Retention times for various components of the WTP are outlined in Table 2-6 below.

Table 2-6:
Summary of WTP retention times[1].

	Iron Precipitation Tank	Mini Actiflo®	Treated Water Tank	Sludge Tank
Retention Time	3.5 min	8 min	4 min	70 min

Note:
[1] *J. Dallaire, personal communication, March 15, 2017.*

2.5.4 Reagent Requirements

The treatment process uses an anionic polymeric flocculant and microsand for enhanced solids removal. A cationic polymer is used to aid in solids dewatering. It should be noted that the specific anionic polymer that was tested during the bench scale study (Hydrex 6183) is being discontinued. Therefore, an equivalent anionic polymer (Hydrex 6105) is proposed for use in the WTP. Hydrex 6324 (or equivalent) is proposed for cationic polymer and Actisand (or equivalent) is proposed for microsand. Material safety data sheets (MSDSs) for all reagents are included as Appendix B. Reagent consumption rates vary

depending on influent water pH, suspended solids concentrations, and flow rates. Estimated reagent consumption rates are presented in Table 2-7 .

All reagents will be shipped to the Site via truck, in bags of up to 25 kg (Table 2-7). The reagents associated with treatment are not regulated as dangerous goods. The anionic and cationic polymers are not controlled substances or considered hazardous. Prolonged exposure of the microsand may have chronic effects (refer to MSDS in Appendix B). To mitigate this risk, proper personal protective equipment (PPE) will be worn at all times during the handling of reagents used within the WTP. Reagents will be stored within the WTP containerized facility. Secondary containment will be incorporated as required. All staff will undergo training on chemical handling and storage.

Table 2-7:
Key reagents used in the WTP[1].

Reagent	Expected Consumption	Shipping	Handling
Anionic polymer	- 126 kg/yr - 6 bags/yr	- Via truck - 25 kg bags	- Not dangerous goods - Keep dry
Cationic polymer	- 57 kg/yr - 3 bags/yr	- Via truck - 25 kg bags	- Not dangerous goods - Keep dry
Microsand	- 190 kg/yr - 9 bags/yr	- Via truck - 22.7 kg bags	- Not dangerous goods - Keep dry - Do not breathe dust

Note:
[1] *J. Dallaire, personal communication, March 20, 2017.*

3. Construction and Operation

Yukon Government

3. Construction and Operation

The following sections contain information pertaining to the construction and operation of the proposed WTP at the Site, including infrastructure requirements (Section 3.1), plant monitoring (Section 3.2), plant maintenance (Section 3.3), staffing requirements (Section 3.4), contingency measures for plant malfunctions (Section 3.5), solids management (Section 3.6), and adaptive management (Section 3.7).

3.1 Infrastructure Requirements

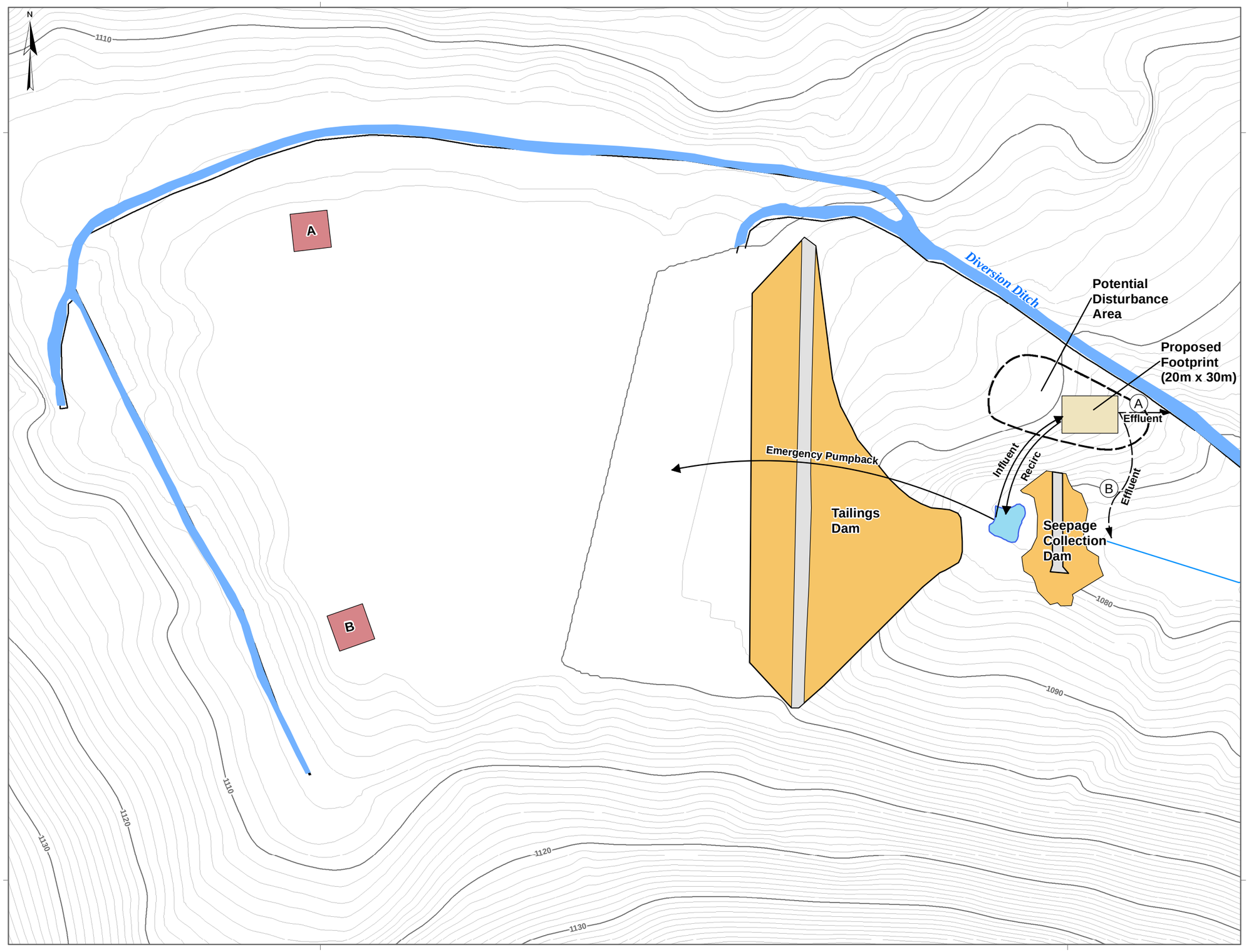
This section outlines the infrastructure requirements for the WTP, including location and layout (Section 3.1.1), water management (Section 3.1.2), power supply (Section 3.1.3), winterizing measures (Section 3.1.4), and equipment and supplies (Section 3.1.5).

3.1.1 Location and Layout

The proposed location and operational layout for the WTP is illustrated in Figure 3-1. To facilitate water management, the WTP will be located within proximity of the effluent source (tailings seepage collection pond) and a suitable discharge location (Dome Creek diversion channel). An overview of the tailings facility and seepage collection pond is illustrated in Figure 3-2. The WTP will be located on the bench between the seepage collection pond and the diversion channel (in the general vicinity of the Suburban on the right-hand image of Figure 3-2). The proposed location is ideal for the following reasons:

- within the disturbance of the TSF;
- close to power;
- well-drained;
- relatively flat; and
- well-suited to convey influent from the seepage collection pond and effluent to Dome Creek via the diversion channel.

The WTP will be housed within modular, insulated containers. The containers will be placed on a well-drained, level, gravel base. Two, connected 40-foot long containers are proposed for the housing of the Mini Actiflo®, water treatment process tanks (except the Sludge Tank), ancillary equipment and polymer make-up systems. An insulated, heated, and ventilated galvanized shelter is proposed for the management of tailings solids, as described in Section 3.6. This shelter is also proposed to house the Sludge Tank. A covered



LEGEND

- Dam
- Dam Crest
- Pond
- Water Treatment Plant Footprint
- Potential Disturbance Area
- Potential Solids Management Area (20m x 20m)
- 10m Contour
- 1m Contour

Coordinate System: *NAD 1983 UTM Zone 8N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:2,000

0 50 100 Meters

DATE SAVED:	Mar 29, 2017
DRAWN BY:	GM
REVIEWED:	JM
VERSION:	1

CLIENT:

Yukon

LORAX ENVIRONMENTAL

PROJECT:

Mount Nansen Care & Maintenance Project Proposal

TITLE:

Proposed Location and Operational Layout of the Water Treatment Plant

PROJECT #: A422-2

FIGURE: 3-1

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Figure 3-2: Overview of tailings facility, seepage collection pond, diversion channel, and Dome Creek (left) and overview of seepage collection pond looking downstream (right).

walkway will be constructed between the solids management shelter and the WTP container. This walkway will also shelter the pipelines between the two facilities. The length of this walkway will be determined by the WTP footprint and layout, but will likely be less than 10 feet in length. The solids management shelter will be located downgradient of the WTP container to allow for gravity flow between the Mini Actiflo® and the Sludge Tank.

The potential disturbance area proposed for the WTP consists of a 20 x 30 m footprint, which will contain the connected 40-foot containers and the solids management shelter (Figure 3-1). Two areas have been identified as potential locations for the disposal of dewatered solids contained within Geotube® bags. These proposed areas are located within the TSF footprint and are situated in elevated areas away from surface water flow paths Figure 3-1).

Construction, installation and commissioning of the WTP is expected to take approximately four months.

3.1.2 Water Management

The WTP influent will be pumped from the seepage collection pond to the WTP container. Treated effluent from the WTP will be discharged to Dome Creek either through the Dome Creek diversion channel or from the current point of discharge (see effluent options A and B, respectively, in Figure 3-1). Effluent option A is advantageous due to the aeration and mixing associated with water in the Dome Creek diversion channel. If freezing within the Dome Creek diversion channel becomes problematic, discharge to effluent option B may be necessary (as per current operations).

In the event that water cannot be discharged for any reason (WTP failure, off-specification water, *etc*.), untreated or partially treated water may be recirculated to the seepage collection pond as necessary until water levels within the pond mandate discharge. Following the build-up of water in the seepage collection pond during extended periods of WTP or pump failure, emergency pump-back of seepage collection pond water to the TSF will be necessary.

The water level of the seepage collection pond should be maintained below elevation 1078.1 m (Tetra Tech EBA, 2015). Available storage capacity for the seepage collection pond at water levels of 1076.8 m and 1077.1 m are 1020 m^3 and 860 m^3, respectively (Table 3-1). In the event of upset conditions or maintenance requirements that require temporary shutdown of the WTP, the seepage collection pond water level and influent flow rate will determine the amount of storage time available before water treatment must continue (Figure 3-3) or pump-back of seepage collection pond water to the TSF will be necessary.

Table 3-1:
Seepage collection pond available storage volumes and rates at 3 L/s influent.

Water Level	Flow	Volume	Storage		
m	L/s	m^3	m^3	hours	days
1078.1	3	1380	0	0	0
1077.1	3	520	860	79.6	3.3
1076.8	3	360	1020	94.4	3.9

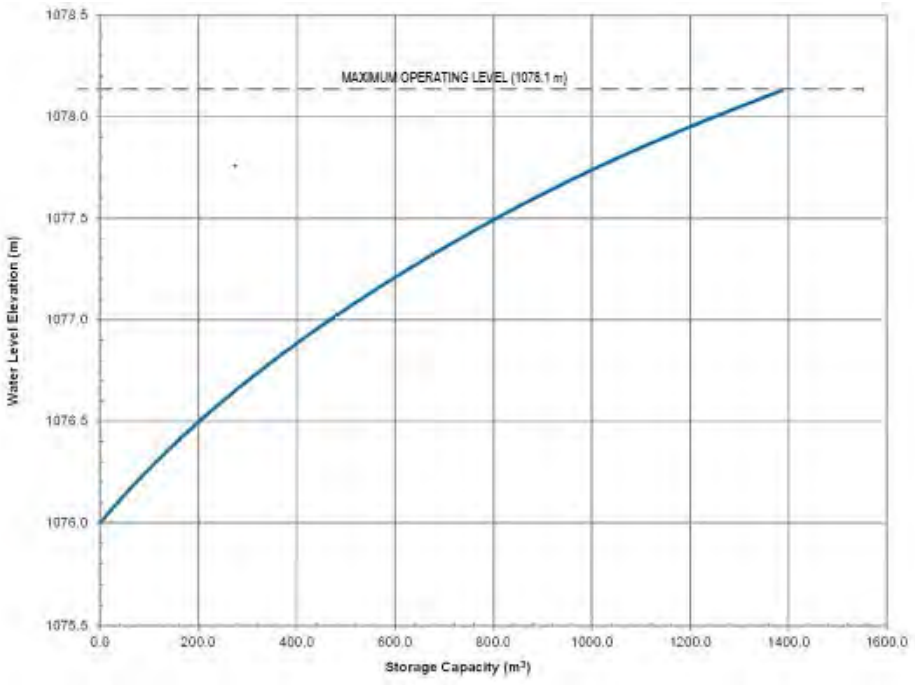

Figure 3-3: Rating curve for seepage collection pond (Tetra Tech EBA, 2015).

3.1.3 Power Supply

Power requirements for the Mini Actiflo® system are a 380V, 3 phase, 50/60 Hz power supply with a maximum total installed power of 4 kW (D. Oliphant, personal communication, January 12, 2017). The existing above-ground powerline that provides service to the pumps at the seepage collection pond is expected to provide the power supply for the WTP. If necessary, electrical upgrades will be made to accommodate the requirements of the water treatment system.

3.1.4 Winterizing Measures

As the WTP will be located in a northern climate, winterizing measures will be required for optimal WTP performance and continuous year-round treatment. The WTP container and solids management shelter will be insulated and heated (with electricity or propane). Water pipelines for the WTP will be installed above-ground, and insulated and heat-traced, if required.

3.1.5 Equipment and Supplies

Equipment associated with the WTP process includes:

- Seepage collection and conveyance system;
- Heated and contained structures to house treatment components;
- Reagent make-up/storage systems and feed systems (polymers);
- Agitated reaction tank(s);
- Solid/liquid separation equipment (*e.g.*, clarifier/thickener); and
- Solids management equipment (*e.g.*, dewatering equipment).

It is possible that the supply of reagents and parts could be interrupted, particularly in the case of an extended period of severe winter weather, when transportation to and from the Site may be impeded. This could result in a short-term shutdown of the plant.

To mitigate this risk, an inventory that represents a high degree of redundancy and wide range of replacement parts will be maintained. In addition, a minimum 14-day supply of reagents will be maintained at the Site.

3.2 Plant Monitoring

Internal WTP monitoring will ensure optimal functionality and performance of the WTP. The plant is equipped with several automatic analyzers and controllers, which are described below and summarized in Table 3-2. These instruments are also shown on the WTP process flow diagram (Figure 2-2).

The influent flow rate is measured and controlled via an electrical diaphragm valve. Turbidity is analyzed at the influent as well as upstream of the Mini Actiflo®. An analyzer measures pH in the coagulation chamber of the Mini Actiflo® and anionic polymer is dosed in the maturation chamber via a flow controller measuring the flow rate upstream of the Actiflo® unit. The clarified water flowing out of the Mini Actiflo® is also analyzed for turbidity to ensure the unit is operating properly. The pH of the treated water is measured in the Treated Water Tank, which is equipped with a level sensor. A flow meter measures the flow rate of the treated water discharge line (J. Dallaire, personal communication, March 15, 2017).

In the Sludge Tank, TSS is measured and used to control the flow of cationic polymer into the slurry prior to dewatering. The slurry line is equipped with a pressure sensor and the Sump is equipped with a level controller (J. Dallaire, personal communication, March 15, 2017).

Table 3-2:
Online instruments for WTP performance monitoring.

Parameter	Influent	Mini Actiflo®	Treated Water	Slurry	Sump
pH		X	X		
Turbidity	X	X	X		
TSS				X*	
Level			X		X*
Pressure				X	
Flow Rate	X*	X*	X		

Note:
** indicates a controller*.

Manual instruments will be on standby for monitoring redundancy. Further details of internal WTP monitoring will be included in the Operations and Maintenance (O&M) Manual provided by the Vendor.

3.3 Plant Maintenance

Maintenance requirements may include maintaining the polymer inventory, calibrating process sensors, and replacing pumps, process sensors and other components. Inspections will be carried out on a daily basis to ensure that all instruments and equipment are working properly. Daily inspections may consist of tasks such as:

- Confirming no leakages are present within the process equipment, piping, and chemical dosing tubes;

- Confirming raw water flow is within the acceptable range with a flow meter;
- Confirming microsand concentrations are within the acceptable range;
- Confirming the microsand recirculation pump is functioning properly (*i.e.*, not making abnormal sounds or vibrations);
- Visually confirming the lamella plates have not accumulated solids;
- Confirming there are no abnormal signals or alarms displayed on the WTP control panel; and
- Visual assessment of outlet turbidity (J. Dallaire, personal communication, March 15, 2017).

An O&M Manual provided by the Vendor will include further details regarding plant maintenance procedures.

3.4 Staffing Requirements

Staff requirements will vary between the commissioning/optimization phase and the operational phase. During commissioning, two field technicians/engineers and one control engineer will be required on-site 7 days per week. During plant operations, one water treatment technician will be required 24 hours a day, 7 days per week to monitor and operate the treatment process (J. Dallaire, personal communication, March 15, 2017). If no other staff are on-site, then one additional support staff will be required 24/7 at all times for safety and to assist with WTP operation as necessary.

The key tasks and responsibilities of the operators include:

- Operating the water treatment process equipment;
- Executing process optimization functions;
- Calibrating instruments;
- Performing routine maintenance;
- Troubleshooting water systems;
- Supervising contractors working on water treatment equipment, if applicable;
- Performing audits and making recommendations for improvements; and
- Participating in the continuous improvement of working procedures (J. Dallaire, personal communication, March 15, 2017).

Operators will be highly qualified with working experience in water chemistry and water treatment technology, as well as physical chemical clarification and electromechanical

works. Operators will have 4-15 years of experience and possess troubleshooting skills along with mechanical, instrumentation and control skills pertaining to water treatment (J. Dallaire, personal communication, March 15, 2017).

3.5 Contingency Measures for Plant Malfunctions

The section describes the contingency measures for potential plant malfunctions, such as a power outage (Section 3.5.1.1), pump failure (Section 3.5.1.2), or polymer injection failure (Section 3.5.1.3). Redundancy features of the WTP (Section 3.5.1.4) and the contingency plan for off-specification water (Section 3.5.1.5) are also described below.

3.5.1.1 Loss of Power

In the event of a power outage, WTP activities will cease. Maintenance of low water levels in the seepage collection pond will allow for the prevention of releasing untreated discharge for up to four days. If power is not restored for an extended period and enough water accumulates in the seepage collection pond, emergency pump-back of seepage collection pond water to the TSF will be required. Following restoration of power to the WTP, water quality from the treatment plant will be off-specification and must be recirculated to the seepage collection pond until acceptable water quality is achieved (approximately 30 minutes) (J. Dallaire, personal communication, March 20, 2017).

3.5.1.2 Pump Failure

In the event of pump failure, resulting changes in water flow will either limit water treatment activities or cease them completely. Alarm systems that monitor turbidity and flow will notify operators if water is off-specification. If so, water will be automatically diverted to the off-specification line and recirculated to the seepage collection pond. If this diversion does not automatically occur, operators are notified via alarm systems, and will manually divert water to the seepage collection pond. If the alarm is not addressed within a specified time period, the raw water valve will shut down automatically, ceasing water treatment operations (J. Dallaire, personal communication, March 20, 2017).

Maintenance of low water levels in the seepage collection pond will allow for the prevention of releasing untreated discharge for up to four days. If enough water accumulates within the seepage collection pond, pump-back of water from the seepage collection pond to the TSF will be necessary to avoid off-specification discharge to Dome Creek.

3.5.1.3 Polymer Injection Failure

Polymer injection volume is a function of WTP flow and water quality. Water treatment efficiency is heavily influenced by the volume of polymer. If too little polymer is injected into the water treatment system, target water quality will not be achieved. Alarm systems that monitor turbidity and flow will notify operators if water is off-specification. If so, water will be automatically diverted to the off-specification line and recirculated to the seepage collection pond. If this diversion does not automatically occur, operators are notified via alarm systems, and will manually divert water to the seepage collection pond. If the alarm is not addressed within a specified time period, the raw water valve will shut down automatically, ceasing water treatment operations (J. Dallaire, personal communication, March 20, 2017).

A spare pump is installed on all polymer feed systems in the event of polymer pumping failure.

3.5.1.4 Redundancy Features

Several redundancy features are built into the WTP that may help avoid or minimize the severity of a WTP failure. Redundancy features include:

- The Iron Precipitation Tank is connected to two blowers, each rated to 100% capacity, such that a backup can be used at full capacity if the other fails;
- Dosing skids will each include one installed spare pump, such that quick replacements may be made in case of failure;
- The control panel will include 30% spare room to accommodate input/output (I/O);
- Each tank will have a dedicated level switch and analog level controller;
- Portable meters capable of measuring turbidity and pH will be maintained and located on-site to provide redundancy for automatic instruments; and
- The presence of a flow meter network will allow for redundancy in data logging (J. Dallaire, personal communication, March 15, 2017).

3.5.1.5 Off-Specification Water

If the WTP produces off-specification water, freeboard maintained within the seepage collection pond will allow for the temporary cessation of WTP activities until such water quality demands can be addressed. Failing available water storage within the seepage collection pond, pump-back of seepage collection pond water to the TSF will be necessary to avoid off-specification discharge to Dome Creek.

3.6 Solids Management

The characterization and management of water treatment solids is described in detail in Appendix C. Solids dewatering via Geotubes® will occur within a temporary shelter. Inside this shelter, Geotubes® will be contained within waste disposal hoppers (Figure 3-4). Two hoppers will be required: one for Geotube® solids filling, and one for Geotube® solids drying. The proposed waste bin hoppers are relatively small, with a capacity of four cubic yards.

Approximately 22 Geotube® bags will be filled with WTP solids per year. Following solids dewatering and drying, filled Geotube® bags will be transported (either with or without the hopper) using a forklift and deposited within the dedicated management area located within the TSF (Figure 3-1). Based on the estimated solids production rate, Geotube® bag filling and exchange will take place approximately once every two weeks. Over four years of solids production, an estimated Geotube® management area of 400 m^2 will be necessary, assuming the Geotubes® are placed in a single layer (*i.e.* not stacked). Physical secondary containment will be installed (*e.g.*, berms) at the solids management area if necessary.

Figure 3-4: Waste bin management of Geotube® solids (from J. Dallaire, personal communication, March 20, 2017).

3.7 Adaptive Management

An adaptive water management plan (AMP) has been developed to inform the management and operation of the WTP as it pertains to discharge water quality, seepage collection pond elevation and storage, and overall WTP performance. This plan is provided under separate cover as *Mount Nansen Water Quality and Quantity Adaptive Management Plan* (SLR, 2015; Lorax, 2017).

4. Closure

Yukon Government

4. Closure

We trust that this water treatment environmental management and technical data report meets your requirements at this time. Please contact us should you have any questions or concerns, or require additional information in support of this work.

Respectfully submitted,
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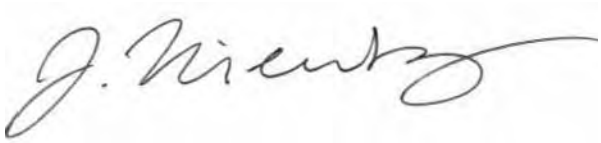

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List of Appendices

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Appendix A: Veolia Bench Scale Test Report

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LORAX

Mount Nansen Mine

IRON AND SUSPENDED SOLIDS REMOVAL IN MINE EFFLUENT

BENCH TESTING AND PILOT TESTING RESULTS

2017-03-29, REVISION 2
PROJECT # 5000196017

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This report is confidential and contains proprietary information. It is not to be disclosed to a third party without the written consent of Veolia Water Technologies Canada.

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EXECUTIVE SUMMARY

Iron and total suspended solids are problematic in Mount Nanson Mine seepage water effluent. In order to evaluate the performance of an Actiflo® ballasted clarification process for treatment of this seepage, Veolia performed bench-scale tests; a first laboratory phase was completed for optimization of the chemical selection and dosage. Once laboratory results were dimed satisfactory, an Actiflo® mini pilot unit was operated for production of sludge to be conditioned and sent for external characterization to SGS Burnaby, BC.

Laboratory testing shown that water can be treated without coagulant addition, as long as the transformation from ferrous iron to ferric iron is recent (the long presence of ferric iron is not as efficient as a coagulant and should be completed with ferric sulfate coagulant dosage (Hydrex™ 6253)). The optimal polymer, Hydrex™ 6183, an anionic polymer, was the best for removal of the TSS and ferric particles. The recommended dosage is from 1.5 to 2.0 mg/L.

Actiflo® mini pilot operation was completed for sludge production. Optimal chemical conditioning of the sludge was obtained using a cationic polymer, Hydrex™ 6423, at a dosage of 6.25 kg polymer/ton of dry solids. This sludge is considered representative to what would be produced on site on similar water quality, even if the short operation time of the Actiflo® was not sufficient to reach clarified water quality stability.

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SECTION 1. INTRODUCTION

Mount Nansen site was a gold and silver mine, located in Yukon. After being operated from 1996 to 1997, the mine was abandoned and left without any remediation. At the present, remediation solutions are being evaluated for this abandoned site. Part of the remediation plan is treatment of seepage from retaining dam on site.

Lorax retained the services of Veolia Water Technologies Canada Inc. (Veolia) to propose an adequate water treatment chain to remediate to the drainage of the seepage accumulated over year on Mount Nansen abandoned mine.

The process selected for the accession of an environmental friendly discharge of this seepage is the following:

- Iron oxidation (ferrous (Fe^{2+}) to ferric (Fe^{3+})) using an aerated contact basin to enhance iron removal;
- Particulate iron and suspended solids (TSS) removal using ballasted flocculation and clarification (Actiflo®); and,
- pH adjustment before discharge into the environment (if necessary).

In addition to the validation of the efficiency of the proposed treatment chain, sludge should be produced for complete characterization for stability assessment. This characterization will be completed by an independent third party (SGS Burnaby, BC).

This report presents the materials and methods used to simulate the iron and suspended solids removal process at bench scale. Further, this report provides the predicted treated water quality obtained during these bench-scale laboratory tests. Finally, information about sludge production, using a pilot unit, and laboratory conditioning of this sludge is presented for reference. Sludge was sent to a third party for characterization.

SECTION 2. OBJECTIVES

The main objectives of the testing completed in Veolia's office are to validate the treatment efficiency of the selected process in suspended solids and iron removal, as well as producing sufficient amount of sludge from the process to obtain its full characterization.

Specifically, the following steps were taken to meet these objectives are the following:

- Optimization of the Actiflo® process for TSS and iron removal at bench scale;
- Production of sludge using the optimized chemical dosages using an Actiflo® pilot;
- Polymer selection and chemical conditioning for partial dewatering of the sludge; and,
- Drying of the produced sludge for 72 hours to recover the solids for characterization by a third party.

Table 1 presents the target for clarified water of the orphan mine effluent (discharge criteria for Yukon's environmental discharge). These targets are according to the current non-compliancy of the seepage on site and are part of a global discharge compliancy.

Table 1: Treated water targets for final discharge to environment in Mount Nansen mine project

Parameters	Units	Clarified Water Quality Targets
Total Suspended Solids (TSS)	**mg/L**	15
Iron (Fe)	**mg/L**	0.5

SECTION 3. MATERIALS AND METHODS

This section presents the materials and methods used to simulate the total suspended solids and iron removal process in jar tests as well as the sludge production with an Actiflo® pilot on the raw water sample sent to Veolia's laboratory in Saint Laurent, QC.

3.1 Materials for bench testing

The clarification bench-scale testing was performed using a Phipps & Bird jar tester and 1 L cylindrical beakers, as shown in Figure 1.

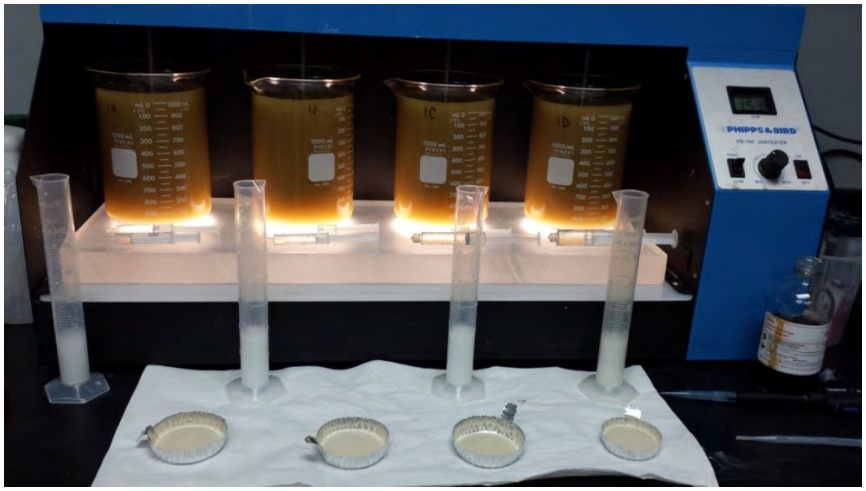

Figure 1: Jar Test Set-Up

Table 2 summarizes the chemicals used during the jar tests program. Material Safety Data Sheets (MSDS) for these chemicals can be found in Appendix B.

Since iron is naturally presents in ferrous/ferric forms in the tested mine effluent, no coagulant injection is expected for water treatability; it would only be necessary if ferric iron in the mine water gets in contact too long with ambient air and loses its coagulation capacity. Pre-aeration of the mine effluent is applied to fully oxidize ferrous forms to ferric forms in order to optimize iron removal. An anionic polymer is used for flocculation.

The chemicals used were selected based on Veolia's experience with similar water qualities.

Table 2: Chemicals used during the iron and TSS removal jar testing

Chemicals	Formula	Purpose
Coagulant	Hydrex™ 6253	Coagulation
Anionic polymer	Hydrex™ 6183 Hydrex™ 6105	flocculation
Actisand	Hydrex™	Ballast

3.2 Materials for pilot testing (sludge production)

The pilot unit used for sludge production is presented in Figure 2. Main specifications of the pilot unit used are presented in Table 3. The list of the chemicals used during the sludge production is presented in Table 4. It selection was based on the jar-test optimization program and on previous sludge conditioning experience. Material Safety Data Sheets (MSDS) for these chemicals can be found in Appendix B.

Figure 2: Actiflo® pilot unit used for sludge production

Table 3: Main specification of the Actiflo® pilot unit used for sludge production

Equipment	Capacity
Actiflo® unit	1.4 m^3/h (40 m/h)
Polymer dosing pump	1 L/h
Microsand recirculation pump	85 L/h @ 15 psi

Table 4: Chemicals Used sludge production with Actiflo® pilot unit

Chemicals	Formula	Purpose
Coagulant	Hydrex™ 6253	Coagulation
Anionic polymer	Hydrex™ 6183	Flocculation
Anionic/Cationic polymer	Hydrex™ 6183 Hydrex™ 6115 Hydrex™ 6324 Hydrex™ 6408 Hydrex™ 6412	Sludge conditioning
Actisand	Hydrex™	Ballast

3.3 Methodology

Five totes (5 m^3) were sent to Veolia's laboratory in Saint Laurent, Quebec. These totes were monitored over the whole duration of the bench test and pilot test to ensure these are not freezing, as the storage of such large volume of water was not possible in a refrigerated environment and outside temperature were variating from 5°C to -20°C during the two weeks of work. When the totes started to freeze, they were moved in Veolia's warehouse. The sample used for the bench scale portion of the whole test was refrigerated in 20 L pails. Pilot tests were performed in Veolia's warehouse.

Internal analyses were done for iron and TSS during bench testing optimization. Complete water characterizations during bench testing and pilot testing were performed by Eurofins certified laboratory in Pointe-Claire, QC (ISO 17025:2005)

3.3.1 Jar Tests Procedure

The proposed treatment chain for iron and TSS removal include an aeration contact tank followed by an Actiflo® unit.

The aeration contact tank upstream of the Actiflo® process is necessary for oxidation of ferrous iron to ferric iron, which is far easier to remove in the Actiflo® process. In addition, ferric iron naturally present in the water can be used as a coagulant for the mine effluent, reducing chemical needs for the operation of the mine effluent water. Oxidation is completed by injecting air in the tank, which hence the volume gives an indication of the retention time.

An Actiflo® unit itself is a sand-ballasted settling system designed to remove suspended solids present in the water. The Actiflo® is a high-rate coagulation/flocculation/ sedimentation process that utilizes microsand as a seed for floc formation. The microsand provides a surface area that enhances flocculation and acts as a ballast or weight. The resulting floc settles very quickly, allowing for more compact clarifier designs than conventional clarifiers, with high overflow rates and short retention times. The use of microsand also allows the unit to perform well under dramatically changing flow rates and raw water quality changes without affecting the effluent quality.

The iron and TSS removal process and the chemicals used for it are summarized in Table 5.

Table 5: Process Treatment Chain for Metals Removal

Process Step	Process Name	Chemicals Added	Objectives
1	Aeration reactor	None (air only)	Ferrous iron oxidation
2	Actiflo® (clarification using ballasted flocculation)	Coagulant, if required Anionic polymer Actisand	Coagulation, Flocculation and Settling

* if ferric iron was exposed to atmospheric air too long.

The jar test program was designed to determine the required retention time in the aeration contact reactor and to simulate Veolia's Actiflo® ballasted flocculation technology. The test procedure to simulate the Actiflo® process is as per the paper included in Appendix C and published in Water Research (2002)[1]. The test procedure used to simulate the metals removal process was the following:

- Raw water was first aerated for a fixed period of time for oxidation of ferrous iron to ferric iron;
- An anionic polymer and sand were added after this aeration period to start the ballasted flocculation process, ensuring precipitated iron and TSS removal; and,

[1] Desjardins, C., Koudjonou, B., & Desjardins, R. (**2002**). 'Laboratory study of ballasted flocculation', *Water Research*, 36, 744-754.

- The clarified water produced after flocculation and settling was sampled, and TSS and iron concentrations measured. The tests were held either at cold temperature (6-8 °C) or at room temperature to assess the difference of the kinetic of iron removal in both cases (most tests were finally done in cold temperature once aeration optimization was completed and no difference was seen).

This test procedure was repeated with different oxidation times, anionic polymer selection and anionic polymer dosages. Various tests were completed until the clarified water quality met the iron and TSS targets at clarified water, while using limited chemical dosages.

3.3.2 Sludge production with Actiflo® pilot unit

Once the iron and TSS removal are optimised, in order to fully characterize the sludge created during an Actiflo® operation, an Actiflo® pilot is used. The objective of the pilot testing is therefore to produce a good volume of sludge to be characterized by a third party (SGS Burnaby, BC).

Once a fair amount of sludge is produced for the characterization, considering the low dryness of Actiflo® sludge, chemical conditioning will be completed in Veolia's laboratory to reduce water content in the sludge. Conditioning will be limited to polymer flocculation and gravitational settling due to the impossibility to reproduce a geotube treatment at laboratory scale. Polymer selection for conditioning was optimised prior of full conditioning of the whole sludge produced. Once polymer conditioning was completed, sludge was finally dried of at low temperature (40 °C) before sending to SGS Burnaby for characterization.

In summary, the sludge production procedure is as followed:

- Treatment of sufficient raw water volume to produce around 100 g of dry sludge (mine water effluent volume needed for preparation of the pilot unit, process stabilization and collecting of sludge was estimated to 5 m^3). Operating conditions for the pilot are as tested in the bench test;

- Actiflo® sludge is watery; the sludge was first set for settling over a 24-hours period to collect settled sludge only prior to chemical conditioning. Anionic and cationic polymers were tested and one was selected for its efficiency to flocculate and dewater the slurry;
- Actiflo® sludge produced with the Actiflo® pilot is conditioned with the best polymer selected at low shear velocity to create cohesive flocs. Conditioning was followed by gravitational settling of 1 hour for maximal thickening of the produced sludge; and
- Prior to sludge shipment to the external laboratory for characterization, the chemically-conditioned sludge sample was dried over 72 hours at 40 °C in an oven to recover the dry material only.

3.4 Monitoring

3.4.1 Monitoring during bench testing program

Monitoring during the bench-scale test program was performed in two steps:

- The clarified water samples were first analysed in Veolia's laboratory to gain an initial idea of the performance of iron and TSS removal in the Actiflo® process. Refer to Table 6 for the parameters monitored and Table 7 for the methods used for the parameters measurement. All laboratory equipment was calibrated according to the supplier's operation manual prior to starting the jar testing program; and,
- Samples with acceptable parameter values and that were visually acceptable, i.e. with low turbidity, were then sent for analysis to Eurofins for complete characterization.

Table 6: Parameters monitored by Veolia's laboratory during bench testing phase

Parameter	Unit	Acceptable Range
Turbidity	NTU	5 to 10
TSS	mg/L	5 to 15
Iron (total and dissolved)	mg/L	Refer to method indicated in Table 7

Table 7: Methods of measurement for Veolia's internal monitoring of clarified water quality

Parameters	Equipment	Method[2]
Turbidity	HACH 2100N turbidimeter	-
pH	HACH HQ-40	-
TSS	-	Standard Methods; 2540-D
Total Iron	HACH DR5000	Method 8008 ; USEPA FerroVer Method
Dissolved Iron	HACH DR5000	Pre-conditioning: Filtration of sample on 0.45um glass filter Method 8008 ; USEPA FerroVer Method

3.4.2 Monitoring during sludge production with the Actiflo® pilot

The Actiflo® pilot unit used for the sludge production is equipped with instrumentation for a continuous follow-up of turbidity, pH and flow going through the unit during operation. The description of the available instrumentation during the sludge production is presented in Table 8.

In addition of these online data, internal measurements were completed through the operation of the Actiflo® pilot unit to validate good performance of the unit and adjust operation when needed (refer to Table 6 and Table 7 for the methodology used for these analyses).

Finally, through the whole duration of the sludge production, a sample was taken every 45 minutes of operation for a complete characterization which was completed by Eurofins to evaluate the fluctuation of the Actiflo® operation over time. An overview of the whole monitoring plan during the sludge production operation is presented in Table 9.

[2] The acronyms and methods mentioned here are described in the Standard Methods Manual and/or in the supplier's equipment and analysis manual.

Table 8: Methods of measurement for Veolia's internal monitoring of clarified water quality

Parameters	Equipment for continuous follow-up
Clarified water Turbidity	HACH 1720E
Clarified water pH	HACH DPC1R1A pH probe with sc100 transmitter
Raw water Flowrate	Magnetic flowmeter; Krohne Ecoflux

Table 9: Monitoring plan of the Actiflo® pilot during sludge production

	Type of monitoring	Purpose	Raw Water	Clarified Water
Turbidity	Continuous	Validation of the optimization of the Actiflo®	X	X
Turbidity	Grab, internal laboratory	Validation of the optimization of the Actiflo®	-	1X /45 min
pH	Continuous	Validation of the optimization of the Actiflo®	X	-
pH	Grab, internal laboratory	Validation of the optimization of the Actiflo®	-	1X /45 min
TSS	Grab, external laboratory	Characterization of the Actiflo® performance through the whole operation	-	1X /45min
TSS	Composite, external laboratory	Global characterization of the produced clarified water and validation of raw water composition through the 5 totes	1X	1X
Total Iron	Grab, internal laboratory	Validation of the optimization of the Actiflo®	-	1X /45 min
Total Iron	Grab, external laboratory	Characterization of the Actiflo® performance through the whole operation	-	1X /45 min
Complete total metal scan	Composite, external laboratory	Global characterization of the produced clarified water and validation of raw water composition through the 5 totes	1X	1X
Complete total metal scan	Grab (possibly external laboratory)*	Security to validate other metals removal performance (if required)	-	1X /45 min
Complete dissolved metal scan	Composite, external laboratory	Global characterization of the produced clarified water and validation of raw water composition through the 5 totes	1X	1X
Complete dissolved metal scan	Grab (possibly external laboratory)*	Security to validate other metals removal performance (if required)	-	1X /45 min
Total anions scan	Composite, external laboratory	Global characterization of the produced clarified water and validation of raw water composition through the 5 totes	1X	1X

*These samples will be conditioned (preserved, filtered) for future reference if need be for a total and dissolved metal scan

SECTION 4. RESULTS AND DISCUSSIONS

4.1 Raw Water Quality Characterization during laboratory tests

The raw water received from Mount Nansen mine was first sampled for laboratory work, than characterized by both Veolia's laboratory and Eurofins accredited external laboratory. Results from these characterizations are presented in Table 10 (internal characterization) and Table 11 (external characterization). Parameters presented in red were flagged as the parameters of interest in the clarified water characterization for process optimization.

Table 10: Raw water analysis of Mount Nansen seepage in Veolia's laboratory (from tote 4), sampled on 2017-03-06.

Elements	Unit	Total	Dissolved
pH	-	6.37	
TSS	mg/L	33	
Turbidity	NTU	123	
Redox	mV	+ 37	
METALS			
Iron (Fe)	mg/L	13.25	0.04
Manganese (Mn)	mg/L	6,34	6.26

Table 11: Raw water analysis of Mount Nansen seepage by external accredited laboratory (from tote 4), sampled on 2017-03-06.

Elements	Unit	Total	Dissolved
Sample name on COA		196017-Mount N-RW	
TSS	mg/L	33	
Alkalinity	mg $CaCO_3$/L	287	
BIOLOGICAL PARAMETERS			
COD	mg/L	51	
Total Kjeldahl Nitrogen (TKN)	mg N/L	8.6	
Ammonia	mg N/L	6.30	
Phosphorus	mg P/L	0.07	
Phosphate	mg P/L	0.04	
ANIONS			
Bromide	mg/L	<0.1	
Chloride	mg/L	2	
Nitrite + Nitrate	mg N/L	0.50	
Sulfate	mg SO_4/L	696	
METALS			
Aluminum (Al)	mg/L	0.01	<0.01
Antimony (Sb)	mg/L	0.002	<0.001

Elements	Unit	Total	Dissolved
Arsenic (As)	mg/L	0.0975	0.0039
Barium (Ba)	mg/L	0.069	0.058
Beryllium (Be)	mg/L	<0.0004	<0.0004
Bismuth (Bi)	mg/L	0.0003	0.0006
Boron (B)	mg/L	0.058	0.052
Cadmium (Cd)	mg/L	0.0005	<0.0002
Calcium (Ca)	mg/L	258	247
Chromium (Cr)	mg/L	0.0014	<0.0005
Cobalt (Co)	mg/L	0.0091	0.0079
Copper (Cu)	mg/L	0.0077	0.003
Iron (Fe)	mg/L	13.4	0.04
Lead (Pb)	mg/L	0.0011	<0.0002
Lithium (Li)	mg/L	0.004	0.001
Magnesium (Mg)	mg/L	56.3	53.7
Manganese (Mn)	mg/L	6.21	5.88
Molybdenum (Mo)	mg/L	0.0017	0.0016
Nickel (Ni)	mg/L	0.004	0.003
Potassium (K)	mg/L	6.0	5.6
Selenium (Se)	mg/L	0.0005	<0.001
Silicon (Si)	mg/L	7.35	6.58
Silver (Ag)	mg/L	0.0005	<0.0002
Sodium (Na)	mg/L	41.7	39.4
Strontium (Sr)	mg/L	0.741	0.743
Thallium (Tl)	mg/L	<0.0002	<0.0002
Tin (Sn)	mg/L	<0.001	<0.001
Titanium (Ti)	mg/L	0.002	<0.001
Vanadium (V)	mg/L	0.003	<0.001
Zinc (Zn)	mg/L	0.039	0.020

Since more than one tote was received to Veolia's office, a brief comparison of a few totes was completed in Veolia's laboratory to make sure water quality was consistent from tote to tote. This characterization is presented in Table 12.

Table 12: Comparison of the raw water contained in three totes received from Mount Nansen for assessment of the homogeneity of the whole sample, sampled on 2017-03-06.

Tote ID	pH	Redox mV	Turbidity NTU	TSS mg/L	Iron mg/L	
					Total	Dissolved
2	6.37	37	123	30	13.25	0.04
5	6.91	60	141	33	11.75	0.1
4	6.81	67	146	34	13.25	0.1

Following the characterization of three out of five totes received, the raw water received from Mount Nansen mine seepage was considered representative (no difference of concentrations for major parameters in all totes tested).

The major conclusion of this characterization is the importance of the efficiency of total solids removal; iron is mainly particular and is expected to be removed by flocculation.

4.2 Jar Test Results

Table 13 presents a summary of all tests carried out for the optimization bench-testing for iron and TSS removal.

Table 13: Overview of the tests completed for optimization of iron and TSS removal

Test ID	Aeration contact time (min)	Polymer Dosage (mg/L)	Purpose
1A	5	2.0	Aeration contact time optimization for iron removal
1B	10	2.0	Aeration contact time optimization for iron removal
1C	15	2.0	Aeration contact time optimization for iron removal
1D	20	2.0	Aeration contact time optimization for iron removal
2A	0	2.0	Aeration contact time optimization for iron removal and polymer selection (H6183)
2B	0	2.0	Aeration contact time optimization for iron removal and polymer selection (H6105)
3A	0	0.5	Polymer dosage optimization for TSS removal
3B	0	1.0	Polymer dosage optimization for TSS removal
3C	0	1.5	Polymer dosage optimization for TSS removal
3D	0	2.0	Polymer dosage optimization for TSS removal
4	0	1.0	Clarified water production for final characterization (sent to external lab)

The major optimization steps during laboratory bench testing were therefore:

- Optimization of the aeration contact time;
- Optimization of the anionic polymer selection;
- Optimization of the polymer dosage; and
- Water production for performance assessment.

4.2.1 Aeration contact time optimization

The first optimization completed on the Mount Nansen mine seepage is to determine the best aeration contact time required for total oxidation of the ferrous iron. Table 14 resumes the tests completed in Veolia's laboratory for aeration optimization. Figure 3 illustrates the water quality obtained following these aeration optimization tests. The polymer used for these tests was the anionic Hydrex™ 6183, at a fixed dosage of 2.0 mg/L.

Table 14: Aeration contact time optimisation during bench testing for Mount Nansen seepage, sampled on 2016-03-07

Sample ID	Aeration contact time	pH	Turbidity	TSS	Iron (external laboratory)
	Min	-	NTU	mg/L	mg/L
RW	-	6.37	123	30	13.4
1A	20	7.49	2.63	5	0.27
1B	15	8.10	2.44	3	-
1C	10	8.18	2.42	5	-
1D	5	8.24	2.51	6	0.27
2A	0	6.98	2.19	4	0.24

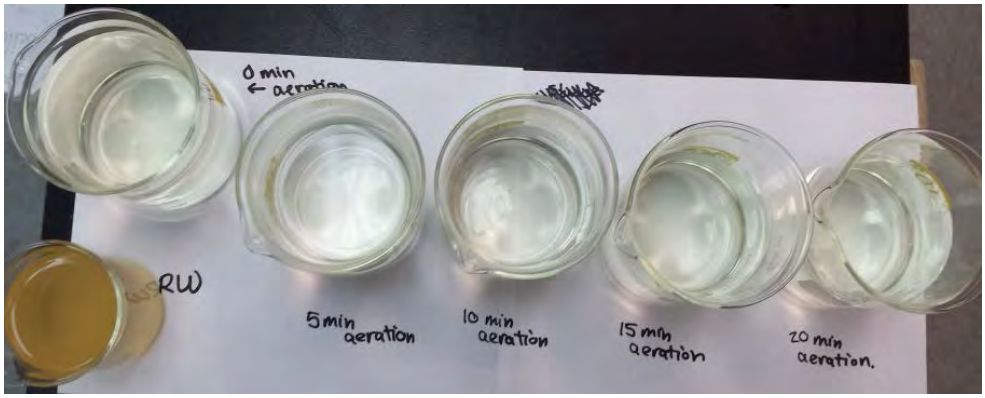

Figure 3: Clarified water quality with the aeration optimization testing sequence

Following the results obtained on this test, no aeration was required on the water received from Mount Nansen. Therefore, no aeration was applied neither on the next laboratory tests, neither on the Actiflo® pilot unit tests for sludge production. However, aeration will be required in the full scale plant to ensure a complete oxidation of iron.

4.2.2 Polymer optimization

Optimization of the polymer was completed with no aeration contact time. The first step (tests 2A-2B) was to find the optimal anionic polymer to use. The second step of the polymer optimization (tests 3A-3D) was to optimize the polymer dosage applied in the jar-test procedure. The final step was to reproduce the best polymer dosage for water production, which is sent for characterization to the external laboratory. Results from the jar-test completed in polymer optimization and the water production are presented in Table 15.

Table 15: Polymer optimisation during bench testing for Mount Nansen seepage

Sample ID	Polymer type	Polymer dosage	pH	Turbidity	TSS	Iron
		mg/L	-	NTU	mg/L	mg/L
RW	-	-	6.37	123	30	13.25
2A	Hydrex™ 6183	2.0	6.98	2.19	4	0.24*
2B	Hydrex™ 6105	2.0	6.90	3.10	6	-
3A	Hydrex™ 6183	0.5	6.87	3.82	3	0.29
3B	Hydrex™ 6183	1.0	6.92	2.48	<3	0.21
3C	Hydrex™ 6183	1.5	6.87	2.25	3	0.20
3D	Hydrex™ 6183	2.0	6.82	1.52	3	0.14

*This measurement was completed by Eurofins external accredited laboratory; when not specified, measurement during optimization was completed internally in Veolia's laboratory

Optimization of polymer showed better turbidity and TSS removal using Hydrex™ 6183. The second polymer tested Hydrex™ 6105 may perform better at higher dosage due to their characteristics similarity. According to internal laboratory results, the optimal polymer dosage for OPEX reduction and good performances was found to be 1.0 mg/L since total iron concentration were good, TSS concentration were below target and little difference could be seen in turbidity.

4.2.3 Clarified Water Production from bench testing program

Clarified water production was completed using the best polymer selection, dosage and the best aeration time contact found through previous tests. Therefore, the testing conditions from test 3B, using Hydrex™ 6183 at a dosage of 1.0 mg/L was reproduced for final assessment of the process efficiency for iron and TSS removal. Operation conditions during this test are consigned in Table 16. Complete water characterization obtained from this clarified water is detailed in Table 17.

Table 16: Clarified water production operating conditions for the laboratory bench tests in comparison with best water production test during optimization (3B), sampled on 2017-03-08

Sample ID	Polymer dosage	pH	Turbidity	TSS	Iron
	mg/L	-	NTU	mg/L	mg/L
RW	-	6.37	123	30	13.25 13.4*
3B	*1.0*	*6.92*	*2.48*	*<3*	*0.21*
4	1.0	-	-	<4	0.52*

*This measurement was completed by Eurofins external accredited laboratory; when not specified, measurement during optimization was completed internally in Veolia's laboratory

Table 17: Final Clarified Water Analysis of Mount Nansen seepage (laboratory tests), sampled on 2017-03-08.

Elements	Unit	Total	Dissolved
Sample name on COA		196017.Mount.N.4	
pH	-	6.92	
TSS	mg/L	<4	
Alcalinity	mg $CaCO_3$/L	286	
BIOLOGICAL PARAMETERS			
COD	mg/L	56	
Total Kjeldahl Nitrogen (TKN)	mg N/L	7.8	
Ammonia	mg N/L	6.30	
Phosphorus	mg P/L	<0.03	
ANIONS			
Bromide	mg/L	<0.1	
Chloride	mg/L	2	
Nitrite + Nitrate	mg N/L	0.44	
Sulfate	mg SO_4/L	744	
METALS			
Aluminum (Al)	mg/L	0.02	<0.01
Antimony (Sb)	mg/L	0.002	<0.001

Elements	Unit	Total	Dissolved
Arsenic (As)	mg/L	0.004	0.003
Barium (Ba)	mg/L	0.07	0.07
Beryllium (Be)	mg/L	<0.001	<0.001
Bismuth (Bi)	mg/L	<0.001	<0.001
Boron (B)	mg/L	0.05	0.07
Cadmium (Cd)	mg/L	<0.0005	<0.0005
Calcium (Ca)	mg/L	286	262
Chromium (Cr)	mg/L	<0.001	<0.001
Cobalt (Co)	mg/L	0.009	0.009
Copper (Cu)	mg/L	0.023	0.019
Iron (Fe)	mg/L	0.52	<0.05
Lead (Pb)	mg/L	<0.001	<0.001
Lithium (Li)	mg/L	0.003	0.002
Magnesium (Mg)	mg/L	63.8	57.4
Manganese (Mn)	mg/L	7.19	6.34
Molybdenum (Mo)	mg/L	0.002	0.002
Nickel (Ni)	mg/L	0.004	0.003
Potassium (K)	mg/L	7.5	7.0
Selenium (Se)	mg/L	<0.001	<0.001
Silicon (Si)	mg/L	7.83	7.01
Silver (Ag)	mg/L	<0.0005	<0.0005
Sodium (Na)	mg/L	44.3	40.3
Strontium (Sr)	mg/L	0.794	0.833
Thallium (Tl)	mg/L	<0.001	<0.001
Tin (Sn)	mg/L	<0.001	<0.001
Titanium (Ti)	mg/L	<0.001	<0.001
Vanadium (V)	mg/L	<0.001	<0.001
Zinc (Zn)	mg/L	0.029	0.030

Total iron concentration at the clarified water is slightly over target for the total scan obtained, even if internal validation were showing good removal performance on test 3B. However, for similar operating conditions, at higher polymer dosage, good iron removal was seen even with external laboratory results.

Table 18 presents jar-testing completed at different polymer dosage (with no aeration, in cold temperature) with resulting iron concentration (internal and external results) and turbidity at clarified water. Figure 3 illustrates the variation of iron concentration and turbidity in clarified water according to the polymer dosage.

Table 18: Iron concentration variation during laboratory bench testing

Sample ID	Polymer dosage	pH	Turbidity	TSS	Total Iron (external laboratory)	Dissolved Iron (external laboratory)	Total Iron (internal)	Dissolved Iron (internal)
	mg/L	-	NTU	mg/L	mg/L	mg/L	mg/L	mg/L
RW	-	6.37	123	30	13.4	0.04	13.25	0.04
3A	0.5	6.87	3.82	3	-	-	0.29	0.06
3B	1.0	6.92	2.48	<3	-	-	0.21	0.05
4	1.0	6.92	2.48	<3	0.52	<0.05	-	-
3C	1.5	6.87	2.25	3	-	-	0.20	0.07
3D	2.0	6.82	1.52	3	-	-	0.14	0.06
2A	2.0	6.98	2.19	4	0.24	-	-	-

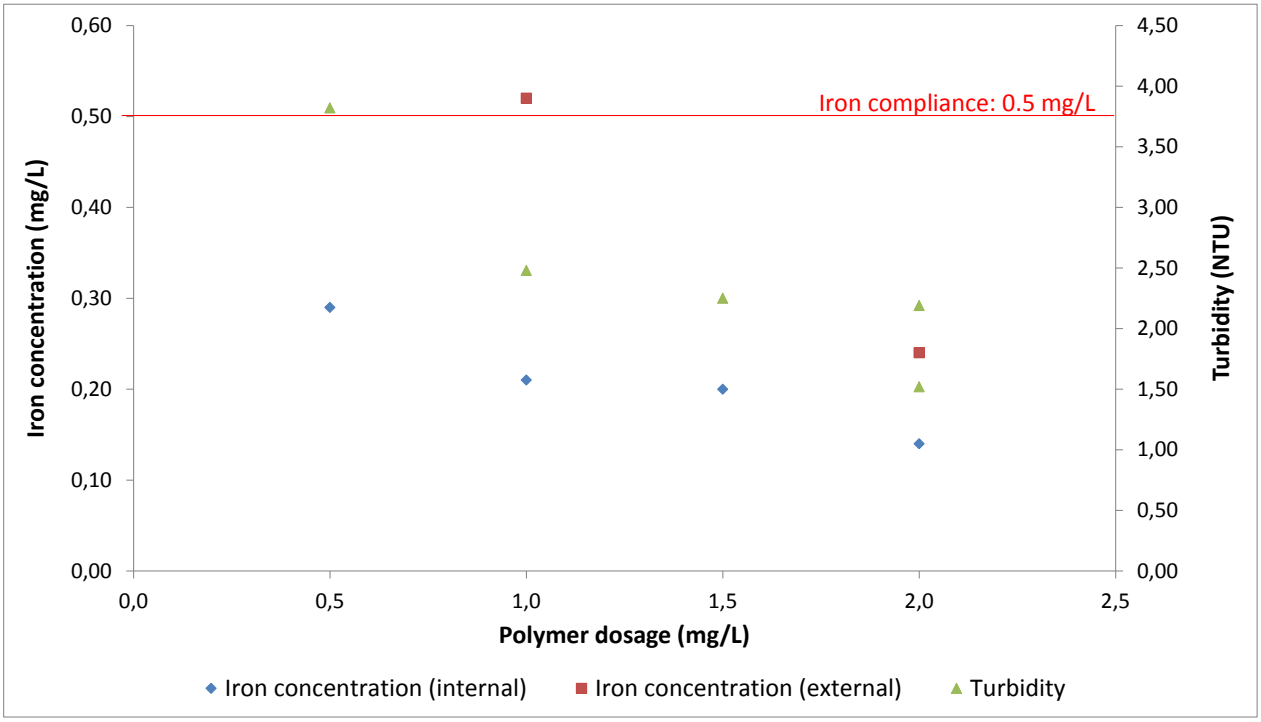

Figure 4: Iron concentration and turbidity variation over polymer concentration fluctuation

Consideration of all the tests completed so far for the iron and TSS removal optimization shows that higher polymer dosages can lower the iron concentration well below the target. This observation also applies to the turbidity that lowers in the clarified water as the polymer dosage increases, even if the TSS concentration is stable. This observation

might point out that the remaining iron particles are between 0.45 µm and 1.5 µm (colloids), but could still be removed using polymer only. Decreasing of turbidity with higher polymer dosages is supporting this observation.

Therefore, it is recommended for the sludge production to run the Actiflo® pilot unit at a polymer dosage of 2.0 mg/L to ensure reaching of the iron compliance.

4.3 Additional laboratory testing (drift of raw water quality)

During the optimization of the Actiflo® mini operation for sludge production several days after the end of the laboratory bench testing, a variation of the water quality was noticed as flocculation wasn't efficient within the unit. Indeed, removal of colloids was very difficult and no coagulation was completed by the ferric iron concentration in the raw water.

In order to produce sludge with optimal clarified water, addition of coagulant was therefore needed from that point to ensure good colloids removal (iron particles).

The new raw water characterization, taken during the Actiflo® operation (composite sampling from every 30-minutes operation) is presented in Table 19.

Table 19: Raw Water from Mount Nansen seepage (Composite sampling to evaluate quality drift), sampled on 2017-03-16

Elements	Unit	Total	Dissolved
Sample name on COA		196017-Mount N-RW	
TSS	**mg/L**	17	
ANIONS			
Bromide	**mg/L**	<0.1	
Chloride	**mg/L**	2	
Nitrite + Nitrate	**mg N/L**	0.50	
Sulfate	**mg SO_4/L**	728	
METALS			
Aluminum (Al)	**mg/L**	0.004	0.01
Antimony (Sb)	**mg/L**	<0.001	<0.001
Arsenic (As)	**mg/L**	0.0423	0.0027
Barium (Ba)	**mg/L**	0.060	0.053
Beryllium (Be)	**mg/L**	<0.0004	<0.0004
Bismuth (Bi)	**mg/L**	<0.0002	<0.0002
Boron (B)	**mg/L**	0.068	0.050
Cadmium (Cd)	**mg/L**	0.0003	<0.0002
Calcium (Ca)	**mg/L**	283	228

Elements	Unit	Total	Dissolved
Chromium (Cr)	**mg/L**	0.0014	<0.0005
Cobalt (Co)	**mg/L**	0.0087	0.0079
Copper (Cu)	**mg/L**	0.0115	0.012
Iron (Fe)	**mg/L**	6.85	0.04
Lead (Pb)	**mg/L**	0.0004	<0.0002
Lithium (Li)	**mg/L**	0.002	0.001
Magnesium (Mg)	**mg/L**	64.4	51.7
Manganese (Mn)	**mg/L**	7.06	5.73
Molybdenum (Mo)	**mg/L**	0.0012	0.0010
Nickel (Ni)	**mg/L**	0.004	0.003
Potassium (K)	**mg/L**	7.3	6.0
Selenium (Se)	**mg/L**	0.0011	<0.001
Silicon (Si)	**mg/L**	7.87	5.95
Silver (Ag)	**mg/L**	<0.0002	<0.0002
Sodium (Na)	**mg/L**	44.6	36.6
Strontium (Sr)	**mg/L**	0.737	0.721
Thallium (Tl)	**mg/L**	<0.0002	<0.0002
Tin (Sn)	**mg/L**	<0.001	<0.001
Titanium (Ti)	**mg/L**	0.001	<0.001
Vanadium (V)	**mg/L**	0.002	<0.001
Zinc (Zn)	**mg/L**	0.039	0.028

Differences in the raw water quality can mainly be seen on the TSS and the iron concentration. Since most of the iron concentration is in particle form, joined reduction of the two parameters is expected. Accumulation of solids as an orange crust was seen on the sides of the tote, suggesting the precipitation of ferric iron on the totes (explaining TSS and iron reduction over time in Mount Nansen seepage), even if the totes were mixed with air. Figure 5 illustrates the formation of this orange tint on the totes side.

Figure 5: Iron/ TSS accumulation stick to the totes wall through the residence time in the totes during laboratory and pilot testing

An additional laboratory bench test was conducted on this raw water quality to determine which coagulant dosage will level the loss of the natural ferric iron efficiency as a coagulant. These tests are presented in Table 20.

Table 20: Clarified water optimization after raw water quality drift for sludge production

Sample ID	Coagulant dosage	Polymer dosage	pH	Turbidity	Total Iron (internal)
	µL/L	mg/L	-	NTU	mg/L
6A	5.0	2.0	7.31	0.93	0.14
6B	10.0	2.0	7.22	0.58	0.11
6C	25.0	2.0	7.14	0.86	0.16
6D	50.0	2.0	7.07	0.93	0.31

All coagulant dosages were efficient to remove turbidity and total iron from the internal measurements performed. In accordance to those results, a final clarified water characterization was sent to the external laboratory in order to validate the complete metal content of the clarified water. Chemical dosages selected for this water production

was 30.0 µL/L of Hydrex™ 6253 coagulant (ferric sulfate) in addition to 2.0 mg/L Hydrex™ 6183 anionic polymer. The final scan of this clarified water is presented in Table 21.

Table 21: Final Clarified Water Analysis of Mount Nansen seepage (laboratory tests after raw water quality change), sampled on 2017-03-16

Elements	Unit	Total	Dissolved
Sample name on COA		196017-Mount N-8	
TSS	**mg/L**	6	
ANION			
Bromide	**mg/L**	<0.1	
Chloride	**mg/L**	2	
Nitrite + Nitrate	**mg N/L**	0.50	
Sulfate	**mg SO_4/L**	745	
METALS			
Aluminum (Al)	**mg/L**	<0.01	<0.01
Antimony (Sb)	**mg/L**	<0.001	<0.001
Arsenic (As)	**mg/L**	0.0021	0.0021
Barium (Ba)	**mg/L**	0.051	0.051
Beryllium (Be)	**mg/L**	<0.0004	<0.0004
Bismuth (Bi)	**mg/L**	<0.0002	<0.0002
Boron (B)	**mg/L**	0.068	0.049
Cadmium (Cd)	**mg/L**	<0.0002	<0.0002
Calcium (Ca)	**mg/L**	277	229
Chromium (Cr)	**mg/L**	<0.0005	<0.0005
Cobalt (Co)	**mg/L**	0.0091	0.0083
Copper (Cu)	**mg/L**	0.0165	0.020
Iron (Fe)	**mg/L**	0.18	0.05
Lead (Pb)	**mg/L**	<0.0002	<0.0002
Lithium (Li)	**mg/L**	0.002	0.001
Magnesium (Mg)	**mg/L**	62.4	51.9
Manganese (Mn)	**mg/L**	6.79	5.66
Molybdenum (Mo)	**mg/L**	0.0011	0.0010
Nickel (Ni)	**mg/L**	0.005	0.006
Potassium (K)	**mg/L**	7.0	5.9
Selenium (Se)	**mg/L**	<0.0004	<0.001
Silicon (Si)	**mg/L**	7.21	5.92
Silver (Ag)	**mg/L**	<0.0002	<0.0002
Sodium (Na)	**mg/L**	42.9	36.4
Strontium (Sr)	**mg/L**	0.707	0.715
Thallium (Tl)	**mg/L**	<0.0002	<0.0002
Tin (Sn)	**mg/L**	<0.001	<0.001
Titanium (Ti)	**mg/L**	<0.001	<0.001
Vanadium (V)	**mg/L**	0.001	<0.001
Zinc (Zn)	**mg/L**	0.026	0.026

The results of this final laboratory test proves the efficiency of the coagulant addition to the aged seepage water in iron and TSS removal, thus proving the efficiency of the Actiflo® process in this application.

4.4 Sludge production pilot testing

Once the laboratory optimization was completed, Mount Nansen seepage was treated according to the laboratory optimization results with an Actiflo® pilot. The objective of the Actiflo® piloting was to produce sufficient sludge for final characterization, since it would have been impossible to complete at a laboratory scale (treatment of 5 m^3 of water).

The operation conditions in which the sludge production was completed are presented in Table 22.

Table 22: Operation condition of the Actiflo® pilot during sludge production

Time	Rise Flow rate	Coagulant dosage	Polymer dosage	pH in	Turbidity in (internal lab analysis)
	m^3/h	µL/L	mg/L	-	NTU
10:10	-	-	-	7.18	-
11:10	1.48	-	2	7.19	76.2
13:35	1.17	23	2	7.25	72.5
14:05	1.32	42	2	7.07	88.9
14:35	1.27	28	2	7.13	93.8
15:05	1.2	30	2	7.11	65.2
15:35	0.97	30	2	7.13	66.5

Modification of the coagulant dosage and of the polymer dosage was applied through the Actiflo® piloting. Indeed, start-up of an Actiflo® process often requires up to 1 full day for stabilization and optimization of the process with a varying and challenging water quality. Since it was not an option in this particular study, stabilization of the Actiflo® process

through optimised chemical dosing was chased during the 3 hours operation required for sludge production after coagulant dosage integration to the Actiflo® mini.

However, it is important to note that even if perfect optimization of the Actiflo® could not be achieved through the sludge production piloting, sludge quality is expected to be representative to what will be seen on regular operation of a optimized Actiflo® process (optimization will mainly impact the clarified water quality).

Through the Actiflo® testing, performance of the process was consigned by taken grabs each 30 minutes until water totes were all emptied. These performance assessments are presented in Table 23.

A composite sampling of the Actiflo® effluent was also taken through the entire operation of the pilot unit. The complete characterization of this clarified water composite is presented in Table 24.

Through the whole duration of the Actiflo® mini operation, great attention was brought to increase the removal performance of iron and TSS validated by in-house turbidity measurement and by total iron measurement. Also, coagulant dosage was implemented in the Actiflo® mini following successful jar test as presented in Section 4.3. Turbidity removal, not being fully optimized in only three hours of operation, was however slightly off and over what was measured in laboratory conditions. As observed during laboratory bench testing, iron is mainly in the colloid fraction of the water (in the particle iron fraction but not reflecting on the TSS; refer to Section 4.2.3). However, since turbidity was not fully optimized through the three hours of operation, iron removal was not optimized neither on the Actiflo® pilot operation, as reflected on the iron concentration at effluent of the Actiflo® pilot. However, the main objective of the Actiflo® mini operation was to produce sludge for characterization, and this was accomplished.

Table 23: Clarified water characterization during Actiflo® operation for sludge production

Elements	Unit	11:10	14:05	14:35	15:05	15:35	Average
pH (internal)	-	7.32	7.08	7.05	7.08	7.08	7.12
Turbidity (internal)	NTU	22.4	4.52	5.03	7.22	4.14	8.66
Turbidity (continuous)	NTU	17.8	3.7	2.5	3.57	2.6	6.03
Iron Total(internal)	mg/L	2.07	1.22	1.26	1.64	1.38	1.51
Iron Total (external)	mg/L	2.41	1.19	1.21	1.41	1.35	1.51
TSS (external)	mg/L	13	11	7	10	8	9.8

Table 24: Final Clarified Water Analysis of Mount Nansen seepage (with Actiflo mini sludge production- composite sampling), sampled on 2017-03-16

Elements	Unit	Total	Dissolved
Sample name on COA		196017-Mount N-CW	
pH – AVERAGE	-	7.12	
TSS – COMPOSITE	mg/L	9	
TSS - AVERAGE	mg/L	9.8	
ANIONS			
Bromide	mg/L	<0.1	
Chloride	mg/L	2	
Nitrite + Nitrate	mg N/L	0.49	
Sulfate	mg SO_4/L	747	
METALS			
Aluminum (Al)	mg/L	0.02	<0.01
Antimony (Sb)	mg/L	<0.001	<0.001
Arsenic (As)	mg/L	0.0034	0.0018
Barium (Ba)	mg/L	0.049	0.056
Beryllium (Be)	mg/L	<0.0004	<0.0004
Bismuth (Bi)	mg/L	0.0006	0.0003
Boron (B)	mg/L	0.093	0.075
Cadmium (Cd)	mg/L	<0.0002	0.0003
Calcium (Ca)	mg/L	255	244
Chromium (Cr)	mg/L	0.0006	0.0007
Cobalt (Co)	mg/L	0.0085	0.0080
Copper (Cu)	mg/L	0.0119	0.014
Iron (Fe)- COMPOSITE	mg/L	1.42	0.08
Iron(Fe)- AVERAGE	mg/L	1.51	-
Lead (Pb)	mg/L	0.0002	<0.0002
Lithium (Li)	mg/L	0.003	0.002
Magnesium (Mg)	mg/L	58.8	56.3
Manganese (Mn)	mg/L	6.33	6.14
Molybdenum (Mo)	mg/L	0.0015	0.0013
Nickel (Ni)	mg/L	0.005	0.006
Potassium (K)	mg/L	6.5	6.2
Selenium (Se)	mg/L	0.0020	0.001
Silicon (Si)	mg/L	6.40	6.09
Silver (Ag)	mg/L	<0.0002	<0.0002
Sodium (Na)	mg/L	39.1	37.5
Strontium (Sr)	mg/L	0.712	0.727
Thallium (Tl)	mg/L	<0.0002	<0.0002
Tin (Sn)	mg/L	<0.001	<0.001
Titanium (Ti)	mg/L	0.001	<0.001
Vanadium (V)	mg/L	0.003	<0.001
Zinc (Zn)	mg/L	0.027	0.047

The results obtained by the internal laboratory are thus confirmed.

4.5 Sludge conditioning and drying

Once the treatment of the totality of the Mount Nansen Mine seepage water was completed, sludge was conditioned prior to be sent for external characterization to SGS. Tests were completed on the 24-hrs settled Actiflo® sludge to determine the best chemical conditioning to apply on this sludge quality. Total solids concentration at this point was 1600 mg/L. A summary of the polymer selection tests completed on this sludge is presented in Table 25 and illustrated in Figure 6.

Table 25: Optimization of sludge conditioning using polymer dosage

Polymer Type	Polymer Dosage		Visual aspect of flocs
	mg/L	kg polymer/ ton dry solids	
Hydrex™ 6183	10	6.25	Little effect of the sludge (anionic polymer)
Hydrex™ 6115	10	6.25	Little effect on the sludge (anionic polymer)- not presented in Figure 6
Hydrex™ 6324	10	6.25	Best results; big flocs formation and little pinflocs in supernatant
Hydrex™ 6408	10	6.25	Floc formation, but higher pinfloc concentration in supernatant
Hydrex™ 6412	10	6.25	Floc formation, but higher pinfloc concentration in supernatant

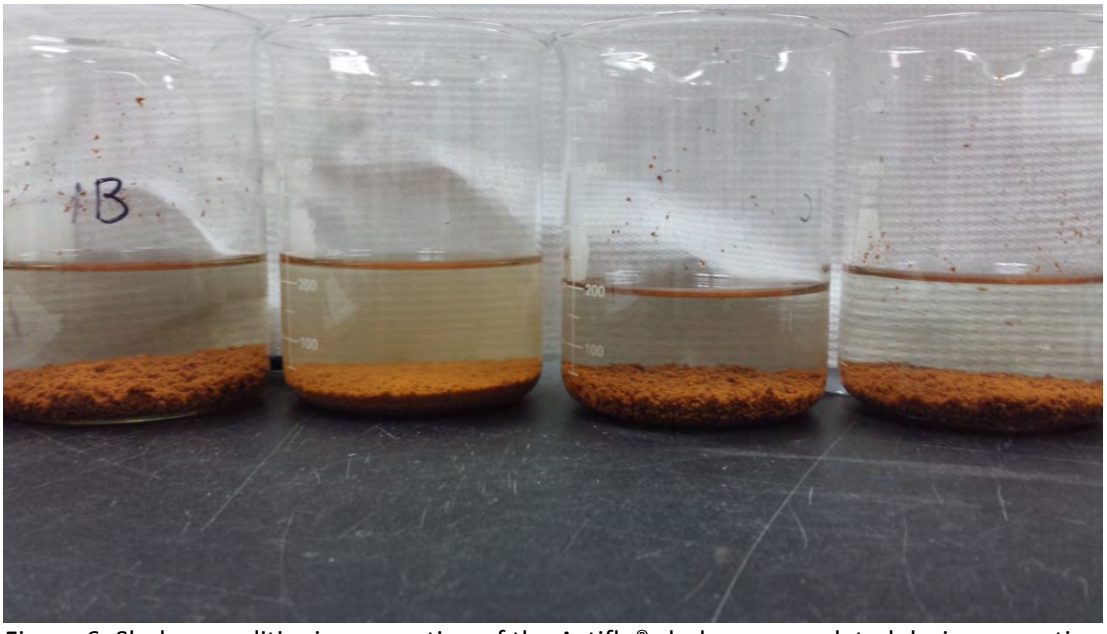

Figure 6: Sludge conditioning operation of the Actiflo® sludge accumulated during operation (From left to right: Hydrex™ 6408, Hydrex™ 6183, Hydrex™ 6324 and Hydrex™ 6412)

Polymer dosage tested ranged from 5 mg/L to 20 mg/L, with an optimal treatment at 10 mg/L (as presented in Table 25).

Once this optimization completed, the whole sludge volume was conditioned using Hydrex™ 6324 at an optimal dosage of 10 mg/L (6.25 kg polymer/ton of dry solids). After settling of the chemically-conditioned water sludge, this sludge was dried of at 40°C for 72 hours prior to be sent to SGS for final characterization. Visual aspect of the dried solids is presented in Figure 7.

Figure 7: Dried sludge accumulated during Actiflo® piloting

Chemical conditioning is in the usual range from standard sludge; a polymer dosage of 5 to 12 kg polymer/ ton of dry solids is expected for optimal sludge conditioning. Eighty seven (87) grams of dry solids were measured following the drying period.

SECTION 5. CONCLUSIONS

Bench testing at laboratory scale was first performed on Mount Nansen mine seepage to test TSS and iron removal using a process treatment chain composed of aeration contact time and Actiflo® ballasted clarification. Once optimization at laboratory scale was completed, an Actiflo® pilot unit was run with remaining water volume sent from the mine to produce sludge for external characterization (by others) The main conclusions of the clarified water production and sludge production are the following:

- Raw water received from Mount Nansen seepage was characterized and parameters of interest (TSS and iron) were present as shown in Table 11;
- Water can be clarified without coagulant addition, as long as the water to be treated is composed of ferrous iron and oxidized to ferric iron in the aeration tank designed for the purpose, and ferric iron use as the coagulant following oxidation;
- Coagulant dosage (ferric sulfate coagulant - Hydrex™ 6253) should be required only if the mine seepage is exposed to atmospheric conditions (by ambient air) for a long period allowing ferric iron to be present in the water prior to clarification;
- Low aeration time to oxidize ferrous iron to ferric iron is required (5 minutes HRT);
- Anionic polymer Hydrex™ 6183 was the best to remove the TSS and ferric particles present in the sample, but equivalent polymer could be used such as Hydrex™ 6105. The recommended dosage is from 1.5 to 2.0 mg/L;
- Cationic polymer Hydrex™ 6423 was the best for sludge conditioning at a dosage of 6.25 kg polymer/ton of dry solids prior to dewatering;
- Sludge produced by the Actiflo® mini pilot is representative to what would be produced on site on similar water quality, even if the short operation time of the Actiflo® was not sufficient to reach clarified water quality stability and effluent iron objective.

The process treatment chain to treat mount Nansen mine seepage is therefore composed of an aeration tank for iron oxidation; an Actiflo® ballasted clarification with anionic polymer and Actisand dosages, as well as sludge thickening and dewatering equipment.

The Mount Nansen mine seepage presented some challenges during the bench-scale tests and Actiflo® mini sludge production as the water is from an underground seepage and water quality changes with time when exposed to atmospheric conditions. Veolia is however confident that its recommendations are adequate for a full-scale installation, although, an Actiflo® pilot testing on site could be recommended to the client to confirm the required aeration time for oxidation and if additional coagulant dosage is required as it could not be tested any place other than with actual site water.

APPENDIX A. EXTERNAL LABORATORY CERTIFICATES (EUROFINS)

eurofins | Environment Testing

Certificate of Analysis

Request number: **17-810667**

Date Received: 2017-03-06

Date Certificate Issued: 2017-03-07

Certificate Version: 1

☑ Official Certificate of Analysis

☐ Preliminary Certificate of Analysis

Client

VEOLIA WATER TECHNOLOGIES CANADA INC

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Comments

This version replaces and cancels all earlier version.

NA : Information Not Available

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The above-mentioned samples will be retained for a period of 30 days following reception at the laboratory. Results pertain only to the samples submitted for analysis.

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

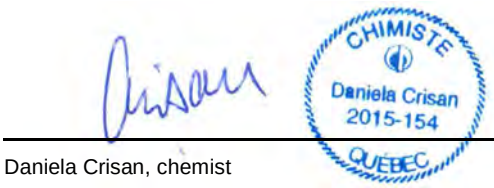
P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Chemical oxygen demand (COD)	Preparation	2017-03-07
Chemical oxygen demand (Closed acid reflux/colorimetry) (Accredited) QC005-95 (REF : SM5220 D / MA. 315 - DCO 1.1 R4)	Analysis	2017-03-07
	Sequential No.	575812
COD	mg/L	51
Suspended Solids	Preparation	2017-03-06
Suspended solids at 104C (gravimetry) (Accredited) QC102-16 (REF : SM2540 D / MA. 115 - S.S. 1.2 R3)	Analysis	2017-03-07
	Sequential No.	575799
Suspended Solids	mg/L	33

Comments:

3320504 196017-Mount M-RW Although the result of total Bismuth et Strontium should be superior or equal to the result of dissolved Bismuth et Strontium, the difference between the results lies within the analytical uncertainty for these parameters. Dissolved metals: Sample filtered and preserved in the laboratory.

Note 1: Results and comments, if any, relate only to samples submitted for analysis at the Saint-Augustin-de-Desmaures laboratory (#302).



Daniela Crisan, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Ammonia (as N)	Preparation	2017-03-06
Ammonia by colorimetry (Accredited) E-A-EN-EN-CHI-PC-MD003 (REF: MA. 300 - N 2.0)	Analysis	2017-03-06
	Sequential No.	575791
Ammonia (as N)	mg/L	6.30
Ortho-phosphate (as P)	Preparation	2017-03-06
Ortho-phosphate by colorimetry. (Accredited) E-A-EN-EN-CHI-PC-MD016 (REF: S.M. 4500-P E)	Analysis	2017-03-06
	Sequential No.	575793
Ortho-Phosphate (as P)	mg/L	0.04
Total alkalinity (as CaCO3)	Preparation	2017-03-07
Alkalinity due to carbonate and bicarbonate (Titration) (Non Accredited) E-A-EN-EN-CHI-PC-MD002 (REF: S.M. 2320B)	Analysis	2017-03-07
	Sequential No.	575844
Alcalinity (as CaCO3)	mg/L	287
Total Kjeldahl Nitrogen (as N)	Preparation	2017-03-07
TKN (Colorimetry) (Accredited) E-A-EN-EN-CHI-PC-MD008 (REF SM4500 NOrg B NH3 D,H)	Analysis	2017-03-07
	Sequential No.	575816
Kjeldahl Nitrogen as N	mg/L	8.6
Total Phosphorus (as P)	Preparation	2017-03-07
Total phosphorus by colorimetry. (Accredited) E-A-EN-EN-CHI-PC-MD016 (REF: S.M 4500 P, E)	Analysis	2017-03-07
	Sequential No.	575826
Phosphorus (as P)	mg/L	0.07
Phosphorus (as PO4)	mg/L	0.2

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s) Method Reference		
Bromide (I.C.)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-06
	Sequential No.	575746
Bromide	mg/L	< 0.1
Chloride (IC)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-06
	Sequential No.	575746
Chloride	mg/L	2
Nitrate (as N)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-06
	Sequential No.	575746
Nitrate (as N)	mg/L	0.46
Nitrite & nitrate (as N)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-06
	Sequential No.	575746
Nitrite & nitrate (as N)	mg/L	0.50
Nitrite (as N)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-06
	Sequential No.	575746
Nitrite (as N)	mg/L	0.04
Sulfate (as SO4)	Preparation	2017-03-06
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-07
	Sequential No.	575746
Sulfates (as SO4)	mg/L	696

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Dissolved Aluminum (Al)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Aluminum	mg/L	< 0.01
Dissolved Antimony (Sb)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Antimony	mg/L	< 0.001
Dissolved Arsenic (As)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Arsenic	mg/L	0.0039
Dissolved Baryum (Ba)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Barium	mg/L	0.058
Dissolved Beryllium (Be)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Beryllium	mg/L	< 0.0004
Dissolved Bismuth (Bi)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Bismuth	mg/L	0.0006
Dissolved Boron (B)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Boron	mg/L	0.052

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Dissolved Cadmium (Cd)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Cadmium	mg/L	< 0.0002
Dissolved Calcium (Ca)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Calcium	mg/L	247
Dissolved Chromium (Cr)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Chromium	mg/L	< 0.0005
Dissolved Cobalt (Co)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Cobalt	mg/L	0.0079
Dissolved Copper (Cu)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Copper	mg/L	0.003
Dissolved Iron (Fe)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Iron	mg/L	0.04
Dissolved Lead (Pb)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Lead	mg/L	< 0.0002

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s) Method Reference		
Dissolved Lithium (Li)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Lithium	mg/L	0.001
Dissolved Magnesium (Mg)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Magnesium	mg/L	53.7
Dissolved Manganese (Mn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Manganese	mg/L	5.88
Dissolved Molybdenum (Mo)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Molybdenum	mg/L	0.0016
Dissolved Nickel (Ni)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Nickel	mg/L	0.003
Dissolved Potassium (K)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Potassium	mg/L	5.6
Dissolved Selenium (Se)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Selenium	mg/L	< 0.001

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Dissolved Silica (Si)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Silicon	mg/L	6.58
Dissolved Silver (Ag)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Silver	mg/L	< 0.0002
Dissolved Sodium (Na)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Sodium	mg/L	39.4
Dissolved Strontium (Sr)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Strontium	mg/L	0.743
Dissolved Thallium (Tl)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Thallium	mg/L	< 0.0002
Dissolved Tin (Sn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Tin	mg/L	< 0.001
Dissolved Titanium (Ti)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Titanium	mg/L	< 0.001

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NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s)		
Method Reference		
Dissolved Vanadium (V)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Vanadium	mg/L	< 0.001
Dissolved Zinc (Zn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575831
Zinc	mg/L	0.020
Total extractable Aluminum (Al)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Aluminum	mg/L	0.01
Total extractable Antimony (Sb)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Antimony	mg/L	0.002
Total extractable Arsenic (As)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Arsenic	mg/L	0.0975
Total extractable Baryum (Ba)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Barium	mg/L	0.069
Total extractable Beryllium (Be)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Beryllium	mg/L	< 0.0004

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P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s) Method Reference		
Total extractable Bismuth (Bi)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Bismuth	mg/L	0.0003
Total extractable Boron (B)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Boron	mg/L	0.058
Total extractable Cadmium (Cd)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Cadmium	mg/L	0.0005
Total extractable Calcium (Ca)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Calcium	mg/L	258
Total extractable Chromium (Cr)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Chromium	mg/L	0.0014
Total extractable Cobalt (Co)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Cobalt	mg/L	0.0091
Total extractable Copper (Cu)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Copper	mg/L	0.0077

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
	Lab. No.	**3320504**
	Your Reference	196017-Mount M-RW
	Matrix	Mine water
	Sampled by	CDM
	Site sampled	NA
	Date sampled	2017-03-06
	Date received	2017-03-06
Parameter(s) Method Reference		
Total extractable Iron (Fe)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Iron	mg/L	13.4
Total extractable Lead (Pb)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Lead	mg/L	0.0011
Total extractable Lithium (Li)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Lithium	mg/L	0.004
Total extractable Magnesium (Mg)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Magnesium	mg/L	56.3
Total extractable Manganese (Mn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Manganese	mg/L	6.21
Total extractable Molybdenum (Mo)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Molybdenum	mg/L	0.0017
Total extractable Nickel (Ni)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Nickel	mg/L	0.004

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
	Lab. No.	**3320504**
	Your Reference	196017-Mount M-RW
	Matrix	Mine water
	Sampled by	CDM
	Site sampled	NA
	Date sampled	2017-03-06
	Date received	2017-03-06
Parameter(s) Method Reference		
Total extractable Potassium (K)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Potassium	mg/L	6.0
Total extractable Selenium (Se)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Selenium	mg/L	0.0005
Total extractable Silica (Si)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Silicon	mg/L	7.35
Total extractable Silver (Ag)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Silver	mg/L	0.0005
Total extractable Sodium (Na)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Sodium	mg/L	41.7
Total extractable Strontium (Sr)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Strontium	mg/L	0.741
Total extractable Thallium (Tl)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Thallium	mg/L	< 0.0002

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

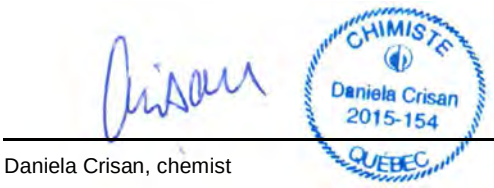
P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3320504**
Your Reference		196017-Mount M-RW
Matrix		Mine water
Sampled by		CDM
Site sampled		NA
Date sampled		2017-03-06
Date received		2017-03-06
Parameter(s) Method Reference		
Total extractable Tin (Sn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Tin	mg/L	< 0.001
Total extractable Titanium (Ti)	Preparation	2017-03-07
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Titanium	mg/L	0.002
Total extractable Vanadium (V)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Vanadium	mg/L	0.003
Total extractable Zinc (Zn)	Preparation	2017-03-07
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-07
	Sequential No.	575806
Zinc	mg/L	0.039

Comments:

3320504 196017-Mount M-RW Although the result of total Bismuth et Strontium should be superior or equal to the result of dissolved Bismuth et Strontium, the difference between the results lies within the analytical uncertainty for these parameters. Dissolved metals: Sample filtered and preserved in the laboratory.

Note 2: Results and comments, if any, relate only to samples submitted for analysis at the Pointe-Claire laboratory (#307).



Daniela Crisan, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total alkalinity (as CaCO3)					
Sequential ID No.: 575844					
Alcalinity (as CaCO3)	mg/L	< 2	< 2	992	800 - 1200
Chemical oxygen demand (COD)					
Sequential ID No.: 575812					
COD	mg/L	< 5	< 5	329	247.2 - 370.8
Bromide (I.C.)					
Sequential ID No.: 575746					
Bromide	mg/L	< 0.1	< 0.1	5.4	4.2 - 6.3
Chloride (IC)					
Sequential ID No.: 575746					
Chloride	mg/L	< 1	< 1	5	4.46 - 6.04
Nitrite (as N)					
Sequential ID No.: 575746					
Nitrite (as N)	mg/L	< 0.02	< 0.02	1.61	1.28 - 1.92
Nitrite & nitrate (as N)					
Sequential ID No.: 575746					
Nitrite & nitrate (as N)	mg/L	< 0.02	< 0.02	2.80	2.23 - 3.35
Nitrate (as N)					
Sequential ID No.: 575746					
Nitrate (as N)	mg/L	< 0.02	< 0.02	1.18	0.95 - 1.43
Sulfate (as SO4)					
Sequential ID No.: 575746					
Sulfates (as SO4)	mg/L	< 0.5	< 0.5	5.1	4.73 - 5.78
Total extractable Silver (Ag)					
Sequential ID No.: 575806					
Silver	mg/L	< 0.0002	< 0.0002	1.11	0.8 - 1.2
Dissolved Silver (Ag)					
Sequential ID No.: 575831					
Silver	mg/L	< 0.0002	< 0.0002	1.15	0.8 - 1.2
Total extractable Aluminum (Al)					
Sequential ID No.: 575806					
Aluminum	mg/L	< 0.01	< 0.01	0.80	0.8 - 1.2
Dissolved Aluminum (Al)					
Sequential ID No.: 575831					
Aluminum	mg/L	< 0.01	< 0.01	0.99	0.8 - 1.2

RDL : Reported Detection Limit

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Arsenic (As)					
Sequential ID No.: 575806					
Arsenic	mg/L	< 0.0003	< 0.0003	1.01	0.8 - 1.2
Dissolved Arsenic (As)					
Sequential ID No.: 575831					
Arsenic	mg/L	< 0.0003	< 0.0003	1.05	0.8 - 1.2
Total extractable Baryum (Ba)					
Sequential ID No.: 575806					
Barium	mg/L	< 0.002	< 0.002	1.03	0.8 - 1.2
Dissolved Baryum (Ba)					
Sequential ID No.: 575831					
Barium	mg/L	< 0.002	< 0.002	1.01	0.8 - 1.2
Total extractable Beryllium (Be)					
Sequential ID No.: 575806					
Beryllium	mg/L	< 0.0004	< 0.0004	0.918	0.8 - 1.2
Dissolved Beryllium (Be)					
Sequential ID No.: 575831					
Beryllium	mg/L	< 0.0004	< 0.0004	0.918	0.8 - 1.2
Total extractable Bismuth (Bi)					
Sequential ID No.: 575806					
Bismuth	mg/L	< 0.0002	< 0.0002	1.09	0.8 - 1.2
Dissolved Bismuth (Bi)					
Sequential ID No.: 575831					
Bismuth	mg/L	< 0.0002	< 0.0002	1.11	0.8 - 1.2
Total extractable Boron (B)					
Sequential ID No.: 575806					
Boron	mg/L	< 0.005	< 0.005	1.01	0.9 - 1.1
Dissolved Boron (B)					
Sequential ID No.: 575831					
Boron	mg/L	< 0.005	< 0.005	1.00	0.9 - 1.1
Total extractable Calcium (Ca)					
Sequential ID No.: 575806					
Calcium	mg/L	< 0.02	< 0.02	5.10	4 - 6
Dissolved Calcium (Ca)					
Sequential ID No.: 575831					
Calcium	mg/L	< 0.02	< 0.02	4.99	4 - 6

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Cadmium (Cd)					
Sequential ID No.: 575806					
Cadmium	mg/L	< 0.0002	< 0.0002	1.09	0.8 - 1.2
Dissolved Cadmium (Cd)					
Sequential ID No.: 575831					
Cadmium	mg/L	< 0.0002	< 0.0002	1.07	0.8 - 1.2
Total extractable Cobalt (Co)					
Sequential ID No.: 575806					
Cobalt	mg/L	< 0.0003	< 0.0003	1.08	0.8 - 1.2
Dissolved Cobalt (Co)					
Sequential ID No.: 575831					
Cobalt	mg/L	< 0.0003	< 0.0003	1.11	0.8 - 1.2
Total extractable Chromium (Cr)					
Sequential ID No.: 575806					
Chromium	mg/L	< 0.0005	< 0.0005	1.03	0.8 - 1.2
Dissolved Chromium (Cr)					
Sequential ID No.: 575831					
Chromium	mg/L	< 0.0005	< 0.0005	1.08	0.8 - 1.2
Total extractable Copper (Cu)					
Sequential ID No.: 575806					
Copper	mg/L	< 0.0006	< 0.0006	1.15	0.8 - 1.2
Dissolved Copper (Cu)					
Sequential ID No.: 575831					
Copper	mg/L	< 0.001	< 0.001	1.18	0.8 - 1.2
Total extractable Iron (Fe)					
Sequential ID No.: 575806					
Iron	mg/L	< 0.03	< 0.03	1.01	0.9 - 1.1
Dissolved Iron (Fe)					
Sequential ID No.: 575831					
Iron	mg/L	< 0.03	< 0.03	0.99	0.9 - 1.1
Total extractable Potassium (K)					
Sequential ID No.: 575806					
Potassium	mg/L	< 0.2	< 0.2	4.5	4 - 6
Dissolved Potassium (K)					
Sequential ID No.: 575831					
Potassium	mg/L	< 0.2	< 0.2	4.5	4 - 6

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Lithium (Li)					
Sequential ID No.: 575806					
Lithium	mg/L	< 0.001	< 0.001	0.865	0.8 - 1.2
Dissolved Lithium (Li)					
Sequential ID No.: 575831					
Lithium	mg/L	< 0.001	< 0.001	0.864	0.8 - 1.2
Total extractable Magnesium (Mg)					
Sequential ID No.: 575806					
Magnesium	mg/L	< 0.01	< 0.01	4.79	4 - 6
Dissolved Magnesium (Mg)					
Sequential ID No.: 575831					
Magnesium	mg/L	< 0.01	< 0.01	4.73	4 - 6
Total extractable Manganese (Mn)					
Sequential ID No.: 575806					
Manganese	mg/L	< 0.001	< 0.001	0.965	0.8 - 1.2
Dissolved Manganese (Mn)					
Sequential ID No.: 575831					
Manganese	mg/L	< 0.001	< 0.001	0.999	0.8 - 1.2
Total extractable Molybdenum (Mo)					
Sequential ID No.: 575806					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.14	0.8 - 1.2
Dissolved Molybdenum (Mo)					
Sequential ID No.: 575831					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.14	0.8 - 1.2
Total extractable Sodium (Na)					
Sequential ID No.: 575806					
Sodium	mg/L	< 0.035	< 0.035	5.08	4 - 6
Dissolved Sodium (Na)					
Sequential ID No.: 575831					
Sodium	mg/L	< 0.035	0.055	5.02	4 - 6
Total extractable Nickel (Ni)					
Sequential ID No.: 575806					
Nickel	mg/L	< 0.001	< 0.001	1.11	0.8 - 1.2
Dissolved Nickel (Ni)					
Sequential ID No.: 575831					
Nickel	mg/L	< 0.001	< 0.001	1.12	0.8 - 1.2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Lead (Pb)					
Sequential ID No.: 575806					
Lead	mg/L	< 0.0002	0.0002	1.00	0.8 - 1.2
Dissolved Lead (Pb)					
Sequential ID No.: 575831					
Lead	mg/L	< 0.0002	< 0.0002	1.01	0.8 - 1.2
Total extractable Antimony (Sb)					
Sequential ID No.: 575806					
Antimony	mg/L	< 0.001	< 0.001	1.04	0.8 - 1.2
Dissolved Antimony (Sb)					
Sequential ID No.: 575831					
Antimony	mg/L	< 0.001	< 0.001	1.04	0.8 - 1.2
Total extractable Selenium (Se)					
Sequential ID No.: 575806					
Selenium	mg/L	< 0.0004	< 0.0004	0.950	0.8 - 1.2
Dissolved Selenium (Se)					
Sequential ID No.: 575831					
Selenium	mg/L	< 0.001	< 0.001	0.965	0.8 - 1.2
Total extractable Silica (Si)					
Sequential ID No.: 575806					
Silicon	mg/L	< 0.05	< 0.05	4.71	4 - 6
Dissolved Silica (Si)					
Sequential ID No.: 575831					
Silicon	mg/L	< 0.05	< 0.05	4.70	4 - 6
Total extractable Tin (Sn)					
Sequential ID No.: 575806					
Tin	mg/L	< 0.001	< 0.001	1.03	0.8 - 1.2
Dissolved Tin (Sn)					
Sequential ID No.: 575831					
Tin	mg/L	< 0.001	< 0.001	1.03	0.8 - 1.2
Total extractable Strontium (Sr)					
Sequential ID No.: 575806					
Strontium	mg/L	< 0.001	< 0.001	0.998	0.8 - 1.2
Dissolved Strontium (Sr)					
Sequential ID No.: 575831					
Strontium	mg/L	< 0.001	< 0.001	1.00	0.8 - 1.2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Titanium (Ti)					
Sequential ID No.: 575806					
Titanium	mg/L	< 0.001	< 0.001	0.936	0.8 - 1.2
Dissolved Titanium (Ti)					
Sequential ID No.: 575831					
Titanium	mg/L	< 0.001	< 0.001	0.968	0.8 - 1.2
Total extractable Thallium (Tl)					
Sequential ID No.: 575806					
Thallium	mg/L	< 0.0002	< 0.0002	1.11	0.8 - 1.2
Dissolved Thallium (Tl)					
Sequential ID No.: 575831					
Thallium	mg/L	< 0.0002	< 0.0002	1.13	0.8 - 1.2
Total extractable Vanadium (V)					
Sequential ID No.: 575806					
Vanadium	mg/L	< 0.001	< 0.001	1.15	0.8 - 1.2
Dissolved Vanadium (V)					
Sequential ID No.: 575831					
Vanadium	mg/L	< 0.001	< 0.001	1.17	0.8 - 1.2
Total extractable Zinc (Zn)					
Sequential ID No.: 575806					
Zinc	mg/L	< 0.007	< 0.007	0.904	0.8 - 1.2
Dissolved Zinc (Zn)					
Sequential ID No.: 575831					
Zinc	mg/L	< 0.007	< 0.007	0.944	0.8 - 1.2
Ammonia (as N)					
Sequential ID No.: 575791					
Ammonia (as N)	mg/L	< 0.05	< 0.05	8.58	7.43 - 11.15
Ortho-phosphate (as P)					
Sequential ID No.: 575793					
Ortho-Phosphate (as P)	mg/L	< 0.03	< 0.03	1.05	0.85 - 1.15
Total Phosphorus (as P)					
Sequential ID No.: 575826					
Phosphorus (as P)	mg/L	< 0.03	< 0.03	1.02	0.85 - 1.15
Phosphorus (as PO4)	mg/L	< 0.1	< 0.1	NA	NA
Suspended Solids					
Sequential ID No.: 575799					
Suspended Solids	mg/L	< 4	<4	944	808 - 1094

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total Kjeldahl Nitrogen (as N)					
Sequential ID No.: 575816					
Kjeldahl Nitrogen as N	mg/L	< 0.8	< 0.8	27.1	21.8 - 32.6

Comments

Sequential ID no. 575831 : Sodium: Blanc positif non soustrait des échantillons. / Positive blank not subtracted from the samples.

RDL : Reported Detection Limit

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810667**

P.O. Number	Your Project ID.	Project Manager
NA	196017-Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate		
		Value 1	Value 2	Difference (%)
Ammonia (as N)				
Sequential ID No: 575791	(Sample no)		(3320504)	
Ammonia (as N)	mg/L	6.30	6.31	0.2
Suspended Solids				
Sequential ID No: 575799	(Sample no)		(3320504)	
Suspended Solids	mg/L	33	33	0.0
Total alkalinity (as CaCO3)				
Sequential ID No: 575844	(Sample no)		(3320504)	
Alcalinity (as CaCO3)	mg/L	287	288	0.3
Total Kjeldahl Nitrogen (as N)				
Sequential ID No: 575816	(Sample no)		(3320504)	
Kjeldahl Nitrogen as N	mg/L	8.6	9.4	8.9
Total Phosphorus (as P)				
Sequential ID No: 575826	(Sample no)		(3320504)	
Phosphorus (as P)	mg/L	0.07	0.07	0.0
Phosphorus (as PO4)	mg/L	0.2	0.2	0.0

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Certificate of Analysis

Request number: **17-810898**

Date Received: 2017-03-07

Date Certificate Issued: 2017-03-08

Certificate Version: 1

☑ Official Certificate of Analysis

☐ Preliminary Certificate of Analysis

Client

VEOLIA WATER TECHNOLOGIES CANADA INC

4105, Sartelon
Saint-Laurent, Québec, Canada
H4S 2B3
Telephone : (514) 334-7230
Fax : (514) 334-5070

P.O. Number	Your project ID.	Project Manager
NA	Mount N.	Mme Myriam de Ladurantaye-Noël

Comments

This version replaces and cancels all earlier version.

NA : Information Not Available

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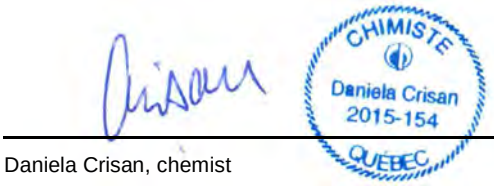
Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810898**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N.	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
Lab. No.		**3321390**	**3321391**	**3321392**
Your Reference		196017-MountN-1A	196017-MountN-1D	196017-MountN-2A
Matrix		Mine water	Mine water	Mine water
Sampled by		MDLN	MDLN	MDLN
Site sampled		NA	NA	NA
Date sampled		2017-03-07	2017-03-07	2017-03-07
Date received		2017-03-07	2017-03-07	2017-03-07
Parameter(s)				
Method Reference				
Total extractable Iron (Fe)	Preparation	2017-03-08	2017-03-08	2017-03-08
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-08	2017-03-08	2017-03-08
	Sequential No.	575936	575936	575936
Iron	mg/L	0.27	0.27	0.24
Total extractable Manganese (Mn)	Preparation	2017-03-08	2017-03-08	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-08	2017-03-08	-
	Sequential No.	575936	575936	-
Manganese	mg/L	7.85	7.86	-

Note 1: Results and comments, if any, relate only to samples submitted for analysis at the Pointe-Claire laboratory (#307).



Daniela Crisan, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-810898**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N.	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Iron (Fe)					
Sequential ID No.: 575936					
Iron	mg/L	< 0.03	< 0.03	1.10	0.9 - 1.1
Total extractable Manganese (Mn)					
Sequential ID No.: 575936					
Manganese	mg/L	< 0.001	< 0.001	0.970	0.8 - 1.2

Comments

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Certificate of Analysis

Request number: **17-811174**

Date Received: 2017-03-08

Date Certificate Issued: 2017-03-10

Certificate Version: 1

☑ Official Certificate of Analysis

☐ Preliminary Certificate of Analysis

Client

VEOLIA WATER TECHNOLOGIES CANADA INC

4105, Sartelon
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Telephone : (514) 334-7230
Fax : (514) 334-5070

P.O. Number	Your project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Comments

This version replaces and cancels all earlier version.

NA : Information Not Available

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
	Lab. No.	**3322272**
	Your Reference	196017.Mount.M.4
	Matrix	Mine water
	Sampled by	C.D.M.
	Site sampled	VSL
	Date sampled	2017-03-08
	Date received	2017-03-08
Parameter(s) Method Reference		
Ammonia (as N)	Preparation	2017-03-10
Ammonia by colorimetry (Accredited) QC019-96 (REF : MA. 300 - N 2.0 R2)	Analysis	2017-03-10
	Sequential No.	576183
Ammonia (as N)	mg/L	6.30
Chemical oxygen demand (COD)	Preparation	2017-03-09
Chemical oxygen demand (Closed acid reflux/colorimetry) (Accredited) QC005-95 (REF : SM5220 D / MA. 315 - DCO 1.1 R4)	Analysis	2017-03-10
	Sequential No.	576093
COD	mg/L	56
Suspended Solids	Preparation	2017-03-09
Suspended solids at 104C (gravimetry) (Accredited) QC102-16 (REF : SM2540 D / MA. 115 - S.S. 1.2 R3)	Analysis	2017-03-10
	Sequential No.	576189
Suspended Solids	mg/L	<4

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s) Method Reference		
Bromide (I.C.)	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Bromide	mg/L	< 0.1
Chloride (IC)	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Chloride	mg/L	2
Nitrate (as N)	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Nitrate (as N)	mg/L	0.40
Nitrite & nitrate (as N)	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Nitrite & nitrate (as N)	mg/L	0.44
Nitrite (IC)	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Nitrite (as N)	mg/L	0.04
Sulfates	Preparation	2017-03-09
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-09
	Sequential No.	576115
Sulfates (as SO4)	mg/L	744

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Comments:

3322272	196017.Mount.M.4	Calcium: Positive blank. Result accepted because the contamination is negligible compared to the concentration found in the sample. Iron: Non reproducible results. Boron, strontium and zinc : Although the result of total metals should be superior or equal to the result of dissolved metals, the difference between the results lies within the analytical uncertainty for these parameters. Dissolved metals: Sample filtered and preserved in the laboratory.

Note 1: Results and comments, if any, relate only to samples submitted for analysis at the Saint-Augustin-de-Desmaures laboratory (#302).

Fatima Sobh, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
	Lab. No.	**3322272**
	Your Reference	196017.Mount.M.4
	Matrix	Mine water
	Sampled by	C.D.M.
	Site sampled	VSL
	Date sampled	2017-03-08
	Date received	2017-03-08
Parameter(s) Method Reference		
Total alkalinity (as CaCO3)	Preparation	2017-03-09
Alkalinity due to carbonate and bicarbonate (Titration) (Non Accredited) E-A-EN-EN-CHI-PC-MD002 (REF: S.M. 2320B)	Analysis	2017-03-09
	Sequential No.	576085
Alcalinity (as CaCO3)	mg/L	286
Total Kjeldahl Nitrogen (as N)	Preparation	2017-03-09
TKN (Colorimetry) (Accredited) E-A-EN-EN-CHI-PC-MD008 (REF SM4500 NOrg B NH3 D,H)	Analysis	2017-03-09
	Sequential No.	576072
Kjeldahl Nitrogen as N	mg/L	7.8
Total Phosphorus (as P)	Preparation	2017-03-09
Total phosphorus by colorimetry. (Accredited) E-A-EN-EN-CHI-PC-MD016 (REF: S.M 4500 P, E)	Analysis	2017-03-09
	Sequential No.	576065
Phosphorus (as P)	mg/L	< 0.03
Phosphorus (as PO4)	mg/L	< 0.1

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s) Method Reference		
Dissolved Aluminum (Al)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Aluminum	mg/L	< 0.01
Dissolved Antimony (Sb)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Antimony	mg/L	< 0.001
Dissolved Arsenic (As)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Arsenic	mg/L	0.003
Dissolved Baryum (Ba)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Barium	mg/L	0.07
Dissolved Beryllium (Be)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Beryllium	mg/L	< 0.001
Dissolved Bismuth (Bi)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Bismuth	mg/L	< 0.001
Dissolved Boron (B)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Boron	mg/L	0.07

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s) Method Reference		
Dissolved Cadmium (Cd)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Cadmium	mg/L	< 0.0005
Dissolved Calcium (Ca)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Calcium	mg/L	262
Dissolved Chromium (Cr)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Chromium	mg/L	< 0.001
Dissolved Cobalt (Co)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Cobalt	mg/L	0.009
Dissolved Copper (Cu)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Copper	mg/L	0.019
Dissolved Iron (Fe)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Iron	mg/L	< 0.05
Dissolved Lead (Pb)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Lead	mg/L	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

	Sample(s)
Lab. No.	**3322272**
Your Reference	196017.Mount.M.4
Matrix	Mine water
Sampled by	C.D.M.
Site sampled	VSL
Date sampled	2017-03-08
Date received	2017-03-08

Parameter(s) / Method / Reference		
Dissolved Lithium (Li)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Lithium	mg/L	0.002
Dissolved Magnesium (Mg)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Magnesium	mg/L	57.4
Dissolved Manganese (Mn)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Manganese	mg/L	6.34
Dissolved Molybdenum (Mo)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Molybdenum	mg/L	0.002
Dissolved Nickel (Ni)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Nickel	mg/L	0.003
Dissolved Potassium (K)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Potassium	mg/L	7.0
Dissolved Selenium (Se)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576059
Selenium	mg/L	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s)		
Method Reference		
Dissolved Silica (Si)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Silicon	mg/L	7.01
Dissolved Silver (Ag)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Silver	mg/L	< 0.0005
Dissolved Sodium (Na)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Sodium	mg/L	40.3
Dissolved Strontium (Sr)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Strontium	mg/L	0.833
Dissolved Thallium (Tl)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Thallium	mg/L	< 0.001
Dissolved Tin (Sn)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Tin	mg/L	< 0.001
Dissolved Titanium (Ti)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Titanium	mg/L	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s)		
Method Reference		
Dissolved Vanadium (V)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Vanadium	mg/L	< 0.001
Dissolved Zinc (Zn)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576059
Zinc	mg/L	0.030
Total extractable Aluminum (Al)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Aluminum	mg/L	0.02
Total extractable Antimony (Sb)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Antimony	mg/L	0.002
Total extractable Arsenic (As)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Arsenic	mg/L	0.004
Total extractable Baryum (Ba)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Barium	mg/L	0.07
Total extractable Beryllium (Be)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Beryllium	mg/L	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3322272**
Your Reference		196017.Mount.M.4
Matrix		Mine water
Sampled by		C.D.M.
Site sampled		VSL
Date sampled		2017-03-08
Date received		2017-03-08
Parameter(s)		
Method Reference		
Total extractable Bismuth (Bi)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Bismuth	mg/L	< 0.001
Total extractable Boron (B)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Boron	mg/L	0.05
Total extractable Cadmium (Cd)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Cadmium	mg/L	< 0.0005
Total extractable Calcium (Ca)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Calcium	mg/L	286
Total extractable Chromium (Cr)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Chromium	mg/L	< 0.001
Total extractable Cobalt (Co)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Cobalt	mg/L	0.009
Total extractable Copper (Cu)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Copper	mg/L	0.023

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

	Sample(s)
Lab. No.	**3322272**
Your Reference	196017.Mount.M.4
Matrix	Mine water
Sampled by	C.D.M.
Site sampled	VSL
Date sampled	2017-03-08
Date received	2017-03-08

Parameter(s) / Method / Reference		
Total extractable Iron (Fe)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Iron	mg/L	0.52
Total extractable Lead (Pb)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Lead	mg/L	< 0.001
Total extractable Lithium (Li)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Lithium	mg/L	0.003
Total extractable Magnesium (Mg)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Magnesium	mg/L	63.8
Total extractable Manganese (Mn)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Manganese	mg/L	7.19
Total extractable Molybdenum (Mo)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Molybdenum	mg/L	0.002
Total extractable Nickel (Ni)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Nickel	mg/L	0.004

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

	Sample(s)
Lab. No.	**3322272**
Your Reference	196017.Mount.M.4
Matrix	Mine water
Sampled by	C.D.M.
Site sampled	VSL
Date sampled	2017-03-08
Date received	2017-03-08

Parameter(s) / Method Reference		
Total extractable Potassium (K)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Potassium	mg/L	7.5
Total extractable Selenium (Se)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Selenium	mg/L	< 0.001
Total extractable Silica (Si)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Silicon	mg/L	7.83
Total extractable Silver (Ag)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Silver	mg/L	< 0.0005
Total extractable Sodium (Na)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Sodium	mg/L	44.3
Total extractable Strontium (Sr)	Preparation	2017-03-09
Metals by ICP (not accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Strontium	mg/L	0.794
Total extractable Thallium (Tl)	Preparation	2017-03-09
Metals by ICP (Accredited)	Analysis	2017-03-09
E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Sequential No.	576058
Thallium	mg/L	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

		Sample(s)
	Lab. No.	**3322272**
	Your Reference	196017.Mount.M.4
	Matrix	Mine water
	Sampled by	C.D.M.
	Site sampled	VSL
	Date sampled	2017-03-08
	Date received	2017-03-08
Parameter(s) Method Reference		
Total extractable Tin (Sn)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Tin	mg/L	< 0.001
Total extractable Titanium (Ti)	Preparation	2017-03-09
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Titanium	mg/L	< 0.001
Total extractable Vanadium (V)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Vanadium	mg/L	< 0.001
Total extractable Zinc (Zn)	Preparation	2017-03-09
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-09
	Sequential No.	576058
Zinc	mg/L	0.029

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Comments:

3322272	196017.Mount.M.4	Calcium: Positive blank. Result accepted because the contamination is negligible compared to the concentration found in the sample. Iron: Non reproducible results. Boron, strontium and zinc : Although the result of total metals should be superior or equal to the result of dissolved metals, the difference between the results lies within the analytical uncertainty for these parameters. Dissolved metals: Sample filtered and preserved in the laboratory.

Note 2: Results and comments, if any, relate only to samples submitted for analysis at the Pointe-Claire laboratory (#307).

Fatima Sobh, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total alkalinity (as CaCO3)					
Sequential ID No.: 576085					
Alcalinity (as CaCO3)	mg/L	< 2	< 2	982	800 - 1200
Chemical oxygen demand (COD)					
Sequential ID No.: 576093					
COD	mg/L	< 5	< 5	343	247.2 - 370.8
Bromide (I.C.)					
Sequential ID No.: 576115					
Bromide	mg/L	< 0.1	< 0.1	3.8	3 - 4.5
Chloride (IC)					
Sequential ID No.: 576115					
Chloride	mg/L	< 1	< 1	18	15.94 - 21.56
Nitrite (IC)					
Sequential ID No.: 576115					
Nitrite (as N)	mg/L	< 0.02	< 0.02	3.71	3 - 4.5
Nitrite & nitrate (as N)					
Sequential ID No.: 576115					
Nitrite & nitrate (as N)	mg/L	< 0.02	< 0.02	11.1	9 - 13.5
Nitrate (as N)					
Sequential ID No.: 576115					
Nitrate (as N)	mg/L	< 0.02	< 0.02	7.40	6 - 9
Sulfates					
Sequential ID No.: 576115					
Sulfates (as SO4)	mg/L	< 0.5	< 0.5	18.7	16.88 - 20.63
Total extractable Silver (Ag)					
Sequential ID No.: 576058					
Silver	mg/L	< 0.0005	< 0.0005	1.05	0.8 - 1.2
Dissolved Silver (Ag)					
Sequential ID No.: 576059					
Silver	mg/L	< 0.0005	< 0.0005	0.953	0.8 - 1.2
Total extractable Aluminum (Al)					
Sequential ID No.: 576058					
Aluminum	mg/L	< 0.01	< 0.01	1.16	0.8 - 1.2
Dissolved Aluminum (Al)					
Sequential ID No.: 576059					
Aluminum	mg/L	< 0.01	< 0.01	1.00	0.8 - 1.2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Arsenic (As)					
Sequential ID No.: 576058					
Arsenic	mg/L	< 0.001	< 0.001	1.07	0.8 - 1.2
Dissolved Arsenic (As)					
Sequential ID No.: 576059					
Arsenic	mg/L	< 0.001	< 0.001	0.874	0.8 - 1.2
Total extractable Baryum (Ba)					
Sequential ID No.: 576058					
Barium	mg/L	< 0.01	< 0.01	1.10	0.8 - 1.2
Dissolved Baryum (Ba)					
Sequential ID No.: 576059					
Barium	mg/L	< 0.01	< 0.01	0.86	0.8 - 1.2
Total extractable Beryllium (Be)					
Sequential ID No.: 576058					
Beryllium	mg/L	< 0.001	< 0.001	1.04	0.8 - 1.2
Dissolved Beryllium (Be)					
Sequential ID No.: 576059					
Beryllium	mg/L	< 0.001	< 0.001	0.831	0.8 - 1.2
Total extractable Bismuth (Bi)					
Sequential ID No.: 576058					
Bismuth	mg/L	< 0.001	< 0.001	1.18	0.8 - 1.2
Dissolved Bismuth (Bi)					
Sequential ID No.: 576059					
Bismuth	mg/L	< 0.001	< 0.001	0.962	0.8 - 1.2
Total extractable Boron (B)					
Sequential ID No.: 576058					
Boron	mg/L	< 0.02	< 0.02	0.99	0.9 - 1.1
Dissolved Boron (B)					
Sequential ID No.: 576059					
Boron	mg/L	< 0.02	< 0.02	1.02	0.9 - 1.1
Total extractable Calcium (Ca)					
Sequential ID No.: 576058					
Calcium	mg/L	< 0.02	0.14	5.74	4 - 6
Dissolved Calcium (Ca)					
Sequential ID No.: 576059					
Calcium	mg/L	< 0.02	< 0.02	5.29	4 - 6

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Cadmium (Cd)					
Sequential ID No.: 576058					
Cadmium	mg/L	< 0.0005	< 0.0005	1.11	0.8 - 1.2
Dissolved Cadmium (Cd)					
Sequential ID No.: 576059					
Cadmium	mg/L	< 0.0005	< 0.0005	0.875	0.8 - 1.2
Total extractable Cobalt (Co)					
Sequential ID No.: 576058					
Cobalt	mg/L	< 0.001	< 0.001	1.14	0.8 - 1.2
Dissolved Cobalt (Co)					
Sequential ID No.: 576059					
Cobalt	mg/L	< 0.001	< 0.001	0.934	0.8 - 1.2
Total extractable Chromium (Cr)					
Sequential ID No.: 576058					
Chromium	mg/L	< 0.001	< 0.001	1.105	0.8 - 1.2
Dissolved Chromium (Cr)					
Sequential ID No.: 576059					
Chromium	mg/L	< 0.001	< 0.001	0.903	0.8 - 1.2
Total extractable Copper (Cu)					
Sequential ID No.: 576058					
Copper	mg/L	< 0.001	0.002	1.15	0.8 - 1.2
Dissolved Copper (Cu)					
Sequential ID No.: 576059					
Copper	mg/L	< 0.001	< 0.001	0.975	0.8 - 1.2
Total extractable Iron (Fe)					
Sequential ID No.: 576058					
Iron	mg/L	< 0.05	< 0.05	1.02	0.9 - 1.1
Dissolved Iron (Fe)					
Sequential ID No.: 576059					
Iron	mg/L	< 0.05	< 0.05	1.03	0.9 - 1.1
Total extractable Potassium (K)					
Sequential ID No.: 576058					
Potassium	mg/L	< 0.3	< 0.3	5.7	4 - 6
Dissolved Potassium (K)					
Sequential ID No.: 576059					
Potassium	mg/L	< 0.3	< 0.3	5.4	4 - 6

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Lithium (Li)					
Sequential ID No.: 576058					
Lithium	mg/L	< 0.001	0.001	1.06	0.8 - 1.2
Dissolved Lithium (Li)					
Sequential ID No.: 576059					
Lithium	mg/L	< 0.001	< 0.001	0.838	0.8 - 1.2
Total extractable Magnesium (Mg)					
Sequential ID No.: 576058					
Magnesium	mg/L	< 0.01	0.03	5.33	4 - 6
Dissolved Magnesium (Mg)					
Sequential ID No.: 576059					
Magnesium	mg/L	< 0.01	< 0.01	4.91	4 - 6
Total extractable Manganese (Mn)					
Sequential ID No.: 576058					
Manganese	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Dissolved Manganese (Mn)					
Sequential ID No.: 576059					
Manganese	mg/L	< 0.001	< 0.001	0.873	0.8 - 1.2
Total extractable Molybdenum (Mo)					
Sequential ID No.: 576058					
Molybdenum	mg/L	< 0.001	< 0.001	1.14	0.8 - 1.2
Dissolved Molybdenum (Mo)					
Sequential ID No.: 576059					
Molybdenum	mg/L	< 0.001	< 0.001	0.943	0.8 - 1.2
Total extractable Sodium (Na)					
Sequential ID No.: 576058					
Sodium	mg/L	< 0.3	< 0.3	5.4	4 - 6
Dissolved Sodium (Na)					
Sequential ID No.: 576059					
Sodium	mg/L	< 0.3	< 0.3	5.1	4 - 6
Total extractable Nickel (Ni)					
Sequential ID No.: 576058					
Nickel	mg/L	< 0.001	< 0.001	1.13	0.8 - 1.2
Dissolved Nickel (Ni)					
Sequential ID No.: 576059					
Nickel	mg/L	< 0.001	< 0.001	0.915	0.8 - 1.2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Lead (Pb)					
Sequential ID No.: 576058					
Lead	mg/L	< 0.001	< 0.001	1.15	0.8 - 1.2
Dissolved Lead (Pb)					
Sequential ID No.: 576059					
Lead	mg/L	< 0.001	< 0.001	0.936	0.8 - 1.2
Total extractable Antimony (Sb)					
Sequential ID No.: 576058					
Antimony	mg/L	< 0.001	0.001	1.11	0.8 - 1.2
Dissolved Antimony (Sb)					
Sequential ID No.: 576059					
Antimony	mg/L	< 0.001	< 0.001	0.873	0.8 - 1.2
Total extractable Selenium (Se)					
Sequential ID No.: 576058					
Selenium	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Dissolved Selenium (Se)					
Sequential ID No.: 576059					
Selenium	mg/L	< 0.001	< 0.001	0.871	0.8 - 1.2
Total extractable Silica (Si)					
Sequential ID No.: 576058					
Silicon	mg/L	< 0.05	0.37	5.34	4 - 6
Dissolved Silica (Si)					
Sequential ID No.: 576059					
Silicon	mg/L	< 0.05	< 0.05	4.95	4 - 6
Total extractable Tin (Sn)					
Sequential ID No.: 576058					
Tin	mg/L	< 0.001	< 0.001	1.09	0.8 - 1.2
Dissolved Tin (Sn)					
Sequential ID No.: 576059					
Tin	mg/L	< 0.001	< 0.001	0.880	0.8 - 1.2
Total extractable Strontium (Sr)					
Sequential ID No.: 576058					
Strontium	mg/L	< 0.001	< 0.001	1.10	0.8 - 1.2
Dissolved Strontium (Sr)					
Sequential ID No.: 576059					
Strontium	mg/L	< 0.001	< 0.001	0.888	0.8 - 1.2

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P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Total extractable Titanium (Ti)					
Sequential ID No.: 576058					
Titanium	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Dissolved Titanium (Ti)					
Sequential ID No.: 576059					
Titanium	mg/L	< 0.001	< 0.001	0.809	0.8 - 1.2
Total extractable Thallium (Tl)					
Sequential ID No.: 576058					
Thallium	mg/L	< 0.001	< 0.001	1.11	0.8 - 1.2
Dissolved Thallium (Tl)					
Sequential ID No.: 576059					
Thallium	mg/L	< 0.001	< 0.001	0.944	0.8 - 1.2
Total extractable Vanadium (V)					
Sequential ID No.: 576058					
Vanadium	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Dissolved Vanadium (V)					
Sequential ID No.: 576059					
Vanadium	mg/L	< 0.001	< 0.001	0.964	0.8 - 1.2
Total extractable Zinc (Zn)					
Sequential ID No.: 576058					
Zinc	mg/L	< 0.007	< 0.007	1.10	0.8 - 1.2
Dissolved Zinc (Zn)					
Sequential ID No.: 576059					
Zinc	mg/L	< 0.007	< 0.007	0.903	0.8 - 1.2
Ammonia (as N)					
Sequential ID No.: 576183					
Ammonia (as N)	mg/L	< 0.02	<0.02	1.97	1.73 - 2.59
Total Phosphorus (as P)					
Sequential ID No.: 576065					
Phosphorus (as P)	mg/L	< 0.03	< 0.03	1.01	0.85 - 1.15
Phosphorus (as PO4)	mg/L	< 0.1	< 0.1	NA	NA
Suspended Solids					
Sequential ID No.: 576189					
Suspended Solids	mg/L	< 4	<4	840	808 - 1094
Total Kjeldahl Nitrogen (as N)					
Sequential ID No.: 576072					
Kjeldahl Nitrogen as N	mg/L	< 0.8	< 0.8	27.8	21.8 - 32.6

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range

Comments

Sequential ID no. 576058 : Antimoine/Antimony, Calcium, Cuivre/Copper, Lithium, Magnésium/Magnesium, Silicium/Silicon : Blanc positif non soustrait des échantillons. / Positive blank not subtracted from the samples.

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P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Ammonia (as N)				
Sequential ID No: 576183	(Sample no)		(3322272)	
Ammonia (as N)	mg/L	6.30	6.41	1.7
Suspended Solids				
Sequential ID No: 576189	(Sample no)		(3322272)	
Suspended Solids	mg/L	<4	<4	-
Total extractable Aluminum (Al)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Aluminum	mg/L	0.02	0.04	66.7
Total extractable Antimony (Sb)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Antimony	mg/L	0.002	0.001	66.7
Total extractable Arsenic (As)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Arsenic	mg/L	0.004	0.004	0.0
Total extractable Baryum (Ba)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Barium	mg/L	0.07	0.07	0.0
Total extractable Beryllium (Be)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Beryllium	mg/L	< 0.001	< 0.001	-
Total extractable Bismuth (Bi)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Bismuth	mg/L	< 0.001	< 0.001	-
Total extractable Boron (B)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Boron	mg/L	0.05	0.05	0.0
Total extractable Cadmium (Cd)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Cadmium	mg/L	< 0.0005	< 0.0005	-
Total extractable Calcium (Ca)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Calcium	mg/L	286	291	1.7
Total extractable Chromium (Cr)				

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P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Sequential ID No: 576058	(Sample no)		(3322272)	
Chromium	mg/L	< 0.001	< 0.001	-
Total extractable Cobalt (Co)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Cobalt	mg/L	0.009	0.009	0.0
Total extractable Copper (Cu)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Copper	mg/L	0.023	0.021	9.1
Total extractable Iron (Fe)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Iron	mg/L	0.52	0.24	73.7
Total extractable Lead (Pb)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Lead	mg/L	< 0.001	< 0.001	-
Total extractable Lithium (Li)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Lithium	mg/L	0.003	0.003	0.0
Total extractable Magnesium (Mg)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Magnesium	mg/L	63.8	63.9	0.2
Total extractable Manganese (Mn)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Manganese	mg/L	7.19	7.09	1.4
Total extractable Molybdenum (Mo)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Molybdenum	mg/L	0.002	0.002	0.0
Total extractable Nickel (Ni)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Nickel	mg/L	0.004	0.003	28.6
Total extractable Potassium (K)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Potassium	mg/L	7.5	7.7	2.6
Total extractable Selenium (Se)				
Sequential ID No: 576058	(Sample no)		(3322272)	

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-811174**

P.O. Number	Your Project ID.	Project Manager
NA	196017_Mount M	Mme Myriam de Ladurantaye-Noël

Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Selenium	mg/L	< 0.001	< 0.001	-
Total extractable Silica (Si)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Silicon	mg/L	7.83	7.96	1.6
Total extractable Silver (Ag)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Silver	mg/L	< 0.0005	< 0.0005	-
Total extractable Sodium (Na)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Sodium	mg/L	44.3	45.0	1.6
Total extractable Strontium (Sr)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Strontium	mg/L	0.794	0.779	1.9
Total extractable Thallium (Tl)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Thallium	mg/L	< 0.001	< 0.001	-
Total extractable Tin (Sn)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Tin	mg/L	< 0.001	< 0.001	-
Total extractable Titanium (Ti)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Titanium	mg/L	< 0.001	< 0.001	-
Total extractable Vanadium (V)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Vanadium	mg/L	< 0.001	< 0.001	-
Total extractable Zinc (Zn)				
Sequential ID No: 576058	(Sample no)		(3322272)	
Zinc	mg/L	0.029	0.027	7.1
Total Phosphorus (as P)				
Sequential ID No: 576065	(Sample no)		(3322272)	
Phosphorus (as P)	mg/L	< 0.03	< 0.03	-
Phosphorus (as PO4)	mg/L	< 0.1	< 0.1	-

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Certificate of Analysis

Request number: **17-812253**

Date Received: 2017-03-16

Date Certificate Issued: 2017-03-23

Certificate Version: 1

☑ Official Certificate of Analysis

☐ Preliminary Certificate of Analysis

Client

VEOLIA WATER TECHNOLOGIES CANADA INC

4105, Sartelon
Saint-Laurent, Québec, Canada
H4S 2B3
Telephone : (514) 334-7230
Fax : (514) 334-5070

P.O. Number	Your project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

Comments

This certificate replaces and invalidates the preliminary version (COA 775481).
Total and dissolved metals analysis redone for sample 3326400, results reported on sample 3329124.

Although the result of total metals should be superior or equal to the result of dissolved metal, the difference between the results lies within the analytical uncertainty for these parameters.

This version replaces and cancels all earlier version.

NA : Information Not Available

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326395**	**3326397**	**3326398**	**3326399**
	Your Reference	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8	196017-Mount N-RW
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Suspended Solids	Preparation	2017-03-20	2017-03-20	2017-03-20	2017-03-20
Suspended solids at 104C (gravimetry) (Accredited) QC102-16 (REF : SM2540 D / MA. 115 - S.S. 1.2 R3)	Analysis	2017-03-20	2017-03-20	2017-03-20	2017-03-20
	Sequential No.	576823	576823	576823	576823
Suspended Solids	mg/L	13	6	6	17

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326400**	**3326404**	**3326405**	**3326406**
	Your Reference	196017-Mount N-CW	Mount N-30	Mount N-60	Mount N-90
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Suspended Solids	Preparation	2017-03-20	2017-03-20	2017-03-20	2017-03-20
Suspended solids at 104C (gravimetry) (Accredited) QC102-16 (REF : SM2540 D / MA. 115 - S.S. 1.2 R3)	Analysis	2017-03-20	2017-03-20	2017-03-20	2017-03-20
	Sequential No.	576823	576823	576823	576823
Suspended Solids	mg/L	9	11	7	10

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)
Lab. No.		**3326407**
Your Reference		Mount N-120
Matrix		Mine water
Sampled by		MDLN/CDM
Site sampled		NA
Date sampled		2017-03-16
Date received		2017-03-16
Parameter(s)		
Method Reference		
Suspended Solids	Preparation	2017-03-20
Suspended solids at 104C (gravimetry) (Accredited) QC102-16 (REF : SM2540 D / MA. 115 - S.S. 1.2 R3)	Analysis	2017-03-20
	Sequential No.	576823
Suspended Solids	mg/L	8

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326397**	**3326398**	**3326399**	**3326400**
	Your Reference	196017-Mount N-7	196017-Mount N-8	196017-Mount N-RW	196017-Mount N-CW
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Nitrate (as N)	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576788	576788	576788	576788
Nitrate (as N)	mg/L	0.48	0.47	0.47	0.46
Nitrite & nitrate (as N)	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576788	576788	576788	576788
Nitrite & nitrate (as N)	mg/L	0.51	0.50	0.50	0.49
Nitrite (IC)	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576788	576788	576788	576788
Nitrite (as N)	mg/L	0.03	0.03	0.03	0.03
Sulfates	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography (Accredited) QC090-08 (REF : MA. 300 - Ions 1.3 R3)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576788	576788	576788	576788
Sulfates (as SO4)	mg/L	750	745	728	747

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

Comments:

3326397	196017-Mount N-7	Dissolved metals: Sample filtered and preserved on site.
3326398	196017-Mount N-8	Dissolved metals: Sample filtered and preserved on site.
3326399	196017-Mount N-RW	Dissolved metals: Sample filtered and preserved on site.
3326400	196017-Mount N-CW	Zinc : Non coherent results. Dissolved metals: Sample filtered and preserved on site.
3329124	196017-Mount N-CW Reprise (3326400)	Zinc : Non coherent results.

Note 1: Results and comments, if any, relate only to samples submitted for analysis at the Saint-Augustin-de-Desmaures laboratory (#302).

Fatima Sobh, chemist

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326397**	**3326398**	**3326399**	**3326400**
	Your Reference	196017-Mount N-7	196017-Mount N-8	196017-Mount N-RW	196017-Mount N-CW
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Bromide (I.C.)	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576701	576701	576701	576701
Bromide	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Chloride (IC)	Preparation	2017-03-17	2017-03-17	2017-03-17	2017-03-17
Anions by ion chromatography. (Accredited) E-A-EN-EN-CHI-PC-MD028 (REF MA300-IONS 1.3 CEAEQ)	Analysis	2017-03-17	2017-03-17	2017-03-17	2017-03-17
	Sequential No.	576701	576701	576701	576701
Chloride	mg/L	2	2	2	2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Aluminum (Al)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Aluminum	mg/L	-	-	0.01	< 0.01
Dissolved Antimony (Sb)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Antimony	mg/L	-	-	< 0.001	< 0.001
Dissolved Arsenic (As)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Arsenic	mg/L	-	-	0.0024	0.0021
Dissolved Baryum (Ba)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Barium	mg/L	-	-	0.053	0.051
Dissolved Beryllium (Be)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Beryllium	mg/L	-	-	< 0.0004	< 0.0004
Dissolved Bismuth (Bi)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Bismuth	mg/L	-	-	< 0.0002	< 0.0002
Dissolved Boron (B)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Boron	mg/L	-	-	0.044	0.049

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Cadmium (Cd)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Cadmium	mg/L	-	-	< 0.0002	< 0.0002
Dissolved Calcium (Ca)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Calcium	mg/L	-	-	236	229
Dissolved Chromium (Cr)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Chromium	mg/L	-	-	< 0.0005	< 0.0005
Dissolved Cobalt (Co)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Cobalt	mg/L	-	-	0.0084	0.0083
Dissolved Copper (Cu)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Copper	mg/L	-	-	0.022	0.020
Dissolved Iron (Fe)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Iron	mg/L	-	-	0.10	0.05
Dissolved Lead (Pb)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Lead	mg/L	-	-	< 0.0002	< 0.0002

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Lithium (Li)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Lithium	mg/L	-	-	0.001	0.001
Dissolved Magnesium (Mg)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Magnesium	mg/L	-	-	53.5	51.9
Dissolved Manganese (Mn)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Manganese	mg/L	-	-	5.79	5.66
Dissolved Molybdenum (Mo)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Molybdenum	mg/L	-	-	0.0011	0.0010
Dissolved Nickel (Ni)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Nickel	mg/L	-	-	0.005	0.006
Dissolved Potassium (K)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Potassium	mg/L	-	-	6.0	5.9
Dissolved Selenium (Se)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Selenium	mg/L	-	-	< 0.001	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Silica (Si)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Silicon	mg/L	-	-	6.08	5.92
Dissolved Silver (Ag)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Silver	mg/L	-	-	< 0.0002	< 0.0002
Dissolved Sodium (Na)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Sodium	mg/L	-	-	37.6	36.4
Dissolved Strontium (Sr)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Strontium	mg/L	-	-	0.714	0.715
Dissolved Thallium (Tl)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Thallium	mg/L	-	-	< 0.0002	< 0.0002
Dissolved Tin (Sn)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Tin	mg/L	-	-	< 0.001	< 0.001
Dissolved Titanium (Ti)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Titanium	mg/L	-	-	< 0.001	< 0.001

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Vanadium (V)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Vanadium	mg/L	-	-	< 0.001	< 0.001
Dissolved Zinc (Zn)	Preparation	-	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-20	2017-03-20
	Sequential No.	-	-	576832	576832
Zinc	mg/L	-	-	0.030	0.026
Total extractable Aluminum (Al)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Aluminum	mg/L	0.01	-	0.08	< 0.01
Total extractable Antimony (Sb)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Antimony	mg/L	< 0.001	-	< 0.001	< 0.001
Total extractable Arsenic (As)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Arsenic	mg/L	0.0024	-	0.0022	0.0021
Total extractable Baryum (Ba)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Barium	mg/L	0.056	-	0.051	0.051
Total extractable Beryllium (Be)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Beryllium	mg/L	< 0.0004	-	< 0.0004	< 0.0004

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Bismuth (Bi)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Bismuth	mg/L	< 0.0002	-	< 0.0002	< 0.0002
Total extractable Boron (B)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Boron	mg/L	0.067	-	0.071	0.068
Total extractable Cadmium (Cd)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Cadmium	mg/L	< 0.0002	-	< 0.0002	< 0.0002
Total extractable Calcium (Ca)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Calcium	mg/L	275	-	280	277
Total extractable Chromium (Cr)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Chromium	mg/L	0.0005	-	< 0.0005	< 0.0005
Total extractable Cobalt (Co)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Cobalt	mg/L	0.0091	-	0.0094	0.0091
Total extractable Copper (Cu)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Copper	mg/L	0.0192	-	0.0144	0.0165

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Iron (Fe)	Preparation	2017-03-20	2017-03-20	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-21	2017-03-20	2017-03-20
	Sequential No.	576816	576816	576816	576816
Iron	mg/L	0.21	2.41	0.80	0.18
Total extractable Lead (Pb)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Lead	mg/L	< 0.0002	-	< 0.0002	< 0.0002
Total extractable Lithium (Li)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Lithium	mg/L	0.002	-	0.002	0.002
Total extractable Magnesium (Mg)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Magnesium	mg/L	62.3	-	63.1	62.4
Total extractable Manganese (Mn)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Manganese	mg/L	6.96	-	6.84	6.79
Total extractable Molybdenum (Mo)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Molybdenum	mg/L	0.0012	-	0.0011	0.0011
Total extractable Nickel (Ni)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Nickel	mg/L	0.005	-	0.006	0.005

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Potassium (K)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Potassium	mg/L	7.3	-	7.2	7.0
Total extractable Selenium (Se)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Selenium	mg/L	0.0005	-	< 0.0004	< 0.0004
Total extractable Silica (Si)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Silicon	mg/L	7.20	-	7.34	7.21
Total extractable Silver (Ag)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Silver	mg/L	< 0.0002	-	0.0004	< 0.0002
Total extractable Sodium (Na)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Sodium	mg/L	43.9	-	43.0	42.9
Total extractable Strontium (Sr)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Strontium	mg/L	0.744	-	0.702	0.707
Total extractable Thallium (Tl)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Thallium	mg/L	< 0.0002	-	< 0.0002	< 0.0002

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326393**	**3326395**	**3326397**	**3326398**
	Your Reference	196017-Mount N-GC	Mount N-60-Initial	196017-Mount N-7	196017-Mount N-8
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Tin (Sn)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Tin	mg/L	< 0.001	-	< 0.001	< 0.001
Total extractable Titanium (Ti)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Titanium	mg/L	< 0.001	-	< 0.001	< 0.001
Total extractable Vanadium (V)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Vanadium	mg/L	0.001	-	0.002	0.001
Total extractable Zinc (Zn)	Preparation	2017-03-20	-	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	-	2017-03-20	2017-03-20
	Sequential No.	576816	-	576816	576816
Zinc	mg/L	0.029	-	0.027	0.026

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Aluminum (Al)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Aluminum	mg/L	0.01	0.02	-	-
Dissolved Antimony (Sb)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Antimony	mg/L	< 0.001	< 0.001	-	-
Dissolved Arsenic (As)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Arsenic	mg/L	0.0027	0.0019	-	-
Dissolved Baryum (Ba)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Barium	mg/L	0.053	0.057	-	-
Dissolved Beryllium (Be)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Beryllium	mg/L	< 0.0004	< 0.0004	-	-
Dissolved Bismuth (Bi)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Bismuth	mg/L	< 0.0002	< 0.0002	-	-
Dissolved Boron (B)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Boron	mg/L	0.050	0.052	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Cadmium (Cd)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Cadmium	mg/L	< 0.0002	0.0002	-	-
Dissolved Calcium (Ca)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Calcium	mg/L	228	228	-	-
Dissolved Chromium (Cr)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Chromium	mg/L	< 0.0005	0.0007	-	-
Dissolved Cobalt (Co)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Cobalt	mg/L	0.0079	0.0084	-	-
Dissolved Copper (Cu)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Copper	mg/L	0.012	0.015	-	-
Dissolved Iron (Fe)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Iron	mg/L	0.04	0.08	-	-
Dissolved Lead (Pb)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Lead	mg/L	< 0.0002	< 0.0002	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Lithium (Li)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Lithium	mg/L	0.001	0.001	-	-
Dissolved Magnesium (Mg)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Magnesium	mg/L	51.7	51.4	-	-
Dissolved Manganese (Mn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Manganese	mg/L	5.73	5.70	-	-
Dissolved Molybdenum (Mo)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Molybdenum	mg/L	0.0010	0.0010	-	-
Dissolved Nickel (Ni)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Nickel	mg/L	0.003	0.006	-	-
Dissolved Potassium (K)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Potassium	mg/L	6.0	5.9	-	-
Dissolved Selenium (Se)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Selenium	mg/L	< 0.001	0.001	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Silica (Si)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Silicon	mg/L	5.95	5.78	-	-
Dissolved Silver (Ag)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Silver	mg/L	< 0.0002	< 0.0002	-	-
Dissolved Sodium (Na)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Sodium	mg/L	36.6	36.4	-	-
Dissolved Strontium (Sr)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Strontium	mg/L	0.721	0.708	-	-
Dissolved Thallium (Tl)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Thallium	mg/L	< 0.0002	< 0.0002	-	-
Dissolved Tin (Sn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Tin	mg/L	< 0.001	< 0.001	-	-
Dissolved Titanium (Ti)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Titanium	mg/L	< 0.001	< 0.001	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Dissolved Vanadium (V)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Vanadium	mg/L	< 0.001	< 0.001	-	-
Dissolved Zinc (Zn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576832	576832	-	-
Zinc	mg/L	0.028	0.049	-	-
Total extractable Aluminum (Al)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Aluminum	mg/L	0.04	0.01	-	-
Total extractable Antimony (Sb)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Antimony	mg/L	< 0.001	< 0.001	-	-
Total extractable Arsenic (As)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Arsenic	mg/L	0.0423	0.0036	-	-
Total extractable Baryum (Ba)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Barium	mg/L	0.060	0.050	-	-
Total extractable Beryllium (Be)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Beryllium	mg/L	< 0.0004	< 0.0004	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Bismuth (Bi)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Bismuth	mg/L	< 0.0002	< 0.0002	-	-
Total extractable Boron (B)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Boron	mg/L	0.068	0.065	-	-
Total extractable Cadmium (Cd)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Cadmium	mg/L	0.0003	0.0002	-	-
Total extractable Calcium (Ca)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Calcium	mg/L	283	269	-	-
Total extractable Chromium (Cr)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Chromium	mg/L	0.0014	0.0006	-	-
Total extractable Cobalt (Co)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Cobalt	mg/L	0.0087	0.0092	-	-
Total extractable Copper (Cu)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Copper	mg/L	0.0115	0.0101	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Iron (Fe)	Preparation	2017-03-20	2017-03-20	2017-03-20	2017-03-20
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-21	2017-03-20	2017-03-21	2017-03-21
	Sequential No.	576816	576816	576816	576816
Iron	mg/L	6.85	1.41	1.19	1.21
Total extractable Lead (Pb)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Lead	mg/L	0.0004	0.0003	-	-
Total extractable Lithium (Li)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Lithium	mg/L	0.002	0.002	-	-
Total extractable Magnesium (Mg)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Magnesium	mg/L	64.4	60.8	-	-
Total extractable Manganese (Mn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Manganese	mg/L	7.06	6.62	-	-
Total extractable Molybdenum (Mo)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Molybdenum	mg/L	0.0012	0.0010	-	-
Total extractable Nickel (Ni)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Nickel	mg/L	0.004	0.006	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Potassium (K)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Potassium	mg/L	7.3	6.9	-	-
Total extractable Selenium (Se)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Selenium	mg/L	0.0011	0.0016	-	-
Total extractable Silica (Si)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Silicon	mg/L	7.87	6.98	-	-
Total extractable Silver (Ag)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Silver	mg/L	< 0.0002	< 0.0002	-	-
Total extractable Sodium (Na)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Sodium	mg/L	44.6	42.1	-	-
Total extractable Strontium (Sr)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Strontium	mg/L	0.737	0.697	-	-
Total extractable Thallium (Tl)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Thallium	mg/L	< 0.0002	< 0.0002	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)			
	Lab. No.	**3326399**	**3326400**	**3326404**	**3326405**
	Your Reference	196017-Mount N-RW	196017-Mount N-CW	Mount N-30	Mount N-60
	Matrix	Mine water	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-16	2017-03-16
Parameter(s) Method Reference					
Total extractable Tin (Sn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Tin	mg/L	< 0.001	< 0.001	-	-
Total extractable Titanium (Ti)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Titanium	mg/L	0.001	0.001	-	-
Total extractable Vanadium (V)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Vanadium	mg/L	0.002	0.003	-	-
Total extractable Zinc (Zn)	Preparation	2017-03-20	2017-03-20	-	-
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-20	2017-03-20	-	-
	Sequential No.	576816	576816	-	-
Zinc	mg/L	0.039	0.028	-	-

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Dissolved Aluminum (Al)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Aluminum	mg/L	-	-	< 0.01
Dissolved Antimony (Sb)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Antimony	mg/L	-	-	< 0.001
Dissolved Arsenic (As)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Arsenic	mg/L	-	-	0.0018
Dissolved Baryum (Ba)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Barium	mg/L	-	-	0.056
Dissolved Beryllium (Be)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Beryllium	mg/L	-	-	< 0.0004
Dissolved Bismuth (Bi)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Bismuth	mg/L	-	-	0.0003
Dissolved Boron (B)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Boron	mg/L	-	-	0.075

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Dissolved Cadmium (Cd)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Cadmium	mg/L	-	-	0.0003
Dissolved Calcium (Ca)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Calcium	mg/L	-	-	244
Dissolved Chromium (Cr)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Chromium	mg/L	-	-	0.0007
Dissolved Cobalt (Co)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Cobalt	mg/L	-	-	0.0080
Dissolved Copper (Cu)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Copper	mg/L	-	-	0.014
Dissolved Iron (Fe)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Iron	mg/L	-	-	0.08
Dissolved Lead (Pb)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Lead	mg/L	-	-	< 0.0002

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Dissolved Lithium (Li)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Lithium	mg/L	-	-	0.002
Dissolved Magnesium (Mg)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Magnesium	mg/L	-	-	56.3
Dissolved Manganese (Mn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Manganese	mg/L	-	-	6.14
Dissolved Molybdenum (Mo)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Molybdenum	mg/L	-	-	0.0013
Dissolved Nickel (Ni)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Nickel	mg/L	-	-	0.006
Dissolved Potassium (K)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Potassium	mg/L	-	-	6.2
Dissolved Selenium (Se)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Selenium	mg/L	-	-	0.001

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
Lab. No.		**3326406**	**3326407**	**3329124**
Your Reference		Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
Matrix		Mine water	Mine water	Mine water
Sampled by		MDLN/CDM	MDLN/CDM	MDLN/CDM
Site sampled		NA	NA	NA
Date sampled		2017-03-16	2017-03-16	2017-03-16
Date received		2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Dissolved Silica (Si)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Silicon	mg/L	-	-	6.09
Dissolved Silver (Ag)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Silver	mg/L	-	-	< 0.0002
Dissolved Sodium (Na)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Sodium	mg/L	-	-	37.5
Dissolved Strontium (Sr)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Strontium	mg/L	-	-	0.727
Dissolved Thallium (Tl)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Thallium	mg/L	-	-	< 0.0002
Dissolved Tin (Sn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Tin	mg/L	-	-	< 0.001
Dissolved Titanium (Ti)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Titanium	mg/L	-	-	< 0.001

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Dissolved Vanadium (V)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Vanadium	mg/L	-	-	< 0.001
Dissolved Zinc (Zn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577119
Zinc	mg/L	-	-	0.047
Total extractable Aluminum (Al)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Aluminum	mg/L	-	-	0.02
Total extractable Antimony (Sb)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Antimony	mg/L	-	-	< 0.001
Total extractable Arsenic (As)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Arsenic	mg/L	-	-	0.0034
Total extractable Baryum (Ba)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Barium	mg/L	-	-	0.049
Total extractable Beryllium (Be)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Beryllium	mg/L	-	-	< 0.0004

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Total extractable Bismuth (Bi)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Bismuth	mg/L	-	-	0.0006
Total extractable Boron (B)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Boron	mg/L	-	-	0.093
Total extractable Cadmium (Cd)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Cadmium	mg/L	-	-	< 0.0002
Total extractable Calcium (Ca)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Calcium	mg/L	-	-	255
Total extractable Chromium (Cr)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Chromium	mg/L	-	-	0.0006
Total extractable Cobalt (Co)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Cobalt	mg/L	-	-	0.0085
Total extractable Copper (Cu)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Copper	mg/L	-	-	0.0119

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Total extractable Iron (Fe)	Preparation	2017-03-20	2017-03-20	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	2017-03-21	2017-03-21	2017-03-23
	Sequential No.	576816	576816	577118
Iron	mg/L	1.41	1.35	1.42
Total extractable Lead (Pb)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Lead	mg/L	-	-	0.0002
Total extractable Lithium (Li)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Lithium	mg/L	-	-	0.003
Total extractable Magnesium (Mg)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Magnesium	mg/L	-	-	58.8
Total extractable Manganese (Mn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Manganese	mg/L	-	-	6.33
Total extractable Molybdenum (Mo)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Molybdenum	mg/L	-	-	0.0015
Total extractable Nickel (Ni)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Nickel	mg/L	-	-	0.005

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Total extractable Potassium (K)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Potassium	mg/L	-	-	6.5
Total extractable Selenium (Se)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Selenium	mg/L	-	-	0.0020
Total extractable Silica (Si)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Silicon	mg/L	-	-	6.40
Total extractable Silver (Ag)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Silver	mg/L	-	-	< 0.0002
Total extractable Sodium (Na)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Sodium	mg/L	-	-	39.1
Total extractable Strontium (Sr)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Strontium	mg/L	-	-	0.712
Total extractable Thallium (Tl)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Thallium	mg/L	-	-	< 0.0002

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

		Sample(s)		
	Lab. No.	**3326406**	**3326407**	**3329124**
	Your Reference	Mount N-90	Mount N-120	196017-Mount N-CW Reprise (3326400)
	Matrix	Mine water	Mine water	Mine water
	Sampled by	MDLN/CDM	MDLN/CDM	MDLN/CDM
	Site sampled	NA	NA	NA
	Date sampled	2017-03-16	2017-03-16	2017-03-16
	Date received	2017-03-16	2017-03-16	2017-03-22
Parameter(s) Method Reference				
Total extractable Tin (Sn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Tin	mg/L	-	-	< 0.001
Total extractable Titanium (Ti)	Preparation	-	-	2017-03-23
Metals by ICP (not accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Titanium	mg/L	-	-	0.001
Total extractable Vanadium (V)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Vanadium	mg/L	-	-	0.003
Total extractable Zinc (Zn)	Preparation	-	-	2017-03-23
Metals by ICP (Accredited) E-A-EN-EN-CHI-PC-MD017 (REF:MA.200-Mét1.2,CEAEQ)	Analysis	-	-	2017-03-23
	Sequential No.	-	-	577118
Zinc	mg/L	-	-	0.027

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

Comments:

3326397	196017-Mount N-7	Dissolved metals: Sample filtered and preserved on site.
3326398	196017-Mount N-8	Dissolved metals: Sample filtered and preserved on site.
3326399	196017-Mount N-RW	Dissolved metals: Sample filtered and preserved on site.
3326400	196017-Mount N-CW	Zinc : Non coherent results. Dissolved metals: Sample filtered and preserved on site.
3329124	196017-Mount N-CW Reprise (3326400)	Zinc : Non coherent results.

Note 2: Results and comments, if any, relate only to samples submitted for analysis at the Pointe-Claire laboratory (#307).

Fatima Sobh, chemist

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P.O. Number	Your Project ID.	Project Manager
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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Bromide (I.C.)					
Sequential ID No.: 576701					
Bromide	mg/L	< 0.1	< 0.1	5.6	4.2 - 6.3
Chloride (IC)					
Sequential ID No.: 576701					
Chloride	mg/L	< 1	< 1	5	4.46 - 6.04
Nitrite (IC)					
Sequential ID No.: 576788					
Nitrite (as N)	mg/L	< 0.02	< 0.02	3.70	3 - 4.5
Nitrite & nitrate (as N)					
Sequential ID No.: 576788					
Nitrite & nitrate (as N)	mg/L	< 0.02	< 0.02	11.1	9 - 13.5
Nitrate (as N)					
Sequential ID No.: 576788					
Nitrate (as N)	mg/L	< 0.02	< 0.02	7.39	6 - 9
Sulfates					
Sequential ID No.: 576788					
Sulfates (as SO4)	mg/L	< 0.5	< 0.5	18.7	16.88 - 20.63
Total extractable Silver (Ag)					
Sequential ID No.: 576816					
Silver	mg/L	< 0.0002	< 0.0002	1.05	0.8 - 1.2
Total extractable Silver (Ag)					
Sequential ID No.: 577118					
Silver	mg/L	< 0.0002	< 0.0002	1.07	0.8 - 1.2
Dissolved Silver (Ag)					
Sequential ID No.: 576832					
Silver	mg/L	< 0.0002	< 0.0002	1.11	0.8 - 1.2
Dissolved Silver (Ag)					
Sequential ID No.: 577119					
Silver	mg/L	< 0.0002	< 0.0002	0.988	0.8 - 1.2
Total extractable Aluminum (Al)					
Sequential ID No.: 576816					
Aluminum	mg/L	< 0.01	< 0.01	1.04	0.8 - 1.2
Total extractable Aluminum (Al)					
Sequential ID No.: 577118					
Aluminum	mg/L	< 0.01	< 0.01	1.13	0.8 - 1.2

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Aluminum (Al) Sequential ID No.: 576832					
Aluminum	mg/L	< 0.01	< 0.01	1.13	0.8 - 1.2
Dissolved Aluminum (Al) Sequential ID No.: 577119					
Aluminum	mg/L	< 0.01	< 0.01	1.16	0.8 - 1.2
Total extractable Arsenic (As) Sequential ID No.: 576816					
Arsenic	mg/L	< 0.0003	< 0.0003	0.987	0.8 - 1.2
Total extractable Arsenic (As) Sequential ID No.: 577118					
Arsenic	mg/L	< 0.0003	< 0.0003	1.00	0.8 - 1.2
Dissolved Arsenic (As) Sequential ID No.: 576832					
Arsenic	mg/L	< 0.0003	< 0.0003	0.996	0.8 - 1.2
Dissolved Arsenic (As) Sequential ID No.: 577119					
Arsenic	mg/L	< 0.0003	< 0.0003	0.945	0.8 - 1.2
Total extractable Baryum (Ba) Sequential ID No.: 576816					
Barium	mg/L	< 0.002	< 0.002	0.983	0.8 - 1.2
Total extractable Baryum (Ba) Sequential ID No.: 577118					
Barium	mg/L	< 0.002	< 0.002	0.969	0.8 - 1.2
Dissolved Baryum (Ba) Sequential ID No.: 576832					
Barium	mg/L	< 0.002	< 0.002	0.975	0.8 - 1.2
Dissolved Baryum (Ba) Sequential ID No.: 577119					
Barium	mg/L	< 0.002	< 0.002	0.918	0.8 - 1.2
Total extractable Beryllium (Be) Sequential ID No.: 576816					
Beryllium	mg/L	< 0.0004	< 0.0004	0.903	0.8 - 1.2
Total extractable Beryllium (Be) Sequential ID No.: 577118					
Beryllium	mg/L	< 0.0004	< 0.0004	1.07	0.8 - 1.2

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Beryllium (Be) Sequential ID No.: 576832					
Beryllium	mg/L	< 0.0004	< 0.0004	0.984	0.8 - 1.2
Dissolved Beryllium (Be) Sequential ID No.: 577119					
Beryllium	mg/L	< 0.0004	< 0.0004	0.998	0.8 - 1.2
Total extractable Bismuth (Bi) Sequential ID No.: 576816					
Bismuth	mg/L	< 0.0002	< 0.0002	1.12	0.8 - 1.2
Total extractable Bismuth (Bi) Sequential ID No.: 577118					
Bismuth	mg/L	< 0.0002	< 0.0002	1.07	0.8 - 1.2
Dissolved Bismuth (Bi) Sequential ID No.: 576832					
Bismuth	mg/L	< 0.0002	< 0.0002	1.16	0.8 - 1.2
Dissolved Bismuth (Bi) Sequential ID No.: 577119					
Bismuth	mg/L	< 0.0002	< 0.0002	1.07	0.8 - 1.2
Total extractable Boron (B) Sequential ID No.: 576816					
Boron	mg/L	< 0.005	0.011	0.985	0.9 - 1.1
Total extractable Boron (B) Sequential ID No.: 577118					
Boron	mg/L	< 0.005	< 0.005	1.09	0.9 - 1.1
Dissolved Boron (B) Sequential ID No.: 576832					
Boron	mg/L	< 0.005	< 0.005	0.947	0.9 - 1.1
Dissolved Boron (B) Sequential ID No.: 577119					
Boron	mg/L	< 0.005	< 0.005	1.09	0.9 - 1.1
Total extractable Calcium (Ca) Sequential ID No.: 576816					
Calcium	mg/L	< 0.02	< 0.02	5.68	4 - 6
Total extractable Calcium (Ca) Sequential ID No.: 577118					
Calcium	mg/L	< 0.02	0.02	5.26	4 - 6

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Calcium (Ca) Sequential ID No.: 576832					
Calcium	mg/L	< 0.02	< 0.02	5.45	4 - 6
Dissolved Calcium (Ca) Sequential ID No.: 577119					
Calcium	mg/L	< 0.02	< 0.02	5.33	4 - 6
Total extractable Cadmium (Cd) Sequential ID No.: 576816					
Cadmium	mg/L	< 0.0002	< 0.0002	0.967	0.8 - 1.2
Total extractable Cadmium (Cd) Sequential ID No.: 577118					
Cadmium	mg/L	< 0.0002	< 0.0002	1.01	0.8 - 1.2
Dissolved Cadmium (Cd) Sequential ID No.: 576832					
Cadmium	mg/L	< 0.0002	< 0.0002	1.00	0.8 - 1.2
Dissolved Cadmium (Cd) Sequential ID No.: 577119					
Cadmium	mg/L	< 0.0002	< 0.0002	0.957	0.8 - 1.2
Total extractable Cobalt (Co) Sequential ID No.: 576816					
Cobalt	mg/L	< 0.0003	< 0.0003	1.03	0.8 - 1.2
Total extractable Cobalt (Co) Sequential ID No.: 577118					
Cobalt	mg/L	< 0.0003	< 0.0003	1.07	0.8 - 1.2
Dissolved Cobalt (Co) Sequential ID No.: 576832					
Cobalt	mg/L	< 0.0003	< 0.0003	1.05	0.8 - 1.2
Dissolved Cobalt (Co) Sequential ID No.: 577119					
Cobalt	mg/L	< 0.0003	< 0.0003	1.01	0.8 - 1.2
Total extractable Chromium (Cr) Sequential ID No.: 576816					
Chromium	mg/L	< 0.0005	< 0.0005	0.972	0.8 - 1.2
Total extractable Chromium (Cr) Sequential ID No.: 577118					
Chromium	mg/L	< 0.0005	< 0.0005	1.07	0.8 - 1.2

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P.O. Number	Your Project ID.	Project Manager
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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Chromium (Cr)					
Sequential ID No.: 576832					
Chromium	mg/L	< 0.0005	< 0.0005	0.996	0.8 - 1.2
Dissolved Chromium (Cr)					
Sequential ID No.: 577119					
Chromium	mg/L	< 0.0005	< 0.0005	0.990	0.8 - 1.2
Total extractable Copper (Cu)					
Sequential ID No.: 576816					
Copper	mg/L	< 0.0006	< 0.0006	1.04	0.8 - 1.2
Total extractable Copper (Cu)					
Sequential ID No.: 577118					
Copper	mg/L	< 0.0006	< 0.0006	1.15	0.8 - 1.2
Dissolved Copper (Cu)					
Sequential ID No.: 576832					
Copper	mg/L	< 0.001	< 0.001	1.10	0.8 - 1.2
Dissolved Copper (Cu)					
Sequential ID No.: 577119					
Copper	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Total extractable Iron (Fe)					
Sequential ID No.: 576816					
Iron	mg/L	< 0.03	< 0.03	0.95	0.9 - 1.1
Total extractable Iron (Fe)					
Sequential ID No.: 577118					
Iron	mg/L	< 0.03	< 0.03	1.08	0.9 - 1.1
Dissolved Iron (Fe)					
Sequential ID No.: 576832					
Iron	mg/L	< 0.03	< 0.03	1.07	0.9 - 1.1
Dissolved Iron (Fe)					
Sequential ID No.: 577119					
Iron	mg/L	< 0.03	< 0.03	0.99	0.9 - 1.1
Total extractable Potassium (K)					
Sequential ID No.: 576816					
Potassium	mg/L	< 0.2	< 0.2	5.4	4 - 6
Total extractable Potassium (K)					
Sequential ID No.: 577118					
Potassium	mg/L	< 0.2	< 0.2	5.0	4 - 6

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Potassium (K) Sequential ID No.: 576832					
Potassium	mg/L	< 0.2	< 0.2	5.3	4 - 6
Dissolved Potassium (K) Sequential ID No.: 577119					
Potassium	mg/L	< 0.2	< 0.2	4.9	4 - 6
Total extractable Lithium (Li) Sequential ID No.: 576816					
Lithium	mg/L	< 0.001	< 0.001	0.859	0.8 - 1.2
Total extractable Lithium (Li) Sequential ID No.: 577118					
Lithium	mg/L	< 0.001	< 0.001	1.11	0.8 - 1.2
Dissolved Lithium (Li) Sequential ID No.: 576832					
Lithium	mg/L	< 0.001	< 0.001	0.932	0.8 - 1.2
Dissolved Lithium (Li) Sequential ID No.: 577119					
Lithium	mg/L	< 0.001	< 0.001	1.01	0.8 - 1.2
Total extractable Magnesium (Mg) Sequential ID No.: 576816					
Magnesium	mg/L	< 0.01	< 0.01	5.45	4 - 6
Total extractable Magnesium (Mg) Sequential ID No.: 577118					
Magnesium	mg/L	< 0.01	< 0.01	5.37	4 - 6
Dissolved Magnesium (Mg) Sequential ID No.: 576832					
Magnesium	mg/L	< 0.01	< 0.01	5.23	4 - 6
Dissolved Magnesium (Mg) Sequential ID No.: 577119					
Magnesium	mg/L	< 0.01	< 0.01	5.16	4 - 6
Total extractable Manganese (Mn) Sequential ID No.: 576816					
Manganese	mg/L	< 0.001	< 0.001	0.942	0.8 - 1.2
Total extractable Manganese (Mn) Sequential ID No.: 577118					
Manganese	mg/L	< 0.001	< 0.001	1.01	0.8 - 1.2

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Manganese (Mn) Sequential ID No.: 576832					
Manganese	mg/L	< 0.001	< 0.001	1.04	0.8 - 1.2
Dissolved Manganese (Mn) Sequential ID No.: 577119					
Manganese	mg/L	< 0.001	< 0.001	1.01	0.8 - 1.2
Total extractable Molybdenum (Mo) Sequential ID No.: 576816					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.07	0.8 - 1.2
Total extractable Molybdenum (Mo) Sequential ID No.: 577118					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.13	0.8 - 1.2
Dissolved Molybdenum (Mo) Sequential ID No.: 576832					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.13	0.8 - 1.2
Dissolved Molybdenum (Mo) Sequential ID No.: 577119					
Molybdenum	mg/L	< 0.0003	< 0.0003	1.07	0.8 - 1.2
Total extractable Sodium (Na) Sequential ID No.: 576816					
Sodium	mg/L	< 0.035	< 0.035	5.43	4 - 6
Total extractable Sodium (Na) Sequential ID No.: 577118					
Sodium	mg/L	< 0.035	< 0.035	4.91	4 - 6
Dissolved Sodium (Na) Sequential ID No.: 576832					
Sodium	mg/L	< 0.035	< 0.035	5.21	4 - 6
Dissolved Sodium (Na) Sequential ID No.: 577119					
Sodium	mg/L	< 0.035	< 0.035	4.74	4 - 6
Total extractable Nickel (Ni) Sequential ID No.: 576816					
Nickel	mg/L	< 0.001	< 0.001	1.03	0.8 - 1.2
Total extractable Nickel (Ni) Sequential ID No.: 577118					
Nickel	mg/L	< 0.001	< 0.001	1.09	0.8 - 1.2

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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Nickel (Ni) Sequential ID No.: 576832					
Nickel	mg/L	< 0.001	< 0.001	1.06	0.8 - 1.2
Dissolved Nickel (Ni) Sequential ID No.: 577119					
Nickel	mg/L	< 0.001	< 0.001	1.03	0.8 - 1.2
Total extractable Lead (Pb) Sequential ID No.: 576816					
Lead	mg/L	< 0.0002	< 0.0002	1.05	0.8 - 1.2
Total extractable Lead (Pb) Sequential ID No.: 577118					
Lead	mg/L	< 0.0002	< 0.0002	1.03	0.8 - 1.2
Dissolved Lead (Pb) Sequential ID No.: 576832					
Lead	mg/L	< 0.0002	< 0.0002	1.12	0.8 - 1.2
Dissolved Lead (Pb) Sequential ID No.: 577119					
Lead	mg/L	< 0.0002	< 0.0002	1.01	0.8 - 1.2
Total extractable Antimony (Sb) Sequential ID No.: 576816					
Antimony	mg/L	< 0.001	< 0.001	0.955	0.8 - 1.2
Total extractable Antimony (Sb) Sequential ID No.: 577118					
Antimony	mg/L	< 0.001	< 0.001	0.976	0.8 - 1.2
Dissolved Antimony (Sb) Sequential ID No.: 576832					
Antimony	mg/L	< 0.001	< 0.001	0.982	0.8 - 1.2
Dissolved Antimony (Sb) Sequential ID No.: 577119					
Antimony	mg/L	< 0.001	< 0.001	0.922	0.8 - 1.2
Total extractable Selenium (Se) Sequential ID No.: 576816					
Selenium	mg/L	< 0.0004	< 0.0004	1.01	0.8 - 1.2
Total extractable Selenium (Se) Sequential ID No.: 577118					
Selenium	mg/L	< 0.0004	< 0.0004	0.993	0.8 - 1.2

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Client: **VEOLIA WATER TECHNOLOGIES CANADA INC** **Request Number: 17-812253**

P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Selenium (Se) Sequential ID No.: 576832					
Selenium	mg/L	< 0.001	< 0.001	1.00	0.8 - 1.2
Dissolved Selenium (Se) Sequential ID No.: 577119					
Selenium	mg/L	< 0.001	< 0.001	0.982	0.8 - 1.2
Total extractable Silica (Si) Sequential ID No.: 576816					
Silicon	mg/L	< 0.05	< 0.05	5.52	4 - 6
Total extractable Silica (Si) Sequential ID No.: 577118					
Silicon	mg/L	< 0.05	< 0.05	5.18	4 - 6
Dissolved Silica (Si) Sequential ID No.: 576832					
Silicon	mg/L	< 0.05	< 0.05	5.37	4 - 6
Dissolved Silica (Si) Sequential ID No.: 577119					
Silicon	mg/L	< 0.05	< 0.05	5.14	4 - 6
Total extractable Tin (Sn) Sequential ID No.: 576816					
Tin	mg/L	< 0.001	< 0.001	1.09	0.8 - 1.2
Total extractable Tin (Sn) Sequential ID No.: 577118					
Tin	mg/L	< 0.001	< 0.001	1.02	0.8 - 1.2
Dissolved Tin (Sn) Sequential ID No.: 576832					
Tin	mg/L	< 0.001	< 0.001	1.11	0.8 - 1.2
Dissolved Tin (Sn) Sequential ID No.: 577119					
Tin	mg/L	< 0.001	< 0.001	0.977	0.8 - 1.2
Total extractable Strontium (Sr) Sequential ID No.: 576816					
Strontium	mg/L	< 0.001	< 0.001	0.967	0.8 - 1.2
Total extractable Strontium (Sr) Sequential ID No.: 577118					
Strontium	mg/L	< 0.001	< 0.001	0.984	0.8 - 1.2

RDL : Reported Detection Limit

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237 rue de Liverpool
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Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Strontium (Sr) Sequential ID No.: 576832					
Strontium	mg/L	< 0.001	< 0.001	0.972	0.8 - 1.2
Dissolved Strontium (Sr) Sequential ID No.: 577119					
Strontium	mg/L	< 0.001	< 0.001	0.929	0.8 - 1.2
Total extractable Titanium (Ti) Sequential ID No.: 576816					
Titanium	mg/L	< 0.001	< 0.001	1.03	0.8 - 1.2
Total extractable Titanium (Ti) Sequential ID No.: 577118					
Titanium	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Dissolved Titanium (Ti) Sequential ID No.: 576832					
Titanium	mg/L	< 0.001	< 0.001	1.01	0.8 - 1.2
Dissolved Titanium (Ti) Sequential ID No.: 577119					
Titanium	mg/L	< 0.001	< 0.001	0.968	0.8 - 1.2
Total extractable Thallium (Tl) Sequential ID No.: 576816					
Thallium	mg/L	< 0.0002	< 0.0002	1.11	0.8 - 1.2
Total extractable Thallium (Tl) Sequential ID No.: 577118					
Thallium	mg/L	< 0.0002	< 0.0002	1.10	0.8 - 1.2
Dissolved Thallium (Tl) Sequential ID No.: 576832					
Thallium	mg/L	< 0.0002	< 0.0002	1.18	0.8 - 1.2
Dissolved Thallium (Tl) Sequential ID No.: 577119					
Thallium	mg/L	< 0.0002	< 0.0002	1.06	0.8 - 1.2
Total extractable Vanadium (V) Sequential ID No.: 576816					
Vanadium	mg/L	< 0.001	< 0.001	1.08	0.8 - 1.2
Total extractable Vanadium (V) Sequential ID No.: 577118					
Vanadium	mg/L	< 0.001	< 0.001	1.06	0.8 - 1.2

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P.O. Number	Your Project ID.	Project Manager
NA	Mount N	Mme Myriam de Ladurantaye-Noël

Quality Control Results (CQ)

Parameters (Sequential ID No.)	Units	RDL	Blank	Certified Control Result	Certified Control Expected Range
Dissolved Vanadium (V)					
Sequential ID No.: 576832					
Vanadium	mg/L	< 0.001	< 0.001	1.12	0.8 - 1.2
Dissolved Vanadium (V)					
Sequential ID No.: 577119					
Vanadium	mg/L	< 0.001	< 0.001	1.02	0.8 - 1.2
Total extractable Zinc (Zn)					
Sequential ID No.: 576816					
Zinc	mg/L	< 0.007	< 0.007	1.05	0.8 - 1.2
Total extractable Zinc (Zn)					
Sequential ID No.: 577118					
Zinc	mg/L	< 0.007	< 0.007	1.09	0.8 - 1.2
Dissolved Zinc (Zn)					
Sequential ID No.: 576832					
Zinc	mg/L	< 0.007	< 0.007	1.08	0.8 - 1.2
Dissolved Zinc (Zn)					
Sequential ID No.: 577119					
Zinc	mg/L	< 0.007	< 0.007	1.02	0.8 - 1.2
Suspended Solids					
Sequential ID No.: 576823					
Suspended Solids	mg/L	< 4	<4	976	808 - 1094

Comments

Sequential ID no. 576816 : Bore/Boron : Blanc positif non soustrait des échantillons. / Positive blank not subtracted from the samples.
Sequential ID no. 577119 : Calcium: Blanc positif non soustrait des échantillons. / Positive blank not subtracted from the samples.

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P.O. Number	Your Project ID.	Project Manager
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Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Bromide (I.C.)				
Sequential ID No: 576701	(Sample no)		(3326400)	
Bromide	mg/L	< 0.1	< 0.1	-
Chloride (IC)				
Sequential ID No: 576701	(Sample no)		(3326400)	
Chloride	mg/L	2	2	0.0
Suspended Solids				
Sequential ID No: 576823	(Sample no)		(3326395)	
Suspended Solids	mg/L	13	14	7.4
Sequential ID No: 576823	(Sample no)		(3326397)	
Suspended Solids	mg/L	6	9	40.0
Sequential ID No: 576823	(Sample no)		(3326398)	
Suspended Solids	mg/L	6	6	0.0
Total extractable Aluminum (Al)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Aluminum	mg/L	0.01	0.01	0.0
Total extractable Antimony (Sb)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Antimony	mg/L	< 0.001	< 0.001	-
Total extractable Arsenic (As)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Arsenic	mg/L	0.0024	0.0023	4.3
Total extractable Baryum (Ba)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Barium	mg/L	0.056	0.056	0.0
Total extractable Beryllium (Be)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Beryllium	mg/L	< 0.0004	< 0.0004	-
Total extractable Bismuth (Bi)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Bismuth	mg/L	< 0.0002	< 0.0002	-
Total extractable Boron (B)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Boron	mg/L	0.067	0.069	2.9
Total extractable Cadmium (Cd)				

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Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Sequential ID No: 576816	(Sample no)		(3326393)	
Cadmium	mg/L	< 0.0002	< 0.0002	-
Total extractable Calcium (Ca)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Calcium	mg/L	275	286	3.9
Total extractable Chromium (Cr)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Chromium	mg/L	0.0005	0.0005	0.0
Total extractable Cobalt (Co)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Cobalt	mg/L	0.0091	0.0095	4.3
Total extractable Copper (Cu)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Copper	mg/L	0.0192	0.0201	4.6
Total extractable Iron (Fe)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Iron	mg/L	0.21	0.20	4.9
Total extractable Lead (Pb)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Lead	mg/L	< 0.0002	0.0003	-
Total extractable Lithium (Li)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Lithium	mg/L	0.002	0.002	0.0
Total extractable Magnesium (Mg)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Magnesium	mg/L	62.3	64.4	3.3
Total extractable Manganese (Mn)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Manganese	mg/L	6.96	7.00	0.6
Total extractable Molybdenum (Mo)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Molybdenum	mg/L	0.0012	0.0012	0.0
Total extractable Nickel (Ni)				
Sequential ID No: 576816	(Sample no)		(3326393)	

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Quality Control Results - Part 2

Parameters (Sequential ID No.)	Units	Duplicate Value 1	Duplicate Value 2	Duplicate Difference (%)
Nickel	mg/L	0.005	0.006	18.2
Total extractable Potassium (K)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Potassium	mg/L	7.3	7.6	4.0
Total extractable Selenium (Se)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Selenium	mg/L	0.0005	0.0004	22.2
Total extractable Silica (Si)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Silicon	mg/L	7.20	7.51	4.2
Total extractable Silver (Ag)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Silver	mg/L	< 0.0002	< 0.0002	-
Total extractable Sodium (Na)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Sodium	mg/L	43.9	45.5	3.6
Total extractable Strontium (Sr)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Strontium	mg/L	0.744	0.747	0.4
Total extractable Thallium (Tl)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Thallium	mg/L	< 0.0002	< 0.0002	-
Total extractable Tin (Sn)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Tin	mg/L	< 0.001	< 0.001	-
Total extractable Titanium (Ti)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Titanium	mg/L	< 0.001	< 0.001	-
Total extractable Vanadium (V)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Vanadium	mg/L	0.001	0.001	0.0
Total extractable Zinc (Zn)				
Sequential ID No: 576816	(Sample no)		(3326393)	
Zinc	mg/L	0.029	0.029	0.0

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APPENDIX B. MATERIAL SAFETY DATA SHEETS FOR CHEMICALS USED DURING THE TESTS

Hydrex

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6253**
Version #	03
Issue date	08-19-2013
Revision date	09-08-2014
Supersedes date	08-15-2014
CAS #	Mixture
Product use	Coagulant
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Emergency overview DANGER

Corrosive. Causes skin and eye burns. Prolonged exposure may cause chronic effects.

Potential health effects

Routes of exposure	Inhalation. Ingestion. Skin contact. Eye contact.
Eyes	Corrosive to the eyes and may cause severe damage including blindness. Causes chemical burns. Do not get this material in contact with eyes.
Skin	Causes chemical burns. Do not get this material in contact with skin.
Inhalation	May cause cancer by inhalation. May cause irritation of respiratory tract. Prolonged inhalation may be harmful. Do not breathe dust/fume/gas/mist/vapors/spray.
Ingestion	Harmful if swallowed. Ingestion causes burns of the upper digestive and respiratory tracts. Do not ingest.
Chronic effects	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Signs and symptoms	Contact with this material will cause burns to the skin, eyes and mucous membranes.
Potential environmental effects	Components of this product are hazardous to aquatic life.

3. Composition / Information on Ingredients

Non-hazardous components	CAS #	Percent
IRON, WATER-SOLUBLE SALTS, N.O.S.	10028-22-5	40 - 65
Other components below reportable levels		30 - 60

4. First Aid Measures

First aid procedures

Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. If a contact lens is present, DO NOT delay irrigation or attempt to remove the lens. Continue rinsing. Get medical attention immediately.
Skin contact	Remove and isolate contaminated clothing and shoes. Immediately flush skin with plenty of water. Get medical attention immediately. For minor skin contact, avoid spreading material on unaffected skin. Wash clothing separately before reuse.

Inhalation	Move to fresh air. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention, if needed.
Ingestion	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Never give anything by mouth to a victim who is unconscious or is having convulsions. Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.
Notes to physician	In case of shortness of breath, give oxygen. Keep victim warm. Symptoms may be delayed.
General advice	In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Get medical attention if symptoms occur. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Do not use mouth-to-mouth method if victim ingested the substance.

5. Fire Fighting Measures

Flammable properties	Not flammable by WHMIS criteria.
Extinguishing media	
Suitable extinguishing media	Water fog.
Fire fighting equipment/instructions	Not available.
Explosion data	
Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep people away from and upwind of spill/leak.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
Methods for containment	Stop leak if you can do so without risk. Dike the spilled material, where this is possible. Prevent entry into waterways, sewer, basements or confined areas.
Methods for cleaning up	Should not be released into the environment. The product is immiscible with water and will spread on the water surface. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills in original containers for re-use. Clean up in accordance with all applicable regulations. For waste disposal, see section 13 of the MSDS.
Other information	Clean up in accordance with all applicable regulations.

7. Handling and Storage

Handling	Do not breathe dust/fume/gas/mist/vapors/spray. Do not get this material in contact with eyes. Do not get this material in contact with skin. Do not get this material on clothing. Wear personal protective equipment. Do not use in areas without adequate ventilation. Avoid prolonged exposure. Wash thoroughly after handling. Avoid release to the environment.
Storage	Store in a closed container away from incompatible materials. Keep out of the reach of children.

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	TWA	1 mg/m3

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	TWA	1 mg/m3

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	STEL	2 mg/m3
	TWA	1 mg/m3

Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act)

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	TWA	1 mg/m3

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	TWA	1 mg/m3

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Components	Type	Value
IRON, WATER-SOLUBLE SALTS, N.O.S. (CAS 10028-22-5)	TWA	1 mg/m3

Biological limit values No biological exposure limits noted for the ingredient(s).

Engineering controls Ensure adequate ventilation, especially in confined areas.

Personal protective equipment

Eye / face protection Do not get in eyes. Chemical goggles are recommended.

Skin protection Do not get this material in contact with skin. Chemical resistant gloves. It may provide little or no thermal protection.

Respiratory protection Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

9. Physical & Chemical Properties

Appearance Not available.

Physical state Liquid.

Form Liquid

Color Red brown.

Odor Not available.

pH < 2

Vapor pressure Not available.

Vapor density Not available.

Boiling point	Not available.
Melting point/Freezing point	-0.4 °F (-18 °C)
Solubility (water)	Not available.
Specific gravity	1.45 - 1.59
Flash point	Not available.
Auto-ignition temperature	Not available.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Reacts violently with strong alkaline substances. This product may react with reducing agents. Do not mix with other chemicals.
Incompatible materials	Incompatible with bases. This product may react with reducing agents.
Hazardous decomposition products	Sulfur oxides
Possibility of hazardous reactions	Hazardous polymerization does not occur.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6253 (CAS Mixture)		
Acute		
Dermal		
LD50	Mouse	>= 290 mg/kg Calculated
Inhalation		
LC50	Guinea pig	>= 7 mg/l, 8 Hours Calculated
Oral		
LD50	Rat	500 mg/kg Calculated

* Estimates for product may be based on additional component data not shown.

Acute effects	Causes burns.
Local effects	May produce corrosive solutions on contact with water.
Chronic effects	Hazardous by WHMIS criteria. Prolonged inhalation may be harmful. Prolonged exposure may cause chronic effects.
Carcinogenicity	Hazardous by WHMIS criteria. Cancer Hazard.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6253 (CAS Mixture)			
Fish	LC50	Fish	64.6086 mg/l, 96 hours estimated

* Estimates for product may be based on additional component data not shown.

Ecotoxicity	Components of this product are hazardous to aquatic life. Because of the low pH of this product, it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.
Environmental effects	Harmful to aquatic organisms.
Persistence and degradability	Not available.

13. Disposal Considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

UN number	UN3264
UN proper shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Ferric Sulfate Solution)
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	III
Environmental hazards	Not available.
Special precautions for user	Not available.

IATA

UN number	UN3287
UN proper shipping name	Toxic liquid, inorganic, n.o.s.
Transport hazard class(es)	
Class	6.1(PGIII)
Subsidiary risk	-
Packing group	III
Environmental hazards	No.
ERG Code	6L
Special precautions for user	Not available.
Other information	
Passenger and cargo aircraft	Allowed.
Cargo aircraft only	Allowed.

IMDG

UN number	UN3287
UN proper shipping name	TOXIC LIQUID, INORGANIC, N.O.S.
Transport hazard class(es)	
Class	6.1(PGIII)
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-A, S-A
Special precautions for user	Not available.

IATA; IMDG

TDG

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Controlled

WHMIS classification D1B - Immediate/Serious-TOXIC
D2A - Other Toxic Effects-VERY TOXIC
E - Corrosive

WHMIS labeling

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Further information HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings Health: 2
Flammability: 0
Physical hazard: 0

NFPA ratings Health: 2
Flammability: 0
Instability: 0

Disclaimer Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s): Composition / Information on Ingredients: Disclosure Overrides
Toxicological Information: Toxicological Data
Ecological Information: Mobility in environmental media
Transport Information: Material Transportation Information

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6183**
Version #	01
Issue date	11-07-2014
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Emergency overview	May be irritating to eyes.
Potential health effects	
Eyes	May cause eye irritation.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

4. First Aid Measures

First aid procedures	
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	Not flammable by WHMIS criteria. Dust accumulation from this product may present an explosion hazard in the presence of an ignition source.
Extinguishing media	
Suitable extinguishing media	Water spray, fog, CO2, dry chemical, or alcohol resistant foam.
Protection of firefighters	
Protective equipment for firefighters	In the event of fire, wear self-contained breathing apparatus.
Fire fighting equipment/instructions	Use water spray to cool unopened containers. Dust may form an explosive mixture in the atmosphere.
Specific methods	Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.

6. Accidental Release Measures

Personal precautions	Slippery when wet.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Avoid release to the environment. Material can be slippery when wet.
Storage	Store in a dry area. Store in closed original container at temperatures between 5°C and 30°C.

8. Exposure Controls / Personal Protection

Biological limit values	No biological exposure limits noted for the ingredient(s).

Personal protective equipment

Skin protection	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	No personal respiratory protective equipment normally required.

9. Physical & Chemical Properties

Appearance	Not available.
Physical state	Solid.
Form	Not available.
Color	Off-white.
Odor	Not available.
pH	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Not available.
Specific gravity	0.7 - 0.9
Flash point	Not available.
Auto-ignition temperature	Not available.
Ph Of 1% Solution	6 - 8.5

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None under normal conditions.
Incompatible materials	Not available.
Hazardous decomposition products	Upon decomposition, this product may yield oxides of nitrogen and ammonia, carbon dioxide, carbon monoxide and other low molecular weight hydrocarbons.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6183 (CAS Mixture)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Chronic effects Not expected to be hazardous by WHMIS criteria.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6183 (CAS Mixture)			
Algae	IC50	Algae	> 1000 mg/l, 72 hr
Crustacea	EC50	Daphnia	> 200 mg/l, 48 hr
Fish	LC50	Fish	> 200 mg/l, 96 hr
Aquatic			
Fish	LC50	Zebra danio (Danio rerio)	> 100 mg/l, 96 hr

* Estimates for product may be based on additional component data not shown.

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability Not available.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Further information
HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
Health: 0
Flammability: 1
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 1
Instability: 0

Disclaimer
Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s):
Product and Company Identification: Product Review
Hazards Identification: Emergency overview
Hazards Identification: Eyes

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6324**
Version #	01
Issue date	03-31-2016
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer information	
Supplier	Veolia Water Technologies Canada Inc.
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwtcanada-hydrex@veolia.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)
Supplier	Not available.

2. Hazards Identification

Potential health effects

Routes of exposure	Eye contact. Ingestion. Inhalation. Skin contact.
Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.
Potential environmental effects	May cause long-term adverse effects in the environment.

3. Composition / Information on Ingredients

Components	CAS #	Percent
ADIPIC ACID	124-04-9	1 - 5
Other components below reportable levels		60 - 100

Composition comments None by WHMIS criteria.

4. First Aid Measures

First aid procedures

Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties Not flammable by WHMIS criteria.

Extinguishing media

Suitable extinguishing media	Not available.

Unsuitable extinguishing media	Not available.

Protection of firefighters

Specific hazards arising from the chemical	Material can be slippery when wet.
Fire fighting equipment/instructions	Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.
Hazardous combustion products	Not available.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. For personal protection, see section 8 of the MSDS. Slippery when wet.
Environmental precautions	Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. This product is miscible in water. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Material can be slippery when wet. Avoid release to the environment.
Storage	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the MSDS).

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Biological limit values	No biological exposure limits noted for the ingredient(s).

Engineering controls	Not available.
Personal protective equipment	
Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	Wear suitable protective clothing. Chemical resistant gloves.
Respiratory protection	No personal respiratory protective equipment normally required. In case of insufficient ventilation, wear suitable respiratory equipment.
Hand protection	Chemical resistant gloves.

9. Physical & Chemical Properties

Appearance	Granular or Powder.
Physical state	Solid.
Form	Solid.
Color	White.
Odor	Odorless.
pH	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Limited by viscosity
Specific gravity	Not available.
Flash point	Not available.
Flammability limits in air, upper, % by volume	Not available.
Flammability limits in air, lower, % by volume	Not available.
Auto-ignition temperature	Not available.
Bulk density	650 - 850 kg/m³
Other data	
pH in aqueous solution	7 - 9 in a 0.5% aq. sol.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Not available.
Hazardous decomposition products	Not available.
Possibility of hazardous reactions	Not available.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6324		
Acute		
Dermal		
Presumed Non-Toxic	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	> 20 mg/l, 4 hours
Oral		
LD50	Rat	> 5000 mg/kg

Components	Species	Test Results
ADIPIC ACID (CAS 124-04-9)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg
Inhalation		
NOEL	Rat	0.126 mg/l, 6 Hours
Oral		
LD50	Mouse	1900 mg/kg
	Rabbit	> 11000 mg/kg
	Rat	> 11000 mg/kg

Acute effects

Sensitization Not available.

Chronic effects Not expected to be hazardous by WHMIS criteria.

Carcinogenicity Not available.

Skin corrosion/irritation Not available.

Serious eye damage/irritation Not available.

Mutagenicity Not available.

Reproductive effects Not available.

Teratogenicity Not available.

Synergistic materials Not available.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6324			
Aquatic			
Acute			
Crustacea	EC50	Daphnia magna	> 100 mg/l, 48 hours
Fish	LC50	Danio rerio	> 100 mg/l, 96 hours

Components		Species	Test Results
ADIPIC ACID (CAS 124-04-9)			
Aquatic			
Algae	EC50	Algae	31.3 mg/l, 72 hours
Crustacea	EC50	Daphnia	85.6 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	97 mg/l, 96 hours
Acute			
Fish	EC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	> 100 mg/l, 48 hours

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Aquatic toxicity Not available.

Persistence and degradability Not available.

Partition coefficient

ADIPIC ACID 0.08

Mobility in environmental media This product is miscible in water.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Recommended restrictions PROFESSIONAL USE ONLY

HMIS® ratings
Health: 0
Flammability: 0
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 0
Instability: 0

Disclaimer Veolia Water Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Technologies' requirement.

Prepared by Hydrex Global Platform

This data sheet contains changes from the previous version in section(s):	This document has undergone significant changes and should be reviewed in its entirety.

Hydrex

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6105**
Version #	01
Issue date	08-15-2014
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Potential health effects

Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

4. First Aid Measures

First aid procedures

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	Dust accumulation from this product may present an explosion hazard in the presence of an ignition source.
Extinguishing media	
Suitable extinguishing media	Water spray, fog, CO2, dry chemical, or alcohol resistant foam.
Protection of firefighters	
Protective equipment for firefighters	In the event of fire, wear self-contained breathing apparatus.
Fire fighting equipment/instructions	Use water spray to cool unopened containers. Dust may form an explosive mixture in the atmosphere.
Specific methods	Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.

6. Accidental Release Measures

Personal precautions	Slippery when wet.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Avoid release to the environment. Material can be slippery when wet.
Storage	Store in a dry area. Store in closed original container at temperatures between 5°C and 30°C.

8. Exposure Controls / Personal Protection

Biological limit values	No biological exposure limits noted for the ingredient(s).

Personal protective equipment

Eye / face protection	Chemical goggles are recommended.
Skin protection	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	No specific recommendation made, but protection against nuisance dust must be used when the general level exceeds 10 mg/m3.

9. Physical & Chemical Properties

Appearance	Not available.
Physical state	Solid.
Form	Not available.
Color	White
Odor	Not available.
pH	Not available.
Vapor pressure	0 hPa estimated
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Not available.
Specific gravity	0.65 - 0.9
Flash point	Not available.
Auto-ignition temperature	Not available.
Ph Of 1% Solution	5 - 7

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None under normal conditions.
Incompatible materials	Not available.
Hazardous decomposition products	Upon decomposition, this product may yield oxides of nitrogen and ammonia, carbon dioxide, carbon monoxide and other low molecular weight hydrocarbons.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6105 (CAS Mixture)		
Acute		
Dermal		
LD50	Rabbit	> 10000 mg/kg
Oral		
LD50	Rat	> 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Chronic effects Not expected to be hazardous by WHMIS criteria.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6105 (CAS Mixture)			
Algae	IC50	Algae	2276 mg/l, 72 hr
Crustacea	EC50	Daphnia	> 100 mg/l, 48 hr
Other	LC50	Rainbow Trout	> 120 mg/l, 96 hr
Aquatic			
Fish	LC50	Zebra danio (Danio rerio)	> 100 mg/l, 96 hr

* Estimates for product may be based on additional component data not shown.

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability Not available.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose in accordance with all applicable regulations.

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Further information
HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
Health: 0
Flammability: 1
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 1
Instability: 0

Disclaimer
Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s):
Product and Company Identification: Product and Company Identification

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6115**
Version #	01
Issue date	03-31-2016
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer information	
Supplier	Veolia Water Technologies Canada Inc.
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwtcanada-hydrex@veolia.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)
Supplier	Not available.

2. Hazards Identification

Potential health effects

Routes of exposure	Not available.
Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.
Potential environmental effects	May cause long-term adverse effects in the environment.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

Composition comments	None by WHMIS criteria.

4. First Aid Measures

First aid procedures

Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	Not flammable by WHMIS criteria.

Extinguishing media

Suitable extinguishing media	Not available.
Unsuitable extinguishing media	Not available.

Protection of firefighters	
Specific hazards arising from the chemical	Material can be slippery when wet.
Fire fighting equipment/instructions	Use water spray to cool unopened containers.
Explosion data	
Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.
Hazardous combustion products	Not available.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. For personal protection, see section 8 of the MSDS. Slippery when wet.
Environmental precautions	Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. This product is miscible in water. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Material can be slippery when wet. Avoid release to the environment.
Storage	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the MSDS).

8. Exposure Controls / Personal Protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Engineering controls	Not available.
Personal protective equipment	
Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	Wear suitable protective clothing. Chemical resistant gloves.
Respiratory protection	No personal respiratory protective equipment normally required. In case of insufficient ventilation, wear suitable respiratory equipment.
Hand protection	Chemical resistant gloves.

9. Physical & Chemical Properties

Appearance	Granular or Powder.
Physical state	Solid.
Form	Solid.
Color	White.
Odor	Odorless.
pH	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Limited by viscosity
Specific gravity	Not available.
Flash point	Not available.
Flammability limits in air, upper, % by volume	Not available.
Flammability limits in air, lower, % by volume	Not available.

Auto-ignition temperature	Not available.
Bulk density	650 - 850 kg/m³
Other data	
pH in aqueous solution	7 - 9 in a 0.5% aq. sol.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Not available.
Hazardous decomposition products	Not available.
Possibility of hazardous reactions	Not available.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6115		
Acute		
Dermal		
Presumed Non-Toxic	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	> 20 mg/l, 4 hours
Oral		
LD50	Rat	> 5000 mg/kg

Acute effects	
Sensitization	Not available.
Chronic effects	Not expected to be hazardous by WHMIS criteria.
Carcinogenicity	Not available.
Skin corrosion/irritation	Not available.
Serious eye damage/irritation	Not available.
Mutagenicity	Not available.
Reproductive effects	Not available.
Teratogenicity	Not available.
Synergistic materials	Not available.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6115			
Aquatic			
Acute			
Crustacea	EC50	Daphnia magna	> 100 mg/l, 48 hours
Fish	LC50	Danio rerio	> 100 mg/l, 96 hours

Ecotoxicity	Contains a substance which causes risk of hazardous effects to the environment.
Environmental effects	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Aquatic toxicity	Not available.
Persistence and degradability	Not available.
Mobility in environmental media	This product is miscible in water.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Recommended restrictions PROFESSIONAL USE ONLY

HMIS® ratings
Health: 0
Flammability: 0
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 0
Instability: 0

Disclaimer Veolia Water Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Technologies' requirement.

Prepared by Hydrex Global Platform

This data sheet contains changes from the previous version in section(s):	This document has undergone significant changes and should be reviewed in its entirety.

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6408**
Version #	01
Issue date	11-07-2014
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Potential health effects

Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.
Potential environmental effects	May cause long-term adverse effects in the environment.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

4. First Aid Measures

First aid procedures

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	High concentrations of dust may form explosive mixture with air.
Extinguishing media	
Suitable extinguishing media	Dry chemical, CO2, sand, earth, water spray or regular foam.
Fire fighting equipment/instructions	In the event of fire, cool tanks with water spray.
Specific methods	Cool containers exposed to flames with water until well after the fire is out.
Explosion data	
Sensitivity to static discharge	Not available.

Sensitivity to mechanical impact	Not available.
General fire hazards	High concentration of airborne dust may form explosive mixture with air.

6. Accidental Release Measures

Personal precautions	Slippery when wet.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Avoid release to the environment.
Storage	Store in original tightly closed container. Store in accordance with local/regional/national/international regulation.

8. Exposure Controls / Personal Protection

Biological limit values	No biological exposure limits noted for the ingredient(s).
Engineering controls	Local exhaust ventilation is recommended when generating excessive levels of airborne dust or vapors from handling or thermal processing.
Personal protective equipment	
Eye / face protection	Wear safety glasses with side shields (or goggles).
Skin protection	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	Wear a dust mask if dust is generated above exposure limits.

9. Physical & Chemical Properties

Appearance	Not available.
Physical state	Solid.
Form	Powder. Granular.
Color	White
Odor	Not available.
pH	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Not available.
Specific gravity	Not available.
Flash point	Not available.
Auto-ignition temperature	Not available.
Bulk density	0.7 g/cm^3

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None under normal conditions.
Incompatible materials	Not available.
Hazardous decomposition products	Upon decomposition, this product may yield gaseous nitrogen oxides, carbon monoxide, carbon dioxide and/or low molecular weight hydrocarbons.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6408 (CAS Mixture)		
Acute		
Dermal		
LD50	Rat	> 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Chronic effects Not expected to be hazardous by WHMIS criteria.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6408 (CAS Mixture)			
Crustacea	EC50	Daphnia	< 10 mg/l, 48 hr
Fish	LC50	Fish	< 10 mg/l, 96 hr

* Estimates for product may be based on additional component data not shown.

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability The product is not readily biodegradable.

Bioaccumulation / Accumulation Will not bio-accumulate.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes

Country(s) or region	Inventory name	On inventory (yes/no)*
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Further information
HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
Health: 1
Flammability: 1
Physical hazard: 0
Personal protection: B

NFPA ratings
Health: 1
Flammability: 1
Instability: 0

Disclaimer
Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s):
Product and Company Identification: Product Review

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6412**
Version #	01
Issue date	01-25-2016
Supersedes date	01-25-2016
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer information	
Supplier	Veolia Water Technologies Canada Inc.
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwtcanada-hydrex@veolia.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)
Supplier	Not available.

2. Hazards Identification

Emergency overview WARNING

Potential health effects

Routes of exposure	Inhalation. Ingestion. Skin contact. Eye contact.
Eyes	Causes eye irritation. Do not get this material in contact with eyes.
Skin	Prolonged contact may cause dryness of the skin.
Inhalation	Prolonged inhalation may be harmful. Do not breathe dust/fume/gas/mist/vapors/spray.
Ingestion	May cause irritation. Do not ingest.

Potential environmental effects Components of this product are hazardous to aquatic life. May cause long-term adverse effects in the environment.

3. Composition / Information on Ingredients

Non-hazardous components	CAS #	Percent
ADIPIC ACID	124-04-9	1 - 5
Other components below reportable levels		60 - 100

4. First Aid Measures

First aid procedures

Inhalation	Move to fresh air. If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. For minor skin contact, avoid spreading material on unaffected skin.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes.
Ingestion	Rinse mouth thoroughly. Drink plenty of water. If ingestion of a large amount does occur, call a poison control center immediately. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Do not use mouth-to-mouth method if victim ingested the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.

Notes to physician Symptoms may be delayed.

General advice Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire Fighting Measures

Flammable properties Not flammable by WHMIS criteria.

Extinguishing media

Suitable extinguishing media Dry chemical powder. Carbon dioxide (CO2). If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist. Apply extinguishing media carefully to avoid creating airborne dust.

Unsuitable extinguishing media Not available.

Protection of firefighters

Specific hazards arising from the chemical Material can be slippery when wet.

Fire fighting equipment/instructions Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge Not available.

Sensitivity to mechanical impact Not available.

Hazardous combustion products Carbon dioxide (CO2). Carbon monoxide.

6. Accidental Release Measures

Personal precautions Keep unnecessary personnel away. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering them. For personal protection, see section 8 of the MSDS. Slippery when wet.

Environmental precautions Prevent further leakage or spillage if safe to do so. Do not contaminate water.

Methods for cleaning up Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling Material can be slippery when wet. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get this material in contact with eyes. Do not get this material in contact with skin. Avoid prolonged exposure. Do not get this material on clothing. Do not use in areas without adequate ventilation. Wear personal protective equipment. Wash thoroughly after handling. Avoid release to the environment.

Storage Store in a closed container away from incompatible materials. Store in a well-ventilated place. Keep container dry. Store away from incompatible materials (see Section 10 of the MSDS).

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Biological limit values No biological exposure limits noted for the ingredient(s).

Engineering controls Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Ensure adequate ventilation, especially in confined areas.

Personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection Chemical resistant gloves.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Hand protection Chemical resistant gloves.

9. Physical & Chemical Properties

Appearance Not available.

Physical state Solid.

Form Solid. Beads.

Color Off-white.

Odor Odorless.

pH Not available.

Vapor pressure Not available.

Vapor density Not available.

Boiling point Not available.

Melting point/Freezing point Not available.

Solubility (water) Forms viscous solution

Specific gravity 0.65 - 0.9

Flash point Not available.

Flammability limits in air, upper, % by volume Not available.

Flammability limits in air, lower, % by volume Not available.

Auto-ignition temperature 770 °F (410 °C)

Bulk density 800 kg/m³

Other data

Dust explosion properties

Kst 0 - 200 bar.m/s (St 1)

Miscible (water) 10 g/l

pH in aqueous solution 3 - 5

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Strong acids, alkalies and oxidizing agents.
Hazardous decomposition products	Not available.
Possibility of hazardous reactions	Not available.

11. Toxicological Information

Toxicological data

Product	**Species**	**Test Results**
Hydrex 6412		
Acute		
Inhalation		
NOEL	Rat	3.15 mg/l, 6 Hours Calculated
Oral		
LD50	Rat	> 5000 mg/kg

Components	**Species**	**Test Results**
ADIPIC ACID (CAS 124-04-9)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg
Inhalation		
NOEL	Rat	0.126 mg/l, 6 Hours
Oral		
LD50	Mouse	1900 mg/kg
	Rabbit	> 11000 mg/kg
	Rat	> 11000 mg/kg

Acute effects

Sensitization	Not available.
Chronic effects	Not expected to be hazardous by WHMIS criteria. Prolonged inhalation may be harmful.
Carcinogenicity	Not available.
Skin corrosion/irritation	Not available.
Serious eye damage/irritation	Not available.
Mutagenicity	Not available.
Reproductive effects	Not available.
Teratogenicity	Not available.
Synergistic materials	Not available.

12. Ecological Information

Ecotoxicological data

Product		**Species**	**Test Results**
Hydrex 6412			
Aquatic			
Acute			
Crustacea	EC50	Daphnia	10 - 100 mg/l, 48 hours
Fish	LC50	Fish	1 - 10 mg/l, 96 hours

Components		Species	Test Results
ADIPIC ACID (CAS 124-04-9)			
Aquatic			
Algae	EC50	Algae	31.3 mg/l, 72 hours
Crustacea	EC50	Daphnia	85.6 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	97 mg/l, 96 hours

Ecotoxicity Components of this product are hazardous to aquatic life.

Environmental effects Harmful to aquatic organisms. An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Aquatic toxicity Not available.

Persistence and degradability Not available.

Partition coefficient

ADIPIC ACID 0.08

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Controlled

WHMIS classification D2B - Other Toxic Effects-TOXIC

WHMIS labeling

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes

Country(s) or region	Inventory name	On inventory (yes/no)*
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Recommended restrictions PROFESSIONAL USE ONLY

HMIS® ratings
Health: 2
Flammability: 1
Physical hazard: 0

NFPA ratings
Health: 2
Flammability: 1
Instability: 0

Disclaimer Veolia Water Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Technologies' requirement.

Prepared by Hydrex Global Platform

APPENDIX C. WATER RESEARCH PAPER DESCRIBING THE ACTIFLO® ADAPTED JAR-TEST PROCEDURE

PERGAMON

Water Research 36 (2002) 744–754

WATER RESEARCH

www.elsevier.com/locate/watres

Laboratory study of ballasted flocculation

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Received 1 July 1999; received in revised form 1 April 2001; accepted 1 April 2001

Abstract

Ballasted flocculation is applied successfully in the water treatment industry, but the concept has not yet been subject to extended experimental studies. The use of a microsand and a polymer together to increase the weight of the flocs and the rate at which they settle is radically changing the coagulation–flocculation-settling methodology. The objective of this research is to study ballasted flocculation in the laboratory by means of a modified jar-test procedure. The first tests, conducted using a statistical approach, enabled us to identify those parameters that have a significant influence on the quality of settled water. The principal treatment parameters considered in this study were the chemical dosage, the contact times in the different basins, the pH of coagulation and the dosage of microsand. The parameters used to evaluate the quality of the settled water, and hence treatment performances, were turbidity, UV absorbance, TOC and membrane filterability. The results showed that the coagulant dosage and the coagulation pH have a preponderant effect on the variability of the quality of the settled water. By contrast, filterability as measured by the laboratory filter tests, was found to be more sensitive to coagulant and microsand dosages. It was dependent on the ratio of microsand to polymer dosage, and improved when this ratio increased. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Ballasted flocculation; ACTIFLO®; Cold water; Microsand; Filterability; Statistical experimental design

1. Introduction

Most drinking water plants, which treat surface waters, use coagulation–flocculation-settling and filtration, with the objective of removing a large proportion of the colloids and organic matter contained in raw waters. Over the past 30 years, a number of technological innovations have led to substantial space reduction [1]. A more recent innovation involves ballasted flocculation [2]. This process, trade-named ACTIFLO®, was introduced in the 1990s. The weight of the flocs is increased by causing the attachment of grains of high-density microsand (about 2700 kg/m^3) [2]. The quality of water produced by this process is equal to or better than that of the current conventional treatment [1] and requires less space. This new treatment concept was developed by OTV, France, and is shown in Fig. 1. The process takes place in four tanks, one for each part of the process: coagulation, injection of microsand and polymer, maturation of flocs and lamella settling.

At common design conditions, the rapid mixing tank (coagulation) allows for two minutes contact time. The coagulated water then enters the injection basin where polymer and microsand are introduced simultaneously. A 2-min contact time is allowed to initiate flocs formation. Both the coagulation and injection tanks are equipped with mixers which provide high mixing intensity. The flocs grow up in the "maturation tank" which allows for 6 min contact time at a lower mixing intensity. The average design criteria of the ACTIFLO® unit is based on a 40 m^3/h/m^2 of projected surface in the

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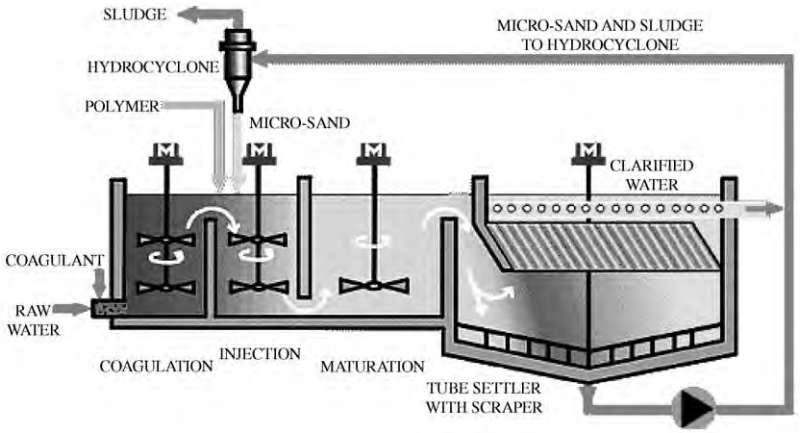

Fig. 1. Schematic description of the ACTIFLO® process.

settling tank. This corresponds to a 2–2–6–3 design, which means 2 min detention time in the coagulation tank, 2 min in the flocculation tank, 6 min of maturation and finally 3 min in the settling tank. The settled mixture of sludge and microsand is recirculated, and the microsand is separated from the sludge by the intense vortex created in a hydrocyclone and then redirected into the injection tank in order to maintain a typical microsand concentration of between 2 and 4 g/L. The microsand-free sludge is diverted into the sewer.

Since its introduction in the 1990s, the use of the ACTIFLO® process in the drinking water industry is constantly on the increase. Table 1 summarises the geographical location of full-scale plants using ACTIFLO® by the year 2000.

The aim of this study is to validate a lab-scale method that allows prediction of the performances of the ACTIFLO® process for different raw water characteristics and treatment parameters. Such a method should help reduce the number of pilot-scale or full-scale tests resulting in substantial savings during plant design and optimisation. In the present case, the laboratory method used is a jar test that is modified to take into account the sequence of addition of coagulant, microsand and polymer.

The results of these tests are used to explain the effects of a number of control parameters or treatment variables (coagulant and polymer dosages, coagulation pH, microsand dosage, contact times and temperature) on process performances. The study is divided into three stages: (1) verify whether or not the performance of the full-scale ACTIFLO® process may be accurately described by a modified jar test; (2) identify the parameters that have the most influence on ballasted flocculation and (3) study the effects of polymer and microsand dosages on process performances.

Table 1
Geographical allocation of the plants using the full-scale ACTIFLO® process in the drinking water industry at the end of 2000

Country	No. of installations	Capacity range (m^3/d)
Canada	25	720–240,000
France	19	1440–800,000
United States	25	1300–151,000
Great Britain	6	7000–270,000
Malaysia	1	1000,000
Denmark	1	2880
Turkey	2	230,000–318,000

2. Current state of knowledge

2.1. Effects of pH and temperature on coagulation–flocculation-settling

The objective of coagulation is to destabilise particles and natural organic matter in order to favour aggregation and physical removal by settling and filtration. The two most widely used types of coagulants are aluminium salts and iron salts, such as aluminium sulphate and ferric chloride. pH and temperature have a significant impact on the efficiency of the coagulation process. The rates of chemical reactions decrease as the temperature drops. In order to ensure complete reaction of the coagulants without an increase in retention time (hence tank size), pre-hydrolysed and pre-polymerised coagulants are often used at low temperature. The most common of these are polyaluminosulphate (PAS), polyaluminosulphate silicate (PASS), polyaluminochloride (PACl) and SPIC, which is a mixture of pre-hydrolysed aluminium sulphate and ferric chloride [3].

A number of researchers [4–8] have shown that each coagulant requires an optimal pH range. This zone corresponds to a minimal solubility of the coagulant, and thus to a minimal concentration of dissolved metals in the water. Some [7] have compared the performances of alum and PACl at 25°C and at 4°C, and shown that the optimal coagulation pH varies as a function of temperature for alum: pH 6 at 25°C and pH 6.8 at 4°C. According to Camp et al. [9], weak coagulation performance in cold water is also due to the poor dispersion of coagulant associated with increased water viscosity, which results in a reduction in the settling velocity of particles. These authors propose two solutions: (1) increase the mixing intensity to improve dispersion and agglomeration and (2) increase pH to minimise solubility of the coagulant.

2.2. Ballasted flocculation

The ACTIFLO® process has previously been described by Plum et al. [10]. The method has been applied to the treatment of surface water to produce drinking water around the world, the capacity of the units being as high as 800,000 m^3/d [11,1]. The process has proved to be efficient and stable enough to meet treatment standards, even under great load variations [11]. Besides coagulant, ballasted flocculation requires the addition of microsand and a polymer. The polymer helps the microsand become attached to the flocs. Dianous and Dernaucourt [12] compared the kinetics of floc formation in the conventional processes to those in the ballasted flocculation process. They showed that during ballasted flocculation the speed gradient G could be as high as 700/s without floc breakage, while in conventional flocculation it is lower by a factor of ten. Although the mixing intensity could be increased up to 700/s during floc maturation, in the full-scale systems the G values are more typically of the order of 160–200/s. This low mixing intensity proved to be adequate, besides being cost-effective. The impellers provide good mixing, which keeps all the ballasted flocs in suspension. The ballasted flocs are heavier than they are in the conventional system, which increases the settling velocity in the lamella separator. The settled ballasted sludge is pumped to a hydrocyclone, where the microsand is recovered for in-line reuse in the injection tank. The recycled flow typically makes up 6% of the total water flow treated [10]. The microsand-free sludge is sent to the sewer or to the sludge treatment units. The flocs produced in conventional treatment seem to be more fragile than ballasted flocs. Dianous and Dernaucourt [12] also showed that the time required for an 80% removal of turbidity drops from 10 to 3 min when conventional flocculation is replaced with ballasted flocculation. For optimal efficiency, they propose that the effective size of microsand be less than 160 μm, in accordance with what had previously been suggested by Guibelin [2]: 100 μm. Typical microsand dosages in the injection tank range from 2 to 4 kg/m^3.

3. Equipment and methods

3.1. Description of the modified jar-test procedure

The tests were conducted using a modified jar-test method: transparent 1-L beakers were placed on a programmable standard jar test apparatus (Phipps and Bird, Richmond, Virginia) designed to reach a rotation speed of 300 rpm and equipped with a single, flat impeller. In each beaker, the impeller was lowered in order to reach a distance less than 3 mm from the bottom of the beaker, to ensure that the ballasted flocs were maintained in suspension. The various products (coagulants, coagulation aids, microsand and polymer) were added in the same order as in the full-scale plant. The elapsed times between additions of the various chemicals were calculated to match the treatment conditions at the plants simulated. The duration of coagulation, injection and maturation for the full-scale installation was simply duplicated in the laboratory. Since lamellar settling cannot be reproduced in jar tests, preliminary tests were performed on the settling time necessary to achieve good settled water quality. The results showed that 15 s were sufficient but a 3-min settling time was kept for more practical reasons. In the laboratory procedure, stirring of the raw water in the beakers was initiated and coagulant injected at time zero. The pre-weighted amount of microsand was introduced 2 min later, along with 30–70% of the required polymer dosage (% depends on the plant simulated). After 2 min of mixing, the residual polymer (70–30%) was added and allowed a 6-min maturation. A constant mixing was maintained at 150 rpm (G in the range of 95/s) from coagulation to maturation. The mixing was then stopped and the flocs allowed to settle. Finally, the required volume of settled water was siphoned from 6 cm below the surface for analysis. Turbidity, TOC and UV were then measured directly on the collected settled water whereas a 200-mL volume of the settled water was filtered through a 0.45 μm membrane to assess membrane filterability.

3.2. Chemicals

The following coagulants and polymers were used during the tests:

- liquid alum, $Al_2(SO_4)_3 \cdot 14H_2O$ (density = 1.32–1.33; 8.3% Al_2O_3; <0.07% of insoluble substances; provided by Alcan Corp., Québec, Canada).

- Polyaluminium silicate sulphate, PASS-100®, polymerised inorganic coagulant, cationic and high molecular weight (density = 1.32–1.34; 10.0% Al_2O_3; <0.07% of insoluble substances; provided by Eaglebrook, Montreal, Canada).
- Aquafloc™ 464 (cationic, high molecular weight organic polymer provided by BetzDearborne Inc., Québec, Canada).
- Percol™ LT-27 (medium anionic organic polymer provided by Ciba Chemical Products, Québec, Canada).

Where pH adjustment was required, preliminary tests were performed in order to predetermine the amounts of acid or alkali required prior to coagulation. Two types of microsand were used, with effective diameters of 85 and 110 μm (John Meunier Inc., Quebec, Canada).

For tests on cold water, the beakers were placed in containers filled with water and ice in order to reach the desired temperature. When very low temperatures were required, the beakers were stored in a freezer at −22°C for 20 min. Under these conditions, the raw water rapidly reaches a temperature between 0°C and 1°C. The ice bath maintained the temperature of the water between 1°C and 2°C during the test.

3.3. Analytical methods

Water quality parameters were measured using standard methods [13]:

- Turbidity: method 2130 B, (Turbidimeter HACH 0-200, John Meunier Inc, Quebec, Canada).
- TOC: method 5310c, (UV-persulphate oxidation—Dorhman-180).
- UV absorbance: measured at 254 nm using a Milton Roy SPECTRONIC 1001 Plus spectrophotometer with a quartz cell having a 10-mm optical length.

Specific ultra violet absorbance (SUVA) is an index corresponding to the ratio of UV absorbance (as 1/m) to TOC (as mg C/L).

- Settled water filterability was determined using an ad hoc method. It was defined as the time required (min) for a given volume (200 mL) of settled water to pass through a 0.45 μm AcetatePlus™ filter (Fischer, Quebec, Canada) under a constant vacuum of 640 mm of mercury.

3.4. Experimental approaches

To meet the three objectives of this research, three experimental approaches were employed.

3.4.1. First approach: laboratory method to predict full-scale ballasted flocculation performance

The modified jar-test procedure (lab-scale) was used to predict ballasted flocculation (full-scale) performances. The actual dosages of chemicals and the contact times at the full-scale systems are duplicated during the laboratory tests.

3.4.2. Second approach: statistical design

The second study aimed at identifying the critical parameters in ballasted flocculation. The statistical experimental approach provides useful and critical information on ballasted flocculation and reveals the relative importance of each of the control parameters considered. Another major advantage is a significant reduction in the number of tests to be conducted, which is achieved by using a fractional factorial design. These designs are much more useful than the one-factor-at-a-time designs that are unable to detect interaction effects. However, caution must be exercised with respect to the choice of the ranges of variation of the control parameters: too wide or too narrow a range can significantly affect the impact of a control parameter on the response parameters.

The seven control parameters listed in Table 2 have been identified as possible key parameters affecting the response parameters. The main response parameters are turbidity, total organic carbon (TOC), UV absorbance and membrane filterability. The complete 2-level factorial design for seven parameters would have required $2^7 = 128$ runs. The statistical design given in Table 2 is a fractional design with coded coefficients, which are unit free $(-1, 0, 1)$ for each of the control parameters. The coefficients −1 and 1 indicate that the value tested is less than or greater than the reference coefficient coded 0. The reference values may vary for each plant; hence, the reference pH values are 6.6, 7.4 and 7.0 for plants #1, 2 and 3. For plant #1, the range of variation of pH is 6.6 ± 0.3 which means that the tests were performed at pH 6.3 (coded −1), pH 6.6 (coded 0) and pH 6.9 (coded 1). The same reasoning is applied to Runs #1 through 17 in Table 2. The 16 runs of the 2-level statistical design (−1 and 1) were replicated once (total 32 runs). Five (5) identical runs (#17) using mid-values (0) for each control parameters are added to the 32 runs, for a total 37 runs.

For each of the output response parameters Y (turbidity, TOC, UV absorbance and filterability), the data may be analysed with a second-order polynomial model:

$$Y = \beta_0 + \sum_{j=1}^{7} \beta_j x_j + \sum_{j \neq j'} \sum \beta_{jj'} x_j x_{j'}, \quad (1)$$

where x_j are the input parameters in coded form. There are several ways to present the results. A Pareto chart of the effects (main effects and interactions) gives a visual

Table 2
Statistical experimental design with coded value matrix (unit-free) and range of variation of the control parameters

Run#	Replicates	Coagulant dosage	Polymer dosage	pH	Coagulation time	Flocculation time	Settling time	MS[a] dosage
1	2	−1	−1	−1	−1	−1	−1	−1
2	2	1	−1	−1	−1	−1	1	1
3	2	−1	1	−1	−1	1	−1	1
4	2	1	1	−1	−1	1	1	−1
5	2	−1	−1	1	−1	1	1	1
6	2	1	−1	1	−1	1	−1	−1
7	2	−1	1	1	−1	−1	1	−1
8	2	1	1	1	−1	−1	−1	1
9	2	−1	−1	−1	1	1	1	−1
10	2	1	−1	−1	1	1	−1	1
11	2	−1	1	−1	1	−1	1	1
12	2	1	1	−1	1	−1	−1	−1
13	2	−1	−1	1	1	−1	−1	1
14	2	1	−1	1	1	−1	1	−1
15	2	−1	1	1	1	1	−1	−1
16	2	1	1	1	1	1	1	1
17	5	0	0	0	0	0	0	0
Range of variation[b]								
TP1		9.3±2.5	0.4±0.15	6.6±0.3	4±1	4±1	6±1.5	3±2
TP2		2.2±1.2	0.1±0.05	7.4±0.4	3±0.75	3±0.75	4±1	3±2
TP3		6.1±2.2	0.4±0.2	7.0±0.4	3±1.2	3±1.2	4±1.6	3±2
Units		mg/l as Al_2O_3	mg/l		min	min	min	mg/l

[a] MS = Microsand.
[b] These ranges represent the conditions applied on full-scale and the range of variation. Example: for TP1 the pH values in the laboratory tests were 6.6 (coded 0), 6.3 (coded –1) and 6.9 (coded 1).

representation of the analysis of variance decomposition. An example of such a Pareto chart is given in Fig. 4. This type of representation allows determination of the extent to which any input parameter or group of parameters contributes to the variability of the results.

3.4.3. Third approach: a case study of a complete 4-level factorial design

From the second experimental approach, microsand and polymer were shown to be the most important parameters in their effect on the filterability of settled water as measured by laboratory membrane filter tests. In the third approach, a complete factorial design is applied to these parameters (four values each), for a total of sixteen tests.

4. Results and discussion

4.1. Impact of laboratory settling time on water quality

The modified jar-test procedure was set up to preserve the retention times in each basin. However, full-scale hydraulics and dynamics cannot be reproduced in a jar.

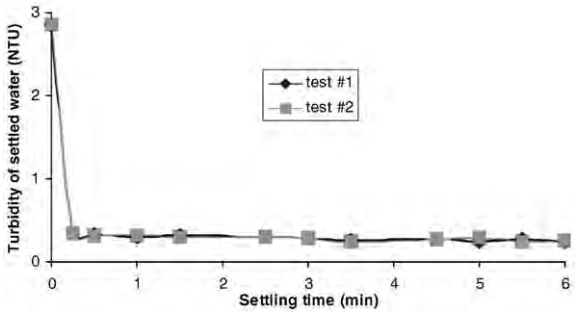

Fig. 2. Evolution of the turbidity of settled water versus the settling time during two duplicate tests.

Hence, preliminary tests were performed to determine the impact of the settling time on turbidity removal efficiency. To do this, turbidity was measured for various settling times and plotted in Fig. 2. Due to the practical delay in sampling, the first sample was collected after 15 s of settling; however, visual observations showed that settling of microsand weighted flocs occurred within 3–5 s following the end of mixing. Fig. 2 shows that settled water final turbidity is reached in a very short period of time; this will be confirmed in

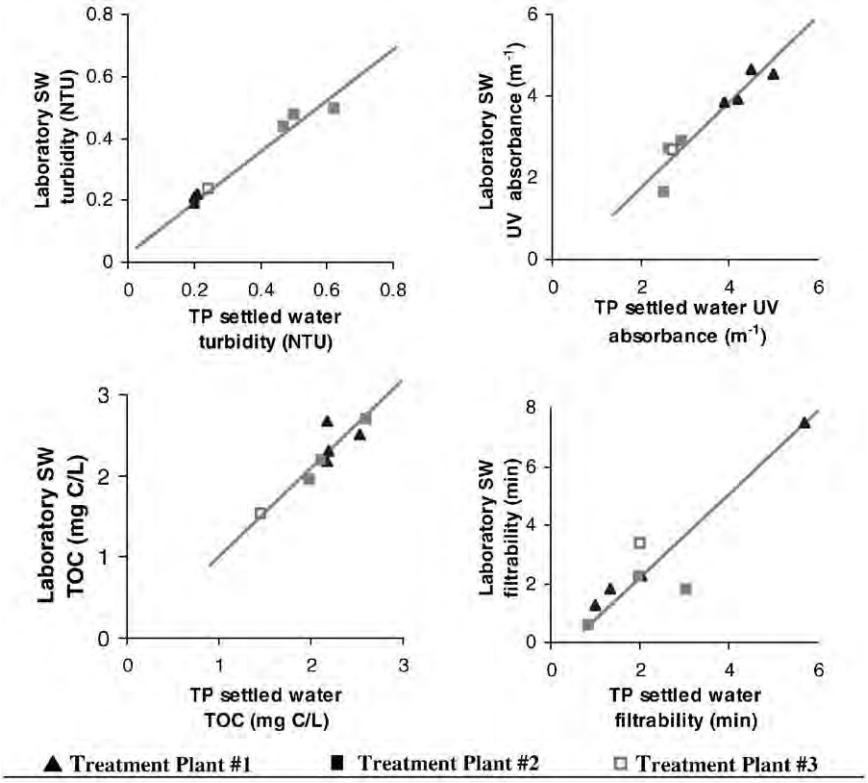

Fig. 3. Simulations of various treatment plants using ballasted flocculation (TP = treatment plant; SW = settled water).

Table 4 where settling time never appeared as a key parameter.

4.2. Laboratory evaluation of full-scale ballasted flocculation

To evaluate the capacity of the jar-test method to predict ballasted flocculation results, the modified jar-test procedure was applied to three types of raw water from the three selected plants where ballasted flocculation technology was applied. The characteristics of these waters are described in Table 3. The same dosages and contact times applied at the plants were accurately replicated in the laboratory. The characteristics of the settled water from full-scale and the lab method are compared in Fig. 3. This comparison reveals that there is a good fit between lab results and full-scale results in terms of turbidity, UV absorbance and TOC of settled water; the percentages of variance between the two sets of results is less than 7%. It should be noted that settled water samples from full-scale settlers and from the jar test did not undergo any other treatment before turbidity, TOC, UV absorbance and membrane filterability were measured.

The aim of the laboratory method was not to recreate the mixing regime applied at full scale; this is not feasible anyway, since many factors are different: impeller design, shape of beaker, lamella in the clarifier, upflow velocity, etc. Thus in the lab method, the mixing intensity was maintained constant from coagulation through maturation to keep the simulation method simple. The results in Fig. 3 confirm that these mixing conditions were appropriate and reproduction of the exact full-scale velocity gradient was not required.

The good fit proves the effectiveness of microsand in ballasting micro-flocs, and hence in ensuring a minimum variation in the quality of settled water between the laboratory and the full-scale plant. As observed, ballasted flocculation is much less sensitive to settling time than conventional techniques, and helps explain the good correlation between full-scale operation and bench-scale experiments. In conventional systems, the occurrence of light micro-flocs in settled water makes the quality of settled water highly dependent on settling time.

As stated earlier, filterability is measured using an ad hoc method. Contrary to the other parameters, the membrane filterability results varied from 3% to 70% when applied to settled water from laboratory jar tests

Table 3
Mean characteristics of raw waters and some operational parameters at the time of simulation

Treatment plant #	1		2		3
Location	St-Jérôme, Qc		St-Lambert, Qc		St-Anselme, Qc
Temperature of raw water (°C)	10	4	9	4	1
Turbidity (NTU)	1.9	2.2	1.4	2.8	0.6
Alkalinity (mg $CaCO_3$/L)	26	30	87	100	29
pH	7.1	7	8	7.9	7
Colour (apparent colour unit)	40	47	5	5	15
UV absorbance (1/m)	20.7	21.8	4.4	5.5	10.4
TOC (mg/L)	5.0	4.9	2.5	2.5	3.0
SUVA (L/mg/m)	4.14	4.4	1.76	2.2	3.4
Operation parameters					
Coagulant type	Alum	Alum	Alum	Alum	PASS
Coagulant dose (as mg/L Al_2O_3)	9.3	9.3	2.2	2.2	6.1
Polymer type	Aquafloc 464	Aquafloc 464	Percol LT-27	Percol LT-27	Percol LT-27
Polymer dosage (mg/L)	0.3	0.3	0.1	0.1	0.4
NaOH dosage (mg/L)	18	18	—	—	—
pH of coagulation	6.7	6.8	7.2	7.2	7
Microsand effective size (μm)	85	85	110	110	85
Microsand dosage (g/L)	3	3	3	3	3
Hydraulic loading rate ($m^3/m^2/h$)	20	20	30	30	30

versus settled water from the full-scale. However, the membrane filterability measurements, are highly repeatable when applied to the same sample. Polymer residuals or the type of turbidity found in the settled water of both scales of treatment could well explain the difference between the measurements. Particle counts and a more detailed characterisation of the settled water could help in understanding such discrepancies.

4.3. Statistical design: key input control parameters

The key input control parameters considered for each of the three treatment plants are given in Table 4.

In general, no common input parameters were found to have a decisive impact on the quality of settled water; the treatment conditions should therefore be considered site-specific. However, certain parameters appear more frequently in Table 4: alum dosage, coagulation pH, microsand dosage and coagulation time. Microsand dosage emerged to have an important impact on the settled water quality mainly on membrane filterability. In fact, the role of microsand is unquestionable since ballasted flocculation is based on the use of microsand and polymer.

4.3.1. Treatment plant #1

For plant 1, the coagulant dosage explains most of the variation in turbidity, UV absorbance and TOC. For these three response parameters, the coagulant dosage is the key parameter to control in order to improve treatment performance, independent of the raw water temperature. The seasonal variation of the impact of alum on the removal of TOC may be ascribed to temperature-variable kinetics and reaction mechanisms, and also to the different forms of organic matter according to the temperature. These results are in agreement with the usual observations made at the plant, and confirm that optimising the coagulant dosage is essential in achieving an effective clarification.

4.3.2. Treatment plant #2

The characteristics of the raw water at plant #2 are different from those at plant #1. The results obtained are also different. Here, the coagulant dosage has very little impact on the quality of the settled water.

The results on plant #2 are not very conclusive because of the characteristics of the raw water: low values of turbidity, colour and low SUVA index. The results confirm the conclusions of Van Benschoten and Edzwald [14] that a SUVA index in the order of 2 or less indicates a low effectiveness for removal of organics. In such a case, the impacts of the parameters on treatment performances are somewhat unpredictable.

4.3.3. Treatment plant #3

At plant #3, the tests were carried out during winter. The characteristics of the raw water were quite similar to those at plant #1. The SUVA index, 3 L/mg/m, is considered to be moderately high according to Van Benschoten and Edzwald [14], while turbidity and

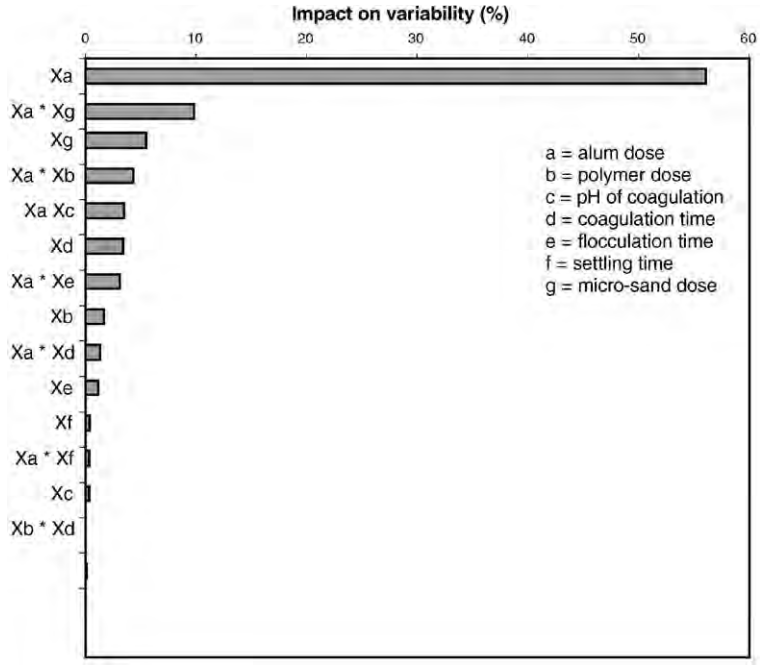

Fig. 4. Pareto chart to explain the % of variability of turbidity removal due to each control parameter and interactions (TP #1, St Jérôme).

Table 4
Key input parameters having an impact on water quality[a]

Treatment plant #	1		2		3
Location	St-Jérôme, Qc		St-Lambert, Qc		St-Anselme, Qc
Settled water parameters (output variables)	Most important operational parameters (input variables)				
	Warm water	*Cold water*	*Warm water*	*Cold water*	*Cold water*
Turbidity	Alum dosage (56%)	Alum dosage (58%)	MS (72%)	No significant parameter	Coagulation time (49%)
	MS[b] Alum (10%)	pH of coagulation (9%)			Flocculation time (19%)
TOC	Alum dosage (73%)	Alum dosage (12%)	pH of coagulation (35%)	No significant parameter	Flocculation time (19%)
UV	Alum dosage (31%)	Alum dosage (32%)	MS (51%)	No significant parameter	Coagulation time (48%)
			pH of coagulation (30%)		Flocculation time (20%)
Filterability	MS (38%)	MS (38%)	pH of coagulation (17%)	pH of coagulation (30%)	MS (65%)
	Alum dosage (36%)				Coagulation time (15%)

[a] The data in parentheses are the contribution (in %) of a given input variable (operational parameter) to the variation of a given output parameter (settled water quality).

[b] MS = microsand dosage.

alkalinity remain low. A particular feature of this plant is the use of a pre-hydrolysed coagulant, PASS-100. Statistically, almost 50% of turbidity and UV removal are explained by the coagulation time. This result at first appears surprising, since pre-hydrolysed coagulants were developed mainly for use in cold water conditions. However, the differences in the hydraulic loading rates must be considered: 30 m/h hydraulic loading rate in plant #3 versus 20 m/h for plant #1. This means that the contact times in coagulation, injection, maturation and settling tanks in plant #1 are 4, 4, 12 and 6 min versus 2.7, 2.7, 5.3 and 4 min for plant #3.

Based on Table 4, coagulation time and flocculation time are the most significant parameters at 4°C: as reaction kinetics decrease when temperature drops, a longer contact time will favour floc growth in cold water.

5. Case study of a complete 4-level factorial design: influence of microsand and polymer dosages

The principle of ballasted flocculation is rigorously associated with the use of microsand and polymer. Their impact on the quality of settled water is studied in the laboratory on the raw water from plant #1.

Four dosages of microsand were applied (1, 3, 5 and 7 mg/L). The results (Fig. 5) show that the best performances are achieved with a dosage of microsand of around 5 g/L, which confirms the conclusions derived from the statistical analysis. This dosage is higher than those commonly applied at full-scale (3 mg/L on average). According to Fig. 5, the overall benefit of increasing microsand to 5 mg/L is marginal and does not justify such additional expenses. Moreover, an excess of microsand (7 mg/L) would cause erosion of the flocs, while low dosages (1 mg/L) would result in a poor ballasting effect.

No correlation seems to exist between turbidity and membrane filterability (Figs. 5a and d). The degradation in filterability observed in the laboratory for high dosages of polymer may be caused by post-flocculation on the membranes used in the ad hoc method to assess filterability. One can hypothesise that the excess polymer would trap the coagulated particles present in the settled water by bridging them on the membrane and clog it. Under these conditions, an increase in the dosage of microsand would cause the residual polymer to be consumed and eliminated during settling and hence result in better filterability. This is the reason why for low dosages of polymer, the effect of the dosage of microsand is negligible. It should be noted that the presence of an excess of microsand does not directly degrade membrane filterability, since it is eliminated during settling. For each polymer dosage, Fig. 5d shows that membrane filterability improves with increasing

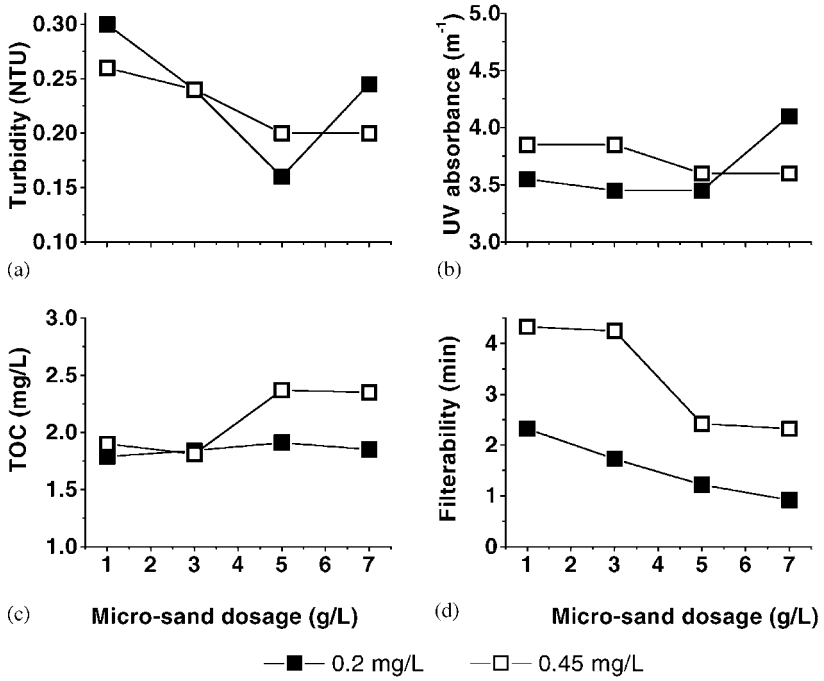

Fig. 5. Settled water quality parameters versus microsand dosage for two different polymer dosages. (a) Turbidity; (b) UV absorbance; (c) TOC; (d) Filterability.

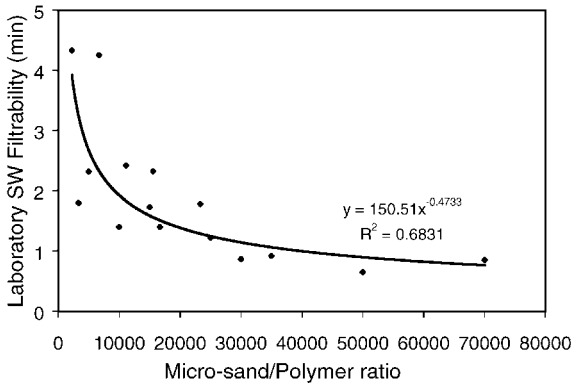

Fig. 6. Settled water membrane filterability versus microsand/polymer ratio.

dosages of microsand. This trend is showed in Fig. 6, where filterability is plotted as a function of the microsand to polymer dosage ratio. For low ratios (below 15,000), filterability is poor, which means that a low dosage is ineffective if a high dosage of polymer is applied. However, high ratios (above 30,000) improve membrane filterability of the settled water.

6. Conclusions

This study has permitted the development of a laboratory methodology that predicts the performance of ballasted flocculation. The ballasted flocculation technology is based on the addition of microsand and polymer during coagulation–flocculation. Three drinking water production plants using the ballasted flocculation process were studied. The modified jar-test procedure was able to predict the performance of the full-scale process with good accuracy.

The use of an optimised statistical approach enables identification of the principal parameters controlling ballasted flocculation through a reduced number of experiments. Besides the microsand and polymer, the major parameters were the coagulant dosage and the pH of coagulation, as in conventional coagulation–flocculation-settling. In both conventional systems and in the ACTIFLO® process, coagulation is not very efficient for raw waters with a low SUVA (UV absorbance to TOC ratio).

No evident correlation was found between the turbidity and membrane filterability of settled water as measured by laboratory membrane filter tests. Membrane filterability is mainly affected by the microsand to polymer ratio; it improves for high ratios. Ballasted flocculation is a dynamic physical process which ensures high stability of the quality of settled water undergoing reasonable changes in operational parameters. This is likely due to the use of microsand which satisfactorily eliminates the micro-flocs that are most often responsible for degradation in the quality of settled water in conventional clarifiers.

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Appendix B: Material Safety Data Sheets for WTP Reagents

Yukon
Government

Hydrex

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name	**Hydrex 6183**
Version #	01
Revision date	08-04-2011
CAS #	Mixture
Product use	Flocculant
Manufacturer	
Supplier	John Meunier Inc
Address	4105, rue Sartelon H4S 2B3 Saint-Laurent, Qc Canada
Contact Person	Hydrex Product Specialist
Telephone	+1 514 334 7230
Fax	+1 514 334 5070
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Potential health effects

Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

4. First Aid Measures

First aid procedures

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	Not flammable by WHMIS criteria. Dust accumulation from this product may present an explosion hazard in the presence of an ignition source.
Extinguishing media	
Suitable extinguishing media	Water spray, fog, CO2, dry chemical, or alcohol resistant foam.
Protection of firefighters	
Protective equipment for firefighters	In the event of fire, wear self-contained breathing apparatus.
Fire fighting equipment/instructions	Use water spray to cool unopened containers. Dust may form an explosive mixture in the atmosphere.

VEOLIA WATER Solutions & Technologies

Specific methods Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge Not available.

Sensitivity to mechanical impact Not available.

6. Accidental Release Measures

Personal precautions Slippery when wet.

Environmental precautions Prevent further leakage or spillage if safe to do so. Do not contaminate water.

Methods for cleaning up Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling Avoid release to the environment. Material can be slippery when wet.

Storage Store in a dry area. Store in closed original container at temperatures between 5°C and 30°C.

8. Exposure Controls / Personal Protection

Personal protective equipment

Skin protection Normal work clothing (long sleeved shirts and long pants) is recommended.

Respiratory protection No personal respiratory protective equipment normally required.

9. Physical & Chemical Properties

Physical state Solid.

Color Off-white.

Specific gravity 0.7 - 0.9

PH of 1% Solution 6 - 8.5

10. Chemical Stability & Reactivity Information

Chemical stability Material is stable under normal conditions.

Conditions to avoid None under normal conditions.

Incompatible materials Not available.

Hazardous decomposition products Upon decomposition, this product may yield oxides of nitrogen and ammonia, carbon dioxide, carbon monoxide and other low molecular weight hydrocarbons.

11. Toxicological Information

Toxicological data

Product	Test Results
Hydrex 6183 (Mixture)	Acute Oral LD50 Rat: > 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Chronic effects Not expected to be hazardous by WHMIS criteria.

12. Ecological Information

Ecotoxicological data

Product	Test Results
Hydrex 6183 (Mixture)	EC50 Daphnia: > 200 mg/l 48.00 hr LC50 Fish: > 200 mg/l 96.00 hr

* Estimates for product may be based on additional component data not shown.

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability	Not available.

13. Disposal Considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose in accordance with all applicable regulations.
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations	This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.
WHMIS status	Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

Further information	HMIS® is a registered trade and service mark of the NPCA.
HMIS® ratings	Health: 0 Flammability: 1 Physical hazard: 0
NFPA ratings	Health: 0 Flammability: 1 Instability: 0
Disclaimer	Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.
Issue date	08-04-2011

Hydrex

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6105**
Version #	01
Issue date	08-15-2014
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Potential health effects

Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.

3. Composition / Information on Ingredients

The components are not hazardous or are below required disclosure limits.

4. First Aid Measures

First aid procedures

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	Dust accumulation from this product may present an explosion hazard in the presence of an ignition source.
Extinguishing media	
Suitable extinguishing media	Water spray, fog, CO2, dry chemical, or alcohol resistant foam.
Protection of firefighters	
Protective equipment for firefighters	In the event of fire, wear self-contained breathing apparatus.
Fire fighting equipment/instructions	Use water spray to cool unopened containers. Dust may form an explosive mixture in the atmosphere.
Specific methods	Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.

6. Accidental Release Measures

Personal precautions	Slippery when wet.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Avoid release to the environment. Material can be slippery when wet.
Storage	Store in a dry area. Store in closed original container at temperatures between 5°C and 30°C.

8. Exposure Controls / Personal Protection

Biological limit values	No biological exposure limits noted for the ingredient(s).

Personal protective equipment

Eye / face protection	Chemical goggles are recommended.
Skin protection	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	No specific recommendation made, but protection against nuisance dust must be used when the general level exceeds 10 mg/m3.

9. Physical & Chemical Properties

Appearance	Not available.
Physical state	Solid.
Form	Not available.
Color	White
Odor	Not available.
pH	Not available.
Vapor pressure	0 hPa estimated
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Not available.
Specific gravity	0.65 - 0.9
Flash point	Not available.
Auto-ignition temperature	Not available.
Ph Of 1% Solution	5 - 7

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None under normal conditions.
Incompatible materials	Not available.
Hazardous decomposition products	Upon decomposition, this product may yield oxides of nitrogen and ammonia, carbon dioxide, carbon monoxide and other low molecular weight hydrocarbons.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6105 (CAS Mixture)		
Acute		
Dermal		
LD50	Rabbit	> 10000 mg/kg
Oral		
LD50	Rat	> 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Chronic effects Not expected to be hazardous by WHMIS criteria.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6105 (CAS Mixture)			
Algae	IC50	Algae	2276 mg/l, 72 hr
Crustacea	EC50	Daphnia	> 100 mg/l, 48 hr
Other	LC50	Rainbow Trout	> 120 mg/l, 96 hr
Aquatic			
Fish	LC50	Zebra danio (Danio rerio)	> 100 mg/l, 96 hr

* Estimates for product may be based on additional component data not shown.

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability Not available.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose in accordance with all applicable regulations.

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Further information
HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
Health: 0
Flammability: 1
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 1
Instability: 0

Disclaimer
Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s):
Product and Company Identification: Product and Company Identification

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Hydrex 6324**
Version #	01
Issue date	03-31-2016
CAS #	Mixture
Product use	Wastewater Flocculant
Manufacturer information	
Supplier	Veolia Water Technologies Canada Inc.
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwtcanada-hydrex@veolia.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)
Supplier	Not available.

2. Hazards Identification

Potential health effects

Routes of exposure	Eye contact. Ingestion. Inhalation. Skin contact.
Eyes	Health injuries are not known or expected under normal use.
Skin	Health injuries are not known or expected under normal use.
Inhalation	Health injuries are not known or expected under normal use.
Ingestion	Health injuries are not known or expected under normal use.
Potential environmental effects	May cause long-term adverse effects in the environment.

3. Composition / Information on Ingredients

Components	CAS #	Percent
ADIPIC ACID	124-04-9	1 - 5
Other components below reportable levels		60 - 100

Composition comments None by WHMIS criteria.

4. First Aid Measures

First aid procedures

Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.
General advice	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties Not flammable by WHMIS criteria.

Extinguishing media

Suitable extinguishing media	Not available.

Unsuitable extinguishing media	Not available.

Protection of firefighters

Specific hazards arising from the chemical	Material can be slippery when wet.
Fire fighting equipment/instructions	Use water spray to cool unopened containers.

Explosion data

Sensitivity to static discharge	Not available.
Sensitivity to mechanical impact	Not available.
Hazardous combustion products	Not available.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. For personal protection, see section 8 of the MSDS. Slippery when wet.
Environmental precautions	Do not contaminate water.
Methods for cleaning up	Should not be released into the environment. This product is miscible in water. Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling	Material can be slippery when wet. Avoid release to the environment.
Storage	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the MSDS).

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Components	Type	Value
ADIPIC ACID (CAS 124-04-9)	TWA	5 mg/m3

Biological limit values	No biological exposure limits noted for the ingredient(s).

Engineering controls	Not available.
Personal protective equipment	
Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	Wear suitable protective clothing. Chemical resistant gloves.
Respiratory protection	No personal respiratory protective equipment normally required. In case of insufficient ventilation, wear suitable respiratory equipment.
Hand protection	Chemical resistant gloves.

9. Physical & Chemical Properties

Appearance	Granular or Powder.
Physical state	Solid.
Form	Solid.
Color	White.
Odor	Odorless.
pH	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Boiling point	Not available.
Melting point/Freezing point	Not available.
Solubility (water)	Limited by viscosity
Specific gravity	Not available.
Flash point	Not available.
Flammability limits in air, upper, % by volume	Not available.
Flammability limits in air, lower, % by volume	Not available.
Auto-ignition temperature	Not available.
Bulk density	650 - 850 kg/m³
Other data	
pH in aqueous solution	7 - 9 in a 0.5% aq. sol.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Not available.
Hazardous decomposition products	Not available.
Possibility of hazardous reactions	Not available.

11. Toxicological Information

Toxicological data

Product	Species	Test Results
Hydrex 6324		
Acute		
Dermal		
Presumed Non-Toxic	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	> 20 mg/l, 4 hours
Oral		
LD50	Rat	> 5000 mg/kg

Components	Species	Test Results
ADIPIC ACID (CAS 124-04-9)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg
Inhalation		
NOEL	Rat	0.126 mg/l, 6 Hours
Oral		
LD50	Mouse	1900 mg/kg
	Rabbit	> 11000 mg/kg
	Rat	> 11000 mg/kg

Acute effects

Sensitization Not available.

Chronic effects Not expected to be hazardous by WHMIS criteria.

Carcinogenicity Not available.

Skin corrosion/irritation Not available.

Serious eye damage/irritation Not available.

Mutagenicity Not available.

Reproductive effects Not available.

Teratogenicity Not available.

Synergistic materials Not available.

12. Ecological Information

Ecotoxicological data

Product		Species	Test Results
Hydrex 6324			
Aquatic			
Acute			
Crustacea	EC50	Daphnia magna	> 100 mg/l, 48 hours
Fish	LC50	Danio rerio	> 100 mg/l, 96 hours

Components		Species	Test Results
ADIPIC ACID (CAS 124-04-9)			
Aquatic			
Algae	EC50	Algae	31.3 mg/l, 72 hours
Crustacea	EC50	Daphnia	85.6 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	97 mg/l, 96 hours
Acute			
Fish	EC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	> 100 mg/l, 48 hours

Ecotoxicity Contains a substance which causes risk of hazardous effects to the environment.

Environmental effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Aquatic toxicity Not available.

Persistence and degradability Not available.

Partition coefficient

ADIPIC ACID 0.08

Mobility in environmental media This product is miscible in water.

13. Disposal Considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not allow this material to drain into sewers/water supplies. Dispose in accordance with all applicable regulations.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS status Non-controlled

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Recommended restrictions PROFESSIONAL USE ONLY

HMIS® ratings
Health: 0
Flammability: 0
Physical hazard: 0

NFPA ratings
Health: 0
Flammability: 0
Instability: 0

Disclaimer Veolia Water Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Technologies' requirement.

Prepared by Hydrex Global Platform

This data sheet contains changes from the previous version in section(s):	This document has undergone significant changes and should be reviewed in its entirety.

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name	**VWS ACTISAND**
Version #	01
Issue date	08-15-2013
Chemical name	SILICA, CRYSTALLINE, QUARTZ
CAS #	Mixture
Manufacturer	
Supplier	VWS Canada
Address	2000 Argentia Road, Plaza IV, Suite 430 Mississauga, ON L5N 1W1 Canada
Contact Person	Hydrex Product Specialist
Telephone	(905) 286-4846
Fax	(905) 286-0488
e-mail	vwscanada.hydrex@veoliawater.com
24-Hour Emergency telephone	+1-760-476-3962 (Code:333239)

2. Hazards Identification

Emergency overview	Cancer hazard. Prolonged exposure may cause chronic effects.
Potential health effects	
Routes of exposure	Inhalation. Eye contact.
Eyes	Avoid contact with eyes.
Skin	Health injuries are not known or expected under normal use.
Inhalation	May cause cancer by inhalation. Repeated or prolonged inhalation may cause toxic effects. Do not breathe dust. For additional information on inhalation hazards, see Section 11 of this safety data sheet.
Ingestion	Do not ingest.
Target organs	Eyes.
Chronic effects	This product has the potential for generation of respirable dust during handling and use. Dust may contain respirable crystalline silica. Overexposure to dust may result in pneumocononiosis, a respiratory disease caused by inhalation of mineral dust, which can lead to fibrotic changes to the lung tissue, or silicosis, a respiratory disease caused by inhalation of silica dust, which can lead to inflammation and fibrosis of the lung tissue. Occupational exposure to respirable dust and respirable crystalline silica should be monitored and controlled.
Potential environmental effects	Ecological injuries are not known or expected under normal use.

3. Composition / Information on Ingredients

Components	CAS #	Percent
SILICA, CRYSTALLINE, QUARTZ	14808-60-7	60 - 100

4. First Aid Measures

First aid procedures

Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. If a contact lens is present, DO NOT delay irrigation or attempt to remove the lens. Continue rinsing. Get medical attention if irritation develops and persists.

Skin contact Remove and isolate contaminated clothing and shoes. Wash off with warm water and soap. For minor skin contact, avoid spreading material on unaffected skin. Get medical attention if irritation develops and persists.

Inhalation Move to fresh air. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Get medical attention, if needed.

Ingestion Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If ingestion of a large amount does occur, call a poison control center immediately.

Notes to physician In case of shortness of breath, give oxygen. Symptoms may be delayed.

General advice In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Get medical attention if symptoms occur. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Do not use mouth-to-mouth method if victim ingested the substance.

5. Fire Fighting Measures

Flammable properties Not flammable by WHMIS criteria.

Extinguishing media

Suitable extinguishing media Water. Dry chemical, CO2, sand, earth, water spray or regular foam.

Fire fighting equipment/instructions No specific precautions.

Specific methods Not applicable.

Explosion data

Sensitivity to static discharge Not available.

Sensitivity to mechanical impact Not available.

6. Accidental Release Measures

Methods for cleaning up Following product recovery, flush area with water. For waste disposal, see section 13 of the MSDS.

7. Handling and Storage

Handling Keep formation of airborne dusts to a minimum. Do not breathe dust. Wear personal protective equipment. Do not use in areas without adequate ventilation. Avoid prolonged exposure. Wash thoroughly after handling.

Storage Store in a closed container away from incompatible materials. Keep out of the reach of children. Provide appropriate exhaust ventilation at places where dust is formed.

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.025 mg/m3	Respirable fraction.

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.025 mg/m3	Respirable fraction.

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.025 mg/m3	Respirable particles.

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.025 mg/m3	Respirable particles.

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.025 mg/m3	Respirable fraction.

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.025 mg/m3	Respirable fraction.

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.1 mg/m3	Respirable.

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.1 mg/m3	Respirable.

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.1 mg/m3	Respirable dust.

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.1 mg/m3	Respirable dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Material	Type	Value	Form
VWS ACTISAND (CAS Mixture)	TWA	0.3 mg/m3	Total dust.
		0.1 mg/m3	Respirable.
		2.4 millions of particle	Respirable.

Components	Type	Value	Form
Crystalline sillica (CAS 14808-60-7)	TWA	0.3 mg/m3	Total dust.
		0.1 mg/m3	Respirable.
		2.4 millions of particle	Respirable.

Exposure guidelines Occupational exposure to nuisance dust (total and respirable) and respirable crystalline silica should be monitored and controlled.

Engineering controls Ensure adequate ventilation, especially in confined areas.

Personal protective equipment

Eye / face protection Wear safety glasses with side shields (or goggles).

Skin protection Wear protective gloves. Leather gloves.

Respiratory protection Use a particulate filter respirator for particulate concentrations exceeding the Occupational Exposure Limit. Half-face filter respirator. Respirator type: P100 filter

9. Physical & Chemical Properties

Physical state Solid.

Form Solid. Granular.

Color White to Off-white.

Vapor pressure < 0.0000001 kPa at 25 °C

Solubility (water) Insoluble

Molecular formula O2Si

Other data

Heat of combustion (NFPA 30B)	0 kJ/g

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None under normal conditions.
Incompatible materials	Powerful oxidizers. Chlorine.
Hazardous decomposition products	Not available.

11. Toxicological Information

Chronic effects	Hazardous by WHMIS criteria. Prolonged inhalation may be harmful. Prolonged exposure may cause chronic effects.
Carcinogenicity	In 1997, IARC (the International Agency for Research on Cancer) concluded that crystalline silica inhaled from occupational sources can cause lung cancer in humans. However in making the overall evaluation, IARC noted that "carcinogenicity was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monographs on the evaluation of the carcinogenic risks of chemicals to humans, Silica, silicates dust and organic fibres, 1997, Vol. 68, IARC, Lyon, France.) Hazardous by WHMIS criteria. Occupational exposure to respirable dust and respirable crystalline silica should be monitored and controlled. Risk of cancer cannot be excluded with prolonged exposure. Hazardous by OSHA criteria.

ACGIH Carcinogens

SILICA, CRYSTALLINE, QUARTZ (CAS 14808-60-7)	A2 Suspected human carcinogen.

IARC Monographs. Overall Evaluation of Carcinogenicity

SILICA, CRYSTALLINE, QUARTZ (CAS 14808-60-7)	1 Carcinogenic to humans.

12. Ecological Information

Ecotoxicity	This product has no known eco-toxicological effects.
Persistence and degradability	Not available.

13. Disposal Considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose in accordance with all applicable regulations.
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

TDG

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Canadian regulations	This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.
WHMIS status	Controlled
WHMIS classification	D2A - Other Toxic Effects-VERY TOXIC

WHMIS labeling

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

Recommended restrictions

Workers (and your customers or users in the case of resale) should be informed of the potential presence of respirable dust and respirable crystalline silica as well as their potential hazards. Appropriate training in the proper use and handling of this material should be provided as required under applicable regulations.

Further information

HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings

Health: 1*
Flammability: 0
Physical hazard: 0

NFPA ratings

Health: 1
Flammability: 0
Instability: 0

Disclaimer

Veolia Water Solutions & Technologies is not able to anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use and or non respect of Veolia Water Solutions & Technologies' requirement.

This data sheet contains changes from the previous version in section(s):

Product and Company Identification: Product Review
Hazards Identification: Target organs
Handling and Storage: Storage
Exposure Controls / Personal Protection: Respiratory protection
Exposure Controls / Personal Protection: Skin protection

Appendix C: Water Treatment Solid Waste Characterization and Management

Yukon Government

Yukon Government

Mount Nansen: Water Treatment Solid Waste Characterization and Management

Prepared for:
Yukon Government
Energy, Mines and Resources
Assessment and Abandoned Mines

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St.
Vancouver, BC, V6J 3H9

Project No. 422-2

26 August 2017

LORAX ENVIRONMENTAL

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1. Introduction

The Yukon Government, Assessment and Abandoned Mines Branch (AAM) is preparing a project proposal and assessment of proposed care and maintenance activities at the Mount Nansen Site (the Site) for submission to the Yukon Environmental and Socio-economic Assessment Board (YESAB). As part of the project proposal, the treatment of seepage flows emanating from the Tailings Storage Facility (TSF) is proposed to improve: 1) water quality in Dome Creek and Victoria Creek; and 2) the health of the downstream aquatic receiving environment. Water treatment is specifically an interim mitigation measure for the care and maintenance period until the closure plan is implemented. The water treatment plant (WTP) will be designed to remove total suspended solids (TSS) and total Fe but is also expected to be beneficial for the removal of other metals and metalloids including As, Cd and Zn.

The treatment system will result in the generation of a solid waste, comprising largely precipitated Fe (as Fe-hydroxides) and associated sorbed metals. In this regard, Lorax Environmental Services Ltd. (Lorax) was retained by AAM to provide information requirements related to proposed water treatment for this Site, including aspects relating to WTP waste solids characterization and management. This report, prepared by Lorax, provides data in support of the geochemical characterization of treatment waste solids through the analysis of both: 1) naturally occurring precipitates that have accumulated in the seepage collection pond; and 2) WTP waste solids generated as part of bench-scale testwork. Both passive and active forms of treatment will trigger the oxidation and hydrolysis of ferrous iron, resulting in the formation of secondary Fe-hydroxides. Overall, the results provide supporting information to the overarching water treatment report (Mount Nansen Water Treatment Environmental Management and Technical Data Report).

Specific objectives of the assessment herein included the following:

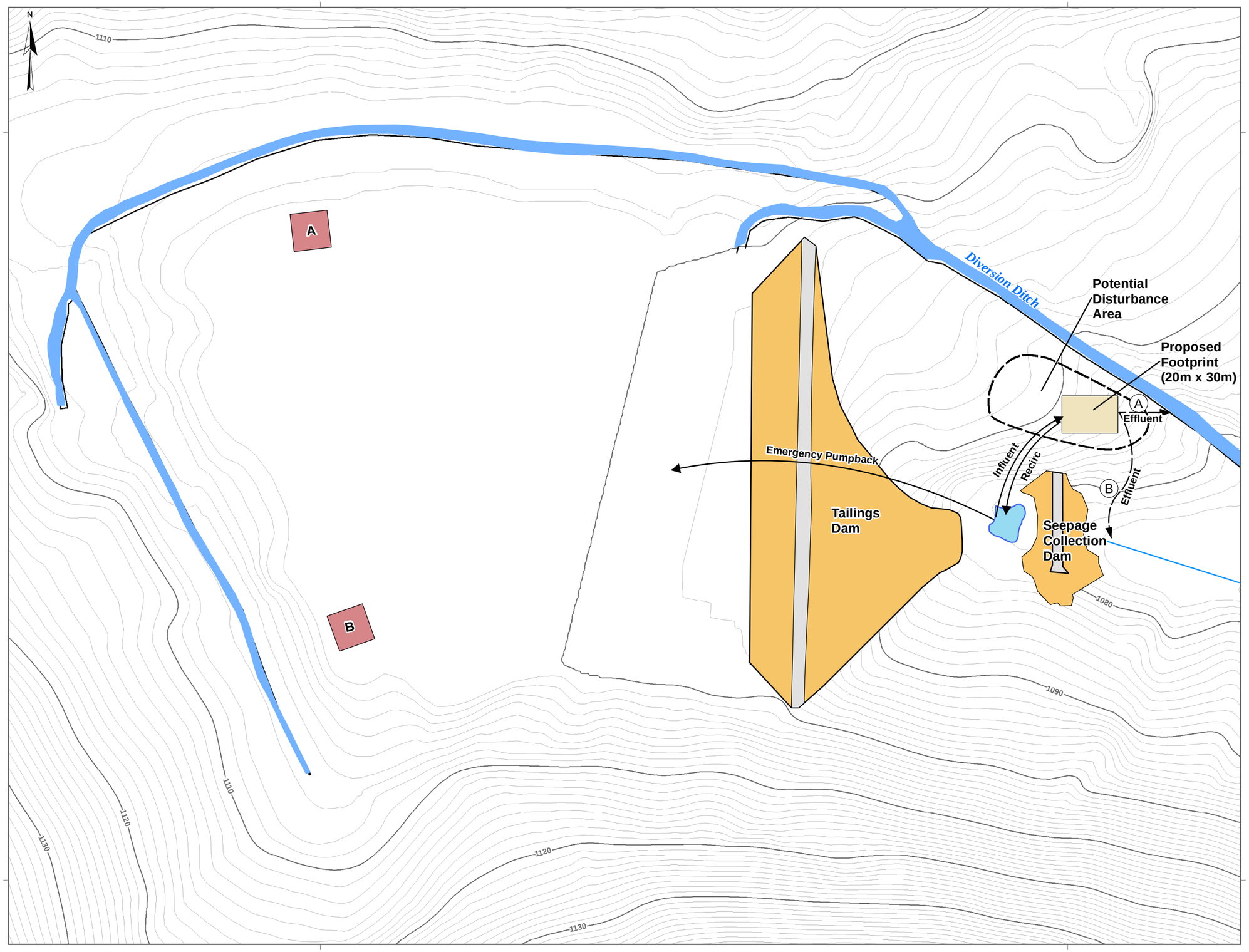
- Characterize the geochemical properties of natural solid samples and WTP (bench-scale) waste via multiple methods (*e.g.,* acid-base accounting, elemental abundance, shake flask extractions and sequential extractions);
- Identify the primary host phase(s) for contaminants of potential concern (*e.g.*, Fe, As, Cd, Mn and Zn); and
- Based on the geochemical data, discuss the implications for WTP solids chemical stability and management.

Following this introduction, a summary of the proposed treatment process is described (Chapter 2). Chapter 3 presents the geochemical test methods and characterization data for the secondary precipitates, while Chapter 4 discusses the implications with regards to WTP solids chemical stability and management.

2. Water Treatment Process

For the purposes of managing total suspended solids (TSS), total iron, and other parameters of interest (e.g., arsenic, cadmium, and zinc) in water discharged from the seepage collection pond, a modular, flow-through, engineered treatment system is proposed (Figure 2-1). The WTP has a maximum capacity of 360 m^3/d, with the normal flow rate expected to be in the range of 170 m^3/d to 260 m^3/d. The treatment process oxidizes the ferrous iron (Fe^{2+}) naturally present in the influent water via aeration to form a ferric hydroxide precipitate. This material is predicted to be extremely fine-grained and amorphous and will serve to attenuate several parameters of concern, including As, Cd and Zn, via co-precipitation and adsorption. This form of treatment is a common method for TSS and dissolved metal removal.

Enhanced coagulation and settling technology will be employed for solid/liquid separation of precipitates and TSS. A Mini Actiflo® unit from Veolia Water Technologies is proposed as a suitable option for the proposed solid/liquid separation process. Microsand and anionic polymer will be added in the Mini Actiflo® to aid with particle formation (flocculation) and for efficient TSS removal (clarification). Slurry generated from the sedimentation and clarification process will be thickened with cationic polymer and dewatered using Geotube® technology. Geotubes® are a simple, low maintenance and cost-effective dewatering solution, which reduce the volume of resulting solids that must be stored and managed. Clarified effluent flows through the porous-mesh material of the Geotube® container, while the same material keeps the solids trapped inside. Geotubes® will be deposited in a dedicated solids management area within the footprint of the TSF. The key WTP process equipment will be housed in two connected 40-ft containers while a galvanized shelter will house the WTP solids management equipment.



LEGEND

- Dam
- Dam Crest
- Seepage Collection Pond
- Water Treatment Plant Footprint
- Potential Disturbance Area
- Potential Solids Management Area (20m x 20m)
- 10m Contour
- 1m Contour

Coordinate System: *NAD 1983 UTM Zone 8N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:2,000

0 50 100 Meters

DATE SAVED:	Mar 29, 2017
DRAWN BY:	GM
REVIEWED:	JM
VERSION:	1

CLIENT:

Yukon

LORAX ENVIRONMENTAL

PROJECT:

Mount Nansen Care & Maintenance Project Proposal

TITLE:

Proposed Location and Operational Layout of the Water Treatment Plant

PROJECT #: A422-2

FIGURE: 2-1

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3. Treatment Solid Waste Characterization

The following sections describe the solid-phase properties and metal leaching characteristics of the WTP solid wastes. The solid-phase information, in combination with an understanding of the environment of deposition, are used to discuss the implications for WTP waste chemical stability and management in Chapter 4.

3.1 Sample Collection and Analysis

3.1.1 Sample Collection

During a site visit in February 2017, EDI personnel collected 12 samples of natural precipitates (henceforth referred to as natural solids) from the seepage collection pond downstream of the TSF. Iron-phase precipitation is inferred to be the dominant process occurring in the seepage collection pond. Therefore, this material is considered to represent a suitable geochemical proxy future WTP solid wastes. Due to ice cover, the sampling crew drilled a hole through ice with a 10"-diameter power auger and removed loose ice. The solids samples were then recovered by pushing a 2.6 m long PVC pipe into the pond bed and withdrawing shallow cores. A photograph of the sampling location is shown in Figure 3-1. Upon visual inspection, the sediment samples were grouped into two subsets based on colour and grain size distribution and combined into two composite samples (Solids A & Solids B) to generate sufficient material for geochemical testing. In parallel to the collection and analysis of naturally occurring precipitates, bench-scale treatment testwork is on-going at Veolia (Montreal, Canada). WTP waste solids generated by these bench-scale tests were submitted for the same geochemical tests as the two natural solids samples.

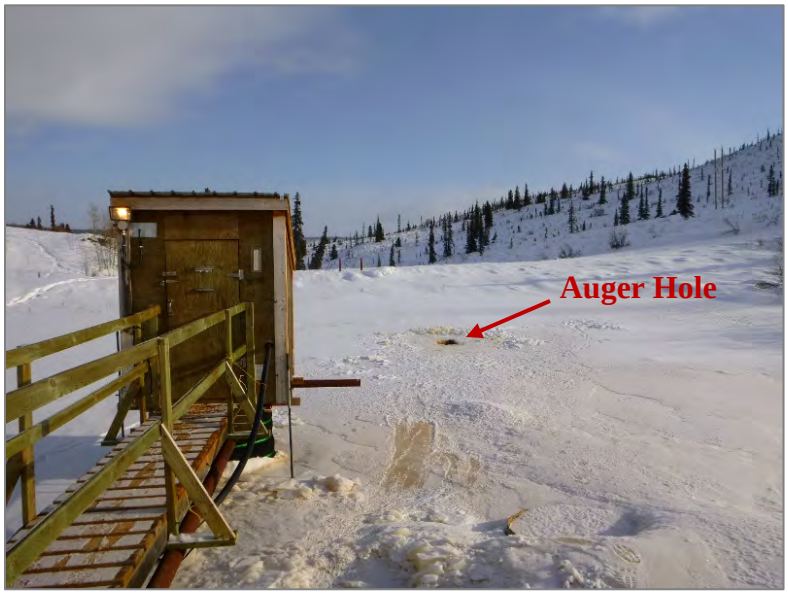


Figure 3-1: Natural solids sample location within the TSF seepage collection pond

3.1.2 Analytical Methods

3.1.2.1 Sample Preparation

The two natural solids samples were composited in the laboratory in accordance with instructions given by Lorax. The composite samples were then oven-dried at low temperatures (40ºC) to avoid mineralogical alteration through heat exposure. Once dry, the samples were sieved using a #200 mesh (75 µm) to separate fine sand and silt from coarser-grained materials. The fine fraction was selected for geochemical testwork, since the secondary precipitates will be preferentially associated with the fine-sand and silt/clay fraction. Figure 3-1 shows photographs of the composited and homogenized natural solids samples (A and B) after drying and screening. As opposed to the natural solids, the WTP waste sample did not undergo screening since the grain size distribution is expected to be representative of the material to be placed in Geotubes® (sample shown on right in Figure 3-2).

3.1.2.2 Acid-Base Accounting

Acid-base accounting (ABA) consists of a series of geochemical tests that quantify the amounts of acid-producing and acid-consuming agents contained in a solid-phase sample. The results from ABA testwork can be used to assess the likelihood of acid generation upon exposure to ambient environmental conditions. ABA measurements include the following:

Acid Potential (AP): Sulfur bearing minerals, and sulfides in particular, represent the dominant source of acidity in mine waste materials. Sulfur species measured during ABA include total-S (LECO), sulfate-S (HCl-digestion), sulfide-S (HNO_3-digestion), and insoluble-S (calculated). Sulfide-S analysis is performed on the sample after sulfate-S has been removed by HCl.

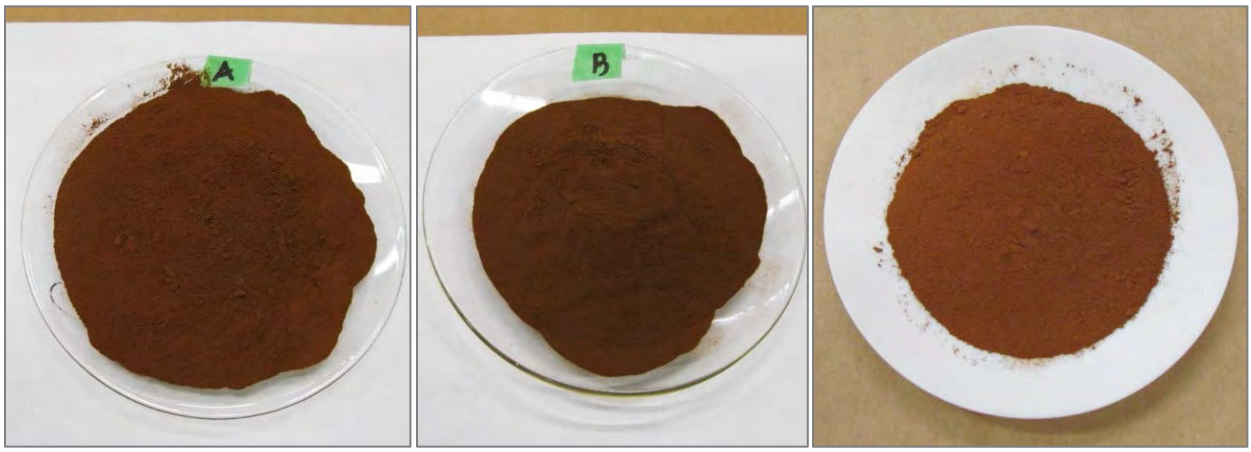


Figure 3-2: Composited samples of natural solids samples (Solids A and B) after drying and screening with a #200 mesh as well as the bench-scale WTP waste sample (right).

Depending on which sulfur species are expected to contribute to the release of acidity, AP can be derived based on stoichiometric considerations. If calculated on a weight basis, the amount of acid produced by 1 g of S is neutralized by 3.125 g of calcite. Therefore, since sulfur concentrations are usually reported as a weight percent, neutralization of a material containing 1% acid generating sulfur is reported as 31.25 kg $CaCO_3$/t of AP. This can be written as:

AP = [Sulfur content (wt. %)] x [31.25 kg $CaCO_3$/t rock]

In conjunction with other geochemical evidence, an assessment of the effective S content contributing to AP is then made.

Neutralization Potential (NP): Two different approaches were used to assess NP. The carbonate neutralization potential (CaNP) is a simple stoichiometric recalculation of the total inorganic carbon content (TIC) content and assumes that all carbonate minerals contained in a sample contribute to acid neutralization. TIC analysis was conducted using coulometry, in which a known weight of sample is placed into a glass test tube and acidified with 25% hydrochloric acid. The sample is boiled to evolve CO_2 which is measured by coulometric titration with a Carbon Dioxide Analyzer.

NP was also determined using methods that measure bulk NP, which may include carbonates as well as other minerals (e.g., aluminosilicates). This analytical technique measures NP by exposing the sample to a strong acid followed by back titration with a base to and end point of pH 8.3. In this process, all neutralizing agents, including highly reactive silicates, are accounted for.

Net Potential Ratio (NPR): The net potential ratio (NPR) relates AP and NP, giving an indication of the likelihood of a sample to generate acidic drainage. The NPR is calculated as NP/AP, yielding the amount of NP available for each kg $CaCO_3$/t of AP. In accordance with recommendations made in Price (2009), a criterion of NPR = 2 was chosen as the cut off value discriminating between potentially acid generating (PAG: NPR < 2) and non-potentially acid generating (NPAG: NPR ≥ 2) materials.

3.1.2.3 Elemental Abundance

A split sample is digested in 5 mL of 3:1 HCl/HNO_3 (aqua regia) at 95ºC for 1.5 hours. The extract is then diluted to 25 mL and analyzed for metals by ICP-MS. The aqua-regia solution is considered a partial digestion method that dissolves mineral phases that are environmentally relevant (e.g., carbonates, hydroxides, sulfides) but may not dissolve refractory silicate or aluminosilicate minerals (Price, 2009).

3.1.2.4 Shake Flask Extractions

Shake flask extractions (SFEs) give insight into the components of a solid material that are readily soluble and mobile within short time frames after exposure to meteoric water. SFEs were

conducted as described by Price (1997), using a 24 hour de-ionized water leach extraction test at a 3:1 liquid to solid ratio. In this test, gentle agitation is provided throughout the experimental duration to ensure continuous exposure of all surfaces and mixing of the rinse solution. The leachate was subsequently filtered and submitted for analysis including pH, conductivity, sulfate and dissolved metals.

3.1.2.5 Sequential Extractions

Sequential extractions were completed on both natural solids and WTP waste samples to gain an understanding of the solid-phase associations of parameters of concern and the potential for leaching of these phases under variable environmental conditions. Sequential extractions were conducted in three steps targeting species that are associated primarily with: 1) carbonate phases; 2) poorly-crystalline (amorphous) Fe-hydroxide phases; and 3) crystalline Fe-oxide phases (Table 3-1). The carbonate extraction step was adopted from Tessier *et al.* (1979). Since no extraction step was conducted before the carbonate removal method, this step can also be assumed to solubilize adsorbed and water-soluble species (as per standard SFE test). The two other extraction steps quantifying the elemental abundance in reducible phases were adopted from Wiederhold *et al*. (2007). Measured concentrations of all species were adjusted with the respective blank sample value and converted into a geochemical load (mass of metal extracted per mass of solid, mg/kg).

Table 3-1:
Overview of Sequential Extraction Procedure for the Natural Solids and WTP Waste Samples

Step	Phases Targeted	Reagent	Comments	Reference
1	Adsorbed, soluble, and carbonate species	NaOAc + HOAc	Only partial dissolution of dolomite; includes water-soluble and adsorbed species.	Tessier et al., 1979
2	Poorly crystalline Fe-oxyhydroxides	HCl	May also attack poorly crystalline Al-hydroxides and silicates	Wiederhold et al., 2007
3	Crystalline Fe-oxides	NH_2OH-HCl	Partly attacks Al-hydroxides and silicates	Wiederhold et al., 2007

3.2 Solid Phase Characterization Results

3.2.1.1 Acid-Base Accounting

The total sulfur content of the two natural solids samples was measured to be 0.14% and 0.15% for Solids 1 and Solids 2, respectively. Sulfur speciation in both samples is dominated by sulfate sulfur (0.1%) with minor amounts of sulfide sulfur (0.04%) (Table 3-2). While minor amounts of total inorganic carbon (TIC) were detected in both samples, the modified NP value was found to be negative, hence negligible. This is interpreted to be a result of Fe- and Mn-carbonates being present in the phase assemblage, although conclusive statements cannot be made without

mineralogical data. Given the negative NP and the detectable sulfide S value, the resulting NPR (<2) would suggest that these samples are potentially acid-generating. However, it should be noted that the low observed sulfide levels are unlikely to generate significant acidity. Overall, the ABA characteristics of the two composited solids samples are remarkably similar suggesting a high level of homogeneity in the precipitates formed within the TSF seepage collection pond.

Table 3-2:
ABA Results for the Natural Solids and WTP Waste Samples

Sample ID	Total S	Sulfate S	Sulfide S	AP	CaNP	Modified NP	NPR
	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
Solids A	0.14	0.10	0.040	1.3	6.7	-0.50	-0.40
Solids B	0.15	0.10	0.040	1.3	5.8	-0.10	-0.08
WTP Waste	0.36	0.32	0.01	0.31	28	19	60

Notes: AP = acid potential; CaNP = carbonate neutralization potential; NP = neutralization potential; NPR = net potential ratio.

The WTP waste sample has slightly different characteristics than the two natural solids samples in that it has higher total sulfur and sulfate contents, but a lower sulfide S content (Table 3-2), and therefore is less prone to acid production. Both CaNP and Modified NP values are significantly higher than those reported for the natural solids, yielding an NPR = 60, which renders this sample NPAG. No reagents specifically intended to elevate pH were used during the treatment process. It can hence be inferred that carbonate precipitation leading to the observed NP is triggered by aeration, alkalinity addition via flocculants/polymers and/or the higher density of nucleation sites resulting from flocculation in the treatment slurry versus the natural collection pond water.

3.2.1.2 Elemental Abundance

The aqua-regia digestible elemental compositions of the solids samples are shown in Table 3-3 for selected parameters. These are compared to average upper crustal abundances (AUCA, Rudnick & Gao, 2003) with values highlighted if the respective AUCA value is exceeded by a factor of three or more. This approach is a common screening tool to identify elements of potential concern (Price, 2009). However, the enrichment factor alone cannot be used to infer an element's leachability, since various other factors including mineralogical association and geochemical regime (*e.g.*, pH, redox conditions) will govern the potential for chemical instability.

Elements exceeding three times the AUCA values include As, Cd, Cu, Pb, Sb, Se, and Zn. These species are commonly enriched in mining environments such that exceedances with respect to the reference database is to be expected. Comparison of the elemental concentrations shows that the natural solids and WTP waste are compositionally similar, as illustrated by the values for As, Cd and Zn (Table 3-3). Differences, however, are evident for some elements. For example, Ca, Fe, and Mn contents in the WTP waste sample are considerably elevated with respect to the natural solids samples (Table 3-3). In the WTP waste sample, Fe makes up 15% of the elemental

composition. In contrast to Fe, the concentrations of Pb and Sb are considerably higher in the natural solids samples in comparison to the WTP waste (Table 3-3). Similarly, Co and Ag show higher contents in the natural solids samples.

Overall, the elemental data suggest that the active treatment process may generate a phase assemblage that differs from that produced by natural processes in the seepage collection pond. Whether this has a significant bearing on mineralogical associations or leaching characteristics will be evaluated once the SFE and sequential extraction data for the WTP waste become available.

3.2.1.3 Shake Flask Extractions

Geochemical parameters measured in the SFE extracts are presented in Table 3-4. Where applicable, these results are compared to CCME water quality guidelines for the protection of freshwater aquatic life and highlighted if these guidelines are exceeded.

The pH produced by the two natural solids samples was 7 in both extracts (Table 3-4). Moderately elevated sulfate concentrations in both samples (94 and 137 mg/L) reflect the dissolution of water soluble sulfate minerals, consistent with the ABA results. Elements showing concentrations in exceedance of CCME guidelines include As, Cd, Cr, Cu, Fe, and Ag in both natural solids SFE leachates. Of these, As, Cd, and Cu, show exceedance factors of greater than five (Table 3-4).

In comparison to the natural solids samples, the WTP waste sample produced a more basic SFE eluate (pH = 7.9) (Table 3-4). Similar to the natural solids samples, the WTP waste SFE leachate also shows exceedances of CCME guidelines with respect to As, Cd, Cr and Cu. Fe, As and Cd concentrations were found to be lower in the WTP waste leachate as compared to the natural solids samples. The lower values for Fe in the WTP waste leachate (below CCME), suggest that the Fe-phase(s) generated in the bench-scale experiment are more stable under the experimental conditions. More stable Fe precipitates may result from the slightly higher pH in combination with the enhanced oxidative environment, as well as the addition of a flocculant during the treatment process. Of note, the Se concentration released during the WTP waste test is significantly higher than those for the natural solids samples, with the WTP value greatly exceeding the CCME guideline. It is likely that the elevated pH as well as the relatively high solid-phase Se content (28 ppm; Table 3-3) in the WTP waste sample contribute to increased Se mobility. A review of the treatment influent chemistry (Se ~ 0.1 ppb) raised concern with respect to the validity of the elevated Se concentrations in the WTP solids and SFE eluate. Consultation with Veolia yielded that, although pilot equipment was reportedly thoroughly flushed before project initiation, solid-phase buildup from a previous application using Se-rich water may have influenced the Mount Nansen treatment results. From consultation with Veolia, there is no plausible reason why Se should be elevated as Se is not a parameter associated with any reagents or materials using in the process. As a result, Se is not a parameter of interest or concern in the WTP solids. Overall, the observed exceedances of CCME guidelines for some elements indicate the potential for metal

leaching from the Geotube® materials that will ultimately be generated on site. Whether this represents a short-term flushing effect or potentially a longer-term metal leaching process, cannot be conclusively identified based on the data available.

Table 3-3:
Selected Aqua-Regia Digestible Elemental Contents for the Natural Solids and WTP Waste Samples

Sample ID	Ag	Al	As	Ca	Cd	Co	Cr	Cu	Fe	Mn	Pb	Sb	Se	Zn
	ppm	*%*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*%*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
AUCA	*53*	*8.2*	*4.8*	*2.6*	*0.090*	*17*	*92*	*28*	*3.9*	*774*	*17*	*0.40*	*0.090*	*67*
Solids A	2.6	1.1	416	0.62	2.5	7.7	29	125	7.0	600	86	22	<1	214
Solids B	2.6	1.1	364	0.58	2.2	8.0	26	116	5.9	533	75	18	<1	190
WTP Waste	0.34	0.12	569	2.1	2.0	3.2	78	82	>15	1330	8.0	1.1	28	276

Notes: AUCA = average upper crustal abundance; shaded values exceed the AUCA by a factor of three

Table 3-4:
Shake Flask Extraction Results for the Natural Solids and WTP Waste Samples

Parameter	Units	Solids A	Solids B	WTP waste	CCME
pH		7.0	7.0	7.9	6.5 - 9
Redox	mV	347	268	326	
Conductivity	uS/cm	463	386	3186	
Total Acidity	mg CaCO3/L	8.1	8.3	11.7	
Alkalinity	mg CaCO3/L	14	11	124	
Sulfate	mg/L	137	94	1421	
Dissolved Metals					
Al	mg/L	0.031	0.047	0.033	0.10
Sb	mg/L	0.00090	0.0010	0.0015	-
As	mg/L	0.031	0.036	0.010	0.0050
Ba	mg/L	0.12	0.13	0.066	-
B	mg/L	0.095	0.074	0.023	1.5
Cd	mg/L	0.00048	0.00052	0.00015	0.000090
Ca	mg/L	55	45	594	-
Cr	mg/L	0.0011	0.0013	0.0023	0.0010
Co	mg/L	0.010	0.011	0.022	-
Cu	mg/L	0.026	0.023	0.11	0.0040
Fe	mg/L	0.56	0.62	0.15	0.30
Pb	mg/L	0.00050	0.00063	0.00083	0.0070
Mg	mg/L	11	9.6	102	-
Mn	mg/L	2.1	2.2	1.0	-
Hg	ug/L	*<0.01*	*<0.01*	*0.010*	-
Mo	mg/L	0.00026	0.00025	0.017	0.073
Ni	mg/L	0.0036	0.0036	0.038	0.15
K	mg/L	2.4	2.1	16	-
Se	mg/L	0.00061	0.00061	0.078	0.0010
Si	mg/L	7.7	9.2	3.4	-
Ag	mg/L	0.00089	0.0015	0.00011	0.00025
Na	mg/L	7.8	5.9	109	-

Sr	mg/L	0.23	0.21	1.3	-
Tl	mg/L	0.000063	0.000082	0.000073	0.00080
Sn	mg/L	0.000070	0.00017	0.00070	-
U	mg/L	0.000075	0.000078	0.0040	0.015
V	mg/L	0.00061	0.00065	0.0018	-
Zn	mg/L	0.016	0.019	0.0070	0.030

Notes: Values shaded in green exceed the respective CCME guideline for freshwater aquatic life; the Cr guideline is for Cr(VI)

3.2.1.4 Sequential Extractions

Selected results from the sequential extraction tests are shown as geochemical loads (mg/kg_{solids}) in Table 3-5. Table 3-6 presents the proportions of the various species that were solubilized during the three-step experiment relative to the total geochemical load extracted. Plots of the selected results are given for both absolute and proportional values in Figure 3-3 and Figure 3-4 for the solids and the WTP waste samples, respectively.

The proportional representation shows that several elements (*e.g.*, Ca, Mn, and S) are relatively soluble, with the bulk of their inventories leached during the first extraction step (Table 3-6). Other elements that show a significant solubility during this step include Cd and U in the natural solids samples, and K, Mg, Co, and Zn in the WTP waste sample. These results imply the presence of labile species that are either adsorbed or associated with readily-soluble phases such as sulfate salts or carbonates.

Several major cations such as Si, Al, Mg, and K, were found to be most prevalent in the crystalline Fe-oxide fraction in the natural solids sequential extractions. This could be explained by: 1) the partial attack of silicate and Al-bearing phases in the low pH regime of the solvents used during these experimental steps as noted by Tessier (1979) or to a lesser extent 2) the presence of these ions within the structure of the Fe-hydroxide phases (Davison, 1993). It is worth noting that the same trend was not observed in the WTP waste sample, for which K, Mg, and Si appear to be more soluble (i.e., more strongly leached in the first two extraction steps). Overall, it may be inferred that silicate sediment makes up a portion of the natural solids samples, while silicate particles are filtered out more effectively in the bench-scale WTP process.

Arsenic was relatively evenly represented in the poorly-crystalline and crystalline Fe-hydroxide phases in both the natural solids and WTP waste samples, with ≤1% being associated with the soluble (adsorbed/carbonate) fraction. Based on these results, As can be expected to be relatively immobile under oxidizing and neutral to slightly acidic conditions. Species that are almost exclusively hosted in the more stable crystalline Fe-oxide fraction include Sb, Hg, and Mo for the natural solids and Mo only for the WTP waste sample.

Another way to assess the elemental quantities leached during the sequential extractions is to compare the sum of the geochemical loads extracted to the respective aqua-regia digestible content. The aqua-regia acid mixture is more aggressive than all of the extraction steps utilized.

Therefore, the difference between the two procedures provides an indication of the more refractory phases present, which may include sulfide or silicate minerals. Table 3-7 provides the sum of geochemical loads leached during all three extraction steps as a percentage of the aqua-regia digestible species. The results illustrate that the most refractory species in the natural solids samples are Sb, Hg, and S, with less than half of their inventory being extracted in the sequential extractions. This suggests that sulfide and insoluble sulfate minerals (*e.g.* barite, anglesite) may

Table 3-5:
Geochemical Loads Leached from the Natural Solids and WTP Waste Samples During Sequential Extraction Tests

		Adsorbed/Carbonate Fraction			Poorly Crystalline Fe-(oxy)hydroxides			Crystalline Fe-Oxides		
		Solids A	Solids B	WTP Waste	Solids A	Solids B	WTP Waste	Solids A	Solids B	WTP Waste
Al	mg/kg	47	62	31	2278	2299	327	7353	7176	348
Sb	mg/kg	0.054	0.054	0.029	0.52	0.48	0.33	8.0	8.2	0.8
As	mg/kg	4.4	5.1	1.8	189	178	184	178	157	353
Ba	mg/kg	29	32	19	120	122	77	62	55	6
Cd	mg/kg	0.64	0.67	0.44	1.2	1.1	1.1	0.39	0.37	0.10
Ca	mg/kg	2874	2749	14470	2014	1911	7037	1065	1040	312
Cr	mg/kg	0.21	0.24	2.45	3.5	3.7	57.5	16	14	16
Co	mg/kg	0.73	0.81	0.79	2.2	2.3	1.8	3.1	2.9	0.5
Cu	mg/kg	5.2	5.0	8.8	61	64	48	33	29	8
Fe	mg/kg	1304	1342	2565	31376	27589	141972	18563	16350	17364
Pb	mg/kg	0.44	0.60	0.00	28	26	5	45	41	2
Mg	mg/kg	214	230	917	699	722	389	2757	2678	57
Mn	mg/kg	225	207	725	173	171	550	129	120	35
Hg	µg/kg	0.18	0.18	0.36	1.2	1.00	2.79	20	25	7
Mo	mg/kg	0.027	0.011	0.000	0.068	0.11	0.25	1.0	0.91	1.60
Ni	mg/kg	0.68	0.76	1.21	3.4	3.7	6.5	11	9.1	5.9
K	mg/kg	54	57	123	237	220	26	828	734	78
Se	mg/kg	0.013	0.011	1.235	0.062	0.056	1.454	0.052	0.056	5.330
Si	mg/kg	194	171	1055	2288	2229	5299	1955	2135	988
Ag	mg/kg	0.013	0.0090	0.0009	1.6	1.6	0.2	0.78	0.93	0.07
S	mg/kg	306	360	2233	20	20	1137	200	160	548
U	mg/kg	0.24	0.32	0.20	0.35	0.40	0.48	0.27	0.26	0.09
Zn	mg/kg	10	10	64	45	45	145	101	91	28

Table 3-6:
Relative Elemental Proportions Leached from the Natural Solids and WTP Waste Samples During Sequential Extraction Tests

	Adsorbed/Carbonate Fraction			Poorly Crystalline Fe-(oxy)hydroxides			Crystalline Fe-Oxides		
	Solids A	Solids B	WTP Waste	Solids A	Solids B	WTP Waste	Solids A	Solids B	WTP Waste
Al	0%	1%	4%	24%	24%	46%	76%	75%	49%
Sb	1%	1%	3%	6%	5%	29%	93%	94%	68%
As	1%	1%	0%	51%	52%	34%	48%	46%	65%
Ba	14%	15%	19%	57%	58%	76%	29%	26%	6%
Cd	29%	31%	26%	53%	51%	68%	18%	18%	6%
Ca	48%	48%	66%	34%	34%	32%	18%	18%	1%
Cr	1%	1%	3%	18%	21%	76%	81%	78%	21%
Co	12%	14%	25%	37%	39%	58%	51%	48%	17%
Cu	5%	5%	14%	62%	65%	74%	33%	30%	12%
Fe	3%	3%	2%	61%	61%	88%	36%	36%	11%
Pb	1%	1%	0%	38%	38%	70%	61%	61%	30%
Mg	6%	6%	67%	19%	20%	29%	75%	74%	4%
Mn	43%	42%	55%	33%	34%	42%	25%	24%	3%
Hg	1%	1%	4%	6%	4%	28%	94%	95%	69%
Mo	2%	1%	0%	6%	11%	14%	92%	88%	86%
Ni	5%	6%	9%	23%	27%	48%	73%	67%	43%
K	5%	6%	54%	21%	22%	12%	74%	73%	34%
Se	10%	9%	15%	49%	46%	18%	41%	46%	66%
Si	4%	4%	14%	52%	49%	72%	44%	47%	13%
Ag	1%	0%	0%	66%	63%	76%	33%	36%	24%
S	58%	67%	57%	4%	4%	29%	38%	30%	14%
U	29%	32%	26%	40%	41%	62%	31%	26%	12%
Zn	7%	7%	27%	29%	31%	61%	65%	62%	12%

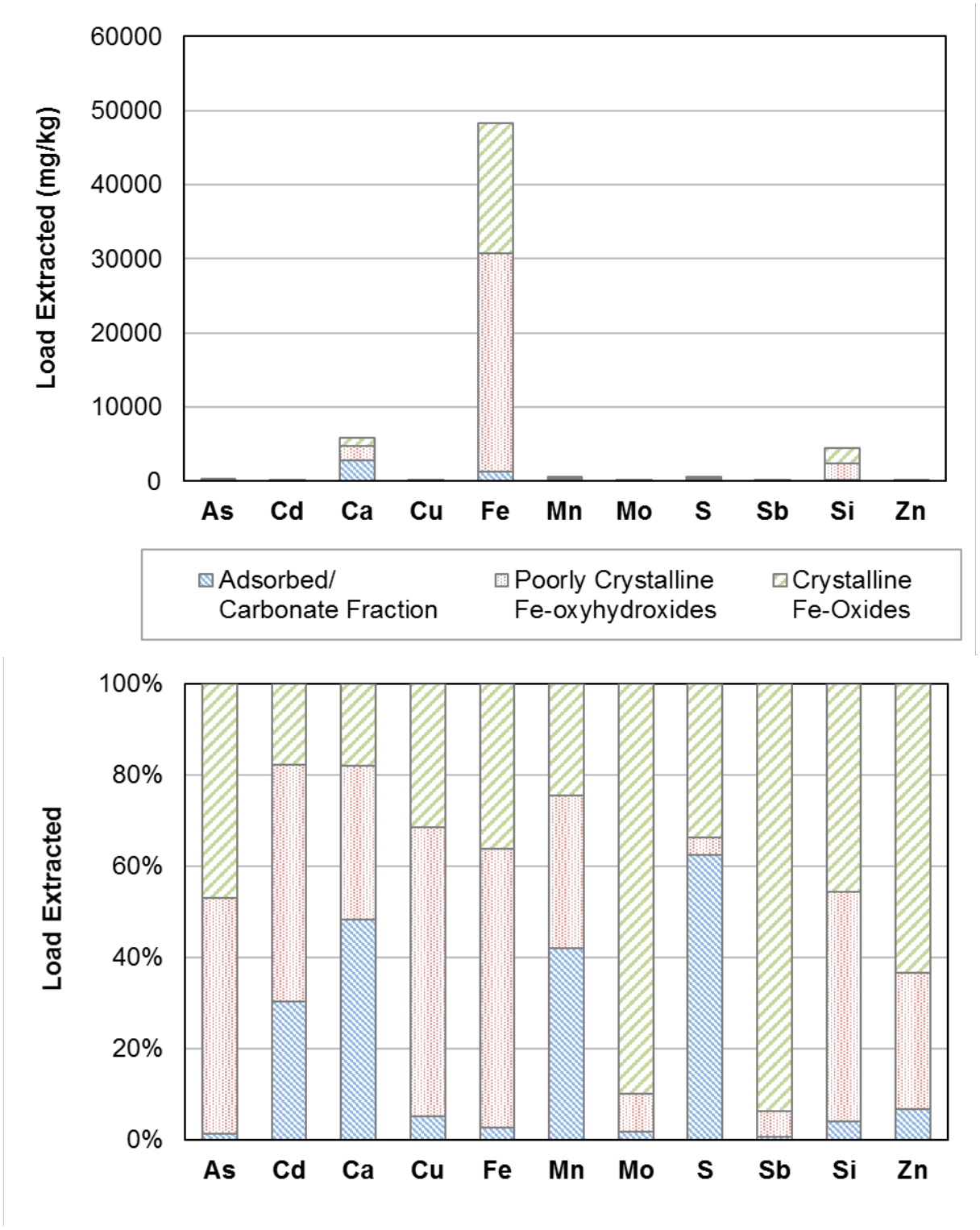


Figure 3-3: Selected absolute and relative geochemical loads extracted from the natural solids (averaged) during the three sequential extraction steps

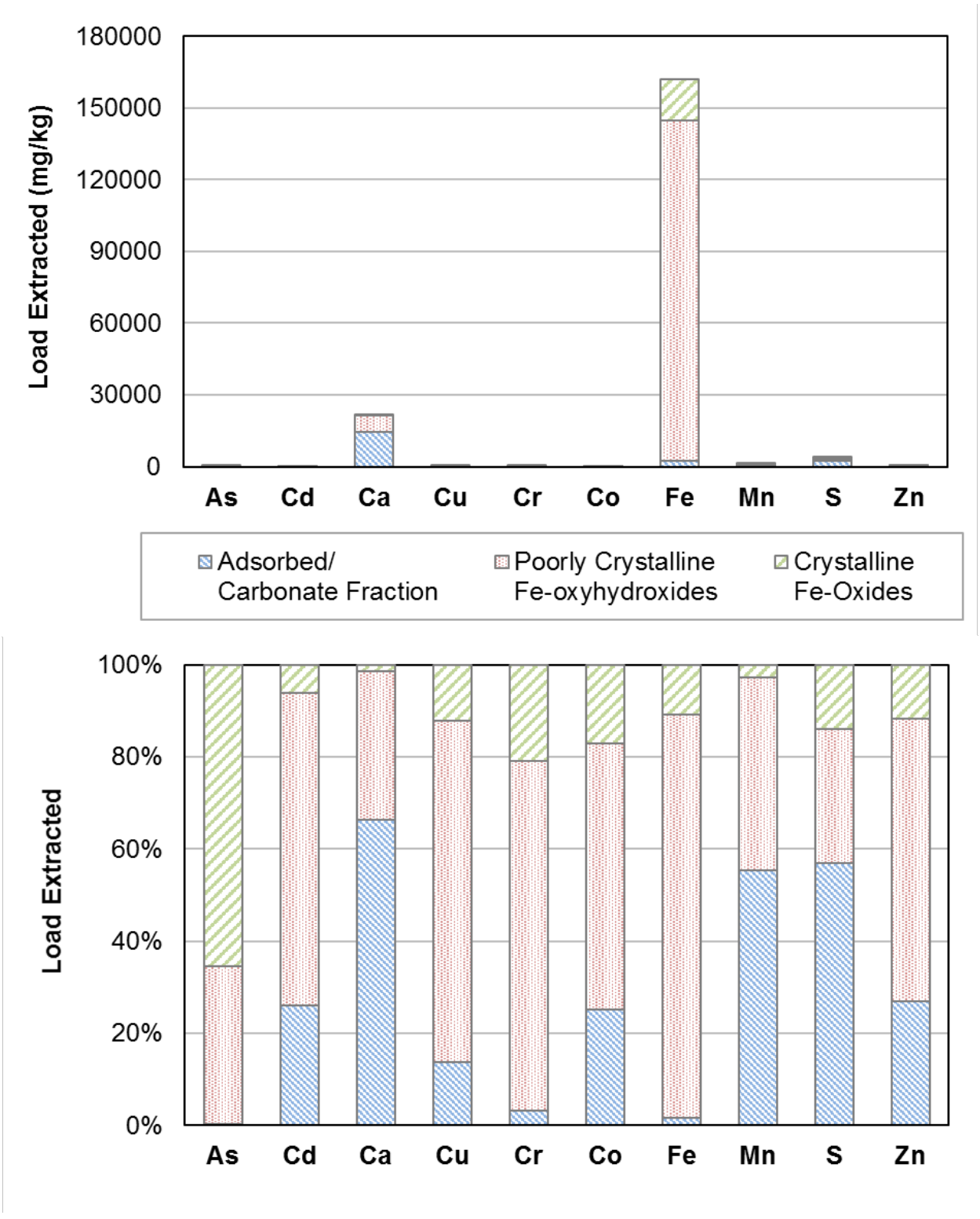


Figure 3-4: Selected absolute and relative geochemical loads extracted from the WTP waste sample during the three sequential extraction steps

not have been fully dissolved during these tests. The dominant portion of most aqua-regia digestible species, however, appears to be hosted in one of the phases attacked during sequential extraction, since 60% to > 90% of the remaining species were extracted from the natural solids samples. The same assessment shows a slightly different trend for the WTP waste material, providing further evidence of its mineralogically different make-up. Specifically, most elements show higher extraction percentages (*e.g.*, As, Sb, Fe, Mg, Mn, S, Zn) suggesting that primary silicates, sulfides and insoluble sulfate salts are lesser "contaminants" in this material.

Table 3-7:
Proportion of Mass Leached During the Three Sequential Extraction Steps with Respect to the Aqua-Regia Digestible Element Inventory

	% Leached in Extractions *(versus Aqua-Regia Digestible)*		
	Solids A	**Solids B**	**WTP waste**
Al	90%	88%	59%
Sb	39%	49%	100%
As	89%	93%	95%
Ba	85%	89%	77%
Be	90%	71%	90%
Cd	87%	95%	86%
Ca	96%	98%	104%
Cr	69%	69%	97%
Co	77%	75%	97%
Cu	79%	84%	78%
Fe	73%	77%	108%
Pb	84%	90%	87%
Mg	75%	76%	91%
Mn	88%	93%	99%
Hg	36%	52%	34%
Mo	59%	69%	69%
Ni	72%	74%	76%
P	68%	71%	69%
K	70%	72%	114%
Sr	88%	94%	102%
S	35%	34%	103%
Sn	86%	108%	87%
U	82%	86%	88%
V	69%	71%	99%
Zn	73%	77%	86%

4. Implications for WTP Solids Chemical Stability and Management

4.1 Treatment Solids Chemical Stability

The potential for contaminant remobilization from WTP waste solids will be dependent upon: 1) the geochemical and mineralogical properties of the waste materials; and 2) the environmental conditions of placement. Overall, the redox-sensitive (Fe-based) solid phases are predicted to remain chemically stable if stored under neutral, aerobic conditions, with metal leaching being limited to the desorption of weakly bound trace elements and/or carbonate dissolution upon interaction with infiltration waters. Vice versa, placement of WTP waste solids under reducing conditions (e.g., under the water table) may lead to enhanced release of Fe and associated trace metals in response to reductive dissolution.

The primary geochemical parameters of concern in TSF seepages at the Mount Nansen site include Fe and As and to a lesser extent Cd, Cu, Cr, Co, Mn and Zn. Although the target parameters of the proposed treatment system are TSS and Fe, these other parameters of potential concern are expected to be positively affected by the treatment process. Of the species listed above, all show significant fractions associated with Fe phases, with Fe, As, Cu, and Cr being almost exclusively contained in the Fe component. Parameters dominantly associated with Fe precipitates can be expected to show a high degree of chemical stability for materials stored under aerobic conditions. Note that the high Se concentrations observed in the WTP solids SFE test are likely a result of contamination during the treatment pilot experiment and is unlikely to be caused by Mount Nansen water. Se is not a parameter associated with any reagents or materials using in the process. As a result, Se is not a parameter of interest or concern in the WTP solids.

4.2 WTP Waste Solids Management

To minimize the leaching of WTP waste products, and hence to maximize the protection of downstream receiving environments, it is crucial that the Geotubes® be stored in an environment that promotes their chemical and physical stability. In the light of the findings presented herein, the following recommendations are made with regards to the Geotube® storage location:

- WTP products should be stored within the footprint of the TMF. This will afford containment of potential seepage loadings to the current seepage collection system;

- The location should be above the water table in an oxidizing environment to promote the chemical stability of reducible Fe-phases that contain the bulk of the species identified to be of potential concern;
- The storage location should be isolated from flowing stream channels. In this regard, berms may be required to minimize interaction with surface runoff within the TMF; and
- Geotubes® should be physically contained using berms as required to minimize erosion and other factors compromising their physical stability.

Two storage locations satisfying these criteria have been identified within the perimeter of the TSF. Potential laydown areas are illustrated in Figure 2-1. Since all TSF seepage is collected in the collection pond immediately downstream of the embankment, any potential effect the Geotubes® would have on the receiving environment would be captured. While not assessed quantitatively herein, it is highly unlikely that seepage affected by desorption and carbonate dissolution under neutral conditions would alter the geochemical signature of the TSF porewater.

Once the WTP is operational, actual WTP solid wastes can be sampled and geochemically tested as per the methods described in this report. These data will be used to ground-truth the results and recommendations presented herein. Characterization of WTP solids will be conducted on a regular basis and may include static and kinetic testwork as well as mineralogy. Regular monitoring of seeps and/or water bodies directly downgradient of the WTP storage location will also be implemented to better understand the direct aqueous effects and to allow for timely WTP solids management should the released geochemical loads exceed the predicted impact.

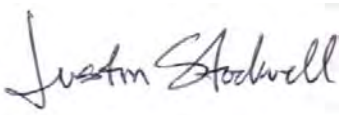
5. Closure

We trust that this report meets your expectations at this time. Please contact the undersigned with any questions or comments.

Sincerely,

LORAX ENVIRONMENTAL SERVICES LTD.

Prepared by:



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Appendix D: Raw Seep Water Quality Data Report

Yukon Government

Report To	Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC. 2195 - 2nd Ave Whitehorse, YT Y1A 3T8	**Date Received** **Report Date** **Report Revision** **Version**	24-Feb-2017 10:30 3-Mar-2017 17:39 1 FINAL
Client Phone	867-393-4882		

Certificate of Analysis

Lab Work Order #	L1894513
Project P.O. #	
Job Reference	MOUNT NANSEN 17Y0069
Legal Site Description	
C of C Numbers	

Case Narrative/Comments

Can Dang
Senior Account Manager

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Sample Summary L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

Sample Details

ALS Sample ID	Client Sample ID	Matrix	Date Sampled	Time Sampled	Qualifier
L1894513-1	WQ-SEEP	Water	22-Feb-17	14:40	

Results Summary L1894513

Results of Analysis L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

Parameter	ALS ID	Client Sample ID	ALS Test Code	Results	Detection Limit	Units	Qual	Date Sampled	Time Sampled	Prep Date	Analysis Date	QC Lot	QC Eval	Hold Time Eval	Matrix	Class
Physical Tests (Water)																
Conductivity	L1894513-1	WQ-SEEP	EC-PCT-VA	1570	2.0	uS/cm		22-Feb-17	14:40		28-Feb-17	625845	✓	✓	Water	Physical Tests
Hardness (as CaCO3)	L1894513-1	WQ-SEEP	HARDNESS-CALC-VA	864	0.50	mg/L		22-Feb-17	14:40		2-Mar-17		✓	✓	Water	Physical Tests
pH	L1894513-1	WQ-SEEP	PH-PCT-VA	7.34	0.10	pH		22-Feb-17	14:40		27-Feb-17	625651	✓	×	Water	Physical Tests
Total Suspended Solids	L1894513-1	WQ-SEEP	TSS-MAN-WR	45.3	3.0	mg/L		22-Feb-17	14:40		28-Feb-17	625129	✓	✓	Water	Physical Tests
TDS (Calculated)	L1894513-1	WQ-SEEP	TDS-CALC-VA	1250	1.0	mg/L		22-Feb-17	14:40		2-Mar-17		✓	✓	Water	Physical Tests
Anions and Nutrients (Water)																
Alkalinity, Bicarbonate (as CaCO3)	L1894513-1	WQ-SEEP	ALK-TITR-VA	288	1.0	mg/L		22-Feb-17	14:40		27-Feb-17	625651	✓	✓	Water	Anions and Nutrients
Alkalinity, Carbonate (as CaCO3)	L1894513-1	WQ-SEEP	ALK-TITR-VA	<1.0	1.0	mg/L		22-Feb-17	14:40		27-Feb-17	625651	✓	✓	Water	Anions and Nutrients
Alkalinity, Hydroxide (as CaCO3)	L1894513-1	WQ-SEEP	ALK-TITR-VA	<1.0	1.0	mg/L		22-Feb-17	14:40		27-Feb-17	625651	✓	✓	Water	Anions and Nutrients
Alkalinity, Total (as CaCO3)	L1894513-1	WQ-SEEP	ALK-TITR-VA	288	1.0	mg/L		22-Feb-17	14:40		27-Feb-17	625651	✓	✓	Water	Anions and Nutrients
Ammonia, Total (as N)	L1894513-1	WQ-SEEP	NH3-F-VA	5.08	0.13	mg/L		22-Feb-17	14:40		2-Mar-17	626239	✓	✓	Water	Anions and Nutrients
Bromide (Br)	L1894513-1	WQ-SEEP	BR-L-IC-N-VA	<0.50	0.50	mg/L	DLDS	22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Chloride (Cl)	L1894513-1	WQ-SEEP	CL-IC-N-VA	<5.0	5.0	mg/L	DLDS	22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Fluoride (F)	L1894513-1	WQ-SEEP	F-IC-N-VA	<0.20	0.20	mg/L	DLDS	22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Nitrate (as N)	L1894513-1	WQ-SEEP	NO3-L-IC-N-VA	0.717	0.050	mg/L		22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Nitrite (as N)	L1894513-1	WQ-SEEP	NO2-L-IC-N-VA	0.028	0.010	mg/L		22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Sulfate (SO4)	L1894513-1	WQ-SEEP	SO4-IC-N-VA	697	3.0	mg/L		22-Feb-17	14:40		25-Feb-17	624939	✓	✓	Water	Anions and Nutrients
Anion Sum	L1894513-1	WQ-SEEP	IONBALANCE-VA	20.3		meq/L		22-Feb-17	14:40		2-Mar-17		✓	✓	Water	Anions and Nutrients
Cation Sum	L1894513-1	WQ-SEEP	IONBALANCE-VA	20.4		meq/L		22-Feb-17	14:40		2-Mar-17		✓	✓	Water	Anions and Nutrients
Cation - Anion Balance	L1894513-1	WQ-SEEP	IONBALANCE-VA	0.2		%		22-Feb-17	14:40		2-Mar-17		✓	✓	Water	Anions and Nutrients
Cyanides (Water)																
Cyanide, Weak Acid Diss	L1894513-1	WQ-SEEP	CN-WAD-CFA-VA	0.0127	0.0050	mg/L		22-Feb-17	14:40		28-Feb-17	625917	✓	✓	Water	Cyanides
Cyanide, Total	L1894513-1	WQ-SEEP	CN-T-CFA-VA	0.0539	0.0050	mg/L		22-Feb-17	14:40		28-Feb-17	625917	✓	✓	Water	Cyanides
Cyanate	L1894513-1	WQ-SEEP	CN-CNO-WT	2.61	0.20	mg/L		22-Feb-17	14:40		1-Mar-17	625953	✓	✓	Water	Cyanides
Thiocyanate (SCN)	L1894513-1	WQ-SEEP	CN-SCN-VA	5.32	0.50	mg/L		22-Feb-17	14:40		1-Mar-17	626694	✓	✓	Water	Cyanides
Total Metals (Water)																
Aluminum (Al)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.0191	0.0030	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Antimony (Sb)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00065	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Arsenic (As)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.0962	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Barium (Ba)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.0663	0.000050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Beryllium (Be)-Total	L1894513-1	WQ-SEEP	BE-T-L-CCMS-VA	<0.000020	0.000020	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Bismuth (Bi)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.000080	0.000050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Boron (B)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.056	0.010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Cadmium (Cd)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.000444	0.0000050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Calcium (Ca)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	252	0.050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Chromium (Cr)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00070	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Cobalt (Co)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00742	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Copper (Cu)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00331	0.00050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Iron (Fe)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	20.5	0.010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Lead (Pb)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.000101	0.000050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Lithium (Li)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	<0.0010	0.0010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Magnesium (Mg)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	57.1	0.10	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Manganese (Mn)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	6.14	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Mercury (Hg)-Total	L1894513-1	WQ-SEEP	HG-T-CVAA-VA	<0.0000050	0.0000050	mg/L		22-Feb-17	14:40		27-Feb-17	625327	✓	✓	Water	Total Metals
Molybdenum (Mo)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00112	0.000050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Nickel (Ni)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00300	0.00050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Phosphorus (P)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.056	0.050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Potassium (K)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	6.70	0.10	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Selenium (Se)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.000276	0.000050	mg/L		22-Feb-17	14:40		2-Mar-17	625017	✓	✓	Water	Total Metals
Silicon (Si)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	9.00	0.050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Silver (Ag)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.000367	0.000010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Sodium (Na)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	34.2	0.050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Strontium (Sr)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.769	0.00020	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Sulfur (S)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	278	0.50	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Thallium (Tl)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	<0.000010	0.000010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Tin (Sn)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	<0.00010	0.00010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Titanium (Ti)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00154	0.00030	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Uranium (U)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00219	0.000010	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals

Results of Analysis L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

Parameter	ALS ID	Client Sample ID	ALS Test Code	Results	Detection Limit	Units	Qual	Date Sampled	Time Sampled	Prep Date	Analysis Date	QC Lot	QC Eval	Hold Time Eval	Matrix	Class
Vanadium (V)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00339	0.00050	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Zinc (Zn)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.0404	0.0030	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Zirconium (Zr)-Total	L1894513-1	WQ-SEEP	MET-T-CCMS-VA	0.00090	0.00030	mg/L		22-Feb-17	14:40		28-Feb-17	625017	✓	✓	Water	Total Metals
Dissolved Metals (Water)																
Dissolved Mercury Filtration Location	L1894513-1	WQ-SEEP	HG-D-CVAA-VA	FIELD		-		22-Feb-17	14:40		25-Feb-17	624813	✓	✓	Water	Dissolved Metals
Dissolved Metals Filtration Location	L1894513-1	WQ-SEEP	BE-D-L-CCMS-VA	FIELD		-		22-Feb-17	14:40		25-Feb-17	624823	✓	✓	Water	Dissolved Metals
Dissolved Metals Filtration Location	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	FIELD		-		22-Feb-17	14:40		25-Feb-17	624823	✓	✓	Water	Dissolved Metals
Aluminum (Al)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.0140	0.0010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Antimony (Sb)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00055	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Arsenic (As)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.0640	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Barium (Ba)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.0636	0.000050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Beryllium (Be)-Dissolved	L1894513-1	WQ-SEEP	BE-D-L-CCMS-VA	<0.000020	0.000020	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Bismuth (Bi)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.000050	0.000050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Boron (B)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.050	0.010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Cadmium (Cd)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.000341	0.0000050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Calcium (Ca)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	256	0.050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Chromium (Cr)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00058	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Cobalt (Co)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00699	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Copper (Cu)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00208	0.00020	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Iron (Fe)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	18.3	0.010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Lead (Pb)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.000050	0.000050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Lithium (Li)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.0010	0.0010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Magnesium (Mg)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	54.4	0.10	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Manganese (Mn)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	5.97	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Mercury (Hg)-Dissolved	L1894513-1	WQ-SEEP	HG-D-CVAA-VA	<0.0000050	0.0000050	mg/L		22-Feb-17	14:40	25-Feb-17	27-Feb-17	624813	✓	✓	Water	Dissolved Metals
Molybdenum (Mo)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00102	0.000050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Nickel (Ni)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00275	0.00050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Phosphorus (P)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.050	0.050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Potassium (K)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	6.37	0.10	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Selenium (Se)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.000256	0.000050	mg/L		22-Feb-17	14:40	25-Feb-17	2-Mar-17	624823	✓	✓	Water	Dissolved Metals
Silicon (Si)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	8.48	0.050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Silver (Ag)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.000013	0.000010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Sodium (Na)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	32.4	0.050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Strontium (Sr)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.755	0.00020	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Sulfur (S)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	267	0.50	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Thallium (Tl)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.000010	0.000010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Tin (Sn)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	<0.00010	0.00010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Titanium (Ti)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00124	0.00030	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Uranium (U)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00214	0.000010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Vanadium (V)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00256	0.00050	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Zinc (Zn)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.0432	0.0010	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals
Zirconium (Zr)-Dissolved	L1894513-1	WQ-SEEP	MET-D-CCMS-VA	0.00089	0.00030	mg/L		22-Feb-17	14:40	25-Feb-17	28-Feb-17	624823	✓	✓	Water	Dissolved Metals

Qualifier Legend

DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

Evaluation Legend

✓	QC Lot met ALS Data Quality Objectives or Test result met ALS Hold Time Recommendations
✗	QC Lot did not meet ALS Data Quality Objectives or Test result did not meet ALS Hold Time Recommendations

Duplicates L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

ALS ID	Reference	Client Sample ID	QC Type	QC Lot #	Analyte	Sample Result	Duplicate Result	Detection Limit	Units	RPD	RPD Limit	Diff	Diff Limit	Qual	Eval	Matrix	Class
Physical Tests (Water)																	
WG2485782-3	L1894513-1	WQ-SEEP	DUP	625129	Total Suspended Solids	45.3	47.3	3.0	mg/L	4.3	20	-			✓	Water	Physical Tests
Cyanides (Water)																	
WG2486875-3	WG2486875-4	WQ-SEEP	DUP	625953	Cyanate	<4.0	<4.0	4.0	mg/L	N/A	20	-			✓	Water	Cyanides

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

Quality Control L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Physical Tests (Water)													
CRM	Conductivity	625845	WG2486134-9	149	147	uS/cm	101.7	90-110	%		✓	Water	Physical Tests
CRM	pH	625651	WG2485155-2	7.00	7	pH	7.00	6.9-7.1	pH		✓	Water	Physical Tests
Anions and Nutrients (Water)													
CRM	Alkalinity, Total (as CaCO3)	625651	WG2485155-3	495	500	mg/L	99.0	85-115	%		✓	Water	Anions and Nutrients
Cyanides (Water)													
CRM	Thiocyanate (SCN)	626694	WG2487518-2	9.86	10	mg/L	98.6	85-115	%		✓	Water	Cyanides
CRM	Thiocyanate (SCN)	626694	WG2487518-3	93.7	100	mg/L	93.7	85-115	%		✓	Water	Cyanides
Physical Tests (Water)													
LCS	Total Suspended Solids	625129	WG2485782-2	66.0	75	mg/L	88.0	85-115	%		✓	Water	Physical Tests
Anions and Nutrients (Water)													
LCS	Ammonia, Total (as N)	626239	WG2487212-10	0.113	0.12	mg/L	94.4	85-115	%		✓	Water	Anions and Nutrients
LCS	Bromide (Br)	624939	WG2485219-2	0.496	0.5	mg/L	99.2	85-115	%		✓	Water	Anions and Nutrients
LCS	Bromide (Br)	624939	WG2485219-18	0.494	0.5	mg/L	98.8	85-115	%		✓	Water	Anions and Nutrients
LCS	Chloride (Cl)	624939	WG2485219-2	99.9	100	mg/L	99.9	90-110	%		✓	Water	Anions and Nutrients
LCS	Chloride (Cl)	624939	WG2485219-18	100	100	mg/L	99.96	90-110	%		✓	Water	Anions and Nutrients
LCS	Fluoride (F)	624939	WG2485219-2	0.981	1	mg/L	98.1	90-110	%		✓	Water	Anions and Nutrients
LCS	Fluoride (F)	624939	WG2485219-18	0.986	1	mg/L	98.6	90-110	%		✓	Water	Anions and Nutrients
LCS	Nitrate (as N)	624939	WG2485219-2	2.51	2.5	mg/L	100.4	90-110	%		✓	Water	Anions and Nutrients
LCS	Nitrate (as N)	624939	WG2485219-18	2.51	2.5	mg/L	100.5	90-110	%		✓	Water	Anions and Nutrients
LCS	Nitrite (as N)	624939	WG2485219-2	0.492	0.5	mg/L	98.5	90-110	%		✓	Water	Anions and Nutrients
LCS	Nitrite (as N)	624939	WG2485219-18	0.492	0.5	mg/L	98.4	90-110	%		✓	Water	Anions and Nutrients
LCS	Sulfate (SO4)	624939	WG2485219-2	101	100	mg/L	100.6	90-110	%		✓	Water	Anions and Nutrients
LCS	Sulfate (SO4)	624939	WG2485219-18	101	100	mg/L	100.7	90-110	%		✓	Water	Anions and Nutrients
Cyanides (Water)													
LCS	Cyanide, Weak Acid Diss	625917	WG2486819-2	0.125	0.125	mg/L	100.2	80-120	%		✓	Water	Cyanides
LCS	Cyanide, Total	625917	WG2486819-2	0.225	0.25	mg/L	90.0	80-120	%		✓	Water	Cyanides
LCS	Cyanate	625953	WG2486875-2	0.952	1	mg/L	95.2	85-115	%		✓	Water	Cyanides
Total Metals (Water)													
LCS	Aluminum (Al)-Total	625017	WG2485624-2	2.23	2	mg/L	111.5	80-120	%		✓	Water	Total Metals
LCS	Antimony (Sb)-Total	625017	WG2485624-2	1.15	1	mg/L	114.6	80-120	%		✓	Water	Total Metals
LCS	Arsenic (As)-Total	625017	WG2485624-2	1.10	1	mg/L	110.2	80-120	%		✓	Water	Total Metals
LCS	Barium (Ba)-Total	625017	WG2485624-2	0.287	0.25	mg/L	114.9	80-120	%		✓	Water	Total Metals
LCS	Beryllium (Be)-Total	625017	WG2485624-2	0.108	0.1	mg/L	107.7	80-120	%		✓	Water	Total Metals
LCS	Bismuth (Bi)-Total	625017	WG2485624-2	1.07	1	mg/L	107.5	80-120	%		✓	Water	Total Metals
LCS	Boron (B)-Total	625017	WG2485624-2	0.988	1	mg/L	98.8	80-120	%		✓	Water	Total Metals
LCS	Cadmium (Cd)-Total	625017	WG2485624-2	0.117	0.1	mg/L	117.1	80-120	%		✓	Water	Total Metals
LCS	Calcium (Ca)-Total	625017	WG2485624-2	53.1	50	mg/L	106.2	80-120	%		✓	Water	Total Metals
LCS	Chromium (Cr)-Total	625017	WG2485624-2	0.266	0.25	mg/L	106.5	80-120	%		✓	Water	Total Metals
LCS	Cobalt (Co)-Total	625017	WG2485624-2	0.284	0.25	mg/L	113.4	80-120	%		✓	Water	Total Metals
LCS	Copper (Cu)-Total	625017	WG2485624-2	0.282	0.25	mg/L	113.0	80-120	%		✓	Water	Total Metals
LCS	Iron (Fe)-Total	625017	WG2485624-2	1.06	1	mg/L	106.0	80-120	%		✓	Water	Total Metals
LCS	Lead (Pb)-Total	625017	WG2485624-2	0.529	0.5	mg/L	105.8	80-120	%		✓	Water	Total Metals
LCS	Lithium (Li)-Total	625017	WG2485624-2	0.267	0.25	mg/L	106.6	80-120	%		✓	Water	Total Metals
LCS	Magnesium (Mg)-Total	625017	WG2485624-2	56.4	50	mg/L	112.8	80-120	%		✓	Water	Total Metals
LCS	Manganese (Mn)-Total	625017	WG2485624-2	0.283	0.25	mg/L	113.1	80-120	%		✓	Water	Total Metals
LCS	Mercury (Hg)-Total	625327	WG2486025-2	0.0000971	0.0001	mg/L	97.1	80-120	%		✓	Water	Total Metals
LCS	Molybdenum (Mo)-Total	625017	WG2485624-2	0.280	0.25	mg/L	111.8	80-120	%		✓	Water	Total Metals
LCS	Nickel (Ni)-Total	625017	WG2485624-2	0.556	0.5	mg/L	111.3	80-120	%		✓	Water	Total Metals
LCS	Phosphorus (P)-Total	625017	WG2485624-2	2.49	2.5	mg/L	99.6	80-120	%		✓	Water	Total Metals
LCS	Potassium (K)-Total	625017	WG2485624-2	56.3	50	mg/L	112.6	80-120	%		✓	Water	Total Metals
LCS	Selenium (Se)-Total	625017	WG2485624-2	1.08	1	mg/L	107.5	80-120	%		✓	Water	Total Metals
LCS	Silicon (Si)-Total	625017	WG2485624-2	1.08	1	mg/L	107.6	80-120	%		✓	Water	Total Metals
LCS	Silver (Ag)-Total	625017	WG2485624-2	0.102	0.1	mg/L	101.8	80-120	%		✓	Water	Total Metals
LCS	Sodium (Na)-Total	625017	WG2485624-2	54.6	50	mg/L	109.1	80-120	%		✓	Water	Total Metals
LCS	Strontium (Sr)-Total	625017	WG2485624-2	0.287	0.25	mg/L	114.9	80-120	%		✓	Water	Total Metals
LCS	Sulfur (S)-Total	625017	WG2485624-2	54.1	50	mg/L	108.1	80-120	%		✓	Water	Total Metals
LCS	Thallium (Tl)-Total	625017	WG2485624-2	1.07	1	mg/L	107.4	80-120	%		✓	Water	Total Metals
LCS	Tin (Sn)-Total	625017	WG2485624-2	0.551	0.5	mg/L	110.2	80-120	%		✓	Water	Total Metals
LCS	Titanium (Ti)-Total	625017	WG2485624-2	0.283	0.25	mg/L	113.2	80-120	%		✓	Water	Total Metals
LCS	Uranium (U)-Total	625017	WG2485624-2	0.00535	0.005	mg/L	106.9	80-120	%		✓	Water	Total Metals
LCS	Vanadium (V)-Total	625017	WG2485624-2	0.547	0.5	mg/L	109.4	80-120	%		✓	Water	Total Metals
LCS	Zinc (Zn)-Total	625017	WG2485624-2	0.529	0.5	mg/L	105.8	80-120	%		✓	Water	Total Metals
LCS	Zirconium (Zr)-Total	625017	WG2485624-2	0.0979	0.1	mg/L	97.9	80-120	%		✓	Water	Total Metals
Dissolved Metals (Water)													
LCS	Mercury (Hg)-Dissolved	624813	WG2485361-2	0.0000983	0.0001	mg/L	98.3	80-120	%		✓	Water	Dissolved Metals
Physical Tests (Water)													
MB	Conductivity	625651	WG2485155-1	<2.0		uS/cm	-	<2.0	uS/cm		✓	Water	Physical Tests
MB	Conductivity	625845	WG2486134-6	<2.0		uS/cm	-	<2.0	uS/cm		✓	Water	Physical Tests
MB	Total Suspended Solids	625129	WG2485782-1	<3.0		mg/L	-	<3.0	mg/L		✓	Water	Physical Tests

Quality Control L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Anions and Nutrients (Water)													
MB	Alkalinity, Total (as CaCO3)	625651	WG2485155-1	<1.0		mg/L	-	<1.0	mg/L		✓	Water	Anions and Nutrients
MB	Ammonia, Total (as N)	626239	WG2487212-9	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-4	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-7	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-10	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-13	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Bromide (Br)	624939	WG2485219-16	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-1	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-4	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-7	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-10	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-13	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Chloride (Cl)	624939	WG2485219-16	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-1	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-4	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-7	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-10	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-13	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Fluoride (F)	624939	WG2485219-16	<0.020		mg/L	-	<0.020	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-1	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-4	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-7	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-10	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-13	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrate (as N)	624939	WG2485219-16	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-1	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-4	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-7	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-10	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-13	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Nitrite (as N)	624939	WG2485219-16	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-1	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-4	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-7	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-10	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-13	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
MB	Sulfate (SO4)	624939	WG2485219-16	<0.30		mg/L	-	<0.30	mg/L		✓	Water	Anions and Nutrients
Cyanides (Water)													
MB	Cyanide, Weak Acid Diss	625917	WG2486819-1	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Cyanides
MB	Cyanide, Total	625917	WG2486819-1	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Cyanides
MB	Cyanate	625953	WG2486875-1	<0.20		mg/L	-	<0.20	mg/L		✓	Water	Cyanides
MB	Thiocyanate (SCN)	626694	WG2487518-1	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Cyanides
Total Metals (Water)													
MB	Aluminum (Al)-Total	625017	WG2485624-1	<0.0030		mg/L	-	<0.0030	mg/L		✓	Water	Total Metals
MB	Antimony (Sb)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Arsenic (As)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Barium (Ba)-Total	625017	WG2485624-1	<0.000050		mg/L	-	<0.000050	mg/L		✓	Water	Total Metals
MB	Beryllium (Be)-Total	625017	WG2485624-1	<0.000020		mg/L	-	<0.000020	mg/L		✓	Water	Total Metals
MB	Bismuth (Bi)-Total	625017	WG2485624-1	<0.000050		mg/L	-	<0.000050	mg/L		✓	Water	Total Metals
MB	Boron (B)-Total	625017	WG2485624-1	<0.010		mg/L	-	<0.010	mg/L		✓	Water	Total Metals
MB	Cadmium (Cd)-Total	625017	WG2485624-1	<0.0000050		mg/L	-	<0.0000050	mg/L		✓	Water	Total Metals
MB	Calcium (Ca)-Total	625017	WG2485624-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MB	Chromium (Cr)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Cobalt (Co)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Copper (Cu)-Total	625017	WG2485624-1	<0.00050		mg/L	-	<0.00050	mg/L		✓	Water	Total Metals
MB	Iron (Fe)-Total	625017	WG2485624-1	<0.010		mg/L	-	<0.010	mg/L		✓	Water	Total Metals
MB	Lead (Pb)-Total	625017	WG2485624-1	<0.000050		mg/L	-	<0.000050	mg/L		✓	Water	Total Metals
MB	Lithium (Li)-Total	625017	WG2485624-1	<0.0010		mg/L	-	<0.0010	mg/L		✓	Water	Total Metals
MB	Magnesium (Mg)-Total	625017	WG2485624-1	<0.0050		mg/L	-	<0.0050	mg/L		✓	Water	Total Metals
MB	Manganese (Mn)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Mercury (Hg)-Total	625327	WG2486025-1	<0.0000050		mg/L	-	<0.0000050	mg/L		✓	Water	Total Metals
MB	Molybdenum (Mo)-Total	625017	WG2485624-1	<0.000050		mg/L	-	<0.000050	mg/L		✓	Water	Total Metals
MB	Nickel (Ni)-Total	625017	WG2485624-1	<0.00050		mg/L	-	<0.00050	mg/L		✓	Water	Total Metals
MB	Phosphorus (P)-Total	625017	WG2485624-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MB	Potassium (K)-Total	625017	WG2485624-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MB	Selenium (Se)-Total	625017	WG2485624-1	<0.000050		mg/L	-	<0.000050	mg/L		✓	Water	Total Metals
MB	Silicon (Si)-Total	625017	WG2485624-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MB	Silver (Ag)-Total	625017	WG2485624-1	<0.000010		mg/L	-	<0.000010	mg/L		✓	Water	Total Metals
MB	Sodium (Na)-Total	625017	WG2485624-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MB	Strontium (Sr)-Total	625017	WG2485624-1	<0.00020		mg/L	-	<0.00020	mg/L		✓	Water	Total Metals
MB	Sulfur (S)-Total	625017	WG2485624-1	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Total Metals
MB	Thallium (Tl)-Total	625017	WG2485624-1	<0.000010		mg/L	-	<0.000010	mg/L		✓	Water	Total Metals
MB	Tin (Sn)-Total	625017	WG2485624-1	<0.00010		mg/L	-	<0.00010	mg/L		✓	Water	Total Metals
MB	Titanium (Ti)-Total	625017	WG2485624-1	<0.00030		mg/L	-	<0.00030	mg/L		✓	Water	Total Metals
MB	Uranium (U)-Total	625017	WG2485624-1	<0.000010		mg/L	-	<0.000010	mg/L		✓	Water	Total Metals
MB	Vanadium (V)-Total	625017	WG2485624-1	<0.00050		mg/L	-	<0.00050	mg/L		✓	Water	Total Metals

Quality Control L1894513

Job Reference MOUNT NANSEN 17Y0069
Report To Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received 24-Feb-2017 10:30
Report Date 3-Mar-2017 17:39
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
MB	Zinc (Zn)-Total	625017	WG2485624-1	<0.0030		mg/L	-	<0.0030	mg/L		✓	Water	Total Metals
MB	Zirconium (Zr)-Total	625017	WG2485624-1	<0.00030		mg/L	-	<0.00030	mg/L		✓	Water	Total Metals
Dissolved Metals (Water)													
MB	Mercury (Hg)-Dissolved	624813	WG2485361-1	<0.0000050		mg/L	-	<0.0000050	mg/L		✓	Water	Dissolved Metals
Cyanides (Water)													
MS	Thiocyanate (SCN)	626694	WQ-SEEP	13.4	15.3	mg/L	80.7	75-125	%		✓	Water	Cyanides
Dissolved Metals (Water)													
MS	Aluminum (Al)-Dissolved	624823	WQ-SEEP	0.216	0.214	mg/L	101.1	70-130	%		✓	Water	Dissolved Metals
MS	Antimony (Sb)-Dissolved	624823	WQ-SEEP	0.0215	0.0206	mg/L	104.8	70-130	%		✓	Water	Dissolved Metals
MS	Arsenic (As)-Dissolved	624823	WQ-SEEP	0.0849	0.084	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Barium (Ba)-Dissolved	624823	WQ-SEEP	0.0820	0.0836	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Beryllium (Be)-Dissolved	624823	WQ-SEEP	0.0387	0.04	mg/L	96.8	70-130	%		✓	Water	Dissolved Metals
MS	Bismuth (Bi)-Dissolved	624823	WQ-SEEP	0.00957	0.01	mg/L	95.7	70-130	%		✓	Water	Dissolved Metals
MS	Boron (B)-Dissolved	624823	WQ-SEEP	0.137	0.15	mg/L	87.2	70-130	%		✓	Water	Dissolved Metals
MS	Cadmium (Cd)-Dissolved	624823	WQ-SEEP	0.00410	0.00434	mg/L	94.0	70-130	%		✓	Water	Dissolved Metals
MS	Calcium (Ca)-Dissolved	624823	WQ-SEEP	249	260	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Chromium (Cr)-Dissolved	624823	WQ-SEEP	0.0392	0.0406	mg/L	96.6	70-130	%		✓	Water	Dissolved Metals
MS	Cobalt (Co)-Dissolved	624823	WQ-SEEP	0.0256	0.027	mg/L	93.2	70-130	%		✓	Water	Dissolved Metals
MS	Copper (Cu)-Dissolved	624823	WQ-SEEP	0.0197	0.0221	mg/L	88.0	70-130	%		✓	Water	Dissolved Metals
MS	Iron (Fe)-Dissolved	624823	WQ-SEEP	20.1	20.3	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Lead (Pb)-Dissolved	624823	WQ-SEEP	0.0201	0.02	mg/L	100.3	70-130	%		✓	Water	Dissolved Metals
MS	Lithium (Li)-Dissolved	624823	WQ-SEEP	0.0933	0.101	mg/L	92.8	70-130	%		✓	Water	Dissolved Metals
MS	Magnesium (Mg)-Dissolved	624823	WQ-SEEP	54.2	55.4	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Manganese (Mn)-Dissolved	624823	WQ-SEEP	6.00	5.99	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Molybdenum (Mo)-Dissolved	624823	WQ-SEEP	0.0212	0.021	mg/L	100.8	70-130	%		✓	Water	Dissolved Metals
MS	Nickel (Ni)-Dissolved	624823	WQ-SEEP	0.0394	0.0427	mg/L	91.6	70-130	%		✓	Water	Dissolved Metals
MS	Phosphorus (P)-Dissolved	624823	WQ-SEEP	10.6	10	mg/L	106.0	70-130	%		✓	Water	Dissolved Metals
MS	Potassium (K)-Dissolved	624823	WQ-SEEP	10.4	10.4	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Selenium (Se)-Dissolved	624823	WQ-SEEP	0.0459	0.04	mg/L	114.8	70-130	%		✓	Water	Dissolved Metals
MS	Silicon (Si)-Dissolved	624823	WQ-SEEP	18.3	18.5	mg/L	98.3	70-130	%		✓	Water	Dissolved Metals
MS	Silver (Ag)-Dissolved	624823	WQ-SEEP	0.00377	0.00401	mg/L	94.0	70-130	%		✓	Water	Dissolved Metals
MS	Sodium (Na)-Dissolved	624823	WQ-SEEP	34.1	34.4	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Strontium (Sr)-Dissolved	624823	WQ-SEEP	0.767	0.775	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Sulfur (S)-Dissolved	624823	WQ-SEEP	277	287	mg/L	N/A	-	%	MS-B		Water	Dissolved Metals
MS	Thallium (Tl)-Dissolved	624823	WQ-SEEP	0.00409	0.004	mg/L	102.0	70-130	%		✓	Water	Dissolved Metals
MS	Tin (Sn)-Dissolved	624823	WQ-SEEP	0.0200	0.02	mg/L	99.9	70-130	%		✓	Water	Dissolved Metals
MS	Titanium (Ti)-Dissolved	624823	WQ-SEEP	0.0424	0.0412	mg/L	102.8	70-130	%		✓	Water	Dissolved Metals
MS	Uranium (U)-Dissolved	624823	WQ-SEEP	0.00614	0.00614	mg/L	100.1	70-130	%		✓	Water	Dissolved Metals
MS	Vanadium (V)-Dissolved	624823	WQ-SEEP	0.105	0.103	mg/L	102.3	70-130	%		✓	Water	Dissolved Metals
MS	Zinc (Zn)-Dissolved	624823	WQ-SEEP	0.383	0.443	mg/L	85.0	70-130	%		✓	Water	Dissolved Metals
MS	Zirconium (Zr)-Dissolved	624823	WQ-SEEP	0.0410	0.0409	mg/L	100.2	70-130	%		✓	Water	Dissolved Metals

Qualifier Legend

MS-B Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

Methodology L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

ALS Test Code	ALS Test Description	Lab Location	Matrix	Method Reference	Methodology Description
Physical Tests (Water)					
EC-PCT-VA	Conductivity (Automated)	Vancouver	Water	APHA 2510 Auto. Conduc.	This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.
HARDNESS-CALC-VA	Hardness	Vancouver	Water	APHA 2340B	Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.
PH-PCT-VA	pH by Meter (Automated)	Vancouver	Water	APHA 4500-H pH Value	This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.
TDS-CALC-VA	TDS (Calculated)	Vancouver	Water	APHA 1030E (20TH EDITION)	This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses". The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.
TSS-MAN-WR	Total Suspended Solids by Gravimetric	Whitehorse	Water	APHA 2540 D	This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.
Anions and Nutrients (Water)					
ALK-TITR-VA	Alkalinity Species by Titration	Vancouver	Water	APHA 2320 Alkalinity	This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
BR-L-IC-N-VA	Bromide in Water by IC (Low Level)	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
CL-IC-N-VA	Chloride in Water by IC	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
F-IC-N-VA	Fluoride in Water by IC	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
IONBALANCE-VA	Ion Balance Calculation	Vancouver	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

Methodology L1894513

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Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

ALS Test Code	ALS Test Description	Lab Location	Matrix	Method Reference	Methodology Description
NH3-F-VA	Ammonia in Water by Fluorescence	Vancouver	Water	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.
NO2-L-IC-N-VA	Nitrite in Water by IC (Low Level)	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
NO3-L-IC-N-VA	Nitrate in Water by IC (Low Level)	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
SO4-IC-N-VA	Sulfate in Water by IC	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Cyanides (Water)					
CN-CNO-WT	Cyanate	Waterloo	Water	APHA 4500-CN-L	This analysis is carried out using procedures adapted from APHA method 4500-CN "Cyanide". Cyanate is determined by the Cyanate hydrolysis method using an ammonia selective electrode
CN-SCN-VA	Thiocyanate by Colour	Vancouver	Water	APHA 4500-CN CYANIDE	This analysis is carried out using procedures adapted from APHA Method 4500-CN- M "Thiocyanate" Thiocyanate is determined by the ferric nitrate colourimetric method. Water samples containing high levels of hexavalent chromium, cyanide (together with sulfide), reducing agents, or hydrocarbons may cause negative or positive interferences with this method. Contact ALS for additional information if required.
CN-T-CFA-VA	Total Cyanide in water by CFA	Vancouver	Water	ISO 14403:2002	This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.
CN-WAD-CFA-VA	Weak Acid Diss. Cyanide in water by CFA	Vancouver	Water	APHA 4500-CN CYANIDE	This analysis is carried out using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.
Total Metals (Water)					
BE-T-L-CCMS-VA	Total Be (Low) in Water by CRC ICPMS	Vancouver	Water	EPA 200.2/6020A (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
HG-T-CVAA-VA	Total Mercury in Water by CVAAS or CVAFS	Vancouver	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

Methodology L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

ALS Test Code	ALS Test Description	Lab Location	Matrix	Method Reference	Methodology Description
MET-T-CCMS-VA	Total Metals in Water by CRC ICPMS	Vancouver	Water	EPA 200.2/6020A (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals (Water)					
BE-D-L-CCMS-VA	Diss. Be (low) in Water by CRC ICPMS	Vancouver	Water	APHA 3030B/6020A (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
HG-D-CVAA-VA	Diss. Mercury in Water by CVAAS or CVAFS	Vancouver	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.
MET-D-CCMS-VA	Dissolved Metals in Water by CRC ICPMS	Vancouver	Water	APHA 3030B/6020A (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Hold Time Details L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTAL DYNAMICS INC.
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

ALS Product Description	Sample ID	Sampling Date	Date Processed	Recommended Hold Time	Actual Hold Time	Units	Qualifier
Physical Tests (Water)							
pH by Meter (Automated)	1	22-FEB-17 14:40	27-FEB-17 11:34	0.25	117	hours	EHTR-FM

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods,or CCME (where applicable).

Detection Limits L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTA
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

Client Sample ID		WQ-SEEP
Date Sampled		22-Feb-2017
Time Sampled		14:40
ALS Sample ID		L1894513-1
Parameter	Units	Water
Physical Tests (Water)		
Conductivity	uS/cm	2.0
Hardness (as CaCO3)	mg/L	0.50
pH	pH	0.10
Total Suspended Solids	mg/L	3.0
TDS (Calculated)	mg/L	1.0
Anions and Nutrients (Water)		
Alkalinity, Bicarbonate (as CaCO3)	mg/L	1.0
Alkalinity, Carbonate (as CaCO3)	mg/L	1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	1.0
Alkalinity, Total (as CaCO3)	mg/L	1.0
Ammonia, Total (as N)	mg/L	0.13
Bromide (Br)	mg/L	0.50
Chloride (Cl)	mg/L	5.0
Fluoride (F)	mg/L	0.20
Nitrate (as N)	mg/L	0.050
Nitrite (as N)	mg/L	0.010
Sulfate (SO4)	mg/L	3.0
Anion Sum	meq/L	
Cation Sum	meq/L	
Cation - Anion Balance	%	
Cyanides (Water)		
Cyanide, Weak Acid Diss	mg/L	0.0050
Cyanide, Total	mg/L	0.0050
Cyanate	mg/L	0.20
Thiocyanate (SCN)	mg/L	0.50
Total Metals (Water)		
Aluminum (Al)-Total	mg/L	0.0030

Detection Limits L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTA
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

Client Sample ID		WQ-SEEP
Date Sampled		22-Feb-2017
Time Sampled		14:40
ALS Sample ID		L1894513-1
Parameter	Units	Water
Antimony (Sb)-Total	mg/L	0.00010
Arsenic (As)-Total	mg/L	0.00010
Barium (Ba)-Total	mg/L	0.000050
Beryllium (Be)-Total	mg/L	0.000020
Bismuth (Bi)-Total	mg/L	0.000050
Boron (B)-Total	mg/L	0.010
Cadmium (Cd)-Total	mg/L	0.0000050
Calcium (Ca)-Total	mg/L	0.050
Chromium (Cr)-Total	mg/L	0.00010
Cobalt (Co)-Total	mg/L	0.00010
Copper (Cu)-Total	mg/L	0.00050
Iron (Fe)-Total	mg/L	0.010
Lead (Pb)-Total	mg/L	0.000050
Lithium (Li)-Total	mg/L	0.0010
Magnesium (Mg)-Total	mg/L	0.10
Manganese (Mn)-Total	mg/L	0.00010
Mercury (Hg)-Total	mg/L	0.0000050
Molybdenum (Mo)-Total	mg/L	0.000050
Nickel (Ni)-Total	mg/L	0.00050
Phosphorus (P)-Total	mg/L	0.050
Potassium (K)-Total	mg/L	0.10
Selenium (Se)-Total	mg/L	0.000050
Silicon (Si)-Total	mg/L	0.050
Silver (Ag)-Total	mg/L	0.000010
Sodium (Na)-Total	mg/L	0.050
Strontium (Sr)-Total	mg/L	0.00020
Sulfur (S)-Total	mg/L	0.50
Thallium (Tl)-Total	mg/L	0.000010
Tin (Sn)-Total	mg/L	0.00010
Titanium (Ti)-Total	mg/L	0.00030
Uranium (U)-Total	mg/L	0.000010
Vanadium (V)-Total	mg/L	0.00050

Detection Limits L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTA
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

Client Sample ID		WQ-SEEP
Date Sampled		22-Feb-2017
Time Sampled		14:40
ALS Sample ID		L1894513-1
Parameter	Units	Water
Zinc (Zn)-Total	mg/L	0.0030
Zirconium (Zr)-Total	mg/L	0.00030
Dissolved Metals (Water)		
Dissolved Mercury Filtration Location	-	
Dissolved Metals Filtration Location	-	
Dissolved Metals Filtration Location	-	
Aluminum (Al)-Dissolved	mg/L	0.0010
Antimony (Sb)-Dissolved	mg/L	0.00010
Arsenic (As)-Dissolved	mg/L	0.00010
Barium (Ba)-Dissolved	mg/L	0.000050
Beryllium (Be)-Dissolved	mg/L	0.000020
Bismuth (Bi)-Dissolved	mg/L	0.000050
Boron (B)-Dissolved	mg/L	0.010
Cadmium (Cd)-Dissolved	mg/L	0.0000050
Calcium (Ca)-Dissolved	mg/L	0.050
Chromium (Cr)-Dissolved	mg/L	0.00010
Cobalt (Co)-Dissolved	mg/L	0.00010
Copper (Cu)-Dissolved	mg/L	0.00020
Iron (Fe)-Dissolved	mg/L	0.010
Lead (Pb)-Dissolved	mg/L	0.000050
Lithium (Li)-Dissolved	mg/L	0.0010
Magnesium (Mg)-Dissolved	mg/L	0.10
Manganese (Mn)-Dissolved	mg/L	0.00010
Mercury (Hg)-Dissolved	mg/L	0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.000050
Nickel (Ni)-Dissolved	mg/L	0.00050
Phosphorus (P)-Dissolved	mg/L	0.050
Potassium (K)-Dissolved	mg/L	0.10
Selenium (Se)-Dissolved	mg/L	0.000050
Silicon (Si)-Dissolved	mg/L	0.050
Silver (Ag)-Dissolved	mg/L	0.000010

Detection Limits L1894513

Job Reference	MOUNT NANSEN 17Y0069
Report To	Lyndsay Doetzel, EDI ENVIRONMENTA
Date Received	24-Feb-2017 10:30
Report Date	3-Mar-2017 17:39
Report Version	1

Client Sample ID		WQ-SEEP
Date Sampled		22-Feb-2017
Time Sampled		14:40
ALS Sample ID		L1894513-1
Parameter	Units	Water
Sodium (Na)-Dissolved	mg/L	0.050
Strontium (Sr)-Dissolved	mg/L	0.00020
Sulfur (S)-Dissolved	mg/L	0.50
Thallium (Tl)-Dissolved	mg/L	0.000010
Tin (Sn)-Dissolved	mg/L	0.00010
Titanium (Ti)-Dissolved	mg/L	0.00030
Uranium (U)-Dissolved	mg/L	0.000010
Vanadium (V)-Dissolved	mg/L	0.00050
Zinc (Zn)-Dissolved	mg/L	0.0010
Zirconium (Zr)-Dissolved	mg/L	0.00030