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Mountain Ash Limited Partnership Aggregate Operation NW and SW 31-26-03 W5M, Rocky View County, Alberta

Hydrogeological Assessment Report



January 2020 SLR Project No.: 212.06650.00003



#### HYDROGEOLOGICAL ASSESSMENT REPORT

# MOUNTAIN ASH LIMITED PARTNERSHIP AGGREGATE OPERATION NW AND SW 31-26-03 W5M ROCKY VIEW COUNTY, ALBERTA

#### SLR Project No.: 212.06650.00003

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for

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### EXECUTIVE SUMMARY

Mountain Ash Limited Partnership (MALP) is proposing to develop an aggregate resource at Section 31, Township 26, Range 3, west of the 5th Meridian in Rocky View County. SLR Consulting (Canada) Ltd. (SLR) was retained to conduct a hydrogeological investigation of this potential aggregate resource development. The objective is to provide a description of baseline hydrogeological conditions in the vicinity of the proposed MALP aggregate resource. We review the potential impacts of the development on groundwater quality and quantity. Based on this we provide mitigation measures to support the development and operation of the aggregate resource being conducted with minimal impact to existing local water users. This includes neighbouring domestic wells, nearby natural heritage features like Big Hill Creek, and the Big Hill Springs Provincial Park. As the ensuing report will identify, it is anticipated that this can be successfully achieved.

The proposed development is an aggregate resource to be worked in six counter-clockwise phases starting in the southeast corner. The sand and gravel will be extracted under dry conditions. No dewatering of the underlying aquifer is planned. In this manner groundwater resources will be protected.

This report creates a picture of the regional setting of the area based on published sources of information such as published geological maps and water well records. Field investigation was undertaken to find local wells, and to drill and install monitoring wells on the site. The soils were scientifically logged for the geologic profile and it was found that the site fit in well with the regional setting. From this, an examination of potential impacts was undertaken and appropriate mitigation was identified. As will be seen in the report, no adverse net impact of the operations on the hydrologic / hydrogeologic setting is predicted.

The two large sloughs in the northwest corner of the site are to be retained on the landscape. A wetland assessment has been undertaken and is covered elsewhere. No streams are located on, or flow from the site, and thus hydrologic impacts are not possible. The following schematic illustrates the hydrogeologic profile found at the site. Given the distances involved, it has been vertically stretched to better show the individual layers and thus is not to scale.



The sloughs are surface water fed and perched on the 4 to 6-metre-thick blanket of dense glacial till which limits the leakage of water into the ground. Beneath the till lies the target sand and gravel deposit which is 11 to 20 metres thick, and generally dry. The water table is close to the bottom

of this deposit and sometimes in the underlying bedrock. This bedrock is the Paskapoo Formation bedrock composed of sandstone, siltstone, mudstone and shale. Although not a very good aquifer, it is permeable enough to provide local water supply and is tapped by the few wells in the area. Groundwater flows to the southeast and eventually discharges in Big Hill Springs at the Provincial Park. The report identifies that this function will not be altered; there may be a slight increase in discharge when the pit is operating, due to the capture of rainfall directly into the sand. It was found that groundwater quality in the sand and gravel and the bedrock is very similar to that in Big Hill Springs.

We have considered the possibility of impacts from manmade sources such as fuels and solvents during the operational phase of the pit. We have also considered natural sources such as suspended solids from reworking of the material on site. These potential effects will be mitigated by using best handling practices as outlined in the *Code of Practice for Pits* (Alberta, 2004), other codes of best practice and adhering to regulatory approval conditions.

Under the current excavation scheme the overall risk of any significant negative impacts on water resources as a result of the development are negligible. This is based on the fact that the aggregate resource will not be mined into the water table and therefore no anticipated changes are possible to the groundwater flow system.

The following mitigation and design measures are recommended to reduce the chance of water quality pollution:

- Develop the site on a phased basis to minimize the working area and allow for progressive site restoration;
- Minimize the size of each working area to reduce the potential for generation of suspended sediment in storm water; and
- Commission settlement ponds and surface infiltration features early in the scheme development and manage all runoff generated during operations onsite; and
- Implement a groundwater monitoring program to monitor the existing groundwater flow system and give early warning of any unanticipated changes.

The effects of the development of an aggregate resource above the water table at this site will be minimal on the surface and groundwater regimes, particularly if the mitigation and design measures discussed above are implemented. It is predicted that there will be no adverse net impact of development at the site on surface water or groundwater users in the vicinity.

## TABLE OF CONTENTS

EXE	CUTI	/E SUMMARY	I
1.0	INTR	ODUCTION	1
	1.1	Site Description	1
	1.2	Physiography, Topography and Geomorphology	1
	1.3	Proposed Development	1
	1.4	Objectives	2
2.0	MET	HODOLOGY	2
	2.1	Desktop Study	2
	2.2	Field Investigation	3
		2.2.1 Water Well Field Verified Survey	3
		2.2.2 SLR Drilling Investigation and Monitoring Well Installation	3
		2.2.3 Hydraulic Conductivity Testing	4
		2.2.4 Groundwater and Surface Water Monitoring and Sampling	4
3.0	GEO	LOGY	5
	3.1	Surficial Topsoil	5
	3.2	Surficial Geology	5
	3.3	Bedrock Geology	6
4.0	HYD	ROGEOLOGY	6
	4.1	Field Verified Water Well Survey	7
	4.2	Aquifer Properties	9
		4.2.1 Surficial Unconsolidated Deposits	9
		4.2.2 Paskapoo Formation Bedrock	9
	4.2	4.2.3 Summary	10
	4.3	Groundwater Levels and Flow	10
	11	4.5.1 Groundwaler / Surrace Waler Interactions	/ /
	4.4	A 4 1 Surficial Denosits	12
		4.4.2 Paskapoo Formation Bedrock	13
		4.4.3 Big Hill Springs	14
	4.5	Water Balance	15
		4.5.1 Water Budget	15
		4.5.2 Surplus Partitioning	16
		4.5.3 Existing Site Water Balance	17
	4.6	Conceptual Model Discussion	18
5.0	HYD	ROGEOLOGICAL IMPACT ASSESSMENT	19
	5.1	Hydrogeological Impact Assessment Criteria	20
	5.2	Potential Impacts on Water Quantity	20
	5.3	Potential Impacts on Groundwater and Surface Water Quality	21
	5.4	Mitigation Measures	21
		5.4.1 Water Quantity	22
		5.4.2 Groundwater and Surface Water Quality	22
	5.5	Net Effects Assessment	23
		5.5.1 Cumulative Effects of Multiple Operations	23
6.0	CON	CLUSIONS AND RECOMMENDATIONS	24
	6.1	Conclusions	24
	6.2	Recommendations	25
7.0	REF	ERENCES	26

8.0	STATEMENT OF LIMITATIONS	28
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### TABLES

Table 1	Water Wells within 500 Metres	8
Table 2	Average Annual Water Budget (Calgary YYC)	.15
Table 3	Comparison of Water Budgets in Wet and Dry Years	.16
Table 4	Infiltration Factors	.17

### **APPENDED TABLES**

- Table A1Sand and Gravel Monitoring Well Groundwater Quality Results
- Table A2
   Paskapoo Formation Residential Well Groundwater Quality Results
- Table A3
   Big Hill Springs Water Quality Results

### **FIGURES**

### DRAWINGS

- Drawing 1 Site Location and Study Area
- Drawing 2 Study Area Topography
- Drawing 3 Borehole, Monitoring Well and Water Well Location Plan
- Drawing 4 Groundwater Elevations (July 3, 2019)
- Drawing 5 Schematic Geological Section A-A'
- Drawing 6 Schematic Geological Section B-B'
- Drawing 7 Schematic Geological Section C-C'

### APPENDICES

- Appendix A Site Gravel Investigation Results and Logs
- Appendix B SLR Consulting Ltd Monitoring Well Construction Logs
- Appendix C Alberta Water Well Records
- Appendix D Residential Well Assessment Questionnaires
- Appendix E Hydraulic Conductivity Test Analysis
- Appendix F Groundwater Elevation Data
- Appendix G Laboratory Analytical Reports
- Appendix H Baseline Water Resources Water Well Testing Results Letter Report

### 1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Mountain Ash Limited Partnership (MALP) to conduct a hydrogeological assessment of a proposed aggregate resource in Rocky View County, Alberta. The assessment and description of baseline hydrogeological conditions within the vicinity of the site is required to ensure the development and operation of the aggregate resource is conducted with minimal impact to existing local water users and the natural environment. This includes neighbouring domestic wells and the Big Hill Springs Provincial Park.

### 1.1 Site Description

Mountain Ash Limited Partnership (MALP) wishes to develop a site at the western half of Section 31, Township 26, Range 3, west of the 5th Meridian (Sec 31, Twp 26, Rge 3, W5M) for the purposes of aggregate extraction. The site location is shown on Drawing 1.

The northern part of the proposed site (Northwest quarter of Sec 31, Twp 26, Rge 3, W5M), is currently zoned by the Rocky View County as Natural Resource Industrial District and the southern part (Southwest quarter of Sec 31, Twp 26, Rge 3, W5M) is zoned Ranch and Farm District (Rocky View County, 2019). Its current use is ranch farming by a tenant occupier who lives in a dwelling on the site and ranches cattle, horses and sheep, and uses some of the land as hay pasture. There are two large sloughs in the northwest corner considered as Class II gramminoid marsh wetlands and a number of other, smaller wetlands mainly classified as Class I farmed through wetlands. A detailed description of the wetlands on site is provided in SLR (2020a; 2020b).

### **1.2** Physiography, Topography and Geomorphology

The Project Site is situated in the Southern Alberta Upland physiographic region of the interior plains division (Pettapiece, 1986). The geomorphological characteristics of this physiographic region are provided by the proximity of bedrock to the surface which causes a varied topography with elevations up to 1,650 metres (m) above sea level (asl) to the west. The site is located at an average elevation of approximately 1,280 masl. The site slopes to the southeast from the topographic high to the north and hosts a low-relief valley feature running northwest to southeast across NW Sec 31, Twp 26, Rge 3, W5M. In SW Sec 31, Twp 26, Rge 3, W5M, the topography slopes steeply southwesterly into the valley running west-northwest to east-southeast which leads to Big Hill Springs Creek. The site is in the Bighill Creek watershed and the study area topography based on LiDAR data is presented on Drawing 2.

The physiographic region coincides with the Foothills natural region which comprises dissected plateaus and rolling uplands with surficial geology comprising glacial till and abundant fluvial deposits. The climate in this natural sub-region is typically characterised by cool summers and cold winters but highly influenced by the periodic warm Chinook winds (Downing and Pettapiece, 2006). Compared to the rest of the country, Alberta has relatively low precipitation in the lee of the mountains and total average annual rainfall in the area is 450 to 500 millimetres (mm) per year (Alberta Agriculture, Food and Rural Development, 2000).

### **1.3 Proposed Development**

The western half of Section 31 covers a total area of approximately 130 hectares (320 acres). The ultimate extraction footprint will be 83.4 ha (206 acres). The property will be operated and

permitted in six phases of uneven size, depending upon setbacks, with operations and permitting commencing initially for the southeast parcel. This is called Phase 1 and comprises about 14.4 ha (35.5 acres) and is expected to take 5 years to extract. It should be noted that the two sloughs in the northwest corner will be retained and Phase 4 will be developed on the lands south and east of them. Each of the subsequent phases is anticipated to take approximately 5 years to extract.

Based on drilling investigations at the site, there is 4 m to 6 m of glacial till overburden overlying approximately 20 m of sand and gravel. The till soils will be stripped and stockpiled for future use in the post-development restoration. The sand and gravel is the target deposit for extraction and lies immediately above the underlying bedrock. Groundwater in assessment boreholes was noted at between 20 m and 24 m below ground surface (m bgs) and above the bedrock. It is anticipated that the site will be worked to 1.0 m above the maximum recorded groundwater level within the gravel deposit and will therefore be worked dry, with no requirement for operational or permanent dewatering. Actual depths will be determined with progressive investigation of water levels as the aggregate resource is developed.

### 1.4 Objectives

The objectives of this hydrogeological assessment are to provide detailed baseline data which would fulfil the information requirements within the Alberta Code of Practice for Pits (Alberta Government, 2004) and inform the development of the aggregate resource. The report is intended to provide the following:

- A general description of the geological features of the proposed aggregate resource site including the surficial geology and bedrock geology;
- A description of the hydrogeology at the site in context with the local and regional study areas;
- Hydrogeological impact assessment of the quarry development on the surrounding groundwater aquifers (e.g. groundwater draw-down) and provide detail on how the impacts will be avoided or mitigated, to establish net impact; and
- A description of any monitoring programs which will be designed to provide information on effects on groundwater quality and quantity.

In order to achieve these objectives, the results section of this report is split into two main parts, the first of which relates to the geological environment and the second of which relates to the hydrogeology.

### 2.0 METHODOLOGY

The hydrogeological investigation was divided into two main parts, the first comprising a desktop study and review of available data, with the second comprising a water well field verified survey, several drilling investigations, hydraulic conductivity testing and groundwater monitoring and sampling.

### 2.1 Desktop Study

A desktop study of existing records was undertaken to obtain regional and local information about the site conditions and site setting. These included:

- Alberta Environment and Parks (AEP) records;
- Historic water well drilling reports;

- Regional and local mapping resources;
- Aerial photographs; and
- Any available operational/environmental documents relating to the site.

This desktop study also included review of existing information that MALP (Formerly Summit Aggregates) collected previously and included aggregate quality analyses (Appendix A) which helped interpret the geologic conditions for the property prior to the SLR and subsequent site investigations. The preliminary desktop review was used to determine:

- the geology and hydrogeology beneath the site;
- locations of surface water bodies in the area;
- the local topography and drainage; and
- the locations of potential sensitive receptors (wells, wetlands and springs).

A initial site reconnaissance was conducted on September 18, 2014 to provide ground-truth for observations made in the initial review and to establish some general characteristics concerning the hydrology of the area. The site visit also included an examination of the creek flowing from Big Hill Springs to the highest upstream point accessible within the Provincial Park. Many other site visits (13) have been made by SLR staff since that time for monitoring and assessment purposes.

### 2.2 Field Investigation

Following the initial desktop study, field assessments were carried out in accordance with SLR's standard field investigation procedures. This included the following items:

- Water well field verified survey;
- Drilling investigations and monitoring well installation;
- Hydraulic conductivity testing; and
- Groundwater monitoring and sampling.

The methodology behind these aspects of the field investigation is outlined in the following sections.

#### 2.2.1 Water Well Field Verified Survey

After the review of historical water well records, a field verified door to door survey to confirm the location of water wells within 500 m of the property boundaries was undertaken. This field verified survey involved filling out a questionnaire with the well owners on well locations, depths, use, history and any other water related information such as drainage or septic disposal practices at available households. Further details are provided in Section 4.1 below.

### 2.2.2 SLR Drilling Investigation and Monitoring Well Installation

The first round of monitoring well installation was conducted by SLR from September 30 to October 2, 2014, utilizing a truck mounted drill rig equipped with 150 mm diameter Becker Hammer supplied and operated by Great West Drilling of Calgary, Alberta. Three boreholes (MW14-101, MW14-102 and MW14-103) were drilled to depths between 16.5 m bgs and 27.7 m bgs around the perimeter of the NW quarter section, where they were drilled until refusal was achieved in the upper bedrock. Soil samples were collected from the air flush centrifuge at ground surface where the cuttings were logged by a qualified geologist.

A second round of monitoring well installation was undertaken by MALP as part of further aggregate assessment in June 2018 across the NW quarter section, the borehole logs from which are presented in Appendix A. Four monitoring wells were completed as MW18-104, MW18-105, MW18-106 and MW18-107, please reference Drawing 3 for locations.

A third round of monitoring well installation was undertaken by SLR Consulting from June 3 to June 5, 2019 utilizing a track-mounted drill rig equipped with 150 mm diameter ODEX supplied and operated by Ernco Drilling of Red Deer, Alberta. Three boreholes (MW19-108, MW19-109 and MW19-110) were drilled to depths between 15.8 m bgs and 36.6 m bgs in the SW quarter section, where they were drilled down to bedrock or until groundwater was encountered. Soil samples were collected from the air flush at ground surface where the cuttings were logged.

Monitoring wells were installed in ten of the boreholes as indicated above. The monitoring wells were screened either at the base of the sand and gravel unit or across the upper bedrock / sand and gravel interface to ensure the water table could be measured. The wells were installed to characterize groundwater quality and depth to the water table within the sand and gravel and upper bedrock. The wells were constructed of 50 mm diameter schedule 40 polyvinyl chloride (PVC) pipe with threaded joints. The screened portion of the well was comprised of 0.25 mm horizontal slots (10 Slot) and the annulus was backfilled with silica sand from the bottom of the screen to approximately 0.3 m above the top of the screen. A hydrated bentonite chip seal was placed around the annulus of the solid section of stand pipe above the screened section to within approximately 0.5 m of ground surface. A 50 mm diameter slip cap was placed on the bottom of the well and a 50 mm diameter j-plug was placed on the top of the monitoring well. An above ground steel protective cover with a lockable lid was concreted in place above the top of the wells. Borehole geological information and well construction details are provided in the SLR well logs in Appendix B and those by others are provided in Appendix A.

### 2.2.3 Hydraulic Conductivity Testing

Hydraulic conductivity tests were conducted on MW14-101 and MW14-103 and comprised a series of rising head slug tests on both wells and a short pumping and recovery test on MW14-101. Yield tests on two private wells were undertaken utilizing the existing water distribution systems at both WW2 and WW4; however, the test in WW4 was not usable for analysis due to interference from the domestic water system. To obtain hydraulic conductivity values, the slug tests were analysed using the Bouwer-Rice method and the recovery tests were analysed using the Theis recovery method, both hosted in the AquiferTest (v3.5) software. A copy of the analysis undertaken is presented in Appendix E. Hydraulic conductivity results from the tests are reported in Section 4.2 below.

### 2.2.4 Groundwater and Surface Water Monitoring and Sampling

Groundwater monitoring events were carried out on 12 occasions in monitoring wells MW14-101, MW14-102 and MW14-103, on eight occasions in two residential wells (WW2 and WW4), three occasions in MW18-104, MW18-105 and MW18-106, and two occasions in MW18-107, MW19-108, MW19-109 and MW19-110. Depth to groundwater was measured using a Solinst water level meter.

Groundwater samples have been collected from the accessible residential wells in the Paskapoo Formation bedrock and the sand and gravel monitoring wells. The furthest publically accessible upstream point of the stream flowing from Big Hill Springs was sampled within the Big Hill Springs Provincial Park. Residential well samples were collected from a point within the household system before any water quality treatment and after a purge of 15 minutes or until field parameters were deemed to have stabilized. The monitoring wells in the sand and gravel were purged using a submersible pump or bailers until groundwater chemistry parameters including pH, electrical conductivity (EC), dissolved oxygen and temperature were considered to have stabilized. Water samples were placed in appropriate sample containers provided by the laboratory and preservative supplied by the laboratory was added to the samples where required. The samples were submitted to KaizenLAB or Bureau Veritas Laboratories of Calgary for testing, both of which are Canadian Association for Laboratory Accreditation (CALA) accredited laboratories.

The water quality samples from both residential wells and site monitoring wells were analysed for general chemistry and total metals for comparison purposes. Results of the water quality sampling are provided in Tables A1 to A3 (appended) and the laboratory analytical certificates provided in Appendix G. Historical water quality analysis for residential well 360164 was provided by the householder and the report is provided as Appendix H (Baseline Water Resource Inc., June 2013).

### 3.0 GEOLOGY

Drawing 3 shows the lines of three vertical cross-sections (Drawings 5, 6 and 7) that run northwest to southeast along the direction of groundwater flow to the springs (A-A'), southwest to northeast across the upper valley (B-B') onsite, and southwest to northeast through the site (C-C') further down valley. They have been prepared to illustrate the relationship between the various geological units in the study area and are referred to in the following subsections.

### 3.1 Surficial Topsoil

Topsoil in the M.D. of Rocky View County has developed on materials of glacial origin and are therefore heavily influenced by the nature of the parent geologic material. The topsoil lying at surface in the vicinity of the project site is comprised of the Dunvargan Series which are formed from moderately fine textured till with less than 20% coarse material. The Dunvargan Series soils are moderately well drained soils with a typical profile being a thick black soil of greater than 15 centimetre (cm) topsoil; however, in the Rocky View County they are associated with less well developed variants with less than 15 cm topsoil thickness (Turchenek and Fawcett, 1994). Based on the onsite drilling, the surficial soils range in thickness from 30 cm to 60 cm.

In summary, the topsoil is relatively thin, fine grained, with significant organic content and tends to temporarily retain water. It is this layer that supports vegetative growth and land use such as range land or cropping, as well as natural ecosystems.

### 3.2 Surficial Geology

Surficial geology in the vicinity of the Project site has been determined from the published geology maps (Shetsen, 1987). Two primary layers are found. The upper strata are predominantly comprised of Pleistocene-age moraine draped over the underlying sand and gravel. This moraine consists of an unsorted mixture of clay, silt, sand and gravel with local water-sorted material and is called a glacial till. The till in the vicinity of the site is of a relatively consistent thickness with a flat to undulating topography which reflects the topography of underlying deposits which in turn reflect the shape of the bedrock surface below. Underlying the draped moraine at the site is sand and gravel of glaciofluvial origin, which formed on the slopes and base of meltwater channels draining melting ice sheets (Shetsen, 1981).

Borehole logs from aggregate assessment at the site (Almor Testing Services Ltd, 2014; 2017a; 2017b and 2018) and hydrogeological investigations as part of this assessment are included as Appendix A and Appendix B, respectively. The borehole logs indicate that surficial deposits over the majority of the site include approximately 3 m to 6 m of silty, sandy or gravelly clay till and topsoil (this overburden will have to be moved to extract the underlying aggregate deposits). Beneath the clay till is the sand and gravel deposit of interest, which is generally a well graded mixture of sand and gravel containing occasional beds of pure sand or pure gravel up to 2 m thick. Some layers were difficult to drill and are interpreted to be hard, and are potentially calcified bands. Based on the drilling results, the sand and gravel generally vary in thickness between 10 m and 27 m, with an average thickness of approximately 18 m in those areas investigated.

### 3.3 Bedrock Geology

Consolidated bedrock underlies the unconsolidated soils at a depth of 15 to 28 m, and represents the basement to site operations where not saturated. Structurally, the site is located several kilometres east of the furthest extent of the main Cordilleran Deformation, and as such is relatively flat-lying bedrock with little folding or faulting compared to older bedrock further west in the Disturbed Belt. The bedrock beneath the sand and gravel at the site consists of Tertiary, Palaeocene age (55 to 65 million years old) sedimentary rocks of the Upper Paskapoo Formation. The Paskapoo formation comprises grey to greenish grey, thickly bedded, calcareous sandstone interbedded with siltstone or mudstone and minor conglomerate or thin limestone beds (Alberta Geological Survey, 1999). The test drilling at this site found grey sandstones and siltstones. The bedrock was derived from sediments eroded from the Rocky Mountains during a period of uplift and erosion and carried east by river systems which drained the mountains. The sandstones within the Paskapoo are a complex series of stacked river channel deposits separated by floodplain siltstone and mudstone deposits (Hamblin, 2004).

Outcrops of the Paskapoo Formation sandstone can be seen in the steep slopes of the Big Hill Springs Provincial Park southeast of the site. A number of domestic well records from the immediate vicinity identify sandstone and shale<sup>1</sup> beneath and surrounding the site.

### 4.0 HYDROGEOLOGY

The hydrogeological regime at the application site and the surrounding area is described in the following sub sections:

- Field verified survey to establish groundwater wells and use;
- Aquifer properties;
- Groundwater levels and flow; and
- Water quality assessment.

The hydrogeological data has been used to develop a conceptual site model that has in turn been used to assess potential impacts associated with the proposed development. The conceptual site model has also been used to determine appropriate mitigation measures.

<sup>&</sup>lt;sup>1</sup> It is common for drillers to use the term "shale" to describe mudstones and siltstones, as the differences are subtle and they all share a common fine grained appearance to the untrained eye.

### 4.1 Field Verified Water Well Survey

The objectives of the field verified water well survey were to establish residential well use, baseline water quality conditions and to provide an assessment of the hydraulic parameters within the aquifers utilised by local residences adjacent to the site. Initially, a water well record search was undertaken by obtaining records from the Alberta Water Wells database which are presented in Appendix C (updated in 2019). This was followed by a door-to-door survey (October to December 2014) of residences within a 500 m radius of the site with visits on a number of occasions to those houses where no resident was at home. Where possible the formal well records were correlated with the actual wells in the field. It is considered that the 1,600 m radius required for a Water Act application is not appropriate for this project as no water body is to be disturbed by the development which will be worked dry and much of that greater area is not in the same groundwater flow field. A number of properties were surveyed and sampled and/or yield tested in order to further assess the relevant aquifer units. At each residential well, a questionnaire was completed to determine the type of well, well completion details, water levels and whether the well user has any issues with water quality or quantity. The questionnaires completed at the residential wells are provided in Appendix D.

The majority of local wells (for which there are records) are utilized for domestic or commercial purposes. The Alberta records indicated a total of 17 wells within 500 m of the Project site with two of those decommissioned (391599 and 391600) and one with very little available detail (395793). Drawing 3 presents the locations of the wells identified from the records search and the door-to-door survey for which Table 1 summarizes the information collected. The majority of drilled wells are drilled to between 30 m and 75 m bgs and are screened within the Paskapoo Formation.

Two drilled wells (WW1 and WW4) are on the site at the residences of the current tenants; however, all of the other drilled wells recorded are greater than 100 m from the site boundary. With respect to the WW1 property, there is a well listed in the records for this property (494800); however, the geology recorded in this record is completely different than the rest of the area. It had been concluded that it is an improperly recorded location in the digital records kept by AEP and has not been used in the analysis.

Dug wells identified at location WW5 (four wells in total) are between 6.1 m and 7.6 m deep according to details provided by the householder. This location is in the bottom of the valley at the southeast end of Section 31. No lithological logs are available for the dug wells; however, based on their estimated depth and the lithological details provided in nearby drilled wells to the east, it is inferred that they are completed in the sand and gravel deposits. The well owners reported that the static water level is 3 m bgs. Although this was unconfirmed by direct measurement, it is a reasonable estimate, given the shallow nature of the wells.

	Alberta Water Well	No.				Well		Distance (m) and
Well Interview Number	Record Number	of Wells	Well Owner	Easting (UTM)	Northing (UTM)	Depth (m)	Drilled / Dug	from Site
WW1	Unknown	1	Waterman	680559 <sup>1</sup>	5682875	Unknown	Drilled	On site
WW2	1475699	1	Rawn	680988 <sup>1</sup>	5682770	50.9	Drilled	200m E
WW3	1475698	1	Rawn	681173 <sup>1</sup>	5682907	36.0	Drilled	400m E
WW4	350194	1	Nugter	680257 <sup>1</sup>	5682091	35.1	Drilled	160m S
WW5	N/A	4	Parker	681547 <sup>1</sup>	5681568	6.1 – 7.6	Dug	
N/A	391000	1		679932 <sup>2</sup>	5683339	39.6	Drilled	
N/A	360164	1	Carroll	680744 <sup>1</sup>	5683480	67.1	Drilled	350m N
			Lafarge					
N/A	1022436	1	Canada Inc.	679682 <sup>2</sup>	5682526	30.5	Drilled	
			Lafarge					
N/A	387449	1 Linc.		See Note <sup>3</sup>	S36-T26-R4	33.8	Drilled	
			Lafarge					
Cana		Canada	<b>O N</b>	NE Quarter,	00.5			
N/A	N/A 494773 1 Inc.		See Note <sup>3</sup>	S36-126-R4	30.5	Drilled		
N/A	N/A 2095665 Unknown		See Note <sup>3</sup>	SW Quarter, S6-T27-R3	25.6	Drilled		
NI/A	200000	4	Unknown	See Note <sup>3</sup>	SE Quarter,		Drilled	
IN/A	390998	1	Onknown	Jee Note	56-127-R3	05.5	Drilled	
N/A	390999	1	Unknown	See Note <sup>3</sup>	SE Quarter, S6-T27-R3	73.2	Drilled	
					NW Quarter,			
N/A	391598	1	Unknown	See Note <sup>3</sup>	S3-T26-R3	39.6	Drilled	On site
N/A	395786	1	Unknown	See Note <sup>3</sup>	NE Quarter, S31-T26-R3	62.5	Drilled	

Table 1Water Wells within 500 Metres

Notes:

1. Location based on GPS measurement in the field.

2. Location based on Abacus Datagraphics database.

3. Wells plotted at quarter-section centroid in Abacus Datagraphics database. Not likely actual location.

## 4.2 Aquifer Properties

A number of different geological units with different hydraulic properties are present in the study area. The distinct units are discussed here in order with depth from surface (and increasing geological age). The testing of two monitoring wells and two residential wells was undertaken and details of the work are provided below.

### 4.2.1 Surficial Unconsolidated Deposits

Surficial deposits of unconsolidated soils consist of till overlying sand and gravel deposits as described in Section 3.2 above. Groundwater flows in the intergranular pores in these soils, and the rate of flow is proportional to the hydraulic conductivity of the soil. For example, the hydraulic conductivity is low where clay rich material infills these pores, but is significantly higher where clean sand and gravel is present.

Since the upper glacial till that caps the site is not saturated, no groundwater monitors were installed and therefore no field testing for hydraulic conductivity was undertaken. These soils are not typically aquifers, as their hydraulic conductivity is in the range of 10<sup>-8</sup> to 10<sup>-7</sup> m/s (Freeze and Cherry, 1979), but they do act as a protective layer for underlying deposits.

As described in Section 2.2.3, a number of slug and pumping and recovery tests were undertaken on monitoring wells MW14-101 and MW14-103 which are screened in the sand and gravel. The slug tests were conducted using bailers with instantaneous head changes in the wells and the pumping and recovery test (MW14-101) was undertaken by pumping for approximately 20 minutes until water levels stabilised. The slug tests determined hydraulic conductivities of approximately  $2 \times 10^{-4}$  m/s to  $3 \times 10^{-4}$  m/s. The pumping and recovery test indicated hydraulic conductivities of  $1 \times 10^{-4}$  m/s. It is considered that the longer pumping and recovery test gives a better idea of the bulk sand and gravel properties due to its larger radius of influence around the wells. These values nonetheless fall in a narrow range and are typical of sand and gravel aquifers.

### 4.2.2 Paskapoo Formation Bedrock

The Paskapoo Formation is the most significant aquifer formation in western Alberta and potentially the Prairie region, and although of regional importance as a whole, the isolated nature of the main sandstone units can provide variable success for residential wells. Only the sandstone facies of the Paskapoo Formation demonstrate any significant intergranular porosity; however, the pore spaces may be filled with calcareous cement in some areas. Bedding planes, joints and structural fractures contribute to a secondary permeability of the bedrock as well. Based on water well records in the area and the drilling at this site, much of the formation in this area is primarily comprised of fine-grained bedrock such as siltstone, mudstone and shale which demonstrate low intergranular porosity. Secondary fracture porosity is likely to be responsible for the yields obtained from residential wells in the vicinity of the site and generally provides lower yields within wells completed within mudstone and siltstone than sandstone (Geological Survey of Canada, 2007; Ozaray and Barnes, 1977). The majority of residential wells in the area are drilled into the Paskapoo Formation indicating that the aquifer is locally important for groundwater supplies.

An in-situ variable head permeability test has been undertaken in residential well WW2 by undertaking a short term pumping and recovery test. One other residential well (WW4) was tested; however, due to interference by the particular characteristics of the method of operation of the existing water distribution system, very little analysis could be undertaken on the test results. No

other residential wells were available for yield testing. Test results were analysed using the Cooper-Jacob Time Drawdown method as hosted by AquiferTest (v3.5) software to obtain hydraulic conductivity values. A copy of the analysis undertaken is presented in Appendix E. The test results show that the Paskapoo Formation penetrated by WW2 has an approximate hydraulic conductivity of  $2 \times 10^{-7}$  m/s with a transmissivity of  $5 \times 10^{-6}$  m<sup>2</sup>/s. The well record corresponding to WW2 is 1475699 (Appendix C), which shows the water bearing layers to be mostly sandstone and shale at a depth of 45 m. The hydraulic conductivity value obtained reflects this fractured bedrock.

Water levels in WW2 and WW4 were measured over a 1-month period at five-minute intervals by a water level transducer and data logger to assess the responses of the wells to their normal use. The first month of data collected is provided in graphical form in Appendix F. Water levels in WW2 respond significantly to normal domestic use with drawdown up to 8 m seen during normal household use. This contrasts with the response of WW4 to normal use as the well shows a maximum drawdown of approximately 0.11 m. The slow aquifer response in WW2 and fast aquifer response in WW4 also were seen during the yield tests where WW2 had drawdown of >7 m at a flow rate of approximately 12 Litres per minute (L/min) and WW4 had drawdown of just 0.09 m at a flow rate of approximately 39 L/min. The contrast between the performances of the two wells demonstrates the variability of the hydraulic properties of the bedrock in the Paskapoo Formation.

## 4.2.3 Summary

In summary, the hydraulic conductivity values for the various aquifer units may be compared:

- The glacial sand and gravel deposits had an approximate hydraulic conductivity of 1 x 10<sup>-4</sup> m/s to 3 x 10<sup>-4</sup> m/s; and
- The Paskapoo Formation hydraulic conductivity was 2 x 10<sup>-7</sup> m/s, but can vary.

While it is recognized that these measurements do not establish the full range for each unit, they do provide insight into the aquifer characteristics. It is commonly held (Freeze and Cherry, 1979; Fetter 2001) that useable aquifers have a hydraulic conductivity of greater than 10<sup>-6</sup> m/s. Only low yield wells (such as some residential wells which only periodically draw water at relatively low rates) are possible below that value. The Paskapoo Formation has a value lower than this, which indicates a low yield aquifer in parts; however, the performance of WW4 indicates that higher yield wells can also be achieved. The Specific Capacity of WW2 is 1.85 L/min/m, and that of WW4 is 433 L/min/m. This is a 234 times difference, and assuming the same saturated thickness (and similar length of pumping time) it can be estimated that the conductivity of the Paskapoo Formation at WW4 is potentially two orders of magnitude higher than at WW2.

### 4.3 Groundwater Levels and Flow

Initially, a total of three groundwater monitoring wells were installed in the sand and gravel at the site in September / October 2014. These monitoring wells were drilled to prove bedrock and then backfilled with bentonite to the base of the sand and gravel. The wells are screened from the base of the sand and gravel to the top of the saturated zone (MW14-101 and MW14-103); however, MW14-102 has remained dry for the period of monitoring included in this report, indicating that the water table is at least seasonally in the bedrock in some areas of the site. Further monitoring wells were installed at the site in 2018 and 2019 as part of site investigations and were screened either at the base of the sand and gravel or across the sand and gravel / bedrock interface to ensure the water table was intersected.

The locations of these monitoring wells and their groundwater elevations (on July 3, 2019) are presented on Drawing 4. The information from these wells has been supplemented with groundwater level information from residential wells WW2 and WW4 also presented in Drawing 4.

The groundwater monitoring points completed at the site have been subject to periodic groundwater elevation monitoring between October 2014 and September 2019. Sand and gravel wells MW14-101 and MW14-103 and residential wells WW2 and WW4 have been recording continuous groundwater levels using data loggers from 29 October 2014. Groundwater hydrographs of monitoring data to date are presented in Appendix F, a review of which shows:

- The highest manual groundwater elevations are recorded in the sand and gravel at MW14-101 (1,274.87 masl) on 20 November 2014;
- The lowest groundwater elevations are recorded in the sand and gravel in the valley at MW19-109 (1,259.46 masl) on 3 July 2019;
- A downward vertical gradient between the sand and gravel deposits and the underlying Paskapoo Formation is likely. Based on the potentiometric surface in the sand and gravel on Drawing 4, the water level is likely about 1,271 masl at WW2, and the approximate static water level in the bedrock at WW2 is around 1,263 masl (the measured level on Drawing 4 is affected by pumping at the well). The higher total head in the overburden than the bedrock dictates a component of downward vertical groundwater flow from the sand and gravel to the bedrock. The amount of downward groundwater flow is probably limited due to the relatively lower hydraulic conductivity of the underlying bedrock, inhibiting drainage to depth;
- Minimal fluctuation in the groundwater levels within the sand and gravel indicates very little or no influence from pumping within residential wells in the area. Groundwater levels within the sand and gravel have been gradually falling over the initial four or five years of monitoring, with a drop of approximately 0.9 to 1.3 m in the period. Levels have rebounded somewhat (0.1 m) in the months between July and September 2019 due to the higher than average rainfall totals in the area in spring and summer 2019; and
- As discussed in Section 4.2.2 above, variable response to the pumping from normal use in residential wells WW2 and WW4 is seen in the hydrographs with large fluctuations in WW2 as compared with WW4. This is indicative of the differing performance of the wells due to variability of the hydraulic conductivity within the Paskapoo Formation.

Using site groundwater observation data, Drawing 4 shows the inferred potentiometric groundwater surface (drawn in blue) in the sand and gravel at site as recorded on 3 July 2019. Drawing 4 shows that the horizontal flow direction in the sand and gravel is towards the south-southeast and the Big Hill Springs valley.

The potentiometric surface within the Paskapoo Formation cannot be drawn based on just two far apart data points (WW2 and WW4). Examination of historical water levels at other wells based on the water well records show that the elevation of the potentiometric surface is between about 1,266 and 1,268 masl in the area of the site, which is near the bedrock surface. If one assumes the bedrock potentiometric surface is near ground level at the Big Hill Springs, which is about 1,240 masl, then there is strong lateral gradient southeast towards the springs at which point groundwater is observed discharging to the surface.

### 4.3.1 Groundwater / Surface Water Interactions

Two large sloughs located in the northwestern corner of the site have a surface elevation of approximately 1,290 masl and are perched on the 6 m of low permeability fine grained till. The

presence of freestanding water is seasonal based on observations made at the site, with water levels generally decreasing through summer and autumn. Monitoring well MW14-101 located close to one of the sloughs has a groundwater elevation in the sand and gravel of approximately 1,274 masl, which is well below the base of the till (at about 1,284 masl). This demonstrates that the sloughs are not fed by groundwater from the sand and gravel. Thus, it is inferred that the sloughs are fed by rainfall and snowmelt from the local catchment and from the catchment across Highway 567 transported by the culvert located beneath the highway. These sloughs will be retained on the landscape and this small area will not be developed for aggregate extraction.

Since groundwater from beneath this site flows southeasterly towards the Big Hill Springs, and this is a significant feature in the natural heritage of the County, it represents an offsite interaction of groundwater with surface water. Section 5 of this report discusses potential impacts to this feature. For the purpose of this report; no specific investigation of the springs has been undertaken, other than a site visit to identify general features and the sampling of water quality. Bedrock outcrops can be seen on the valley walls surrounding the stream and springs and thus it is inferred that the host valley is incised into the bedrock. Ozaray & and Barnes, 1977, reports that spring flow is in the order of 40 L/s and water temperature is typically less than 5°C.

### 4.4 Water Quality Assessment

Groundwater samples have been collected from the accessible residential wells in the Paskapoo Formation bedrock, the sand and gravel monitoring wells and the furthest publically accessible upstream discharge point at Big Hill Springs. Sampling methodologies are described in Section 2.2.4, above and Laboratory analysis certificates are provided in Appendix G.

In order to compare groundwater and surface water quality at this site, a Piper plot showing the relationship between the relative abundance of the major cations and anions in the sampled water has been prepared (Figure 1). These plots include all groundwater and chemistry results from all groundwater monitoring wells on site and are typically helpful in understanding any differences between water types.

On all three plots the sand and gravel aquifer, bedrock aquifer and Big Hill Springs water occupies a very small area exhibiting a calcium and magnesium-rich water with little chloride or sulphate and with high alkalinity (expressed as HCO<sub>3</sub>+CO<sub>3</sub>). This is typical of clean meteoric water and indicates that water in both the aquifers and the springs is heavily influenced by recharge from rainfall. Often on these diagrams there can be a wider spread in the water "fingerprint"; however, the tight grouping here indicates very similar water between the three sources. In addition, the total dissolved solids in these three water sources generally lie in a fairly narrow range of 210 to 360 mg/L (Tables A1, A2 and A3, appended). On this basis, it is concluded that this is the same water type for the sand and gravel, the Paskapoo bedrock, and the discharge from Big Hill Springs. The updated groundwater and spring water chemistry supports the conclusion that the groundwater within the saturated sand and gravel recharges the Paskapoo Formation bedrock and also provides baseflow to the Big Hill Springs.



Figure 1 Piper Plot of Groundwater and Surface Water Quality Collected to Date

### 4.4.1 Surficial Deposits

Table A1 (appended) indicates that groundwater in the sand and gravel deposit is of poor quality for drinking. The Canadian Drinking Water Quality (CDWQ) standards set maximum allowable concentrations (MAC) for 16 parameters for drinking water purposes. A number of these were exceeded in several monitoring wells, including trace metals arsenic, barium, cadmium, chromium, lead, manganese and mercury, and microbiological parameters total coliforms and E. Coli. Other CDWQ guidelines that were exceeded were the aesthetic objective parameters aluminium and iron. Groundwater from a number of the monitoring wells exceeded guidelines for turbidity, which is a parameter that is included because it shows when water is not clear, may contain sediment, and can also mask bacteria counts. The Piper plot in Figure 1 (above) indicates that the sand and gravel samples lie in a zone of Ca-Mg-HCO<sub>3</sub> waters, which indicates an influence from meteoric waters and recharge from rainfall, coupled with the influence of the host soils/bedrock. Of note, the pH was moderately alkaline at 7.8 to 8.2, which is typical of groundwater in these sediments.

The low concentrations of dissolved parameters in the surficial deposits is indicative of recharge from rainfall having a short residence time in the subsurface, where fewer elements have time to

dissolve in the groundwater. Not much of the trace metals are dissolved into the water, but the guidelines are so low that they can be exceeded without contributing significantly to the dissolved load. The high turbidity and total metals in a number of the monitoring wells is potentially artificial and not indicative of the actual water quality. This may have been caused by insufficient development of the monitoring wells before sampling due to the breakdown of the purge pump in both 2014 and 2019, and an undue influence of suspended sediment. The August 2015 sampling in MW14-103 did not experience this problem and sufficient purging and development occurred before the sample was collected on this occasion. The turbidity and concentrations of aluminium, iron and manganese, plus a number of other metals showed a significant reduction from those in November 2014 in the August 2015 sampling.

### 4.4.2 Paskapoo Formation Bedrock

Table A2 (appended) indicates that groundwater in the Paskapoo Formation is of relatively good quality for drinking, with all parameters meeting the Canadian Drinking Water Quality (CDWQ) guidelines except a single exceedance of total coliforms in WW4. E.Coli was not detected in WW4 which indicates that the coliforms were not related to fecal contamination, however they do indicate that the well could be vulnerable to bacterial contamination, especially with no treatment at that property<sup>2</sup>. pH values were moderately high (7.9 to 8.1) in all samples, indicating slightly more alkaline conditions within the bedrock as compared to the sand and gravel. The Piper plot in Figure 1 indicates that the majority of bedrock samples lie in a zone of Ca-Mg-HCO<sub>3</sub> waters, which again indicates an influence from meteoric waters and recharge from rainfall.

### 4.4.3 Big Hill Springs

Table A3 (appended) summarizes the water quality results of the water samples taken from the creek downstream from the springs at Big Hill Springs Provincial Park on October 30, 2014, August 4, 2015 and July 10, 2019. Since this groundwater discharge is the source for a surface water stream, and at the point of sampling is within that stream, it is compared to the CWQG Protection for Aquatic Life (PAL) guideline. The PAL has guidelines for 20 parameters of the sampling suite. The sample met 17 of the guidelines for these parameters indicating that water discharging from the spring is generally of good quality. It is noted that total coliforms and E.Coli concentrations exceed the CDWQ drinking water guidelines; however there is no CWQG bacteria guideline for the protection of aquatic life. The high concentrations are consistent with the presence of livestock in the stream catchment and of which evidence was abundant adjacent to the property line at the sampling location. Only aluminium and selenium exceeded the PAL guideline in these natural waters. Of minor note, the laboratory detection limit for mercury (0.001 ma/L) in 2014 and 2015 exceeded the guideline (0.000026 ma/L) and thus the "non-detect" reported in Table A3 may or may not meet the lower guideline. Mercury sources in this geologic setting are not common, nor will the proposed aggregate operation be a source of mercury. Mercury concentrations measured in 2019 fell below the guideline. Since this water is the source for the stream, the downstream biota will be acclimatized to this form of the natural water quality.

The Piper plot in Figure 1 indicates that the Big Hill Spring sample also lies in a zone of Ca-Mg-HCO<sub>3</sub> water, which again indicates an influence from meteoric waters and recharge from rainfall. Due to the similarity between concentrations within the sand and gravel aquifer, bedrock

<sup>&</sup>lt;sup>2</sup> This well is ultimately scheduled for removal once the aggregate extraction is operational, but is expected to be used in the interim.

aquifer and the spring water, it is clear that the spring water is the same, regardless of which pathway it travelled.

### 4.5 Water Balance

It is often useful to prepare a water balance for a site in order to understand its hydrogeologic function and against which potential impacts can be compared. This section identifies the basic water balance for the site, where "water in" must equal "water out" within the constraints of the measurements. To do this for this site, we first examine the "water in" which is the precipitation available for groundwater recharge or runoff. This is then calibrated against simple groundwater flow calculations to demonstrate the water balance.

### 4.5.1 Water Budget

The meteorological station No. 3031093 at the Calgary International Airport has been used to quantify average annual precipitation amounts. This station was selected for its length of record and similarity of terrain. The period of 1981 to 2012 has been used to calculate long term averages which are used in this analysis. Table 2 summarizes the results.

Month	Ave. Monthly Temperature °C	Precipitation (Snow + Rain) mm	Actual Evapotranspiration mm	Surplus mm	Deficit mm					
January	-7.1	9.6	6.5	3.1						
February	-5.5	9.8	8.7	1.1						
March	-1.6	17.9	16.3	1.6						
April	4.5	27.2	35.3		-8.1					
May	9.7	58.1	63.8		-5.7					
June	13.7	95.2	89.0	6.2						
July	16.6	66.0	101.1		-35.1					
August	15.8	57.8	72.2		-14.4					
September	11.1	44.0	42.7	1.3						
October	5.2	15.2	18.6		-3.4					
November	-2.4	13.0	4.8	8.2						
December	-6.7	10.3	2.9	7.4						
Annual Totals		424.1	461.9	28.9	-66.7					
Annual Average	4.5			Net Defic	it = -37.8					

Table 2	
Average Annual Water Budget (Calgary YY	C)

Notes:

Weather Station: Elevation: 1,084 masl; Latitude 51°06'50" N; Longitude 114°01'13" W; WMO #71877 Based on a soil moisture storage of 150 mm

At this station, which will have similar results to the Cochrane area, an average annual precipitation of about 424 mm per year occurs. This is typical of the region in the lee of the Rocky Mountains. Examination of this period of record shows that the two wettest years were 1998 and 2005, where upwards of 537 mm fell. The two driest years were 1983 (295 mm) and 2001 (319 mm). Based on Table 5, the wettest months are May to September, with little precipitation over the winter months of December to February (around 10 mm per month on average). The area is known for intensive rainfalls, and the highest month in this period of record was June 2005

when 248 mm fell (almost half the year's precipitation). It should be noted that 386 mm of precipitation has fallen from January 1 to August 31, 2019, which is significantly higher than the same period in an average year (342 mm). The highest monthly rainfall for 2019 fell in June with 135 mm being recorded.

The water budget has been calculated by the method of Thornthwaite and Mather (1957), which uses the monthly average temperatures, latitude, and soil moisture storage to calculate the actual evapotranspiration (AET). The AET is that water that is lost back to the atmosphere by evaporation and plant uptake (transpiration). The calculations indicate there is a net annual deficit of about 38 mm each year. To examine the range of results, a water budget was calculated for the driest and wettest years in the period of record, with the results being presented in Table 3 below.

	Precipitation	Actual Evapotranspiration	Surplus/Deficit
Hottest/driest (1983)	295	384	-89
Average Annual	424	462	-38
Coldest/wettest (1998)	538	488	50

Table 3Comparison of Water Budgets in Wet and Dry Years

It can be seen that when the precipitation rises, the evapotranspirative uptake increases as well in response to the available water. However, in the wetter years there is still a surplus available for infiltration and runoff.

With reference to the average annual condition shown in Table 6, the months vary as well. The deficits typically occur in the hotter months, despite increased rainfall. Surplus occurs in the cooler months when evaporation is low, and when there is no plant uptake. In these months the soil moisture is replenished, and in the months where there is a deficit, that storage is tapped by the plant rooting systems.

### 4.5.2 Surplus Partitioning

Section 4.5.1 reports an average annual deficit of about 38 mm. In years when there is a surplus, that surplus water may be partitioned between infiltration and runoff. Using the method of MOEE (1993), which calculates partitioning factors based on topography, soil type and ground cover, an estimate of the annual infiltration and runoff can be derived. Table 4 is reproduced from this manual below, from which the infiltration factors are selected.

	Description of Area/Development Site	Value of Infiltration Factor			
торо	GRAPHY				
1. 2. 3.	Flat and average slope not exceeding 0.6 m per km Rolling land, average slope of 2.8 m to 3.8 m per km Hilly land, average slope of 28 m to 47 m per km	0.30 0.20 0.10			
SOIL					
1. 2. 3.	Tight impervious clay Medium combinations of clay and loam Open sandy loam	0.10 0.20 0.40			
COVE	R				
1. 2.	Cultivated lands Woodlands	0.10 0.20			

Table 4 Infiltration Factors

Reproduced from MOEE (1995), Technical Guidelines for the Preparation of Hydrogeological Studies for Land Development Applications.

In this case the fine-grained soils are assigned a factor of 0.2 and the open pasture land cover is given the factor 0.1. The topographic factor is slightly more complex, as there are flat areas sloped down valley, and valley sidewalls with steeper slopes that favor runoff over infiltration. The flat areas have slopes that range from 0.9% to 2%, and are assigned a factor of 0.14. Therefore for the flatter slopes the infiltration factor is 0.2 + 0.1 + 0.14 = 0.44. The steeper slopes range from 2.7% to 23%, and are assigned a factor of 0.1, according to the MOEE (1993) methodology. Therefore, for the steeper slopes the infiltration factor is 0.2 + 0.1 + 0.1 = 0.4. These infiltration factors are multiplied by the surplus in any given year to estimate the rate of groundwater recharge, the remainder being lost to runoff.

### 4.5.3 Existing Site Water Balance

The final step in the water balance is to judge the contribution of the site to the ground water system. Since the full site is not to be developed, we do not assess those lands that will not change. MALP plan to develop 74 acres (29.83 ha) in the first two phases over ten years. The area of future aggregate extraction is another 132 acres (53.57 ha). To determine volumes available for recharge the maximum surplus (50 mm = 0.05 m) determined above is multiplied by the area. For the full development area (206 acres, or 83.4 hectares) the maximum annual surplus volume of water in a wet year would be 83.4 ha X 10,000 m<sup>2</sup>/ha X 0.05 m/yr. = 41,700 m<sup>3</sup>/yr.

The flatter areas comprise approximately 55.5 ha and the steeper slopes comprise approximately 27.9 ha, having infiltration factors of 0.44 and 0.40, respectively. The flatter area is 66.5% of the development area, and thus the infiltration in that portion can be calculated by multiplying that volume by the infiltration factor:

41,700 m<sup>3</sup>/yr. X 0.665 X 0.44 = 12,201 m<sup>3</sup>/yr.

The steeper area is 33.5% of the development area, and thus the infiltration in that portion can be calculated by multiplying that volume by the steep area infiltration factor:

Therefore, the total infiltration under existing conditions for the development area (in wet year) is the ensuing sum of 17,789  $m^3$ /yr. The difference between this and the total surplus of 41,700  $m^3$ /yr.; therefore, is lost to run off, that is 23,911  $m^3$ /yr.

It is always wise to independently cross-check this kind of calculation, which is based on meteorological data and estimates of soil, vegetative cover and topography. This can be done by examining the groundwater conditions that receive the water. In this case the Darcy Principle for groundwater flow is used, based on the site geometry and measured range of hydraulic conductivity, and lateral hydraulic gradients. Darcy found that groundwater flow can be quantified in the following manner:

$$Q = K x dh/dL x A$$

Where Q is the volumetric flux, K is the horizontal hydraulic conductivity, dh/dL is the horizontal gradient and A is the vertical area (height X breadth) of the sand and gravel available for groundwater flow. In this case the measured range of K for the sand and gravel is  $1 \times 10^{-4}$  to  $3 \times 10^{-4}$  m/s, as reported in Section 4.2.1. The lateral hydraulic gradient (dh/dL) is a minimum of 0.0095 m/m, measured from Drawing 4 where the 2 m (dh) contours are about 210 m (dL) apart. The vertical area, A is not actually known, however it is estimated to be 800 m wide, and the above equation can be used to determine its height. Finally, Q is known because it is necessary to see if the 17,789 m<sup>3</sup>/yr can pass through this soil. The flow of 17,789 m<sup>3</sup>/yr can be converted to consistent units with the above and is equal to 5.6 x  $10^{-4}$  m<sup>3</sup>/s. Rearranging Darcy's equation:

Q = K x dh/dL x A Q = K x dh/dL x (h x b), or K x dh/dL x (h x b) = Q, and rearranging, h = Q / (K x dh/dL x b) =  $5.6 \times 10^{-4} \text{ m}^3/\text{s} / (1 \times 10^{-4} \text{ m/s} \times 0.0095 \times 800 \text{ m})$ = 0.74 m

Since the aquifer is many times thicker than this, it is concluded it can easily convey the recharge water generated by this site in a wet year. The reader should be aware that there is groundwater moving onsite from the northwest as well, and this calculation is intended to see if the site water can move in addition to that. Of some interest, the 17,789 m<sup>3</sup>/yr. is equivalent to about 0.56 L/s, which is therefore the site's contribution (in a wet year) to the 40 L/s reported coming from the Big Hill Springs, which has a much wider groundwater catchment.

### 4.6 Conceptual Model Discussion

Using the above findings, a conceptual model has been constructed to aid the reader in understanding the site setting. This conceptual model is further used in Section 5 to conduct an

impact analysis of the proposed aggregate extraction operation. Underlying the site is the Paskapoo Formation bedrock, composed of sandstone, siltstone, mudstone and shale, which serves as the aquifer for most local wells. During deglaciation, this area became a drainage pathway and there is a blanket of outwash sand and gravels lying directly on the bedrock. This deposit has been excavated elsewhere for aggregate, and is the target deposit for MALP's proposed operations. The sand and gravel is 10 to 27 m thick and hosts the water table at depth, but is not a consistent aquifer which has potentially poor water quality, and is only used for domestic purposes in isolated locations (e.g. WW5). Finally, the whole site is blanketed by up to 6 m of fine grained glacial till soils, left when the ice melted. This low permeability blanket restricts the infiltration of precipitation. The site slopes to the southeast from the topographic high to the north and hosts a low-relief valley feature running northwest to southeast across NW Sec 31, Twp 26, Rge 3, W5M. In SW Sec 31, Twp 26, Rge 3, W5M the topography slopes steeply southwesterly into the valley running west-northwest to east-southeast which leads to Big Hill Springs Creek.

The site lies in an area in the lee of the Rocky Mountains and as such is relatively dry. Evapotranspiration on average exceeds precipitation and there is an average annual deficit in the water balance. On the other hand, there is soil moisture storage in the fine-grained soils at surface, so some water is captured in the wet months and helps sustain plants in the drier months. There is a surplus in wetter years. For these reasons the sand and gravel is largely unsaturated and carries groundwater flow along its base above the bedrock. There is also a recharge of the bedrock aquifer from the sand and gravel, so much so that the sand and gravel at test well MW14-102 is dry. Drainage is not complete however, as further downgradient towards the Big Hill Springs Provincial Park some shallow private wells (WW5) in the sand and gravel have enough water in them.

Few residential wells are completed in the sand and gravel deposits due to their limited saturated area, with most residential wells being completed in the bedrock. Water quality in the two aquifers (surficial deposits and bedrock) are very similar to that in Big Hill Springs and are typical of clean meteoric water which indicates that water in both the aquifers and the spring is heavily influenced by recharge from rainfall. It is considered likely, based on the water quality data and the inferred groundwater flow direction in the sand and gravel that a significant contribution to the spring water at Big Hill Springs is provided by groundwater in both aquifers.

The cross-sections run northwest to southeast along the direction of groundwater flow to the springs (A-A'), southwest to northeast across the upper valley (B-B') onsite, and southwest to northeast through the site (C-C') further down valley. They have been prepared to illustrate the relationship between the various geological units in the study area. The likely groundwater flow path shown on Drawing 5 demonstrates the relationship between recharge and discharge areas. The relatively low permeability of the bedrock (even when fractured) is responsible for the perched water table within the sand and gravel. Groundwater recharge occurs in higher areas where overburden is thin or absent and in areas where there are standing water bodies and sloughs perched on top of the low permeability glacial till. Lateral discharge from the aquifers occurs at Big Hill Springs.

### 5.0 HYDROGEOLOGICAL IMPACT ASSESSMENT

The above sections describe the existing setting where the proposed aggregate resource extraction will be developed. The purpose of impact assessment is to examine how the proposed facility will operate in that setting, and to determine if any adverse effects could be anticipated. The next step is to consider mitigation strategies to ensure the adverse effects are avoided or

corrected. In the ideal case the net effects (the effects of the facility after mitigation) are determined and judged for acceptability within existing practice and regulation.

### 5.1 Hydrogeological Impact Assessment Criteria

The criteria used here to assess impacts can be expressed simply as "water quantity" and "water quality". Water quantity refers to potential effects on water levels in wells and wetlands, groundwater flow volumes, and spring discharge volumes. Water quality refers to the potential changes in groundwater quality and/or surface water quality as might be caused by the facility.

### 5.2 Potential Impacts on Water Quantity

With respect to surface water, there are no streams on or emanating from this site. The presence of the sloughs in the northwest corner is the only surface water feature, and they are seasonal. Examination of the aggregate resource development plan (reproduced on Drawing 3) shows that these lands will be retained in their natural state. Topographically, their catchment area is uphill to the north and west, and thus the development of the aggregate resource downhill to the south will not affect normal overland flow to the sloughs. It can be concluded that there will be no impact to these features.

With respect to groundwater, potential effects include changes to the groundwater levels and/or groundwater flow volumes or directions. It is proposed that the sand and gravel would be worked dry; with the base of the excavation lying 1.0 m above the maximum recorded groundwater level within the deposits, therefore no dewatering is proposed. Based on this, groundwater flow directions will remain the same and there should not be a reduction in groundwater flow volumes, a positive feature as this means no reduction in flow at the Big Hill Springs.

In fact, due to the removal of the lower permeability overburden exposing the more permeable sand and gravel below, recharge to the aquifer is expected to increase. Examination of Table 7 shows that the soil factor increases from 0.2 (for the glacial till) to 0.4 for the sand and gravel. This increases the overall infiltration factor from 0.44 to 0.64 for the flatter areas. The steeper areas will be levelled and will increase from 0.4 to 0.64 as well. Therefore, the calculation for existing conditions shown in Section 4.5.3 can be conducted again with these higher factors. Without listing the details here, the contribution to groundwater (in a wet year) increases from 17,789 m<sup>3</sup>/yr to 26,688 m<sup>3</sup>/yr due to infiltration. Further to this, there will be no runoff leaving the site due to the management of precipitation falling on the site by infiltration. It is expected that this will be an additional 15,012 m<sup>3</sup>/yr, and thus a total of 41,700 m<sup>3</sup>/yr of groundwater recharge will occur in a wet year and with the full excavation developed and open. This is conservative, as the site will be progressively restored, returning infiltration conditions to close to their natural state as each phase progresses. With respect to the springs, this amount of water is about 1.3 L/s (an increase of 0.76 L/s) in comparison to the reported Big Hill Springs flow of 40 L/s. It can be concluded that this is a positive impact, but a very minor one. In a drier year there will be no change, other than the momentary capture of any higher intensity storms.

The fine-grained overburden soils removed for sand and gravel extraction would be used to restore the site to an agricultural use. It is anticipated that the final site grade would provide a similar overall average slope to the site as the pre-development state and therefore would have infiltration rates of a similar magnitude. In a dry year or an average year, where there is no surplus, groundwater conditions would remain similar to existing conditions.

### 5.3 Potential Impacts on Groundwater and Surface Water Quality

During the operational phase of working, the main potential source of water pollution is from manmade sources such as fuels and solvents and natural sources such as suspended solids from reworking of the material on site. These of course are mitigated by best handling practices under the Code of Practice for Pits (Alberta, 2004). The first step in impact assessment is to describe the potential problems to be addressed.

During the aggregate extraction and associated processing (crushing, screening, conveying), there is potential for onsite runoff water to become affected by suspended solids due to surface runoff from working areas, stockpiles and haul roads. In addition, wash water from the crushing plant can convey a heavy suspended sediment load. Without appropriate mitigation measures employed, it is considered that the likelihood of occurrence of this water containing suspended solids loading is high, although with the base of the excavation below ground there is no surface discharge from the site. Thus, the magnitude of impact would be low from a surface water perspective. From a groundwater perspective, the infiltration of these waters into the porous sand and gravel however would mean the capture of the fine sediment in the underlying soils, which may potentially lead to eventual blinding of the near surface. Mitigation measures are proposed as discussed in Section 5.4 below.

During the aggregate extraction and associated works, the use of diesel powered equipment has the potential to cause local impacts should there be any accidental spillage of fuels or lubricants. The specific unmitigated impact of any accidental spillage of raw materials, fuels and lubricants would be on the water quality of the sand and gravel aquifer, since there is no surface water discharge. The implications for unmitigated releases to groundwater are for the down-gradient receptors including the Big Hill Springs approximately 800 m downgradient and nearby groundwater users. It is considered that in the short to medium term the likelihood for contamination of groundwater associated with accidental spillage is low but nevertheless appropriate mitigation measures should be employed. The magnitude of an impact under these conditions could be locally severe, due to the removal of the low permeability glacial till and a significant thickness of unsaturated sand and gravel. It is unlikely that the Environmental Protection and Enhancement Act would be breached offsite unless the spill were directly adjacent to the property boundary. For this reason, the potential overall impact is therefore considered to be of significance to water quality. Therefore, mitigation measures are proposed as discussed in Section 5.4 below.

### 5.4 Mitigation Measures

Sections 5.2 and 5.3 above identify the potential impacts of the proposed development at the site, and also identify where mitigation measures are required to reduce these potential impacts to acceptable levels. Proposed mitigation measures, over and above those already identified and included in the scheme design, are identified below and for ease of reference are detailed in terms of water quantity and water quality (subdivided further by surface or groundwater). The mitigation measures either reduce the likelihood of an event occurring or reduce the magnitude of the consequences if the event does occur.

It should be noted that several of the mitigation measures proposed below would have a positive effect on more than one potential impact.

The development and restoration of the site would be undertaken using technical guidance including the Code of Practice for Pits (Albert Government, 2004), relevant EPEA rules and other

codes of best practice in order to limit the potential for contamination of both ground and surface waters.

### 5.4.1 Water Quantity

It is concluded that under the current excavation scheme the overall risk of any significant negative impacts are negligible. This is based on no anticipated changes to the groundwater flow system. However, as an additional safeguard the current groundwater monitoring programmes should continue to be undertaken in order to give an early warning of any potential impacts (either short or long term) on the groundwater resources within the vicinity of the site.

The environmental monitoring programme should include the following:

- Water levels within the perimeter monitoring boreholes and the nearby residential water users at WW2 and WW4 should be monitored regularly by manual measurements and continuously by pressure transducers equipped with data loggers. This will protect both the surrounding water users and the proponent (from frivolous claims);
- Routine inspections to confirm that there are no signs of groundwater entering the excavation and which would indicate that the base of the excavation was below the maximum groundwater level. These should be documented in writing and with photographic confirmation of conditions so found;
- As the base of the excavation is lowered to near the anticipated depth (1.0 m above maximum recorded water level) shallow confirmatory monitoring wells should be installed (on a temporary basis) to refine the actual position of the water table. This information should be surveyed for elevation and location to the site datum to permit revision of any necessary pit design; and
- All monitoring data should be subject to routine review and interpretation to ensure no unanticipated problems exist or go unaddressed.

### 5.4.2 Groundwater and Surface Water Quality

In order to further reduce the potential risk of impacts to water quality pollution a number of mitigation measures are proposed, and these would be incorporated into the scheme development. The proposed measures include the following:

- The Application site is developed on a phased basis in order to minimise the working area and allow progressive restoration;
- The size of the working areas are minimised in order to reduce the potential for generation of suspended sediment in storm water;
- Settlement ponds and surface infiltration features are commissioned early in the scheme development and all runoff generated at site (including runoff from overburden storage areas and areas of stockpiling) is actively controlled and routed to these ponds as necessary; and
- In addition to the formal settlement ponds and infiltration features, temporary catch basins and sumps are used to collect, gather and manage surface water runoff generated at site within the working areas.

To prevent the discharge of suspended solids from the access road and Plant Site these areas should be developed with appropriate cross-falls to allow immediate drainage to ditches. All drainage would be routed to lined site settlement ponds to ensure no blinding of aquifer soils by sediment occurs.

Given these proposed mitigation measures the risk of unacceptable impacts is low. Nonetheless it is recommended that the following monitoring is undertaken:

- Frequent inspection of the water treatment ponds for erosion or other problems should be undertaken and documented by site operatives to ensure their efficacy; and
- Discharge from the water treatment ponds should only be made in accordance with approval from AEP, i.e. in accordance with the site's EPEA approval.

The threat of accidental spillage of fuels and oils or a vehicular accident occurring on site poses a risk to the groundwater. Standard mitigation measures for training, spill prevention, traffic and handling as per best practices are considered appropriate, along with an effective Emergency Response Plan. Bulk fuel storage would be undertaken in accordance with the *Guide to the Code of Practice for Pits (2004)* and be located in areas where thick clay overburden is still present. Storage would also be in accordance with the *Guidelines for Secondary Containment for Above Ground Storage Tanks (2015).* 

The above measures would significantly reduce the likelihood of suspended solids or other pollutants being discharged from the Application site, such that the overall risk is reduced to near zero.

### 5.5 Net Effects Assessment

After consideration of the mitigation measures detailed in Section 5.4 it may be concluded that the proposed development can be implemented with no adverse net impact to the groundwater or surface water environment. This is based on the fact that the excavation will be operated above the water table, and there is no direct offsite discharge of surface water. No impact is expected on downgradient wells or the Big Hill Spring. A slight benefit will be felt from the additional infiltration of precipitation surplus in that spring flow should increase during wet years.

### 5.5.1 Cumulative Effects of Multiple Operations

It is noted that several sand and gravel operations are proposed for the immediate surrounding area in addition to the MALP proposal and the currently operating Hillstone Aggregates pit. All are below ground facilities with no surface water discharge.

The same stringent operating procedures will need to be adopted by the other proposed operations to prevent contamination of the underlying aquifers and surface water by fuels, lubricants and sediments. This will include the same high level of preventative mitigation measures and Emergency Response preparations. Based on these factors, the likelihood of a pollution incident is low and therefore the cumulative risk to water quality is negligible from multiple operations in the area.

The water balance indicates that recharge to the underlying aquifers increases when an operation removes the low hydraulic conductivity till material and exposes the sand and gravel to precipitation. As a much larger area will be open at any one time with multiple pits operating together, this will proportionally increase the recharge to the aquifer and therefore the discharge from Big Hill Springs. To illustrate the potential change to groundwater recharge (and discharge at Big Hill Springs) due to multiple pits operating in the same area we have made some simplistic and conservative assumptions below. This is because we do not have details of the proposed phasing and working at the other sites. Assuming conservatively that four additional pits (including the MALP operation) are opened and each has the same total area as used in the

calculations in Section 4.5.3 (83.4 Ha) the total operating recharge in a wet year would be  $41,700 \text{ m}^3/\text{yr} \times 4 = 166,800 \text{ m}^3/\text{yr}$ . This compares to the current, undeveloped recharge of  $17,789 \text{ m}^3/\text{yr} \times 4 = 71,156 \text{ m}^3/\text{yr}$ , as an increase in recharge to the underlying sand and gravel of  $95,644 \text{ m}^3/\text{yr}$ . This would equate to an increase in flow at Big Hill Springs of approximately 3.0 L/s, which is less than a 10% increase from the 40 L/s quoted in the literature (Ozaray & and Barnes, 1977). This small increase in flow at the Big Hill Springs is overly conservative, as it is known that progressive restoration is planned for the MALP site and is likely to be proposed at the other sites. The real increase will be significantly lower, based on progressive restoration, and therefore the development of multiple sites is likely to provide a small beneficial impact to flow at Big Hill Springs and recharge to the underlying aquifers.

### 6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the above physical setting, study results and analyses the following conclusions are offered.

### 6.1 Conclusions

The site lies in an area of substantive sand and gravel, overlain by a blanket of fine grained soils. In an average meteorological year there is a slight moisture deficit and therefore no groundwater recharge. The water table lies in the bottom of the sand and gravel, moving laterally along the top of and recharging the Paskapoo Formation bedrock. In wetter years a small surplus contributes to the water table at this site, which appears to be maintained by groundwater flow from the northwest. Most local residential wells draw water from the bedrock formation with the exception of some shallow dug wells at location WW5, 1 km southeast of the site. No drawdown of these wells is expected as there will be no dewatering required for extraction of the aggregate. Groundwater from under this site eventually discharges at the Big Hill Springs.

There are no surface water streams or springs on this site, and two sloughs in the northwest corner (fed by storm runoff and perched on the glacial till overburden) will be retained as the site develops. During site development and after site closure, there will be no surface water discharge from the site. When storm water is abundant enough to move on the ground surface it will collect in the lower parts of the site (below existing grade) and ultimately infiltrate into the sand and gravel aquifer. There will be no dewatering of the aquifer because the site sits above the water table, and in fact in wetter years there will be slight augmentation of the groundwater from site infiltration. This will mean a slight increase in spring flow at Big Hill Springs, but probably not at a perceptible level.

Effects of the operation of an aggregate resource development above the water table at this site will be minimal on the ground and surface water, particularly if the mitigation measures discussed in Section 5 of this report are implemented. It is predicted that there will be no adverse net impact of the site.

### 6.2 Recommendations

Based on the above discussion and conclusions, the following recommendations are provided.

- 1) The mitigation measures discussed above are implemented as part of the final design;
- 2) Determination of ultimate excavation depths are based on future monitoring of water table levels beneath the extraction area, through periodic use of temporary shallow groundwater monitoring wells. Monitoring of those wells should include determining their position by survey to the site datum, and documentation of seasonal results to support any re-design thus instigated. The excavation floor should be at least 1.0 m above the maximum recorded water table level;
- 3) The storm runoff water is directed to sedimentation ponds, designed to ensure clear water discharges. The discharge should be to an unlined infiltration pond for return to the aquifer;
- 4) Best handling and storage practices for fuels and lubricants are implemented as per the *Guide to the Code of Practice for Pits (2004)* and the *Guidelines for Secondary Containment for Above Ground Storage Tanks (2015)* to minimize the risk of accidental spillage of contaminants at this site; and
- 5) A monitoring program as described above is implemented to document the lack of effect of the site, and to allow the operators to respond to any unanticipated problems that may occur.

### 7.0 REFERENCES

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### 8.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Mountain Ash Limited Partnership, hereafter referred to as the "Client". The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. It is intended for the sole and exclusive use of Mountain Ash Limited Partnership. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion.

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Nothing in this report is intended to constitute or provide a legal opinion. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to Albert Environment and Parks and/or related Alberta environmental regulatory authorities or persons for review and comment purposes.

# TABLES

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003

	Guideline (CDWQ)	leline WQ) Units	MW14-101	MW14-103		MW18-104	MW18-105	5 MW18-106	MW18-107	MW19-108	MW19-109	MW19-110
Parameter			20-Nov-14	20-Nov-14	4-Aug-15	4-Jul-19	4-Jul-19	4-Jul-19	4-Jul-19	4-Jul-19	5-Jul-19	10-Jul-19
Total Aluminum <sup>1</sup>	0.1 (OG)	mg/L	0.164	5.57	0.109	3.7	5.4	13	7	15	95	10
Total Antimony	0.006 (MAC)	mg/L	<0.00050	< 0.00050	< 0.00050	0.0049	0.006	0.0048	0.00079	0.0022	0.0034	< 0.00060
Total Arsenic	0.01 (MAC)	mg/L	0.00035	0.007858	0.000336	0.0044	0.0056	0.017	0.0076	0.0086	0.071	0.0084
Total Barium	1 (MAC)	mg/L	0.424	0.7	0.332	0.61	2.8	1.1	0.79	1.1	7.2	2.2
Bicarbonate (as HCO3)	NV	mg/L	382	380	375	310	320	360	370	390	350	330
Total Boron	5 (MAC)	mg/L	<0.020	<0.020	<0.020	0.025	0.021	<0.020	<0.020	0.029	0.087	<0.020
Total Cadmium	0.005 (MAC)	mg/L	0.000016	0.00029	<0.000005	0.00036	0.0055	0.00095	0.00033	0.00095	0.01	0.0042
Dissolved Calcium	NV	mg/L	76	75	73	63	69	73	71	74	77	62
Chloride	<250 (AO)	mg/L	10.5	7.8	8.8	29.0	13.0	9.3	10.0	14.0	18	8.4
Total Chromium	0.05 (MAC)	mg/L	<0.0010	0.0076	0.0016	0.018	0.0046	0.081	0.025	0.038	0.19	0.019
Total Copper	2 (MAC) / 1 (AO)	mg/L	<0.0010	0.0093	0.0013	0.064	0.11	0.11	0.018	0.038	0.29	0.032
Total Iron	<0.3 (AO)	mg/L	0.28	12	0.22	7.6	49	37	17	29	190	10
Total Lead	0.005 (MAC)	mg/L	0.00031	0.00464	<0.00030	0.0049	0.025	0.019	0.0075	0.024	0.15	0.019
Total Mercury	0.001 (MAC)	mg/L	<0.00010	<0.00010	<0.00020	0.00003	0.0013	0.00032	0.000048	0.000067	0.00208	0.000002
Dissolved Magnesium	NV	mg/L	33.7	33.4	32.6	30	32	31	32	32	37	30
Total Manganese	0.12 (MAC) / 0.02 (AO)	mg/L	0.02	0.93	0.01	0.62	2.90	1.90	0.60	0.74	8.9	7.3
Total Molybdenum	NV	mg/L	0.0008	0.00184	0.00086	0.015	0.0014	0.005	0.0021	0.0065	0.023	0.0015
Total Nickel	NV	mg/L	<0.00050	0.01196	0.00051	0.02	0.015	0.036	0.014	0.047	0.41	0.065
Nitrate-N	10 (MAC)	mg/L	1.19	5.22	1.801	0.97	2.6	2.3	2	2.4	1.7	1.9
Nitrite-N	1 (MAC)	mg/L	<0.05	<0.05	<0.005	0.098	<0.010	<0.010	0.034	0.048	0.065	<0.010
Dissolved Potassium	NV	mg/L	4.8	4.3	3.9	4.1	2.9	3.3	3	3.4	6.3	2.7
pH <sup>2</sup>	7.0 -10.5		7.9	7.8	8	7.91	8.05	7.87	7.8	7.91	8.19	7.82
Total Selenium	0.05 (MAC)	mg/L	<0.00060	0.00112	0.00087	0.00049	0.00093	0.0011	0.00094	0.0013	0.00059	0.00096
Total Silver	NV	mg/L	<0.000070	<0.000070	<0.000070	0.00044	<0.00010	0.0017	0.0001	0.0003	0.0025	<0.00010
Dissolved Sodium	<200 (AO)	mg/L	6	8.8	7.9	13	5.7	9	6.6	12	18	6
Sulphate	<500 (AO)	mg/L	8.88	11.9	10.56	9.2	5.8	7.6	6.6	17	26	8.1
Total Thallium	NV	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00023	0.0002	<0.00020	0.00028	0.0026	0.00024
Total Dissolved Solids (calculated) <sup>3</sup>	<500 (AO)	mg/L	337	354	333	310	300	320	320	350	360	290
Turbidity	1 (OG)	NTU	9.6	680	8	130	>4000	3100	53	670	>4000	<0.10
Total Uranium	0.02 (MAC)	mg/L	0.001697	0.002014	0.001563	0.0019	0.012	0.003	0.0027	0.0047	0.016	0.006
Total Zinc	<5 (AO)	mg/L	<0.020	0.033	<0.020	0.072	0.19	0.13	0.037	0.15	1.2	0.14
Total Coliforms	<1 (MAC)	MPN/100 mL	-	-	<1	>24000	<100	1100	>2400	<10	120000	180
E.Coli	<1 (MAC)	MPN/100 mL	-	-	<1	10	<100	<10	<1.0	<10	100	63

 Table A1

 Sand and Gravel Monitoring Well Groundwater Quality Results

Notes:

NV = no value OG = Operational Guidance

AO = Aesthetic Objective

MAC = Maximum Allowable Concentration

Canadian Drinking Water Quality CDWQ Guidelines: September 2019

1. Aluminum Aesthetic Objective (CDWQ - AO): Conventional Treatment Plants <0.1 mg/L (100 ug/L), Other Treatment Systems <0.2 mg/L (200 ug/L)

2. pH Objective (CDWQ): 7.0 - 10.5

3. Calculated result only includes measured parameters. Actual TDS may be higher.

BOLD RED – Exceeds guideline
	Guideline		w	N1		WW2			<b>W</b> 3	WW4		
Parameter	(CDWQ)	Units	29-Oct-14	4-Aug-15	29-Oct-14	4-Aua-15	10-Jul-19	29-Oct-14	4-Aug-15	30-Oct-14	4-Aug-15	5-Jul-19
Total Aluminum <sup>1</sup>	0.1 (OG)	mg/L	0.0068	0.011	<0.0050	<0.0050	0.006	0.0061	<0.0050	<0.0050	<0.0050	0.0041
Total Antimony	0.006 (MAC)	mg/L	0.00088	<0.00050	0.00059	<0.00050	<0.00060	<0.00050	<0.00050	<0.00050	<0.00050	<0.00060
Total Arsenic	0.01 (MAC)	mg/L	0.000126	0.000132	0.000165	0.000205	<0.00020	0.000143	0.000121	0.000192	0.000194	0.00032
Total Barium	1 (MAC)	mg/L	0.282	0.284	0.128	0.142	0.11	0.221	0.225	0.385	0.391	0.36
Bicarbonate (as HCO3)	NV	mg/L	366.6	359.6	380.6	375.1	350	391.6	377.7	371.8	365.2	340
Total Boron	5 (MAC)	mg/L	0.022	<0.020	0.032	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020
Total Cadmium	0.005 (MAC)	mg/L	0.000013	<0.00005	0.000016	0.000024	0.000029	0.00004	0.000024	0.000008	<0.000005	<0.000020
Dissolved Calcium	NV	mg/L	70.3	68.2	63.6	63.4	55	73.2	69.7	75.3	72	80
Chloride	<250 (AO)	mg/L	4.29	4.49	1.38	1.93	2	10.31	5.88	10.86	10.95	12
Total Chromium	0.05 (MAC)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Total Copper	2 (MAC) / 1 (AO)	mg/L	0.0317	0.013	0.0022	0.0016	0.0045	0.125	0.0057	0.0017	0.0018	0.034
Total Iron	<0.3 (AO)	mg/L	0.015	0.014	0.018	0.04	<0.060	<0.010	<0.010	0.017	0.044	0.3
Total Lead	0.005 (MAC)	mg/L	0.00127	0.00048	<0.00030	<0.00030	0.00054	0.00302	<0.00030	<0.00030	<0.00030	0.011
Total Mercury	0.001 (MAC)	mg/L	<0.00010	<0.00020	<0.00010	<0.00020	<0.000020	<0.00010	<0.00020	<0.00010	<0.00020	<0.000020
Dissolved Magnesium	NV	mg/L	35.1	31.8	37.3	35	30	39.9	35.5	35.2	31.5	35
Total Manganese	0.12 (MAC) / 0.02 (AO)	mg/L	<0.0010	<0.0010	0.004	0.0042	0.012	0.0014	<0.0010	<0.0010	<0.0010	<0.0040
Total Molybdenum	NV	mg/L	0.00148	0.00147	0.00222	0.00193	0.0014	0.00113	0.00104	0.00076	0.00066	0.00065
Total Nickel	NV	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.0006	0.00174	<0.00050	<0.00050	<0.00050	<0.00050
Nitrate-N	10 (MAC)	mg/L	1.67	1.658	0.78	1.054	0.37	1.87	1.889	3.02	3.314	3.2
Nitrite-N	1 (MAC)	mg/L	<0.05	<0.005	<0.05	<0.005	<0.010	<0.05	<0.005	<0.05	<0.005	<0.010
Dissolved Potassium	NV	mg/L	3.3	3.2	2.8	2.6	2	3.1	3	3.1	2.9	3
рН <sup>2</sup>	7.0 -10.5		8.1	8	8	8.1	7.95	7.9	8	8	8	8.13
Total Selenium	0.05 (MAC)	mg/L	0.00084	<0.00060	0.00112	0.00105	0.00052	0.0007	0.00085	0.0018	0.00096	0.00093
Total Silver	NV	mg/L	<0.000070	<0.00007	<0.00007	<0.00007	<0.00010	<0.00007	<0.00007	<0.00007	<0.00007	0.00012
Dissolved Sodium	<200 (AO)	mg/L	7.2	7	13.8	9.3	17	7.8	7.6	7.1	6.5	7.7
Sulphate	<500 (AO)	mg/L	6.95	7.51	15.82	12.85	20	10.33	11.09	7.66	6.77	5.9
Total Thallium	NV	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Dissolved Solids (calculated) <sup>3</sup>	<500 (AO)	mg/L	318	310	328	317	300	349	330	339	328	330
Turbidity	1 (OG)	NTU	0.2	0.31	0.2	1.23	0.31	0.2	0.25	0.6	0.23	0.66
Total Uranium	0.02 (MAC)	mg/L	0.001299	0.001241	0.001023	0.001214	0.00091	0.001744	0.001688	0.001785	0.001672	0.0021
Total Zinc	<5 (AO)	mg/L	<0.020	<0.020	0.024	<0.020	0.046	0.205	<0.020	0.029	0.031	0.99
Total Coliforms	<1 (MAC)	MPN/100 mL	-	<1	-	<1	1	-	<1	-	<1	11
E.Coli	<1 (MAC)	MPN/100 mL	-	<1	-	<1	<1	-	<1	-	<1	<1

Table A2 Paskapoo Formation Residential Well Groundwater Quality Results

Notes:

NV = no value

OG = Operational Guidance

AO = Aesthetic Objective

MAC = Maximum Allowable Concentration

Canadian Drinking Water Quality CDWQ Guidelines: September 2019

1. Aluminum Aesthetic Objective (CDWQ - AO): Conventional Treatment Plants <0.1 mg/L (100 ug/L), Other Treatment Systems <0.2 mg/L (200 ug/L)

2. pH Objective (CDWQ): 7.0 - 10.5

3. Calculated result only includes measured parameters. Actual TDS may be higher.

BOLD RED – Exceeds guideline

	Cuidalina (CWOC	<u> </u>		BUS1	
Parameter	PAL Freshwater)	Units	30-Oct-14	4-Aug-15	10- Jul-19
Hardness (as CaCO3)	NV	ma/l	336		200
	0.1	mg/L	0.0182	0 0144	0.3
Total Antimony	NV	mg/L	<0.00050	<0.00050	<0.00060
Total Arsenic	0.005	mg/L	0.000153	0.000146	0.00061
Total Barium	NV	mg/L	0.304	0.313	0.21
Bicarbonate (as HCO3)	NV	mg/L	376.1	371	240
Total Boron <sup>2</sup>	1.5	mg/L	0.024	<0.020	<0.020
Total Cadmium <sup>3</sup>	0.00009	ma/L	0.000032	0.00008	0.000034
Dissolved Calcium	NV	mg/L	74.1	72	48
Chloride <sup>4</sup>	120	ma/L	9.6	10.12	8.2
Total Chromium <sup>5</sup>	0.001	ma/L	<0.0010	<0.0010	0.001
Total Copper <sup>6</sup>	0.004	mg/L	<0.0010	0.001	0.0013
Total Iron	0.3	ma/L	0.027	0.019	0.25
Total Lead <sup>7</sup>	0.007	ma/L	<0.00030	< 0.00030	<0.00020
Total Mercury	0.000026	mg/L	<0.00010	<0.00020	0.0000025
Dissolved Magnesium	NV	mg/L	36.7	33.3	20
Total Manganese	NV	mg/L	0.0019	0.0012	<0.0040
Total Molybdenum	0.073	mg/L	0.00141	0.00089	0.00038
Total Nickel <sup>8</sup>	0.15	mg/L	<0.00050	<0.00050	0.00088
Nitrate-N <sup>9</sup>	2.9	mg/L	2.83	3.037	1.4
Nitrite-N	0.06	mg/L	<0.05	<0.005	<0.010
Dissolved Potassium	NV	mg/L	3.4	3.3	4.8
pН	6.5-9		8.2	8.2	8.07
Total Selenium	0.001	mg/L	0.00218	0.0013	0.00068
Total Silver	0.00025	mg/L	<0.000070	<0.000070	<0.00010
Dissolved Sodium	NV	mg/L	7.8	7.5	5
Sulphate	NV	mg/L	9.36	8.36	4.7
Total Thallium	0.0008	mg/L	<0.00020	<0.00020	<0.00020
Total Dissolved Solids (calculated) <sup>10</sup>	NV	mg/L	342	334	210
Turbidity	NV	NTU	0.8	1.07	5.1
Total Uranium <sup>11</sup>	0.015	mg/L	0.001953	0.001875	0.0013
Total Zinc	0.007	mg/L	<0.020	<0.020	<0.0030
Total Coliforms	NV	MPN	-	2420	>2400
E.Coli	NV	MPN	-	1733	1600

Table A3 Big Hill Springs Water Quality Results

#### Notes:

NV = no value

Canadian Water Quality Guidelines (CWQG) Protection for Aquatic Life (PAL) Freshwater Guidelines Updated to September 2019 1. Aluminum Guideline (CWQG Aquatic Life - Freshwater): if pH < 6.5 then 0.005 mg/L (5 ug/L), else if pH >= 6.5 then

0.1 mg/L (100 ug/L)

2. Boron Guideline value is for long term exposure. Short term exposure value is 29 mg/L

- 3. Cadmium Guideline value is for long term exposure. Short term exposure value is 0.001 mg/L
- 4. Chloride Guideline value is for long term exposure. Short term exposure value is 640 mg/L

5. Chromium Guideline value is for hexavalent chromium as conservative value. Trivalent chromium guideline is 0.0089 mg/L.

6. Copper Guideline (CWQG Aquatic Life - Freshwater): if hardness (as CaCO<sub>3)</sub> < 82 mg/L then 0.002 mg/L (2 ug/L),

if CaCO3 = 83-180 mg/L then is calculated using an equation, if CaCO3 >180 mg/L then 0.004 mg/L (4 ug/L),

7. Lead Guideline (CWQG Aquatic Life - Freshwater): if hardness (as CaCO3) < 60 mg/L then 0.001 mg/L (1 ug/L),

if CaCO3 = 60-180 mg/L then is calculated using an equation, if CaCO3 = >180 mg/L then 0.007 mg/L (7 ug/L)

8. Nickel Guideline (CWQG Aquatic Life - Freshwater): if hardness (as CaCO3) < 60 mg/L then 0.025 mg/L (25 ug/L), if CaCO3 = 60-180 mg/L then is calculated using an equation, if CaCO3 > 180 mg/L then 0.150 mg/L (150 ug/L),

9. Nitrate Canadian Water Quality Guidelines (CWQG) for Aquatic Life represents lower value for "Long Term Exposure". Short Term exposure value is 124 for Freshwater

10. Calculated result only includes measured parameters. Actual TDS may be higher.

11. Uranium Guideline value is for long term exposure. Short term exposure value is 0.033 mg/L

BOLD RED – Indicates Exceeds guideline

## DRAWINGS

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003





#### NOTES:

DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION: W 1/2 SEC 31 TWP 026 RGE 03 W5M ROCKY VIEW COUNTY, ALBERTA

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY. IMAGERY DATE: SEPTEMBER 9, 2016.

#### LEGEND:



PROPERTY BOUNDARY SUBJECT BOUNDARY

BIG HILL SPRINGS PROVINCIAL PARK

0 100 200 400 600

SCALE 1:12,500 WHEN PLOTTED CORRECTLY ON A 11 x 17 PAO NAD 1983 UTM ZONE 11N

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ( LOCATIONS MAY VARY AND NOT ALL STRUCTURE

	MOUNTAIN ASH LIMITED PARTNE AGGREGATE OPERATION NW & SW 31-26-03-W5M ROCKY VIEW COUNTY, ALBER	RSHIP
	HYDROGEOLOGICAL ASSESSM	ENT
	SITE LOCATION & STUDY AREA	
	Date: January 14, 2020	Drawing No.
0 800 m	Project No. 212.06650.00003	1
GE LAYOUT ONLY. ACTUAL ES ARE SHOWN.		





adfile name: S\_212-06650-00003-A6.dwg;



lfile name: S 212-06650-00003-



















# APPENDIX A Site Gravel Investigation Results and Logs

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003



7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2014 08 27

099-89-14

Summit Aggregates 10919 - 84 Street SE Calgary, Alberta T2C 5A6

Attention: Mr. Tige Brady, C.E.T.

Re: Waterman Pit Gravel Investigation Highway 567, RR 40

We were retained to observe the advancement of test holes, within the proposed Waterman gravel borrow pit, located south of Highway 567 and east of Range Road 40, on July 18 and 19, 2014.

At that time, five (5) test holes, designated as TH1 to TH5, were advanced at the approximate locations shown on the attached Site Plan. The test holes were advanced using a diesel hammer rig operated by Great West Drilling, of Calgary, Alberta. The total depth of the test holes ranged from 16.8m to 22.8m, below existing ground surface. Gravel samples were obtained at regular intervals and returned to our laboratory for further classification and analysis. Groundwater was observed in four (4) test holes (TH1 to TH4) at completion of drilling, perched on top of the bedrock.

Enclosed are five (5) Test Hole Logs, recorded during drilling and four (4) Aggregate Gradation Analyses conducted on representative samples from TH1, TH2, TH3 and TH5. Also enclosed are the results of LA Abrasion testing conducted on representative samples from TH1, TH3, TH4 and TH5, by Curtis Engineering Ltd.

We trust this meets with your present requirements.

Respectfully submitted, ALMOR TESTING SERVICES LTD.

Abdul Alemi, E.I.T. AA:ms:A04665

Attachments

Serving the Construction Industry for 40 Years

PROJEC	CT: WATERMAN GRAVEL PIT ASSESSMENT SH 567 & RR40			PF NC	ROJECT D.		HOLE NO.	TH1
CLIENT:	SUMMIT AGGREGATES			DF TY	RILL BECKER H	AMMER		
GEODETIC ELEVATIO	DATUM		түре	sED	WATER CONTENT (%) ●	COMPRES STRENGT	SSIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE -	MOD UNIFI SOIL CLAS:	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d ▲ n △ 4 5	OTHER TESTS
N/r	TOPSOIL/ORGANICS	F,						
- 1 - 2	Silty CLAY (TILL) brown, trace sand, trace to some gravel, stiff, moist	4 4 6 8						
-3		-10						
- 4 - 5		14 16						
		-18						
	Sandy GRAVEL brown, silty, compact, fine to coarse grained, poorly graded, damp	-20 -22						
-8 0		-24 -26	D					
-9 0	- compact to dense below 8.5m	-28	D					
00	- some cobble below 9.4m	-32						
	- sand layer approx. 0.6m thick	-34	B		•			
- 11 00		36						
- 12		-38						
1200		-40						
- 13	- sand layer approx. 0.6m thick							
		-46	В					
15 0	- sand layer approx. 0.6m thick	-48						
		-50						
- 16 0		-52						
- 17 0		-56	R					Gravel 65.1 %
0		-58						Silt and Clay 3.1 %
		60						
- 19 6		-62						
- 20		66						
21		-68						
	- groundwater level 17.4m at completion	-70						
- 22	- test hole backfilled with soil cuttings	-72						
- 23		-74 -76						
		-78						
- 24		80						
				KN/	n <sup>3</sup> 16 18 20 22	20 40 PENETRAT	60 FION <b>—</b>	
	ALMOR TESTING SERVICES LTD.			PC	100 120 140 F└─└─└─└─┘	RESISTAN	CE	
	TEST HOLE LOG			WE		I SPT I ■ Cone I	Case BT Pen	Measuréd
COMPLI DEPTH	ETION 20.4 m DATE July 18, 2014			LC BY	GGED Abdul A	lemi	PLATE NO.	1

PROJEC	T: WATERMAN GRAVEL PIT ASSESSMENT SH 567 & RR40			PF NC	ROJECT D.			HOLE NO.	TH2
CLIENT:	SUMMIT AGGREGATES			DF TY	RILL BE	CKER H	AMMER		
GEODETIC ELEVATION	I (m) DATUM	1	-YPE	<u>م</u>	WATER CONTEN	(%) ●	COMPRES STRENGT	SSIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE SOIL CLASS	PLASTIC LIMIT 20 40	LIQUID LIMIT	Unconfine Pocket Pe TSF 2 3 KPa 200 30	d ▲ n △ 4 5	OTHER TESTS
	TOPSOIL/ORGANICS	<b>F</b> _							
-1	Silty CLAY (TILL) brown, trace sand, trace gravel, stiff, moist	-2 -4						· · · · · · · · · · · · · · · · · · ·	
-2		-8						· · · ·	
-4	Sandy GRAVEL brown, silty, compact, fine to							· · · ·	
_5	coarse grained, poorly graded, damp	-16							
	- occasional cobble below 5.2m	-18							
-6 0		-20	В		●				
		-22							
00		-24							
		-26							
-9 00		-30							
10 0		-32							
	- some cobble below 10.1m	-34							
- 11 %		_36							
	highly ovidized below 11 0m	-38				<u> </u>		· · · ·	Gravel 57.6 %
00			R		<b>T</b>			· · · ·	Sand 31.2 % Silt and Clay 11.2 %
- 14 0		-46				<u> </u>			
		-48							
	- sand layer approx. 0.6m thick	-50	R		•				
- 16		-52							
		-56	Ь.						
00		-58							
		60							
- 19 0	- sand layer approx. 0.6m thick	_62							
		64				<u> </u>			
		68							_
- 21	- saturated sand layer at 21.0m	-70							At completion
		-72							
	SANDSTONE (BEDROCK)	-74							
	END OF TEST HOLE AT 22.8m	-76							
- 24	<ul> <li>groundwater level 21.0m at completion</li> <li>test hole backfilled with soil cuttings</li> </ul>	-80							
	~ 	E		KN,		20 22	20 40	<u>60</u>	
	ALMOR TESTING SERVICES LTD				n' '0 100 120	0 140	PENETRA		GROUNDWATER
				PC	F L			Case	y Date Measured
							Cone	BT Pen	
	22.8 m   DATE DRILLED July 18, 2014			LC   B1	/GGED	Abdul A	lemi	NO.	<sup>⊨</sup> 2

PROJEC	CT: WATERMAN GRAVEL PIT SH 567 & RR40	T ASSESSMENT			PF NC	ROJECT ).			HOLE NO.	TH3
CLIENT:	SUMMIT AGGREGATES				DF TY	RILL Pe	BECKER H	AMMER		
GEODETIC ELEVATIO	) N (m)	DATUM		YPE	Ω.,	WATE CONTE	R ENT <sup>(%)</sup> ●	COMPRE STRENG	SSIVE FH	
DEPTH (m)	SOIL DESCRIP	TION	DEPTH (ft)	SAMPLE T	MOD UNIFIE SOIL CLASS	PLASTIC LIMIT	LIQUID LIMIT 40 60	Unconfine Pocket Pe TSF 2 3 KPa 200 30	nd ▲ en △ 4 5	OTHER TESTS
	TOPSOIL/ORGANICS									
-1	Silty CLAY (TILL) brown, to gravel, stiff, moist	race sand, trace to some	4 4							
			-8							
	Sandy GRAVEL brown, tra	ace clay, silty, compact,	-14	R		<u> </u>			<u> </u>	
-5 0	inte to obtroe grained, pot	ony graded, damp	-16							
0			-18	В		<b>1</b>				
-6	- highly oxidized below 6.1r	n	_20	R						Gravel 60.7 %
	- occasional cobble below 6	6.7m	-22						<u> </u>	Silt and Clay 11.3 %
			-24							
			-26							
-9 00	- occasional fine grained sa	and layer below 8.5m	-30						<u>:</u> : : : : :	
			-32							
			-34							
- 11	- sand layer approx. 0.6m tl	hick	-36						<u> </u>	
00			-38	Б						
- 12			_40							
- 13			-42						<u> </u>	
	- some cobble below 13 7m		-44							
		,		В		•				Sand 29.8 %
- 15	- becoming compact to den	se	_40 _50						: : :	Silt and Clay 10.4 %
									· · · ·	
		L:-1.	_ 54							
- 17 6	- sand layer approx. 0.6m ti	NICK	-56						<u>: : :</u> : : :	
- 18 0			-58	В		•				Sand 29.6 %
			_60						· · · ·	Slit and Clay 8.3 %
- 20	- coarse grained sand layer	approx. 0.6m thick	66	R					<u> </u>	
	SANDSTONE (BEDROCK)	)	68							At completion
- 21	END OF TEST HOLE AT 2	0.6m	-70							
- 22	<ul> <li>groundwater level 20.4m a</li> <li>test hole backfilled with so</li> </ul>	at completion	-72				· · · · ·		· · · ·	
	toot noie buokinieu with St	Sector Se	_74							
			_76						· · · ·	
- 24									<u> </u>	
			80						· · · ·	
	ne .				KN/r	n <sup>3</sup> 16 18	3 20 22	20 40 PENETRA	60 TION <b>—</b>	
		G SERVICES LTD.			PC	F		RESISTAN	ICE	■ Date
	TEST HC	DLE LOG			WE	T UNIT V		SPT	Case	Measured
COMPLI	ETION 20.6 m	DATE July 17. 20	14	+	LC	GGED	Abdul A	lemi		E 3
LDEVIH					BI				UNU.	

PROJE	CT: WATERMAN GRAVEL PIT SH 567 & RR40	ASSESSMENT			PF N(	ROJE D.	СТ			HOLE NO.	TH4
CLIENT	SUMMIT AGGREGATES				DI דו	RILL YPE	BE	CKER H	AMMER		
GEODETI ELEVATIO	C DN (m)	DATUM	(ft)	LE TYPE	NIFIED	WA CO		IT <sup>(%)</sup> ●	COMPRE STRENGT Unconfine	SSIVE ſH d ▲	OTHER
DEPTH	SOIL DESCRIP	TION	DEPTH	SAMP	SOIL C MOD U		MIT 20 40		TSF 2 3 KPa 200 30	4 5 4 0 400	TESTS
CALL CALL	TOPSOIL/ORGANICS		+								
	Silty CLAY (TILL) brown, the	race sand, trace gravel,	<b>F</b> <sup>2</sup>								
	stiff, low to medium plastic	c, moist	4								
-2			_6					<u> </u>			
			_8			:		::::			
-3			_10								
			-12								
-4			-14								
			-16								
			-18								
-6 00	Sandy GRAVEL brown, tra	ice clay, silty, compact,	-20	В		•					
Po	fine to coarse grained, poo	oriy graded, damp						::::			
			<b>–</b> 24					::::			
-8 õ			-26	Б							
			-28								
			_30								
	- sand layer approx. 0.6m ti	NCK	_32					<u> </u>			
0	- occasional cobble below 1	0.1m	_34	В		•					
			-36								
Po			-38								
	aama aabbia balaw 40 0m		-40								
120	- Some cobble below 12.20	I	-42	R							
[ '''			44								
	-		-46								
0			48					: : :		: : :	
- 15 °C	- sand layer approx. 0.6m tl	nick	50								
60			52								
	-										
			-56	Þ							
0	- coarse grained sand laver	approx 0 6m thick	-50								
- 18 %				B		<b>∳</b>		<u> </u>			
0											
- 19	- saturated below 18.9m		<b>H</b> <sup>62</sup>								+ At completion
			-64							: : :	
20 0			-66								
- 21			-68					<u> </u>			
			70	R							
- 22	SANDSTONE (BEDROCK)	/	72	H		H					
	END OF TEST HOLE AT 2	1.9m	-74								
23	- groundwater level 18.9m a - test hole backfilled with so	at completion il cuttings	_76								
- 24			-78			L.					
			_80			:					
					KN,	 16	18	20 22	20 40	60	
	DR ALMOR TESTING				'	100	12	0 140	PENETRA		GROUNDWATER
		J GEINVIOLO LI D.			PC	F L			RESISTAN	ICE	
	TEST HC	DLE LOG			WE	ET UN	IIT WE			Case	Measured
COMPI	ETION	DATE			10	DGGI	ED			PLATE	
DEPTH	21.9 m	DRILLED July 17, 2014			B	Y		Abdul A	lemi	NO.	4

PRC	DJECT: WATERMAN GRAVEL PIT SH 567 & RR40		PF NC	ROJECT D.		HOLE NO.	TH5		
CLIE	ENT: SUMMIT AGGREGATES				DF TY	RILL BECKER H	AMMER		
GEOU ELEV (m) HTT	DETIC (ATION (m) SOIL DESCRIPT		EPTH (ft)	AMPLE TYPE	IOD UNIFIED	WATER CONTENT (%) • PLASTIC LIQUID LIMIT LIMIT	COMPRES STRENGT Unconfined Pocket Pe TSF 2 3	SSIVE H d ▲ n △ 4 5	OTHER TESTS
ä			ä	S	Σø	20 40 60	KPa 200 300	0 400	
	Silty CLAY (TILL) brown tr	and trace gravel	-2						
	stiff, low to medium plastic.	moist	-						
			-4						
2		-	-6						
-		-	-8						
3		-	-						
		_	-						
			-12						
		_	-14						
5		-	- -16						
		_	-						
	Sandy GRAVEL brown, trac	e clay, silty, compact,	- 18						
-6	fine to coarse grained, poor	rly graded, damp	-20						
		_	-22						
-7		-	- -24	R		•			
	- occasional cobble below 7.	6m	-						
-8		-	-26						
	0	_	-28						
-9	lo () sand laver approx, 0.3m thi	ick	-30						
			-32						
- 10	<u>6</u>	-	-					<u>: : :</u>	
		-	-34						
- 11		_	-36						Gravel 68.4 %
		-	- -38	В		●			Sand 27.8 % Silt and Clay 3.8 %
- 12			-	D					
		-	-						
- 13	- some cobble below 12.8m	-	-42   -						
		_	-44						
- 14		-	-46						
			- -48						
- 15	- becoming compact to dens	e							
			-50 -	$ \square$					Gravel 71.2 %
- 16		F	-52	В					Sand 22.8 % Silt and Clav 6.0 %
	Pol	F	-54						
- 17	- becoming dense	/	-56						
	END OF TEST HOLE AT16.	8m							
- 18	test hole dry at completion     test hole backfilled with soil		-58   -						
			-60						
- 19		F	-62						
			-64						
			-		1/1				
					κn <sub>/r</sub>	n <sup>3</sup> 16 18 20 22	20 40 PENETRAT		GROUNDWATER
A	ALMOR TESTING SERVICES LTD.					F	RESISTAN	CE	▼ Date
	TEST HOLE LOG						🗆 SPT 🛛	Case	Measured
		<b>_                                 </b>		$\dashv$	10		Cone	BT Pen	
	2TH 16.8 m	DRILLED July 18, 2014			BY	Abdul A	lemi	NO.	- 5









	Client	Summit	Aggregate	98		Jo Da Da	b No. te San te Rec	npled eived		July 18/14 July 18/14		By By	AA AA
	Attention	Tige Bra	dy			Da	te Tes	ted		July 22/14		By	JC,KW
	Project	Gravel P Waterma	'it Investig an Pit, Hw	ation y567 & RR40		Ag	grega grega	te Type te Sour	ce	Silty, Sa Existing	andy Gl Materi	RAVEL	
	Sieve Size	Percent	Passing b	y Weight		/ ·9	grogu		00	Exioting	maton		
	(mm)		Min.	Max.		Cla	assific	ation	GP-GM				
	200								C <sub>C</sub> =	3.3			
	150								C <sub>U</sub> =	135.6			
	100												
	80					Sp	ecifica	ation					
	50	100.0				•							
	40	95.9											
	25	84.9				Co	mmer	nts					
	20	77.5											
	16	71.5					Т	H # 2 @	39-40ft.				
	12.5	64.1					N	loisture	Content =	4.2%			
	10	57.9											
	5	42.4											
	2.5	32.1											
	1.25	27.0											
	0.63	23.5											
	0.315	19.6											
	0.16	15.5											
	0.08	11.2											
	100												
	90	$+ \lambda$											_
		) I I	<b>\</b>										
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	80	50 40	16	5 5	2.5	1	63	15	16	0.1			.01
	•		1			-i	Ö	0.3	0.	0.			0
					Sie	eve Size	(mm)						



Aggregate	Analy	sis R	eport
	·		









	<b>Analysis</b>	Report
Ayyıcyalc	Allalysis	Nepoli

















August 1, 2014 File: 313-Misc.

# Almor Testing Service

7505 40 Street SE Calgary, AB T2C 2H5 Email: general@almor.com

Attention: Barry Martin

## RE: LA Abrasion Testing (ASTM C131, ASTM C-535)

Curtis Engineering Associates Ltd. ran ASTM C-131 Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine on two (2) samples. Additionally two (2) samples were tested in accordance with ASTM C-535 Standard Test Method for resistance to degradation of large-size coarse aggregate by apbrasion and impact in the Los Angeles machine. The samples delivered to our office washed, split, and dried. The sample was then run through the test process and the results are tabulated below.

Sample ID	Gradin	Mass Prior	Mass After	Mass Loss	Percent
		To Test (g)	Test (g)	Due to Test (g)	Loss (%)
1	A	4999.3	3580.9	1418.4	28.4
2	Α	4998.6	3657.6	1341.0	26.8
3	2	10061.5	8033.8	2027.7	20.2
4	2	9975.5	8219.9	1755.6	17.6

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

Curtis Engineering Associates Ltd.

Michael Staple, B.Sc., P.Eng. Geotechnical Engineer

MS/rwc



/	
PLAN DRILL HO WATERMA RES NW <sup>1</sup> / <sub>4</sub> SECTION 3 UTM, MD OF ROCK	SHOWING LE LOCATION N AGGREGATE SOURCE 1 TWP 26 RGE 3 W5M NAD83 Z11 (Y VIEW COUNTY
LEGEND PROP X PROP	ERTY LINE OSED TESTHOLE LOCATION
S U Calgary,	MMIT EGATES LTD.
LEGAL LANI NW 1/4 SECTION	D DESCRIPTION 31 TWP 26 RGE 3 W5M 6 1314 15 16 1211 10 9 5 6 7 8 4 3 2 1 IVISION - LSD - 40 ACRES
DATE: June 23, 2014 SCALE: 5,500 DATE REVISED:	DRAWN BY: T BRADY DRAWING: FIGURE 3 REVISED BY:
July 20, 2014 FILE: 2014 Waterman Aggregates	T BRADY- Resource (COP).dwg
AIR PHOTO TAKEN : JULY 04, 20	12
DATE PRINTED: June 23, 2014	)



7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2017 11 20

099-86-17

Mountain Ash Limited Partnership

Attention: Mr. Tige Brady, C.E.T. *tige.brady@telus.net* 

> Re: Gravel Pit Investigation Summit Pit Phase 2 Highway 567 and Range Road 40 Rockyview County, Alberta

Almor Testing Services Ltd. observed and obtained gravel samples, during the advancement of ten (10) test holes, at the subject site from July 31 to August 5, 2017. Test holes designated as TH1 through TH10 were advanced in the triangular area of the northeast to southwest portion of the quarter of Section 31, Township Road 26, Range Road 3, W5M. The test holes were advanced using a Becker Hammer drill rig, operated by Great West Drilling of Calgary, Alberta. Refer to Figure 1 in Appendix 'A' for the approximate test hole locations.

Test hole depths ranged from a minimum of 14.1m (TH5) to a maximum of 27.6m (TH10). The thickness of the granular deposit in the test holes ranged from a minimum 9.3m (TH5) to a maximum 23.0m (TH9). The mean average thickness of the granular deposit encountered is 17.5m and ground water elevation ranged between 13.5m (TH5) to 25.5m (TH8).

Samples were obtained for gradation analysis, representative of the granular deposit encountered below the silty clay overburden. Eighteen (18) Gradation Analyses and one (1) Hydrometer Test were performed on samples from Test Hole No.'s 1 through 10. The Test Hole logs and the results of the Gradation Analyses are attached in Appendix 'B'. The Gradation Analyses of the samples indicated fines contents (material passing the 80 µm sieve size) in the range of 5.9% to 19.5%.

The fines content of the gravel samples obtained using a Becker Hammer drill rig is typically higher due to the crushing or fracture of the rocks during pounding of the hammer casing into gravels by the drill rig. A fines content to a maximum of 10% is generally considered desirable for gravels used for structural purposes (roads construction, foundation base, etc.). Aggregates for use in the manufacture of concrete and asphalt products typically have more stringent fines content requirements. In order to estimate the insitu fine content of gravel at the site, three (3) test pits were advanced in close proximity of Test Hole No.'s 2, 5 and 8 and gravel samples were obtained. The Test Pit logs and the results of the Gradation Analyses of the test pit samples are attached in Appendix 'B'. Table 1 compares the fine content of gravel samples obtained using Becker Hammer drill rig and from the test pits.

# TABLE 1Fine Content Comparison of Gravel SamplesBecker Hammer Drilling vs Test Pits

TP/TH No.	Depth (m)	Fines Content (%)
TP1	5.0 - 6.0	3.1
TH5	5.0 - 6.0	7.8
TP2	5.0 - 6.0	3.1
TH8	5.0 - 6.0	12.1
TP3	5.0 - 6.0	4.0
TH8	5.0 - 6.0	12.1

Table 1 indicates the fines content of the samples obtained using Becker Hammer drill rig is almost 2 to 3 times higher than those obtained from test pits. It is anticipated that the granular material recovered during a commercial mining operation would yield lower fines contents than what is indicated by the samples recovered during this investigation using a hammer rig.

A cursory examination of the coarse aggregate was completed on representative samples and is presented in Table 2. The examination was done by visual means only. This examination is not meant to replace a proper petrographic analysis, which is recommended after crushing operations have commenced.

Type of Aggregate	Category	Quantity (%)			
Quartzite	Good	40.0			
Carbonite	Carbonite Good & Fair				
Sandstone	Good & Fair	30.0			
Chert Fair		4.0			
Iron Concretion	Poor & Deleterious	1.0			

### TABLE 2

Los Angeles Abrasion testing of a representative sample was conducted by Curtis Engineering of Calgary, Alberta and is attached in Appendix 'C', with a value of 32.3%. The City of Calgary specification for granular base and granular subbase is an L.A. Abrasion loss of maximum of 45%.

Overall, the aggregates and gradation of the gravels at the test hole locations are suitable for producing aggregates required in the construction industry, with some sorting and blending sand seams.

The volume of the gravel has been estimated based on the limited bore holes advanced and is presented in Appendix 'D'.

- 2 -

The overburden in the subject areas consisted of topsoil/browns overlying silty clay till.

The topsoil/browns were encountered in all test hole locations and ranged from100 to 300mm in thickness. A Grain Size Distribution test conducted on a topsoil/browns indicated a Gravel content of 0.2%, Sand content of 11.8%, Silt of 67.3%, Clay 20.7% and an Organic Content of 12.6%.

Below topsoil/browns, silty clay till was encountered in all test hole locations. The thickness of silty clay overburden ranged from 4000mm to 9000mm, resulting in an average thickness of 5100mm. The silty clay till overburden had a Moisture Content of approximately 7.7%. An Atterberg Limit test conducted on silty clay till soil indicated a Liquid Limit of 36, a Plastic Limit of 12, resulting in a Plasticity Index of 24. This classifieds the soil as a medium plastic clay (CI).

The attached Appendix 'E' details tests performed on the overburden soils.

The silty clay and topsoil overburden can be utilized for grading during the pit rehabilitation stages of the gravel pit.

We trust this meets with your present requirements.

Respectfully submitted, ALMOR TESTING SERVICES LTD.



J.B. Montgomery, P.Eng.

AA: rn:A06227

\* APEGA Permit to Practice #P2260

APPENDIX A



**APPENDIX B** 

PROJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PF NC	ROJECT ).		HOLE TH1 NO.	
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP	DRILL TYPE DIESEL HAMMER RIG						
GEODETIC ELEVATION (m) DATUM		ΥPE	Ω.,	WATER CONTENT (%) ●	COMPRES	SSIVE H	
E SOIL E DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE SOIL CLASS	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	$\begin{array}{c} d \\ n \\ 4 \\ 5 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1$	OTHER TESTS
Silty CLAY stiff to very stiff, medium plastic, trace to some sand, mottled olive, damp to moist	-2 -4 -6						_
<ul> <li>Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist</li> </ul>							Gravel 20.8 % Sand 22.3 % Silt 31.2 %
- 5 - 6 - 7	-16 -18 -20 -22 -24						Clay 25.7 %
<ul> <li>8</li> <li>9</li> <li>- becoming sandy, trace cobble</li> <li>Silty GRAVEL compact to dense, trace clay, some sand, fine to coarse grained, poorly graded, brown, damp</li> </ul>	-26 -28 -30 -32 -34 -36						- Gravel 53.1 % Sand 33.9 % - Silt 10.5 %
- 12 - cleaner below 11.0 m							Clay 2.5 %
-13 $-14$	-42 -44 -46						
<ul> <li>trace to some cobble below 14.0 m</li> <li>15</li> <li>16</li> <li>17</li> <li>17</li> <li>18</li> <li>19</li> <li>- occasional fine grained sand lens below 18.5 m</li> </ul>	48 50 52 54 56 58 60 62						Gravel 61.9 % Sand 29.7 % Silt & Clay 8.4 %
$ \begin{array}{c} -20 \\ -21 \\ -22 \\ 0 \\ -23 \\ 0 \\ -24 \\ 0 \\ 0 \\ -24 \\ 0 \\ 0 \\ -24 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0$	64 66 70 72 74 76 78						Gravel 18.6 % Sand 72.6 % Silt & Clay 8.8 %
-25 $-25$ $-25$ $-25$ $-26$ $-27$	80 82 84 86 88						Gravel 65.0 % Sand 29.1 %
28       SILTSTONE (BEDROCK)         END OF TEST HOLE AT 27.5m         - 29       - no standpipe installed         - test hole dry at completion         - 30       - test hole backfilled with soil cuttings	90 92 94 94 96 98						Sin α Giay 3.9 %
ALMOR TESTING SERVICES LTD.			PC	n <sup>,</sup> 16 18 20 22 100 120 140 F 1 1 1 1 1 T UNIT WEIGHT O	20 40 PENETRAT RESISTAN	<sup>60</sup> ⊓ON ∎ CE Case	GROUNDWATER
COMPLETION 28 m DATE July 31. 2017				GGED Abdul A	Iemi	BT Pen PLAT	 E1

PROJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PF N(	ROJECT D.		HOLE NO.	TH2
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP	DF T`	RILL DIESEL HA	MMER RIG				
GEODETIC ELEVATION (m) DATUM		ΥΡΕ	0	WATER CONTENT <sup>(%)</sup> ●	COMPRES	SIVE	
G E H H H H H H H H H H H H H	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3	d $\blacktriangle$ n $\bigtriangleup$ 4 5	OTHER TESTS
End       SOIL DESCRIPTION         -1       Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist         -2	(1) HLd30 -2 -2 -4 -6 -8 -12 -14 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -8 -12 -14 -16 -16 -16 -16 -16 -16 -16 -16	SAMPLE	MOD UNIF       SOIL CLAR				OTHER TESTS
<ul> <li>(Hammer Refusal)         <ul> <li>no standpipe installed</li> <li>test hole dry at completion</li> <li>test hole backfilled with soil cuttings</li> </ul> </li> </ul>	-72 -74 -76 -78 -80						
ALMOR TESTING SERVICES LTD. TEST HOLE LOG			KN/ PC WE	10 120 140 F UNIT WEIGHT O	20 40 PENETRAT RESISTAN □ SPT	60 CION ∎ CE Case BT Pen	GROUNDWATER Tote Measured
COMPLETION 21.2 m DATE July 31, 2017			LC B1	GGED Abdul A	lemi	PLAT NO.	E 2

PROJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PI N	ROJECT D.		HOLE TH3 NO.	
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP				RILL DIESEL HA	MMER RIG		
GEODETIC ELEVATION (m) DATUM	EPTH (ft)	AMPLE TYPE	OD UNIFIED	WATER CONTENT (%) ● PLASTIC LIQUID LIMIT LIMIT	COMPRES STRENGT Unconfined Pocket Per TSF 2 3	SSIVE TH d ▲ n △ 4 5	OTHER TESTS
	B	S/	ĕ ĭ	20 40 60	KPa 200 300	0 400	Gravel 0.2 %
	2   4   4						Sand 11.8 % Silt 67.3 % Clay 20.7 %
<ul> <li>2 Sandy SILT compact, non to low plastic, some gravel to gravelly, brown, damp</li> <li>3</li> </ul>	0 8 10						Gravel 48.8 %
- 4 - 5 - 5	-12 -14 -16 -18						Silavei 40.8 % Sand 33.6 % Silt & Clay 17.6 %
	20 22 24						
- 8 - 9 - 9	-26 -28 -30						
- 10 - trace to some cobble below 10.0 m	-32 -34 -36 -38						
	_40 _42 _44						
	-46 -48						
Silty SAND compact, some gravel, line to coarse grained, poorly graded, brown, damp     Silty GRAVEL compact, some sand to sandy, fine to     coarse grained, poorly graded, brown, damp	50 52 54						Gravel 27.2 % Sand 54.3 % Silt & Clay 18.5 %
	56 58						
	-60 -62 -64						Gravel 71 %
$ \begin{array}{c c} -20 \\ \times \\ -21 \\ \times \\ $	66 68 70						Sand 20.3 % Silt & Clay 8.7 %
- 22       x x x         - 23       END OF TEST HOLE AT 22.5m (Hammer Refusal)	72 74 76						
<ul> <li>- no standpipe installed</li> <li>- test hole dry at completion</li> <li>- test hole backfilled with soil cuttings</li> </ul>	-78 -80						
ALMOR TESTING SERVICES LTD.	_		PC	m <sup>3</sup> 16 18 20 22 100 120 140 ;F└──└──└──┘	20 40 PENETRAT RESISTAN	60 FION CE Case	GROUNDWATER
TEST HOLE LOG			W			BT Pen	
COMPLETION         22.5 m         DATE         August 1, 2017			L(   B`	GGED Abdul A	lemi	PLAT    NO.	± 3

PROJE	CT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PI N	ROJECT D.		HOLE NO.	TH4
CLIENT	: MOUNTAIN ASH LIMITED PARTNERSHIP			D T	RILL DIESEL HAN	MMER RIG		
GEODETI	C DATUM		ΥΡΕ		WATER CONTENT <sup>(%)</sup> ●	COMPRES	SIVE	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	$\begin{array}{c} 1 \\ d \\ 1 \\ 4 \\ 5 \\ \hline 0 \\ 400 \end{array}$	OTHER TESTS
	TOPSOIL	-2						
	Silty CLAY stiff to very stiff, medium plastic, trace to some sand, olive, damp to moist	4						
-2	Silty CLAY (TILL) stiff to very stiff, low to medium	-6 -8						
- 3	to moist	-10						
-4								
		-14 -16						
	Silty GRAVEL compact, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	-18						
r° la		-20 -22						Gravel 52.1 %
		_24						Sand 32.1 % Silt & Clay 15.8 %
-8		-26						Gravel 31.2 %
-9		-28 -30						Sand 55.5 % Silt & Clav 13.3 %
- 10		-32						
	- trace cobble below 10.0 m	-34 -36						
		-38						
		-40						
		_42 _44						
		46						
- 15 b	- occasional fine grained sand lens below 14.5 m	-48 -50						
- 16		-52						
17 9		54						
		58						
- 18		60						
- 19 °		-62 -64						
- 20 9		66						Gravel 64.2 %
- 21	<b>CLAY</b> very stiff to hard, high plastic, trace to some silt, trace sand, olive/yellow, moist	-68 -70						Sand 28.2 % Silt & Clav 7.6 %
	Silty SAND compact, trace gravel, fine to coarse	-72						,
	Sandy GRAVEL dense, trace to some silt, fine to	-74						At completion
	coarse grained, poorly graded, brown, damp	<u>⊢</u> ⁄6 −78						
		80						
- 25 õ		-82 -84						
- 26		86						
- 27	SILTSTONE (BEDROCK)	-88						
- 28	- no standpipe installed	_90 _92						
29	- groundwater level 23.0m at completion - test hole backfilled with soil cuttings	-94						
		96 						
				KN	m <sup>3</sup> 16 18 20 22	20 40 PENETRAT	60 ION <b>—</b>	GROUNDWATER
	ALMOR TESTING SERVICES LTD.			PC	F	RESISTAN	CE	∎ Date
	TEST HOLE LOG			W		□ SPT	Case BT Pen	Measured
COMPL DEPTH	ETION 27 m DATE August 2, 2017			L( B	OGGED Abdul Al	lemi	PLATI NO.	E 4
PROJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO		PROJECT HOLE TH5 NO.						
--	---	--						
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP		DRILL TYPE DIESEL HAMMER RIG						
GEODETIC ELEVATION (m) DATUM		WATER (%) ● COMPRESSIVE STRENGTH						
	DEPTH (ft)	$\begin{array}{c c c c c c c c c c c c c c c c c c c $						
a       TOPSOIL         Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist         -2         -3         -4         -5         -6         -7         -8         -9         -10         -7         -8         -9         -10         -11         -7	a $b$ $c$	∅       20       40       ê0       KPa       200       300       400         I       I       I       I       I       I       I       I       I         I       I       I       I       I       I       I       I       I       I         I       I       I       I       I       I       I       I       I       I         I						
	64 	KN 16 18 20 22 20 40 60						
ALMOR TESTING SERVICES LTD.		100     120     140     PENETRATION     GROUNDWATER       PCF       Date       □ SPT     □ Case     Measured						
DEPTH 15.6 m DATE August 2, 2017		BY Abdul Alemi PLATE 5						

PR	DJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PR NO	OJECT		HOLE NO.	TH6
CLI	ENT: MOUNTAIN ASH LIMITED PARTNERSHIP			DR TY	ILL DIESEL HAI	MMER RIG		
GEO ELE\	DETIC ATION (m) DATUM		TYPE	s E	WATER CONTENT (%) ●	COMPRES STRENGT	SIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE -	SOIL CLAS	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d ▲ n △ 4 5	OTHER TESTS
	PREDRILLED	F						
- 1		4		-				
- 2		_6						
		-8						
- 3		-10		F				
- 4		-12						
		-14						
- 5				ŀ				
- 6	Sandy GRAVEL compact, some silt, fine to coarse							
		-20						
- 7		-24						
- 8		-26						
	c trace cobble below 8.5 m							
- 9		-30		ŀ				
L 10		-32						
		-34						
- 11	Silty SAND compact to dense, trace gravel, fine to	-36		ŀ				Gravel 23.3 %
12	coarse grained, poorly graded, brown, damp	-38						Sand 58.7 % Silt & Clay 18.0 %
	coarse grained, poorly graded, brown, damp	-40						
- 13		-42 -		-				
	- trace cobble below 13.4 m							
- 14				ſ				
- 15		-50		-				
		-52						▼ At completion
	SANDSTONE (BEDROCK)	 54						
- 17	END OF TEST HOLE AT 16.2m	-56		+				
	<ul> <li>no standpipe installed</li> <li>groundwater level 15.8m at completion</li> </ul>	-58						
<b>18</b>	- test hole backfilled with soil cuttings	60		Ī				
- 19		-62		ŀ				
		-64						
			ŀ	KN/m	<sup>3</sup> 16 18 20 22	20 40 PENETRAT	60 ION <b></b>	GROUNDWATER
A	ALMOR TESTING SERVICES LTD.			PCF				y Date Measured
	TEST HOLE LOG			WE			BT Pen	
DE	VIPLE FION 16.8 m DATE August 3, 2017			LO BY	GGED Abdul A	lemi	PLATI NO.	⊨ 6

PR	OJE	CT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PI N	ROJECT O.			HOLE NO.	TH7
CLI	ENT	: MOUNTAIN ASH LIMITED PARTNERSHIP			D T	RILL DI YPE DI	ESEL HA	MMER RIG		
GEO ELE	DETIC VATIO	C DATUM		ΥΡΕ		WATER	JT <sup>(%)</sup> ●	COMPRES	SSIVE	
DEPTH (m)		SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIEI SOIL CLASS			Unconfine Pocket Pe TSF 2 3 KPa 200 300	d $\blacktriangle$ n $\bigtriangleup$ 4 5	OTHER TESTS
		PREDRILLED	2							
- 1			4							
- 2		Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	-6 -8							
- 3	000	Silty GRAVEL compact, trace to some sand, fine to	-10							
- 4	00		-12							
	Pa		-14 -16							
- 5		- trace cobble below 5.3 m	-18							
- 6	20		_20							
- 7	$\mathbb{S}^{\mathbb{N}}$		-22							
8	00		-24 -26							
	Pol		-28							
- 9	000		_30							
- 10	00		-32 -34							
- 11			36							
10	00		_38							
	Pad		-40							
- 13			_42 _44							
- 14	00		-46							
- 15	Po		-48 							
	00		-50 -52							
- 16	200		-54							
- 17			_56							
- 18	00		-58 -60							
- 19	Pa		-62							
	$\mathbb{S}^{\mathbb{N}}$	- becomiing moist to wet	_64							At completion
- 20	00	- saturated below 19.8 m	-66							
- 21	po	1 	70							
- 22		SANDSTONE (BEDROCK)	-72							
- 23		- no standpipe installed	-74							
		- groundwater level 19.8m at completion - test hole backfilled with soil cuttings	-76 -78							
24			-80							
					KN	<u>  : : : :</u> /m <sup>3</sup> 16 18	20 22	20 40	60	
A	M	ALMOR TESTING SERVICES LTD.			PC	100 12 SF	20 140	PENETRA RESISTAN	CE	GROUNDWATER
		TEST HOLE LOG			w	ET UNIT WE			Case	* Measured
CO	MPL	ETION 22.1 m DATE August 3, 2017				OGGED	Abdul A	lemi		7

PROJEC	CT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PI N	ROJECT D.		HOLE NO.	TH8
CLIENT	MOUNTAIN ASH LIMITED PARTNERSHIP			DI די	RILL DIESEL HA	MMER RIG		
GEODETIC	DATUM		ſΡΕ	0	WATER CONTENT (%) ●	COMPRES	SIVE	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TY	MOD UNIFIED	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3	d $\blacktriangle$ h $\bigtriangleup$ 4 5 4 00	OTHER TESTS
- 1 - 2 - 3	Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, dam to moist	p -2 -4 -6 -8 -10 -12						
	Silty GRAVEL compact, trace to some sand, fine to coarse grained, poorly graded, olive, damp	-12 -14 -16 -18 -20 -22						Gravel 58.5 % Sand 29.4 % Silt & Clay 12.1 %
	- occasional coarse grained sand lens below 9.0 m	22 24 26 30 32 32 34						
- 11 0 - 12 0 - 13	Silty SAND compact to dense, trace gravel, fine to coarse grained, poorly graded, brown, damp	-36 -38 -40 -42 -44						
$-14^{\circ} 000^{\circ} 000^$	Sandy GRAVEL compact to dense, some silt, fine to coarse grained, poorly graded, brown, damp	46 48 50 52 54 56 58 60 62 64 66 68 70 72						
- 23 °	- moist below 23.5 m - becoming wet	-76 -78 -80 -82						Gravel 56.2 % Sand 36.9 % Silt & Clay 6.9 %
	- saturated below 25.5 m	-84						✓ At completion
	SANDSTONE (BEDROCK)							
- 28 - 29	END OF TEST HOLE AT 26.6m - no standpipe installed - groundwater level 25.5m at completion - test hole backfilled with soil cuttings	90 92 94 96						
	ALMOR TESTING SERVICES LTD.			PC WE	100 120 140 F UNIT WEIGHT O	20 40 PENETRAT RESISTANO	60 TON ∎ CE Case BT Pen	GROUNDWATER Date Measured
COMPLI DEPTH	ETION 27.1 m DATE August 4, 20	)17		L( B`	GGED Jeremy	Crawford	PLATI NO.	8

PROJEC	CT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PI N	ROJECT D.		HOLE NO.	TH9
CLIENT:	MOUNTAIN ASH LIMITED PARTNERSHIP			DI די	RILL DIESEL HA	MMER RIG		
GEODETIC	N (m) DATUM		YPE	<u>а</u>	WATER CONTENT <sup>(%)</sup> ●	COMPRES	SSIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d ▲ n △ 4 5	OTHER TESTS
	plastic, trace to some sand, trace gravel, olive, damp	<b>E</b> 4						
-2	to moist	6						
-3								
		-12						
	Sandy GPAVEL compact some silt to silty fine to							
	coarse grained, poorly graded, olive, damp							
-6 0		_20						
		-22						
		-24						Gravel 56.9 % Sand 33.7 %
<b>Г°</b> ₿¶	- fine to medium grained below 8.0 m	-28						Silt & Clay 9.4 %
-9 0		_30						
- 10 b°		-32						
- 11 0		-36						
		_38						
		40						
- 13 °								
- 14 0		-46						
		48						
0		-50						
	- some silt below 16.0 m	-54						
- 17 0		56						
- 18 a		-58						
		62						
Pall		64						
		66						
- 21								
		-72						
L 23 Pall		-74						
		80						
		-82						
- 26 g		-86						
L 27 €		88						
	MUDSTONE (BEDROCK)							
	END OF TEST HOLE AT 28.3m							
- 29	- no standpipe installed	-96						
- 30	<ul> <li>test hole dry at completion</li> <li>test hole backfilled with soil cuttings</li> </ul>	-98						
		<u> </u>	•	KN,	m <sup>3</sup> 16 18 20 22		60	
AM	ALMOR TESTING SERVICES LTD.			PC	100 120 140 F	RESISTAN	CE	GROUNDWATER
	TEST HOLE LOG			WE			Case	* Measured
COMPLE		7		LC	DGGED ALLA	Cone	BT Pen PLAT	E o
DEPTH	28.3 m   DRILLED August 5, 201	1		B	Abdul A	lemi	NO.	9

PR	DJECT: GRAVEL PIT ASSESSMENT SUMMIT PIT PHASE TWO			PF N(	ROJECT D.		HOLE NO.	TH10
CLI	ENT: MOUNTAIN ASH LIMITED PARTNERSHIP			DF דץ	RILL DIESEL HA	MMER RIG		
GEO ELE	DETIC ATION (m) DATUM		YPE	۵	WATER CONTENT <sup>(%)</sup> ●	COMPRES	SSIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE SOIL CLASS	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d $\blacktriangle$ n $\bigtriangleup$ 4 5	OTHER TESTS
	TOPSOIL							
- 1	Silty CLAY (TILL) stiff to very stiff, low to medium	4						
	grey, damp to moist	6						
		-8						
- 3		<u> </u>						
4		_12						
-								
- 5	Silty GRAVEL compact, some sand to sandy, fine to							
- 6	coarse grained, poorly graded, olive, damp	$E_{20}^{18}$						
		-22						
- 7		-24						
- 8		-26						
	• • • • • • • • • • • • • • • • • • •	28						
- 9		_30						
- 10	• becoming fine grained	-32						Gravel 69.0 %
L 11		-34						Sand 23.4 %
Γ''		38						Silt & Clay 7.6 %
- 12		40					: : :	
_ 13		-42						
		-44						
- 14		46						
- 15		-48						
	- occasional fine grained sand lens below 15.0 m	-50						
- 16		-52 -54						
- 17		-56						Gravel 12.6 %
1	۰ <b>۹</b>	-58						Sand 66.2 %
18		60						Silt & Clay 21.2 %
- 19		_62						
20								
- 21								
- 22		72						
		-74						
F 23		-76						
- 24								
- 25		-82					· · ·	
		-84						
26		-86						
- 27		88						
28	MUDSTONE (BEDROCK)	-90 Laz						
	END OF TEST HOLE AT 27.6m	-94						
- 29	- no standpipe installed	-96						
- 30	- test hole backfilled with soil cuttings	_98						
	, , , , , , , , , , , , , , , , , , ,	L		KN/	16 18 20 22	20 40	60	
	MOR ALMOR TESTING SERVICES I TO				 100 120 140	PENETRA		GROUNDWATER
				PC	F			The Date
	TEST HOLE LOG			WE			Case BT Pen	เพอลอนเฮน
CO	IPLETION 28 m DATE August 5 2017			LC			PLAT	E 10
DEI	TH DRILLED August 5, 2017			B١	, Abuul A	a crini	NO.	10

#### EXPLANATION OF SOIL DESCRIPTIONS AND SYMBOLS SHOWN ON TEST HOLE LOGS

The test hole logs summarize the results of field investigations and, if applicable, also laboratory test data. It should be appreciated that conditions established at a test hole location may not be representative of subsurface conditions across the investigated site. Transitions of the soil stratigraphy, either classified or graphically shown, are gradual, rather than the distinct unit boundaries presented.

#### SOIL DESCRIPTION AND CLASSIFICATION

Soils are described according to their appearance, lithological composition and probable mode of deposition (genetic type). Expected engineering properties and behaviour of the materials are interpreted relative to the soil type and laboratory test results.

#### I) DEFINITION OF SOIL TYPES

Material

Boulders Cobbles Gravel - Coarse - Fine Sand - Coarse - Medium - Fine Silt and Clay <u>Grain Size</u>

Larger than 300mm 75mm - 300mm 19mm - 75mm 5mm - 19mm 2mm - 5mm 425um - 2mm 75um - 425um Smaller than 75um

#### II) COMPOSITION OF SOIL

- 2.1 <u>Principal Component</u> Major soil type representing at least 50% by weight of material.
- 2.2 <u>Minor Component</u> Minor soil types identified by the following terms with respect to their percentages by weight of material:

"Trace"	:	1% - 10%	"Some"	:	10% - 20%
Modifier "Y"	:	20% - 30%	Connector "and"	:	30% - 50%

#### III) CONSISTENCY OR STRENGTH OF SOIL

3.1 <u>Coarse Grained Soils</u> - (Principal Component larger than 75um). The following terms are used relative to the Standard Penetration Test (SPT), ASTM D1586:

Description	<u>No. of Blows per Foot</u>
Very Loose	Less than 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	Over 50

3.2 <u>Fine Grained Soils</u> - (Principal Component smaller than 75um). The following terms are used relative to the unconfined strength and Standard Penetration Test (SPT), ASTM D1586:

#### **Unconfined Compressive**

<b>Description</b>	<u>Strength kPa</u>	<u>(tsf)</u>	No. Blows per Foot
Very Soft	Less than - 24 (0	).25)	Less than 2
Soft	24 - 48 (0	).25 - 0.5)	2 - 4
Firm	48 - 96 (0	).5 - 1.0)	4 - 8
Stiff	96 - 190 (1	1.0 - 2.0)	8 - 15
Very Stiff	190 - 380 (2	2.0 - 4.0)	15 - 30
Hard	> 380 (4	4.0)	Over 30

#### SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

Ν	IAJOR DIV	SION	GROUP SYMBOL	TYPICAL DESCRIPTION	LABOR CLASSIFICAT	ATORY ION CRITERIA
HIG	HLY ORGANI	C SOILS	РТ	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOF OFTEN FIBRO	R OR ODOR AND DUS TEXTURE
	ARSE 'HAN	CLEAN	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES. <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4; C_c =$	$\frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
K THAN	VELS HALF CO ARGER T SIEVE)	GRAVELS	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES. <5% FINES	NOT MEE ABOVE REQ	TING ALL UIREMENTS
OILS LARGEF E)	GRA E THAN I CTION L/ NO. 4	DIRTY	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES. >12% FINES	ATTERBERG L "A" LINE	IMITS BELOW OR I <sub>p</sub> < 4
ained S Weight Ieve Siz	(MOR FRA	GRAVELS	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES. >12% FINES	ATTERBERG I "A" LINE	LIMITS ABOVE OR I <sub>p</sub> > 7
RSE-GR ALF BY 0. 200 S	ARSE HAN )	CLEAN	sw	WELL-GRADED SANDS, GRAVELLY SANDS. <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6; C_c =$	$= \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
COA THAN F N	NDS HALF CC ARGER T EVE SIZE	SANDS	SP	POORLY-GRADED SANDS, OR GRAVELLY SANDS. <5% FINES	NOT MEE ABOVE REQ	TING ALL UIREMENTS
(MORE	SAN E THAN I CTION L/ VO. 4 SIE	DIRTY	SM	SILTY SANDS, SAND-SILT MIXTURES. >12% FINES	ATTERBERG L "A" LINE	LIMITS BELOW OR lp < 4
	(MORI FRAG	SANDS	SC	CLAYEY SANDS, SAND-CLAY MIXTURES. >12% FINES	ATTERBERG I '"A" LINE	LIMITS ABOVE OR lp > 7
	S BELOW PLASTIC	BILTS "A" LINE ON	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	W <sub>L</sub> < 50	
SSES	NEGLIGIE CO	BLE ORGANIC INTENT	МН	INORGANIC SILTS, MICACEOUS OR DIATO- MACEOUS, FINE SANDY OR SILTY SOILS	W <sub>L</sub> > 50	
SOILS /EIGHT F SIZE)	С	LAYS	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	W <sub>L</sub> < 30	
RAINED ALF BY W 00 SIEVE	ABOVE PLASTIC NEGLIGIE	"A" LINE ON CITY CHART; BLE ORGANIC	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	W <sub>L</sub> > 30, < 50	SEE PLASTICITY CHART BELOW
FINE-G THAN H/ NO. 20	CO	NTENT	СН	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	W <sub>L</sub> > 50	
(MORE '		LTS AND CLAYS	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	W <sub>L</sub> < 50	
	PLASTIC	CITY CHART	ОН	ORGANIC CLAYS OF HIGH PLASTICITY	W <sub>L</sub> > 50	

1. All sieve sizes mentioned on this chart are U.S. Standard, ASTM E11.

- 2. Boundary classifications possessing characteristics of two groups are given combined group symbols, eg. GW-GC is a well graded gravel sand mixture with clay binder between 5% and 12%.
- 3. Soil fractions and limiting textural boundaries are in accordance with the United Soil Classification System, except that an inorganic clay of medium plasticity (C) is recognized.





ALMOR TESTING SERVICES LTD.

#### **ROCK CLASSIFICATION AND DESCRIPTION**

The following factors are usually incorporated in a test hole log for adequate engineering geotechnical description:

<u>Rock Name</u>. Established names for igneous, metamorphic and sedimentary rocks are used. This could include established local names rather than the actual rock name. It is believed that for engineering purposes classification by mechanical properties is more significant than classified by mineralogy and texture.

<u>Alteration and Weathering State</u>. The following grades are used: fresh, slightly weathered, moderately weathered, highly weathered and decomposed. In some cases of decomposed rocks the material may exhibit plasticity and soil mechanics classification could be used.

<u>Structure and Discontinuities</u>. This includes comments on discontinuities (bedding planes or separation along foliation planes and fissures in igneous or sedimentary rocks) and veins in relation to their type, orientation, frequency, infilling and surface structures. RQD percentage of core fractions that are 100mm (4 in.) or greater in length, relative to length of solid core recovered (defined by Deere et al. as the Rock Quality Designation) is indicative of the fractured state.

<u>Assessment of Strength</u>. The field assessment of rock strength can be aided by simple tests such as the use of a hammer or penknife and supplemented by laboratory testing. Any rock with a strength significantly less than 1 MPa (145 psi) could be described with reference to soil mechanics practice.

Ancillary Geological Information. This might include dip, identification of infill, etc.

#### TEST DATA AND SAMPLE TYPES

Data obtained from laboratory and field testing are shown in appropriate columns on the test hole logs and at the corresponding depth interval. Abbreviations and graphic symbols are as follows:

W	moisture content	рр	pocket penetrometer test
W <sub>P</sub> or PL	plastic limit (ASTM D 424)	Y	unit weight of soil or rock
$W_L$ or LL	liquid limit (ASTM D 423)	Yd	dry unit weight
lp or Pl	Plastic index (LL-PL)	$\mathbf{q}_{u}$	unconfined compressive strength
	undisturbed shelby tube sample or rock core	RQD	rock quality designation
	disturbed SPT sample		
В	disturbed bag sample		



# Aggregate Analysis Report

Client	Mountair	n Ash Lim	nited Partne	ership	Job No Date S Date F	o. ample eceiv	ed ed	י0 ונ ונ	99-80 uly 3 uly 3	6-17 1/17 1/17		By By	AA AA
Attention	Tige Brad	dy			Date T	ested		A	Aug 2	2/17		By	BN
Project	Summit I Investiga	Pit Ph 2, o Ition	Gravel		Aggre	gate T	уре		Sai	ndy G	irave	el, trace s	silt/clay
Sieve Size	Percent	Passing	by Weight		Aggre	gate S	ouro	ce					
(mm)		Min.	Max.		Classi	ficatio	on	GP-GM					
200								C <sub>C</sub> =	3.1				
150								C <sub>U</sub> =	119	9.8			
100													
80	100.0				Specif	icatio	n						
50	96.4												
40	93.4	ļ			•			• ·			-		
25	82.4		<u> </u>		Comm	ents		Gavel			61	.9 %	
20	/5.8							Sand			29 م	.1 % 1 0/	
10	09.U 50.7							SilvClay			ð	.4 70	
12.0	53.0		+					тн	1				
5	38.1		┨					Depth	16	- 17m	า		
2.5	30.0										•		
1.25	25.7												
0.63	22.9												
0.315	19.0												
0.16	13.4												
0.08	8.4												
00 90 80 70													
00     •••       90     •••       80     •••       70     •••       60     •••       50     •••       40     •••													
00     •       90     •       80     •       70     •       60     •       50     •       40     •													
00     •••       90     •••       80     •••       70     •••       60     •••       50     •••       40     •••													
00     •••       90     •••       80     •••       70     •••       60     •••       50     •••       40     •••       30     •••       20     •••													
00     •••       90     •••       80     •••       70     •••       60     •••       50     •••       40     •••       30     •••       20     •••													
00     •       90     •       80     •       70     •       60     •       50     •       40     •       30     •       20     •       10     •													
00     •••       90     •••       80     •••       70     •••       60     •••       50     •••       40     •••       30     •••       20     •••       10     •••					•								
$00$ $90$ $80$ $70$ $60$ $50$ $40$ $30$ $20$ $10$ $8 \approx$		. s											0



# Aggregate Analysis Report

C	lient ttention	Mountair Tige Bra	n Ash Lim dy	ited Partners	ship	Job No. Date Sampled Date Received Date Tested	09 A A A	99-86-17 Aug 1/17 Aug 1/17 Aug 2/17	By By By	AA AA BM
Ρ	roject	Summit Investiga	Pit Ph 2, ( ation	Gravel		Aggregate Type	60	Sand, some (	gravel, tra	ce silt/clay
S	Sieve Size	Percent	Passing b	ov Weiaht		Aggiegate ooui				
	(mm)		Min.	Max.		Classification	SP-SM			
	200						C <sub>C</sub> =	1.5		
	150						C <sub>U</sub> =	5.1		
	100									
	80					Specification				
	50					•				
	40	100.0								
	25	93.4				Comments	Gavel	18.6 %		
	20	90.8					Sand	72.	.6 %	
	16	87.3					Silt/Clay	8.	.8 %	
	12.5	85.1								
	10	83.6					TH	1		
	5	81.4					Depth	22.2 - 22.6m		
	2.5	80.7								
-	1.25	80.2								
	0.03	79.0								
	0.315	30.9 15.4								
	0.08	8.8								
10	0		•							_
9	0									
			-	·						
8	0					) <b></b> .				
7	0									
, 6	0									_
5	0									
4	0									
2										
3										
~							$\mathbf{N}$			
2										
1										
1										1
	100 · 80	50 25	20 20 16 12.5	· 50	2.5 2 2	0.63	0.16	0.08		0.01 ·
					Sieve	Size (mm)	-			



# Aggregate Analysis Report

Client	Mountain	n Ash Lim	ited Partne	rship	Job No. Date Sampled Date Received	C	)99-86-17 Aug 1/17 Aug 1/17	By Bv	AA AA
Attention	Tige Brad	dy			Date Tested		Aug 5/17	By	DK
Project	Summit F Investiga	Pit Ph 2, ( ition	Gravel		Aggregate Type	9	Sandy Gra	avel, trace silt	/clay
Siovo Sizo	Porcont	Possing k	ov Woight		Aggregate Sou	rce			
(mm)	Feiceni	Min	Max		Classification	GP			
200			Max.		Classification	$C_{c}=$	3.8		
150						C <sub>U</sub> =	91.7		
100						0			
80	100.0				Specification				
50	97.0				•				
40	92.1								
25	77.8				Comments	Gavel		65.0 %	
20	69.6					Sand		29.1 %	
16	61.7					Silt/Clay	/	5.9 %	
12.5	52.9								
10	47.9					TH	1		
5	35.0		ļ			Depth	26 - 27m		
2.5	27.1								
1.25	22.4								
0.63	19.7								
0.315	16.0								
0.10	9.7								
0.00	0.5								
	•								
90									
90									
90									_
90									_
90 90 80 70									_
90 90 80 70									_
90       80       70       60									-
90 90 80 70 60									_
90       80       70       60       50									_
90       90       80       70       60       50									
90       90       80       70       60       50       40									
90       90       80       70       60       50       40       30									
90       90       80       70       60       50       40       30									
90       90       80       70       60       50       40       30       20									
90       90       80       70       60       50       40       30       20									
90       90       80       70       60       50       40       30       20									
90       90       80       70       60       50       40       30       20       10									
90       90       80       70       60       50       40       30       20       10									
$\begin{array}{c} 80\\ 90\\ 80\\ 70\\ 60\\ 50\\ 40\\ 30\\ 20\\ 10\\ 0\\ \\ \hline \\ \\ \hline \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	50 40 25	20 16 12.5		2 <sup>2</sup>					0.01































































20

10

5

2

0.425

0.080

0.005

84.6

63.8

46.9

36.4

29.6

13.0

2.5

7505 - 40 Street SE Calgary, Alberta T2C 2H5 Telephone: (403) 236-8880

#### **Grain Size Distribution**

ASTM D-422

Project	Summit	Pit Ph 2	Test Hole #	TH1 9 - 11m JC		
Client	Mounta	in Ash Limited	Depth			
Almor Job #	099-86-	17	Technician			
Date Recieved	July 31/	'17				
Date Tested	Aug 7/1	7	Soil Classification	Gravel	53.1%	
				Sand	33.9%	
Sie	eve Size			Silt	10.5%	
	(mm)	% Passing		Clay	2.5%	
	150					
	100		Soil Description	Sandy G	RAVEL, some silt,	trace clay
	80	100.0				
50		97.9	Soil Properties	Natural M	loisture Content	%
	40	95.7			Liquid Limit	%
	25	90.0			Plastic Limit	%

Plasticity Index %

Specific Gravity 2.65

Comments















APPENDIX C



Aug 23, 2017 File: 317-Misc.

Almor Testing Services Ltd. 7505 - 40 Street SE Calgary, AB T2C 2H5

Email: aalemi@almor.com

Attn: Abdul Alemi

#### Re: LA Abrasion Testing (ASTM C - 131)

Curtis Geo Solutions Inc. tested one (1) sample in accordance with ASTM C-131 Standard Test Method for resistance to degradation of small-size coarse aggregate by abrasion and impact in the Los Angeles machine. The sample was delivered to our office washed, graded (Gradation A) and dried. The sample was run through the test process and the results are tabulated below.

Sample ID	Mass Prior To Test	Mass After Test	Mass Loss	Percent	
	(g)	(g)	Due to Test (g)	Loss (%)	
Summit Pit Ph. 2	5002.7	3385.2	1617.5	32.3	

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

**Curtis GEO Solutions Inc.** 

Michael Staple, B.Sc., P.Eng. Geotechnical Engineer

MS/bd



Aug 23, 2017 File: 317-Misc.

Almor Testing Services Ltd. 7505 - 40 Street SE Calgary, AB T2C 2H5

Email: aalemi@almor.com

Attn: Abdul Alemi

#### Re: LA Abrasion Testing (ASTM C - 535)

Curtis Geo Solutions Inc. tested one (1) sample in accordance with ASTM C-535 Standard Test Method for resistance to degradation of Large-size coarse aggregate by abrasion and impact in the Los Angeles machine. The sample was delivered to our office washed, graded (Gradation 1) and dried. The sample was run through the test process and the results are tabulated below.

Sample ID	Mass Prior To Test	Mass After Test	Mass Loss	Percent
	(g)	(g)	Due to Test (g)	Loss (%)
Summit Pit Ph. 2	10030.1	7735.6	2294.5	22.9

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

Curtis GEO Solutions Inc.

Michael Staple, B.Sc., P.Eng. Geotechnical Engineer

MS/bd

APPENDIX D

#### Gravel/Sand Volume Calculations

As requested, we submit our gravel/sand calculations based on the limited test holes advanced to the depth of bedrock, with a Diesel Hammer Rig.

Per your request, we have combined the data obtained during the 2014 Waterman Gravel Pit Investigation and the data from the Summit Phase 2 Investigation.

Depth (m)
20.4
22.8
20.6
21.9
<u>16.8</u>
20.5

#### Summit Phase 2

Depth (m)
18.5
14.2
14.0
21.5
9.3
10.5
19.1
22.6
23.0
<u>22.6</u>
17.5

Combined Average = 18.5m

 $1 \text{ acre} = \pm 4046.89 \text{ m}^2$ 

160 acres = 160 x 4046.89  $m^2 = \pm 647502.4 m^2$ 

Based on the test hole logs (Waterman Pit and Summit Phase 2), total volume of aggregate:

Total volume = Average Depth x Area =  $18.5 \text{ m x } 647502.4 \text{ m}^3$ =  $11,978,794.4 \text{ m}^3$
APPENDIX E



### **Grain Size Distribution**

ASTM D-422

Project		Summit	t Pit I	Ph 2				Test Hole #	TH3
Client		Mounta	in As	sh Limited	Partnership			Depth	0.2m
Almor Job	o #	099-86	-17					Technician	KC
Date Reci	eved	Aug 1/1	7						
Date Tested		Aug 4/1	7			Soil Classification	Gravel	0.2%	
							Sand	11.8%	
	Siev	ve Size					Silt	67.3%	
	(	mm)	%	Passing			Clay	20.7%	
		150							
		100				Soil Description	Clayey S	SILT, some Sand,	trace Gravel
		80							
		50				Soil Properties	Natural M	loisture Content	18.7 %
		40						Liquid Limit	%
		25						Plastic Limit	%
		20						Plasticity Index	%
		10		100.0				Specific Gravity	2.65
		5		99.8			(	Organic Content	12.6 %
		2		99.6		Comments Tops	soil - Grain Size	e Distribution	
	0	.425	1	98.7					
	0	.080	1	88.0					
	0	.005	1	31.2					
	0	002		20.7					





### **Atterberg Limits Determination**

ASTM D4318

Mountain Ash Limited Partr		DATE Sept 28/17				
Summit Pit Ph 2		JOB # <u>099-86-17</u>				
TH1	DEPTH	4.5m	TECH. JKC			
			DATE REC'D. Aug 1/17			
	Mountain Ash Limited Partr Summit Pit Ph 2 TH1	Mountain Ash Limited Partnership Summit Pit Ph 2 TH1 DEPTH	Mountain Ash Limited Partnership Summit Pit Ph 2 TH1			

L	Wn	PLASTI	PLASTIC LIMIT           1         2           AT-44         AT-45           37.664         36.373				
Trial No.	1	2	3			1	2
Number of Blows	34	22	12				
Tare Number	AT-41	AT-42	AT-43		MF-96	AT-44	AT-45
Wet + Tare (g)	34.340	41.740	47.312		210.0	37.664	36.373
Dry + Tare (g)	29.370	34.661	38.440		199.8	35.178	34.125
Tare Weight (g)	15.039	15.213	15.661		3.8	15.278	15.669
Weight Dry Soil (g)	14.331	19.448	22.779		196.0	19.900	18.456
Weight Water (g)	4.970	7.079	8.872		10.2	2.486	2.248
Moisture Content (%)	34.7%	36.4%	38.9%		5.2%	12.5%	12.2%

Natural Moisture Content (%) = 5.2

Liquid Limit ( $L_L$ ) = 36

Plastic Limit ( $P_L$ ) = 12

Plasticity Index (I<sub>P</sub>) = 24

USC Soil Classification = CI





10

5

2

0.425

0.080

0.005

83.8

79.2

74.7

66.8

56.9

34.1

7505 - 40 Street SE Calgary, Alberta T2C 2H5 Telephone: (403) 236-8880

### **Grain Size Distribution**

ASTM D-422

Project	Summit	Pit F	Ph 2				Test Hole #	TH1					
Client	Mountai	in As	sh Limited	Partnership			Depth	3.0m					
Almor Job #	099-86-	17					Technician	Technician KC					
Date Recieve	<b>d</b> Aug 1/1	7											
Date Tested	Aug 4/1	7			Soil Classification	Gravel	20.8%						
						Sand	22.3%						
s	ieve Size					Silt	31.2%						
	(mm)	%	Passing			Clay	25.7%						
	150												
	100				Soil Description	Sandy Cl	ayey SILT, some	gravel					
	80												
	50	50			Soil Properties	Natural M	oisture Content	7.7 %					
	40		100.0				Liquid Limit	%					
	25		90.8				Plastic Limit	%					
	20		88.3				Plasticity Index	%					

Specific Gravity 2.65

Comments Silty Clay Till (Overburden) - Grain Size Distribution





7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2017 12 28

099-144-17

Mountain Ash Limited Partnership

Attention: Mr. Tige Brady, C.E.T. (*tige.brady@telus.net*)

Re: Gravel Pit Investigation John Nugter Property Highway 567 and Range Road 40 Rocky View County, Alberta

Almor Testing Services Ltd. observed and obtained gravel samples, during the advancement of six (6) test holes, at the subject site from August 8 to August 12, 2017. Test holes designated as JN01 through JN06 were advanced mostly to the north and northeast of the SW 1/4, Section 31, Township Road 26, Range Road 3, W5M. The test holes were advanced using a Becker Hammer drill rig, operated by Great West Drilling of Calgary, Alberta. Refer to Figure 1 in Appendix 'A' for the approximate test hole locations.

Test hole depths ranged from a minimum of 7.6m (JN06) to a maximum of 28.6m (JN04). The thickness of the granular deposit in the test holes ranged from a minimum 7.1m (JN03) to a maximum 24.2m (JN04). The mean average thickness of the granular deposit encountered is 20.2m and groundwater seepage was not encountered in the test holes. This value does not include the data from Test Hole JN06, as no gravel was encountered in this test hole.

Samples were obtained for gradation analysis, representative of the granular deposit encountered below the silty clay overburden. Four (4) Gradation Analyses were performed on samples from Test Hole No.'s JN01 through JN04. The Test Hole logs and the results of the Gradation Analyses are attached in Appendix 'B'. The Gradation Analyses of the samples indicated fines contents (material passing the 80 µm sieve size) in the range of 9.8% to 16.4%.

The fines content of the gravel samples obtained using a Becker Hammer drill rig is typically higher, due to the crushing or fracture of the rocks during pounding of the hammer casing into the gravels. A fines content to a maximum of 10% is generally considered desirable for gravels used for structural purposes (roads construction, foundation base, etc.). Aggregates for use in the manufacture of concrete and asphalt products typically have more stringent fines content requirements. In order to estimate the insitu fine content of gravel at the site, two (2) test pits were advanced in close proximity of Test Hole No.'s 2 and 3 and gravel samples were obtained. The Test Pit logs and the results of the Gradation Analyses of the test pit samples are attached in Appendix 'C'. Table 1 compares the fine content of gravel samples obtained using the Becker Hammer drill rig and from the test pits.

.../2

# TABLE 1Fine Content Comparison of Gravel SamplesBecker Hammer Drilling vs Test Pits

TP/TH No.	Depth (m)	Fines Content (%)
TP01	4.5 - 5.25	5.8
JN02	5.5	16.2
TP02	4.5 - 5.25	7.9
JN03	4.9 - 5.5	9.8

Table 1 indicates the fines content of the samples obtained using Becker Hammer drill rig is almost 1.3 to 3 times higher than those obtained from test pits. It is anticipated that the granular material recovered, during a commercial mining operation would yield lower fines contents than what is indicated by the samples recovered, during this investigation using a hammer rig.

Overall, the aggregates and gradation of the gravels at the test hole locations are suitable for producing aggregates required in the construction industry, with some sorting and blending sand seams.

The volume of the gravel has been estimated based on the limited bore holes advanced and is presented in Appendix 'D'.

The overburden in the subject areas consisted of topsoil/browns overlying silty clay till.

The topsoil/browns were encountered in all test hole locations and ranged from 100 to 300mm in thickness.

Below topsoil/browns, silty clay till was encountered in all test hole locations. The thickness of silty clay overburden ranged from 3500mm (JN05) to 7500mm (JN06). The thickness of the overburden at the test hole JN06 location may be more, as drilling was terminated at a depth of 7.5m. The overburden soil was described as silty clay till of low to medium plasticity.

The silty clay and topsoil overburden can be utilized for grading, during the pit rehabilitation stages of the gravel pit.

We trust this meets with your present requirements.

Respectfully submitted, ALMOR TESTING SERVICES LTD.



\* APEGA Permit to Practice #P2260

J.B. Montgomery, P.Eng. AA:ms:A06268

Attachments

APPENDIX A





**APPENDIX B** 

PROJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			P N	PROJECT HOLE JN01 NO. NO.				
CLIE	NT: MOUNTAIN ASH LIMITED PARTNERSHIP			D T	RILL DIESEL HAI	MMER RIG		
GEOD ELEV/	TIC (m) DATUM		ΥΡΕ		WATER CONTENT (%)		SIVE	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID I LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d $\blacktriangle$ n $\bigtriangleup$ 4 5	OTHER TESTS
	TOPSOIL	E,						
-1	Silty CLAY (TILL) stiff to very stiff, low to medium	4						
-2	to moist	6						
		-8						
		=10						
-4		=14						
-5	grained, poorly graded, olive, damp	-16						
-6		$   \begin{bmatrix}     -18 \\     -20   \end{bmatrix} $						
	Silty GRAVEL compact to dense, some sand to	-22						
	sandy, fine to coarse grained, poorly graded, brown,	-24						
-8	damp	26						
-9		-28 -30						
		-32						
		34						
- 11		-36						
- 12	8	-40						
- 13		-42						
	X	44						
		40						
- 15		50						
- 16		52						
- 17		-54 -56						
		-58						
	Å	60						
- 19		-62						
- 20		-66						
- 21	20.0 m	68						Gravel 57.1 % Sand 26.5 %
22		$E_{72}^{70}$						Silt & Clay 16.4 %
		-74						
- 23	$\mathbb{R}$	<b>E</b> 76						
- 24								
- 25	$\mathbb{Q}$	-82						
- 26		-84						
		-86 -88						
$\begin{bmatrix} 2' \end{bmatrix}$	END OF TEST HOLE AT 26.6m	<u>=90</u>						
28	- no standpipe installed	-92						
- 29	- test hole backfilled with soil cuttings	-94 -96						
- 30		<b>E</b> 98						
		$[-102]{104}$						
- 32		-104						
				KN	/m <sup>3</sup> 16 18 20 22	20 40 PENETRA1		GROUNDWATER
A	ALMOR TESTING SERVICES LTD.			P		RESISTAN	CE	<u>▼</u> Date
	TEST HOLE LOG			w	ET UNIT WEIGHT ()	SPT	Case	Measured
COM					OGGED	Cone ⊾	BT Pen PLAT	
DEP	TH 27 m DRILLED August 8, 2017			B	Y Kevin C	arter	NO.	- 11

PROJE	PROJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			P N	ROJECT D.		HOLE JN02 NO.	
CLIENT	: MOUNTAIN ASH LIMITED PARTNERSHIP			D T	RILL DIESEL HA	MMER RIG		
GEODET	C (m) DATUM		ΥPE		WATER CONTENT <sup>(%)</sup> ●		SIVE	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d $\blacktriangle$ n $\bigtriangleup$ 4 5	OTHER TESTS
E Sta	TOPSOIL	-2						
	Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp	4						
-2	to moist							
- 3		E10						
-4	Sandy CRAVEL compact to donce trace to some							
-5	silt, fine to coarse grained, poorly graded, olive,							
	damp	-18						Gravel 47.4 %
		-20						Silt & Clay 16.2 %
	Gravelly SAND compact, trace to some silt, fine	24						
-8 0	grained, poorly graded, olive, damp	26						
-9 0		-28 -30						
- 10 0		-32						
		-34						
Ø		38						
		40						
- 13 0		-42 -44						
- 14 0	-	46						
- 15	come gravel below 15.0 m	-48 -50						
- 16 <del>} ज</del> ⊓		52						
	Silty GRAVEL compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown,	-54						
l' pa	damp	-58						
		60						
- 19 0		-62 -64						
- 20 0		66						
- 21 0	- occasional medium to high plastic clay lens below	68						
- 22	20.5 m	-70 -72						
		74						
		-76 -78						
		80						
- 25 0		-82						
		-86						
- 27		88						
		-90 -92						
20	END OF TEST HOLE AT 27.8m	94						
	- no standpipe installed	-96 - 98						
- 30	<ul> <li>test hole dry at completion</li> <li>test hole backfilled with soil cuttings</li> </ul>							
- 31	Lot here busining with our outlings							
- 32		$\frac{104}{106}$						
				KN	m <sup>3</sup> 16 18 20 22	20 40 PENFTRAT	60 TION —	
A	ALMOR TESTING SERVICES LTD.			PC	100 120 140 F	RESISTAN	CE	▼ Date
	TEST HOLE LOG			w		SPT	Case	- Measured
COMPL	ETION 28.5 m DATE August 8, 2017			L	OGGED Kovin C	arter	PLAT	E 12
DEPTH	DRILLED August 0, 2017			B'			NO.	12

PROJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			PROJECT HOLE JN03 NO. NO.				
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP		!	DRILL TYPE DIESEL HAMMER RIG				
GEODETIC ELEVATION (m) DATUM		E L	WATER CONTENT <sup>(%)</sup> ● COMPRESSIVE STRENGTH				
	DEPTH (ft)	SAMPLE MOD UNIFI	Unconfined ▲ PLASTIC LIQUID LIMIT LIMIT 20 40 60 KPa 200 300 400 CTHER TSF 2 3 4 5 KPa 200 300 400				
<ul> <li>TOPSOIL</li> <li>Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist</li> <li>2</li> <li>3</li> </ul>	2 4 4 6  8  -10						
- 4							
Silty GRAVEL compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown, damp			Gravel 58.6 % Sand 31.6 % Silt & Clay 9.8 %				
- 6 • - occasional medium to high plastic clay lens below - 7 • - 7	20  22 						
	24 26  28						
	30 32						
	34  36 						
- 12 MUDSTONE (BEDROCK)							
<ul> <li>13</li> <li>END OF TEST HOLE AT 12.8m</li> <li>- no standpipe installed</li> <li>- test hole dry at completion</li> <li>- test hole backfilled with soil cuttings</li> </ul>	-42 -44 46 48						
AMOR ALMOR TESTING SERVICES LTD. TEST HOLE LOG		к I V	KN/m 16       18       20       22       20       40       60         100       120       140       PENETRATION RESISTANCE       GROUNDWATER         VET UNIT WEIGHT ○       SPT       Case       Date         Measured       SPT       Case				
COMPLETION 12.8 m DATE August 10, 2017			LOGGED Kevin Carter PLATE 13 BY Kevin Carter NO.				

PROJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			PI N	ROJECT D.		HOLE NO.	JN04	
CLI	ENT: MOUNTAIN ASH LIMITED PARTNERSHIP			DI T	RILL DIESEL HA	MMER RIG		
GEO ELE\	DETIC (ATION (m) DATUM		ΥPE	Ω.,	WATER CONTENT <sup>(%)</sup> ●	COMPRES	SSIVE H	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE T	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d $\blacktriangle$ n $\bigtriangleup$ 4 5 0 400	OTHER TESTS
	TOPSOIL	-2						
<u> </u> 1	Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp	-4						
- 2	to moist	-6 -8						
- 3		-10						
4	Sendu CRAVEL compositio donos, trace to como	-12						
	silt, fine to coarse grained, poorly graded, brown,	-14 -16						
- 5	damp	-18						
- 6		-20						
- 7		-22						
8		-24						
		-28						
- 9		-30						
- 10		-32 -34						
- 11		-36						
- 12	Pa	-38						
		-40						
- 13		-44						
- 14		-46						
- 15		-48 -50						
16		-52						
		-54						
17		-56						
- 18								Gravel 56.6 %
- 19		62						Silt & Clay 10.2 %
20		64						
	$\circ \bigcirc$							
- 21		70						
- 22		-72						
- 23								
- 24		-78						
	<ul> <li>- occasional medium to high plastic clay lens below</li> <li>24.0 m</li> </ul>	-80						
<sup>25</sup>	₀ ⊈ - becoming silty	-82 -84						
26		86						
- 27		88						
- 28		-90 -92						
20	MUDSTONE (BEDROCK)	<b>E</b> 94						
29	- no standpipe installed	-96						
30	- test hole dry at completion							
- 31	- test hole backfilled with soil cuttings	E102						
- 32								
		-106	L	KN,	16 18 20 22	20 40	60	
	MOR ALMOR TESTING SERVICES LTD.				100 120 140	PENETRA	ΓΙΟN ∎ CE	GROUNDWATER
				PC	F		Case	y Date Measured
	IEST HOLE LOG			WE		Cone	BT Pen	
	MPLETION DATE August 11, 2017			L( B)	GGED Kevin C	arter	PLAT NO	E 14

PRO	DJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			P N	ROJECT O.		HOLE NO.	JN05
CLII	ENT: MOUNTAIN ASH LIMITED PARTNERSHIP			D T	RILL DIESEL HA	MMER RIG		
GEO ELE\	DETIC (ATION (m) DATUM		ΥPE		WATER		SIVE	
DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TY	MOD UNIFIED	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	$\begin{array}{c} d \\ 1 \\ - \\ 4 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ -$	OTHER TESTS
	TOPSOIL	-2						
- 1	Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp	-4						
- 2	to moist	-6						
- 3		-10						
4	Sandy GRAVEL compact to dense, trace to some	=12						
5	silt, fine to coarse grained, poorly graded, brown,	-14						
		-18						
6	a	-20						
- 7	- occasional fine to coarse grained sand lens below	-22						
- 8	6.8 M Gravelly SAND compact trace to some silt fine	26						
- 9	grained, poorly graded, olive, damp	-28 -30						
10	- trace to some gravel below 8.5 m	32						
	- some gravel below 9.8 m	_34						
- 11	silt, fine to coarse grained, poorly graded, brown,	-36 -38						
- 12	o C damp	40						
- 13		42						
- 14		-44 -46						
15		-48						
<b>15</b>		-50						
- 16		-52 -54						
- 17		56						
- 18		-58						
- 19		62						
20		64						
20		-68						
- 21	Pa	70						
- 22		-72						
- 23		-76						
- 24		-78						
25		<sup>_80</sup>						
	ξ. <mark>Έ</mark>	84						
26	- occasional medium to high plastic clay lens below	86						
- 27	20.0 111							
- 28		<b>=</b> 92						
- 29	- no standpipe installed	-94 -96						
- 30	- test hole dry at completion	-98						
21	- test hole backfilled with soil cuttings	E100						
- 31		E102						
- 32		E106		1/1-1				
	MOR ALMOR TESTING SERVICES I TO			NN	m <sup>3</sup> 16 18 20 22 100 120 140	PENETRAT		GROUNDWATER
				PO			Case	y Date Measured
COI						Cone	BT Pen PLATE	15
	PTH 28.2 m   DRILLED August 11, 2017			B	Y Kevin C	arter	NO.	15

PROJECT: GRAVEL PIT ASSESSMENT JOHN NUGTER PROPERTY			PROJECT NO.				JN06
CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP			DF TY	RILL DIESEL HA	MMER RIG		
GEODETIC ELEVATION (m) DATUM	1	γPE	<u>ا</u>	WATER CONTENT <sup>(%)</sup> ●	COMPRES	SSIVE H	
E SOIL B DESCRIPTION	DEPTH (ft)	SAMPLE 1	MOD UNIFIE	PLASTIC LIQUID LIMIT LIMIT 20 40 60	Unconfined Pocket Per TSF 2 3 KPa 200 300	d ▲ n △ 4 5	OTHER TESTS
Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp	-						
to moist	-2						
- 1	-						
	-4						
	+						
	-6						
	-						
	-8						
	L						
- 3	-10						
	-12						
- 5	-16						
	Γ.,						
	-18						
- 6							
	24						
- no standpipe installed							
8     - test hole dry at completion     - test hole backfilled with soil cuttings	-26						
	-28						
9	F						
	-30						
	F						
	-32						
			KN/	m <sup>3</sup> 16 18 20 22	20 40 PENETRAT		GROUNDWATER
ALMOR TESTING SERVICES LTD.			PC	120 120 140 F└──└──└──┘	RESISTAN	CE	■ Date
TEST HOLE LOG			WE		□ SPT	Case BT Pen	Measured
COMPLETION 7.5 m DATE August 12, 201	7		LC B)	GGED Kevin C	arter	PLATE NO.	16

















APPENDIX C









APPENDIX D

#### Estimated Sand/Gravel Volumes

As requested, we submit our sand/gravel calculations for the above noted project, based on the limited test holes advanced to the depth of bedrock, with a Diesel Hammer Rig.

Please refer to the site plan indicating the triangular shaped area used for the sand/gravel volume calculations.

Based on the logs, the thickness of sand/gravel in the test holes are as follows:

JN01 - 22.1m JN02 - 23.8m JN03 - 7.1m JN04 - 24.2m JN05 - 24.0m

The average depth of sand/gravel is 20.2m

The area of triangle is :

Base of triangle	= 660m
Height of triangle	= 530m
Total area of triangle	$= \frac{1}{2} \times Base \times Height$
	= ½ x 800m x 490m
	= 174,900 m <sup>2</sup>

The estimated volume of aggregate is:

Average Depth x Area = Total Volume ( $m^3$ ) 20.2m x 174,900  $m^2$  = 353,2980  $m^3$ 






















#### APPENDIX B SLR Consulting Ltd – Monitoring Well Construction Logs

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003

					CLIENT: Summit Aggregates	Resource	BC	DRE	HC	)L	E LOG	
L		SL	.K		PROJECT: Hydrogeological As NW 31-026-3 W5M A	sessment Iberta	BOREHOLE NO:	MV	٧1	4-	101 COORDIN 56828	IATES 69 N
S	SLR C	ONSULTIN	IG (CA	ANADA)	LTD. PROJECT No. 203.50065.00001		SURFACE ELEVATION:	1293	.53	m 	680066 ب	5.4 E Ê
Ê	ТҮР	9	very	Щ			TEST DATA					NOI
DEPTH	SAMPLE	SAMPLE	% Recov	SOIL TY	SOIL DESCRIPTION		■SPT Count ♦ % Moisture		WELL		COMPLETION NOTES	ELEVAT
-1-									Г	1		-
-											stickup, above ground steel	-129
0-				1. SUS	Ground Surface					<u> </u>	protector	F
-					Clay, some silt, occasional gravel, rootle	ts, brown, moist, soft						-
				♥•		/					backfilled with drill cuttings	- 129
1-		WP1			Sandy, gravelly (fine to coarse grained) very hard	clay, light brown, dry,			AD	AQ		-
				•				Ç	9	6		-129
2-				•.								-
												-
												-129 -
3-								· ·				-
												-
4-												E
				•.								-128
5-												F
				•								F
												-128
6-					SAND AND GRAVEL	6.1						-
		WP2			Fine to medium grained sand, fine to coa	arse grained gravel,						-128
7-					occasional hard, calcified bands	, a. ,, compact mai						-
												-
												-128
8-					•	-		· ·				ŀ
											chips	-
9-												E
												-128
10-					1							-
												-
												-128
11-								· ·				F
												-128
12-												ŀ
												ŀ
												-128
	DRIL	LING ME	 Thoi	): D:	Becker Hammer N	lotes: GRAB SAM	PLE					
	DRII		30	Senter						~		
	- 1 I L		50	Sopiol						Sh	ieet 1 of 2	

•	_ 🏠	CLIENT: Summit Aggregates Resource	BC	REHO	LE	LOG	
SL	R	PROJECT: Hydrogeological Assessment NW 31-026-3 W5M Alberta	BOREHOLE NO:	MW1	4-1	0 <sup>1</sup> <sup>TM COORDIN</sup> 568286	ATES 69 N
SLR CONSULTI	NG (CANADA) LT	D. PROJECT No. 203.50065.00001	SURFACE ELEVATION:	1293.53 r	n	680066	6.4 E
	<u>ک</u>		TEST DATA	NOI	EVEL		L N
	Cove	SOIL DESCRIPTION	■SPT Count		ER LI	WELL	ATIC
SAMF SAMF	% Re		♦ % Moisture	NELL	VATE	NOTES	
13-					_		
							+
							-128 -
14-							Ł
							ŀ
		GRAVEL 14.63					-12
15-	b Sed	Medium to coarse grained, sandy, light brown, moist, compact with occasional hard hands		·		50 mm solid PVC pipe	Ŀ
	Do.	Below 15.2 m: Occasional cobbles					ŀ.,
WP3							-12  -
16-	Do.			[][			ŀ
						GW = 16.40  mbg	ŀ
	Do					(2002014)	-12  -
17-		Below 16.8 m: Wet					Ł
-	Do						ŀ
-					-		-12
18-	Do						ŀ
-							F
-	00				•	50 mm 010 slot	-12
9-						PVC pipe	-
							F
-		SAND 19.5					-12  -
20-		Medium to coarse grained, grey brown, wet, very loose					ŀ
WP4							-
					•		-12  -
21-	· · · · · · ·						Ł
WP5		Fine grained, brown, grey, wet, weak					ŀ
		Below 21.6 m: Weathered, clavey, silty, soft				bentonite chips	-12  -
22- WP6							ŀ
		End of borehole at 22.3 m 22.3					
		Screened interval from 16.5 m to 21.0 m below surface					
		Elevation at top of pipe (TOP) = 1294.240 m					
		Groundwater Information: Depth to groundwater from TOP = 17.11 m (20ct2014)					
DRILLING ME	THOD: B	ecker Hammer Notes: GRAB SAM	PLE				
DRILL DATE:	30 Septemb	er 2014 LOGGED BY: RT			She	et 2 of 2	

						CLIENT: Summit Aggregat	es Resource	B	ORE	НС	)L	E LOG	
		SL	.R			PROJECT: Hydrogeological A NW 31-026-3 W5M	Assessment I Alberta	BOREHOLE NO:	M٧	<b>V1</b>	4-	-102 <sup>TM COORD</sup> 5682	INATES 2280 N
S		ONSULTIN	IG (CA	ANADA) L	TD.	PROJECT No. 203.50065.00001		SURFACE ELEVATION:	1283	3.26	m	6807	91.6 E
Ê	ТҮРЕ	Q	Jry I	ш				TEST DATA					UN (L
ц Н	Ble	LE I	SCOVE	ΤΥΡ		SOIL DESCRIPTION		■SPT Count		ن ם, ا			'ATIC
DEP	SAMI	SAMI	% Re	SOIL				♦ % Moisture				NOTES	ELE\
-1-													-
-												stickup, above	-128
												ground steel protector	-
0+			-	<u>7, 1</u> 7, 7,	TOF	Ground Surfac	e				<b>I</b>		
-					Sar	ndy, occasional gravel, dark brown	, rootlets, moist 0.3					silica sand	-128
-				<b>▼</b> •	Silty	y, sandy clay, some gravel, brown,	moist, very hard						-
1-													-
-				•									-128
-													-
2-		WP7										bydrated bentoni	to -
-												chips	-128
_				•									L
3-													-
-													-128
-													-
4-					SAN	ND	3.96			X	ž		-
-		WP8			Meo coa	dium to coarse grained, well grade arse, rounded), occasional cobble,	d, gravelly (fine to brown, moist				Ă		-127
1				000	GR	AVEL AND SAND	4.57				A		-
5-				200	coa	arse sand, occasional cobble, roun	ded, moist				ð		-
-		WP9		000							ġ		-127
-		-		200							6 A		-
6-				$ 0\rangle$									-
-				Park	SAL	ND AND GRAVEL	6.4			A	Ă	backfilled with dri	-127 ill -
-					Fine	e grained, trace medium, trace coa	arse sand. Fine to				X	cuttings	L
7-		WP10			coa	arse, rounded gravel, red, moist					ð		-
-											<b>X</b>		- 12/
-					Fro	m 7.6 to 7.9 m: Rounded, medium	to coarse gravel, sandy,						-
8-					ary			<u> </u>		R	X		-
-											Ä		- 12/
1											A		F
9-								<u> </u>		6	6		-
]												hydrated bentonit chips	te   '2'
]												E0	, F
10-								<u> </u>				pipe	′ -
]													- 21
]				POC	GR	AVEL	10.7	-					F
11-		WP11			Poc coa	orly graded, medium, rounded, san ating on gravel, black and dark brow	dy, trace silt, trace clay wn staining	<u> </u>					-
				60C	Belo	ow 11.3 m: Fine to coarse grained	gravel, rounded, sandy,			目			- 21
-					ine	, aan diown, must				目			F
12-		WP12		000				<u></u>		!泪			-127
				Po o						目		50 mm 010 slot	- 2
_				96			1					PVC pipe	
0	ORIL	LING ME	THO	D:	Becker	r Hammer	Notes: GRAB SAM	IPLE					
	DRIL	L DATE:	1 (	October	2014	LOGGED BY: MH					Sł	heet 1 of 2	
							1				0		

					CLIENT: Summit Aggi	regates Resource		BO	REHC	LE	LOG	
		SL	.R		PROJECT: Hydrogeolog NW 31-026-3	Ical Assessment W5M Alberta		BOREHOLE NO:	<b>MW1</b>	4-1	02 <sup>TM COORDIN</sup> 568228	ATES 30 N
EPTH (m)		ONSULTIN AMPLE ID	S Recovery	OIL TYPE	TD. PROJECT No. 203.50065.00	TION		SURFACE ELEVATION: TEST DATA ■SPT Count ◆ % Moisture		ATER LEVEL	WELL COMPLETION NOTES	с LEVATION (m) п
		WP13	<u>o</u> ,		GRAVEL AND SAND Fine to medium, trace coarse, ro medium, trace coarse sand, occ Below 13.7 m: Increasing cobble	1 punded gravel. Fine, trace casional cobble, dry	2.8					 1270 - - - - - - 1269 - -
15-		WP14 WP15			<b>SANDSTONE</b> Weak, fine grained, silty, dry From 15.5 to 15.8 m: Higher clay	1 / and silt	4.93				silica sand	- - 1268 - -
16-					Becoming more competent below	w 15.8 m					bentonite chips	- - 1267
LE LOG (MOISTURE) 203:50065.00001.GPJ SLR_CAN V5.2 MOISTURE.GDT 21/1/15					Well Completion Details: Screened interval from 10.4 m to Elevation at top of pipe (TOP) =	o 14.9 m below surface 1284.060 m						
ОКЕНО	DRIL	LING ME		):	Becker Hammer	Notes: GRAB	SAM	PLE			1	
	DRIL	L DATE:	1 (	October	2014 LOGGED BY: MH					She	et 2 of 2	

						CLIENT: Summit Aggregate	es Resource	B	ORE	HC	)LE	LOG	
		SL	.R			PROJECT: Hydrogeological A NW 31-026-3 W5M	Assessment Alberta	BOREHOLE NO:	MV	V1-	4-1	03 <sup>TM COORDIN</sup> 568310	ATES 00 N
	SLR	CONSULTIN	IG (CA	NADA)	LTD.	PROJECT No. 203.50065.00001		SURFACE ELEVATION:	1299	.81 r	m	6807:	39 E
	YPE		2					TEST DATA		NO			L N
<u>ш</u> Ш	ЦЦ ЦЦ		Sovel	ΓΥΡΕ		SOIL DESCRIPTION		■SPT Count		LET	LE LE	WELL	ATIO
EPT	AMP	AMP	% Re	OIL				♦ % Moisture		VELL	VATE	NOTES	
-1-	0	<u>م</u>	0	0						>0			-
	1											stickup above	
	-											ground steel	-
0	1			1.11.1		Ground Surface	e			T   ]	<u> </u>		-130 -
	1			1, 1,	Silty	y and clay, trace sand, rootlets, dar	k brown, moist					silica sand	E
	-			hiiii	CLA	AY TILL	0.61				•		-
1.	1			•	Silty	y, sandy clay, trace rounded gravel,	, grey, moist, very hard,						-129
	1				Solt								E
	-												-
2.	1												-129
	1			•									E
	-											hydrated bentonite chips	-
3-		WP16											-129
	_												Ł
	-			•									F
4	1												-12
	1												E
	-								2	X 2	X		F
5	1			<b>•</b> •						DA R	A		-12
	-										DA		+
	1								ž		2AC		F
6	1										A C		-12
	-			-							N N		-
	1				Belo	ow 6.4 m: Brown			ç		204		F
7	1										RCIA		-12
'	-				SAN Ver	ND AND GRAVEL v fine, trace coarse sand, Medium t	7.01 to coarse grained.		Ç	DAT 6	AC		-
2	1				rour	nded gravel. Some silt, red/brown,	dry		Š		DAC AA		ŀ
- - - -											A		-12
	-										A D		-
	1				GB		8 53				X OA		È
				$\beta O_{c}^{*}$	Fine	e to medium, (trace coarse) gravel.	Poorly graded, very				RC		-12
10	-				Tine	sand, brown, moist			2	DA R	A		-
	1			$b \circ c$					Ż		DAC		-
				00 C							JAC A		-12
5				$\beta \beta $	1				P		AIO		ŀ
		vvr= 1 /		ÞŎ C	-						AIO		ŀ
200				$\beta$	Belo	ow 10.7 m: Increasing gravel					ŔĊ		-12
	-			þ <u>ŏ</u> c						IN CAL	DA		-
-	1			Po n	1						ZIAC		ŀ
12.				600						AA	A		-12
	-			Po n	1				P		AD		-
2	1			600	-						AD V		F
1				$\mathbb{P}_{\mathcal{O}_{\mathcal{O}}}$					į	66	5		-12
	DRI			י: 	Becker	Hammer	Notes: GRAB SAM	IFLE					
	DRII	L DATE:	1 (	October	2014	LOGGED BY: MH					She	et 1 of 3	
· ·													

		~			CLIENT: Summit Aggregates Resource	BC	OREHO	LE	LOG	
	SIP				PROJECT: Hydrogeological Assessment NW 31-026-3 W5M Alberta	BOREHOLE NO:	<b>MW1</b> 4 1299.81 m	<b>1-1</b> า	103 <sup>TM COORDIN</sup> 56831 6807	ATES 00 N 39 E
	<u>ын</u>						Z	/EL		E E
(m)	ЕТΥ	ЦП	overy	ΥPE	SOIL DESCRIPTION	■SPT Count	LETIC	R LEV	WELL	TION
EPTF	AMPI	AMPI	% Rec			<ul> <li>♦ % Moisture</li> </ul>	VELL	VATE	COMPLETION NOTES	ILEVA
13	s S	s s	0`	SC	Below 12.8 m: Increasing gravel, some cobble			>		-
	-			Polo					50 mm solid PVC	-
				00C					pipe	- -1286
14				Pool	Below 14.0 m: Decreasing gravel, no cobble					-
				60%						ŀ
15-				000						-128
				60%						ŀ
	]			000						-
16-	-			200				9		- 1284
	1			0 0 0 0 0						F
				Poor	Below 16.8 m. Decreasing gravel					- -1283
17.	1			6000	Solow role in Decreasing graver					F
				60C						ŀ
18-				Po O						-1282
				000						-
				Polo						-
19-		WP18		000						- 120
	-				SAND AND GRAVEL 19.2 Poorly graded, very fine sand, Medium with trace fine and					-
					trace coarse gravel. Occasional cobble, red/brown, moist					-1280
20-								5		-
										-
21.										-1279
					Below 21.3 m: Increasing gravel					-
										-1278
22								5		
								5		E
	-									-127
23	-				Below 23.2 m: 0.08 m clay lens			_		-
	-							<b>_</b>	GW = 23.49 mbg (2Oct2014)	-
24	1									-127  -
5										-
200									50 mm 010 slot	- -127
25										ŀ
		WP19			Below 25.3 m: Wet gravel, very angular					F
26						L				-1274
	-									ŀ
	-									-
	1 DRII	LLING ME	 THOI	D:	Becker Hammer RRAB SAM	I IPLE	<u> .'  .'</u>			-12/3
	DRII		1 (	October	2014 LOGGED BY: MH			CL	at 0 of 0	
	וורוש			2010000				She	et 2 of 3	

						CLIENT: Summit Aggregat	es Resource		BC	)RE	HO	LE	LOG	
		S	R			PROJECT: Hydrogeological	Assessment			ΜV	V14	l-1	03 COORDINA	ATES
	SIRC			ΝΔΠΔ		PROJECT No <b>203.50065.00001</b>	i Alberta		SUBFACE ELEVATION	1299	.81 m		68073	39 E
	ш										7	Ц		Ê
Ê	۲Ľ	₽	ery	щ					TEOT DATA		TIO	Ξ		NO
Η	FE	PLE	ecov	Ϊ		SOIL DESCRIPTION			SPT Count		L	ER	WELL COMPLETION	VATI
)EP	SAM	SAM	% R(	SOIL					<ul> <li>% Moisture</li> </ul>		VEL	NAT	NOTES	ELE
27-		0)						-				_		-
													silica sand	-
		WP20 WP21		$\times \times \times$		ATHERED SILTSTONE	d striations moist	27.4					hydrated bentonite chips	-
					Bel	ow 27.7 m: Siltstone, grey, dry		27.7/						
					Enc	d of borehole at 27.7 m								
					We	Il Completion Details:								
					Scr	eened interval from 22.6 m to 27.1	m below surface							
					Ele.	valion at top of pipe $(10P) = 1300$	.720 m							
					Gro	oundwater Information:	40 m (20 ot 2014)							
					Det	511100 groundwater from $10F = 24$	.40 111 (20012014)							
/15														
21/1														
2DT														
E.C														
ISTU														
MC														
I V5.														
CAN														
SLR														
L L L														
001.0														
5.00														
5006														
203.														
LE)														
ISTU														
OW)														
LOG														
	DRIL	LING ME	THO	D:	Becker	r Hammer	Notes: GRA	B SAM	PLE					
	ייסח		1 (	Dotobor	2014		-							
SLF	URIL	L DATE:	10	Juober	2014							She	et 3 of 3	

		CI	D			CLIENT: PROJECT:	Mountain As Proposed Su	h Limited Pa Immit Pit	artnersh	nip		E	BORE		)L			INATES
	SLR (			NADA) L	TD.	PROJECT	NW 31-026-0	3 W5M Coch 0003	hrane, A	B	I SURF/	BOREHOLE NO: ACE ELEVATION	IVIN <sub>1:</sub> 1293	<b>V I</b> 3.64	9- m	100	<b>D</b> 68 568	80386 N 82182 E
DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE			SOIL DESCRIP	PTION			-	■ SPT Count SPT Count Moisture		WELL			WELL COMPLETION NOTES	ELEVATION (m)
	-															ab pr	oove ground ste otector	- - el -1294 -
0					CL/	AY TILL	Ground	Surface		ony dny								-
1				•	FIN	e trace grave	a, dark grey brow	n, minor samp	pie recovi	ery, ary				-				- - - 129: - -
2	-			•	@1	I.5 m: Some	fine to coarse gr	avel						-		hy ch	drated bentonit ips	- - - 129; e _ -
3	-			•										-				- - - 129 - -
T 12/6/19 +	-				<b>SAI</b> Fine	ND AND GR	AVEL and and gravel, b	prown, dry		3.35				CH CH CH C	CAN CAN CAN			- 1290 - - -
N V5.2 MOISTURE.GD	• • •				SAI Med	NDY GRAVI dium to coar	<b>EL</b> se gravel, coarse	sand, brown,	dry	4.57				CHCHCHCHCHCH	NONONONONO			- - 1289 - - -
JNE2019.GPJ SLR_C/	-													CH CH CH CH CH CH				- - 128 - - -
<u>8_100 SERIES_3-5JI</u> 2	-													ACK CARCARCA	ACKNOWCA			- 128 <sup>-</sup> - -
E) 212.06650.00003 ∞	-													SHOW ON ON O				- 1286 - -
ole Log (Moistur														KONCH CHICK	TACHACKACKON			- - - 128 - -
SLR BOREH	DRIL	LING MET	HOD: Jui	Sine 3, 201	onic/Ode 9	ex LOGGE	D BY: NY	Notes:	: •••••	GRAB SAM	PLE				Sł	neet	1 of 4	

					CLIENT: Mountain Ash Lin	nited Partnership	B	OREHOLE	LOG	
		SL	.R		PROJECT: Proposed Summi NW 31-026-03 W5	t Pit M Cochrane, AB	BOREHOLE NO:	MW19-1	108 <sup>UTM COORDIN/</sup> 6803	ATES 86 N
	SLR (		IG (CA	NADA) L	TD. PROJECT No. 212.06650.00003		SURFACE ELEVATION:	1293.64 m	56821	82 E
Ê	TYP	₽	ery	Ш			TEST DATA			I) NOI
DTH (	APLE	APLE	Recov	ГТ Г	SOIL DESCRIPTION		SPT Count		WELL COMPLETION	VATI
DEF	SAN	SAN	% H	sol			♦ % Moisture	COL COL	NOTES	Ш
	-				GRAVELLY SAND	9.14	-			-
					Fine to coarse sand and gravel, yellow	brown, dry				-
	-									-128
10								X X		-
	-									-
										-
	-									- 128
11	-									-
	-									-
										-
	-									- 120
12	-									-
										-
	-									-128
	-									-
13	-									-
										-
	-									-128
6	-									-
14	-									-
GDT										-
'URE.	-									-127
LSION	-									-
15 V 72'5 V										-
CAN	-									_
SLR	-									-127
GPJ	-									-
12019 d									slough and backfill	-
5JUNI	-									_
с, Ч	-									-127
	_									-
100	_									
00003	-									-
6650.	-									-127
512.0 18	_									-
URE)	-									_
IOIST	1									-
00 (V	1									-127
اد 19_							<u></u>			
DREHC	DRIL	LING MET	HOD:	S	onic/Odex	Notes: GRAB SAN	/IPLE			
SLR B(	DRIL	L DATE:	Ju	ne 3, 201	9 LOGGED BY: NY			Sh	eet 2 of 4	

		CI	D			CLIENT: PROJECT:	Mountain Ash Lim Proposed Summit	ited Partnership t Pit	B				COORDIN	ATES
		JL					NW 31-026-03 W5	M Cochrane, AB		1293.6	19-1 4 m	801	6803 56821	386 N
	<u>SLR (</u> ш			ANADA) L	TD.	PROJECT NO	212.06650.00003		SURFACE ELEVATION:	1233.0			50021	Ē
Ē	TYF	9	/ery	Щ										NOI
TH	<b>IPLE</b>	APLE	Recov	L 1			SOIL DESCRIPTION		SPT Count	=	TER   LE	COM	VELL PLETION	VAT
DE	SAN	SAN	% F	SOI					% Moisture	UVE VVE	N N	N	JIES	
	-				@1	19.2 m: Trace	silt present to 20.7 m							-
	1				0		·			Ŕ	Ŕ			-
	1													-1274
20-														
	-													_
	-									2A				-
	1													-1273
21-										6	<b>B</b>			-
	-									Ko ko				
	-													_
	-													-1272
	1													-
22-														-
										R.				-
	-									No.				-127
	-													-
23-	1													-
	1													-
											R			-
	-									Ŕ				- 12/0
61/9/2	-													-
τ 1	1													-
SE.GI										A A	A			-
ISTU										A C				-1269
0 ₩ 25-	-									6				_
N V5	-									Ko ko				-
CA	-													-
J SL	]													-1268
0 0 10 10 10 10 10 10 10 10 10 10 10 10														-
IE201	-													_
-5JUN	-									Ŕ				-
ES 3.	-									NO A				-1267
	]				SAN	ND	fine to second	26.8						ŀ
00					Son	ne gravel, bro	own, nne to coarse san	iu and gravel, dry			K			Ĺ
20003	-			·····										-
3650.(	-										RC I			-1266
212.0(	1													ŀ
(III) (III)														t
ISTU	-										X			
(WC	-													-126
	1													-
공 <u> </u> 29- 문	1 DRIL	LING MET	 Hod	<u> .                                    </u>	onic/Ode	ex		Notes: GRAB SAM	<u> </u> /PLE	<u></u>				-
BOR														
SLR	DRIL	L DATE:	Ju	ine 3, 201	9	LOGGED	BY: NY				She	eet 3	of 4	

		CI				CLIENT:	Mountain Ash Lim	ited Partners	ship	В	ORE	HC	)LE		ATES
	910				TD	PRO IECT No	NW 31-026-03 W5	M Cochrane,	AB	BOREHOLE NO: SURFACE ELEVATION:	1293	<b>N1</b> 3.64 r	9-1 <sup>n</sup>	08 68038 568218	86 N 82 E
(m) HTH			Recovery		<u>.</u>		SOIL DESCRIPTION			TEST DATA SPT Count % Moisture		ELL	ATER LEVEL	WELL COMPLETION NOTES	EVATION (m)
DG (MOISTURE) 212.06660.00003_100 SERIES_3-5JUNE2019.GPJ SLR_CAN V5.2 MOISTURE.GDT 12/6/19 C		SAMPLE SAMPLE	% Recov	x x x x x x x x x x x x x x x x x x x	BED Siltst	ROCK one, grey, d	soil description		30.48	• SPT Count • % Moisture				WELL COMPLETION NOTES	LLEN 313 - 1264 - 1264 - 1263 - 1263 - 1267 - 1267 - 1267 - 1267 - 1275 - 1255 - 1255 - 1255
SLR BOREHOLE L			HOD: Ju	S ne 3, 201	onic/Ode>	LOGGED	BY: NY	Notes:	GRAB SAM	PLE			She	eet 4 of 4	

					CLIENT: Mounta	ain Ash Limited Partner	ship	E	BORE	HC	DLE	LOG	
	SID	SL			PROJECT: Propos NW 31- PROJECT No. 212 06	-026-03 W5M Cochrane	, AB	BOREHOLE NO	. <b>MV</b> ⊪ 1271	<b>V1</b> .68 r	9-1 <sup>ຠ</sup>	09 56818 6806	ATES 303 N 379 E
DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DES	SCRIPTION		TEST DATA SPT Count & % Moisture	•	WELL	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
	-				G	round Surface						above ground steel protector	- - -1272
C	-				CLAY TILL Trace fine gravel, dark brow	wn. moist							-
1	-			•									- 127' - - -
2	-			•	@ 1.5 m: Some fine grave	4						hydrated bentonite chips	- 127 - - -
3	-			•									- 126 - - -
DISTURE.GDT 12/6/19	-				SAND AND GRAVEL Coarse sand, fine to coarse	e gravel, grey brown, dry	3.66			ANONONONONONO	MONDADADAD		126 - - 126 -
=2019.GPJ SLR_CAN V5.2 MC					<b>GRAVELLY SAND</b> Fine to coarse gravel and s	sand, grey brown, dry	5.49			NONONONONONON	NONONONONON		- - 126 -
3_100 SERIES_3-5JUNI	-										CHOROHOHOHO	slough and backfill	- 126 - -
TURE) 212.06650.0000 m	-									ANCHONOMONO.	RORDRORDRORD		- 126 - - -
	- - DRIL	LING MET		0	EX Air Rotary Drilling	Notes:				NONONON N	NONONON		- 1263 - -
SLR BOR	DRIL	L DATE:	Ju	ne 4, 201	LOGGED BY: NY						She	et 1 of 2	

						CLIENT:	Mountain Ash Lim	ited Partnership		BC	OREH	OL	E LOG	
		SL	R			PROJECT:	NW 31-026-03 W5	Pit M Cochrane, AB		BOREHOLE NO:	MW	19-	109 <sup>UTM CC</sup>	ORDINATES 5681803 N
	SLR C	ONSULTIN	G (CA	NADA) L	TD.	PROJECT No	212.06650.00003			SURFACE ELEVATION:	1271.68	5 m _   -		680679 E
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HOLE LOG (MOISTURE) 212.06650.00003_100 SERIES_3-5JUNE2019.GPJ SLR_CAN V5.2 MOISTURE.GDT 12/6/19 -01 -01 -01					SAN Fine BEI Cou	DROCK and not determ d of borehole a bundwater Info oth to groundw	L avel and sand, grey brown nine lithology with minin at 15.8 m prmation: vater from TOP = 12.3	own, dry mal returns 12 m (5June2019)	11.58				Image: set of the s	
BORE														
SLRE	DRIL	L DATE:	Ju	ne 4, 201	9	LOGGED	BY: NY					Sł	neet 2 of	2

	CLIENT: Mountain Ast PROJECT: Proposed Su						CLIENT:	Mountain Ash Lin	nited Partner	ship							
			SL	<u>.R</u>			PROJECT:	NW 31-026-03 W5	it Pit 5M Cochrane	AB	BOREHO	LE NO:	<b>MW</b>	<b>1</b> 4 r	9-1 "	10 <sup>UTM COORDIN 56820</sup>	ATES )58 N 788 F
	S	LRC	ONSULTIN	IG (CA	NADA) L	TD.	PROJECT N	<u>o. <b>212.00050.00005</b></u>			TEST D	ATA	1231.	Z			<u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u>
ОС DTU ()	UEPIN (m)	SAMPLE TY	SAMPLE ID	% Recovery	SOIL TYPE			SOIL DESCRIPTION	I		■ SPT 0 ◆ % Mo	Count pisture		WELL COMPLETIC	WATER LEV	WELL COMPLETION NOTES	ELEVATION
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	-				•	Tra	ce gravel, da	rk brown, moist									-
	-				-												-
	1-				●.												-1290
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	- 2-																-
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:	3-				●.												- 
	-					SAI	ND AND GR	AVEL	brown dry	3.35	-						-
0	-					1 110		and and gravel, yellow	brown, dry								-
T 12/6/1	4-																-1287
JRE.GD	-					GR	AVELLY SA	ND		4.57	_						-
MOIST	5-					Fine	e to coarse s	and and gravel, reddis	h brown, dry								
CAN V5.	-																- 1286
J SLR	-					@5	5.5 m: Yellov	v brown to 11.6 m								hydrated bentonite chips	-
2019.GF	6-																- 
3-5JUNE	-																-
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LR BOR	[	DRILI	L DATE:	Jur	ne 4, 201	9	LOGGE	D BY: NY	-						She	et 1 of 4	
vi ∟																•	

						CLIENT:	Mountain Ash Lim	ited Partners	ship	B	ORE	HO	LE	LOG		
	SIR		R			PROJECT:	Proposed Summit NW 31-026-03 W5I 212.06650.00003	: Pit M Cochrane,	AB	BOREHOLE NO: SURFACE ELEVATION <sup>.</sup>	<b>MV</b>	<b>V19</b> .14 m	<b>)-1</b> '	10 <sup>0111 CO</sup>	DORDIN 56820 6807	ATES 158 N 188 E
	Щ.				10.					TEST DATA		N	ΈL			(m)
DEPTH (m)	SAMPLE TY	SAMPLE ID	% Recovery	SOIL TYPE			SOIL DESCRIPTION			■SPT Count ♦ % Moisture			NATER LEV	WE COMPLI NOT	LL ETION ES	ELEVATION
		0,			@9	9.1 m: Clay la	ayer, dark brown, moist	to 10.1 m					_			
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SLRE	DRIL	L DATE:	Ju	ne 4, 201	9	LOGGEI	DBY: NY						Shee	et 2 of	f 4	

						CLIENT:	Mountain Ash Lim	ited Partnership		B	ORE	HO	LE	LOG	
		SL	.R			PROJECT:	NW 31-026-03 W5	: Pit M Cochrane, AB		BOREHOLE NO:	<b>MV</b>	/19	9-1	10 <sup>UTM COORDIN</sup> 56820	ATES 158 N
	SLR (		G (CA	NADA) L	TD.	PROJECT N	lo. 212.06650.00003			SURFACE ELEVATION: TEST DATA	1291.	14 II Z		6807	Ê E
JEPTH (m)	AMPLE TYI	AMPLE ID	% Recovery	OIL TYPE			SOIL DESCRIPTION			■SPT Count ◆ % Moisture		VELL COMPLETIO	VATER LEV	WELL COMPLETION NOTES	LEVATION
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22.	-											N CHUCKONCONC			- - -1269 -
23	-											A PANCHARANA A			- - -1268 -
E.GDT 12/6/19	-											KOKOKOKOKO			- - 1267 -
CAN V5.2 MOISTUR	-											KONONONONO			- - 1266 -
3-5JUNE2019.GPJ SLF	-											KONONONONON			- - 1265 -
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29 <sup>-</sup>						Deter D ""							Į	GW = 1262.29 m (5June2019)	-
30REH	DRIL	LING MET	HOD:	O	JEX Air	Rotary Drilling	]	Notes: GRAB S	SAMPL	E					
SLR	DRIL	L DATE:	Jur	ne 4, 201	9	LOGGE	DBY: NY						She	et 3 of 4	

		•				CLIENT:	Mountain Ash Limi	ited Partnership		B	ORE	HO	LE	LOG	
		SL	.R			PROJECT:	Proposed Summit NW 31-026-03 W5	Pit VI Cochrane. AB		BOREHOLE NO:	M٧	N19	9-1	10 <sup>UTM COORDINA</sup> 56820	ATES 58 N
	SLR C	ONSULTIN	G (CA	NADA) L	TD.	PROJECT No	212.06650.00003			SURFACE ELEVATION:	1291	1.14 m	ן 	6807	'88 E
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	+			<u> </u>	End	l of borehole a	at 33.2 m		33.2						-1258
					Gro	undwater Info	ormation:	5 m (5 luno2010)							
/19					Dep	orn to ground	valer from TOP - 20.0	5 m (5June2019)							
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GDT															
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	ייסח		.hu	ne 4 201	19	IOCCEP		-					0.		
SLF	URIL	LDATE:	Jul	iu <del>-1</del> , 201		LUGGEL	וטי. או						She	et 4 of 4	

#### APPENDIX C Alberta Water Well Records

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003

Alberta

### **Reconnaissance Report**

View in Imperial Export to Excel

### **Groundwater Wells**

Please click the water Well ID to generate the Water Well Drilling Report.

GIC Well ID	LSD	SEC	ТWP	RGE	м	DRILLING COMPANY	DATE COMPLETED	DEPTH (m)	TYPE OF WORK	USE	СНМ	LT	РТ	WELL OWNER	STATIC LEVEL (m)	TEST RATE (L/min)	SC_DIA (cm)
<u>350194</u>	SW	31	26	3	5	LOU'S WATER WELL DRILLING	1990-03-09	35.05	New Well	Domestic		9		DAVIDSON, D.W.	15.24	54.55	14.12
<u>360164</u>	SE	6	27	3	5	AERO DRILLING & CONSULTING LTD.	1991-10-08	73.15	New Well	Domestic		10		BARGETZI, ERNIE	33.53	136.38	14.12
<u>387449</u>	NE	36	26	4	5	PARSONS DRLG	1962-08-10	33.83	New Well	Unknown		9		BRISTOW, C.R.	21.95	72.74	0.00
<u>390998</u>	SE	6	27	3	5	ALBERTA SOUTHERN EXPLORATION DRILLING LTD.	1987-02-11	65.53	New Well	Domestic & Stock		11		STRANGE, R.	45.72	36.37	16.84
<u>390999</u>	SE	6	27	3	5	ALBERTA SOUTHERN EXPLORATION DRILLING LTD.	1987-11-19	73.15	New Well	Stock		15		STRANGE, R.	39.62	45.46	16.84
<u>391000</u>	4	6	27	3	5	DIVERSIFIED DRILLING & EXPLORATION CO.	1984-11-07	40.23	New Well	Domestic & Stock	1	7		CIRCLE J RANCHES	28.96	68.19	13.97
<u>391598</u>	NW	31	26	3	5	PARSONS DRILLING		39.62	New Well	Domestic & Stock				MURRAY, R.J.			17.78
<u>391599</u>	NE	31	26	3	5	KRIEGER DRILLING LTD.		49.38	New Well- Decommissioned	Investigatio n		14		PARKER, G.L.	0.00		0.00
<u>391600</u>	NE	31	26	3	5	KRIEGER DRILLING LTD.	1981-10-14	27.43	New Well- Decommissioned	Domestic		9		PARKER, G.L.			0.00
<u>395786</u>	NE	31	26	3	5	PARSONS DRILLING	1981-11-19	62.48	New Well	Domestic & Stock		21		PARKER, G.L.	48.77	68.19	17.78
<u>395793</u>	NE	31	26	3	5	UNKNOWN DRILLER		62.48	Chemistry	Domestic				KIRK, S.			0.00
<u>494773</u>	NE	36	26	4	5	ALKEN BASIN DRILLING LTD.	1999-11-16	30.48	New Well	Stock		4	9	GOETJEN, MORRIE	22.25	63.65	13.97
<u>498400</u>	NW	31	26	3	5	MEDICINE VALLEY WATER WELLS	2001-05-14	74.68	New Well	Domestic		14	24	GIBBS, DAVE	10.82	9.09	13.97
<u>1022436</u>	9	36	26	4	5	AARON DRILLING INC.	2014-05-05	30.48	New Well	Investigatio n		6		LAFARGE CANADA INC			16.81
<u>1475698</u>	16	31	26	3	5	M&M DRILLING CO. LTD.	2003-01-14	39.62	New Well	Domestic		10	24	QUICK WAY FARMS LTD	32.00	45.46	14.13
<u>1475699</u>	15	31	26	3	5	M&M DRILLING CO. LTD.	2003-01-17	53.95	New Well	Domestic		10	24	QUICK WAY FARMS LTD	32.64	24.55	14.13
2095665	SW	6	27	3	5	UNKNOWNDRILLINGCOMP11		25.60	Well Inventory	Domestic & Stock		1		CIRCLE J RANCHES LTD			

## Water Well Drilling Report

View in Imperial Export to Excel

350194

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public databas Date Report Received 1990/03/16 Well Identification and Location Measurement in Metric Address Postal Code Owner Name Town Province Country TOL OWO DAVIDSON, D.W. P.O. BOX 970 COCHRANE 1/4 or LSD SEC TWP RGE W of MER Block Additional Description Location Lot Plan SW 31 026 03 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.259801 Longitude -114.414277 m m from How Elevation Obtained How Location Obtained m from Not Verified Not Obtained

**Drilling Information** Method of Drilling Type of Work Cable Tool New Well **Proposed Well Use** Domestic Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate 0.00 L/min Water Depth from Lithology Description Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 54.55 6.10 Boulders 1990/03/09 15.24 10.67 Sand & Gravel Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth End Date Start Date 12.19 Sand 35.05 m 1990/03/02 1990/03/09 15.24 Gravel **Borehole** 18.29 Gray Shale Diameter (cm) From (m) To (m) 22.86 Light Green Shale 0.00 0.00 35.05 28.96 Green Shale Surface Casing (if applicable) Well Casing/Liner 32.00 Green Shale Steel Steel Size OD : 14.12 cm Size OD : 11.43 cm 35.05 Green Shale 0.478 cm 0.318 cm Wall Thickness : Wall Thickness : Bottom at : 15.24 m Top at : 13.72 m Bottom at : 35.05 m Perforations Diameter or Slot Hole or Slot Slot From (m) To (m) Width(cm) Length(cm) Interval(cm) 22.86 35.05 0.318 25.40 Perforated by Torch Annular Seal Driven Placed from 0.00 m to 15.24 m Amount Other Seals At (m) Type Screen Type Size OD : 0.00 cm From (m) To (m) Slot Size (cm) Attachment Bottom Fittings Top Fittings Pack Grain Size Type 0.00 Amount

#### Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name LOU'S WATER WELL DRILLING

Certification No 1

#### The driller supplies the data contained in this report. The Province disclaims responsibility for its

GoA Well Tag No.

View in Imperial Export to Excel

350194

Drilling Company Well ID

GIC Well ID

acc	uracy. The information on thi	s report will be retaine	d in a public database.	, , , , , , , , , , , , , , , , , , , ,	Date Rep	ort Received	1990/03/16
Well Identification and Location						Me	easurement in Metric
Owner Name DAVIDSON, D.W.	Address P.O. BOX 970 COCH	RANE	Town	P	rovince	Country	Postal Code T0L 0W0
Location1/4 or LSDSECSW31	TWP         RGE           026         03	W of MER 5	Lot Block	Plan	Additional Descri	otion	
Measured from Boundary of m from m from		GPS Coordinate Latitude 51.2 How Location O Not Verified	es in Decimal Degre 59801 Longi btained	es (NAD 83) tude <u>-114.4142</u> 7	7 Elevation How Ele Not Obta	n evation Obtained ained	
Additional Information						Me	easurement in Metric
Distance From Top of Casing to Gr Is Artesian Flow Rate	ound Level	cm	Is Flow Con	trol Installed Describe			
Recommended Pump Rate		0.00 L/min	Pump Installed		Depth	n	<u>–</u>
Recommended Pump Intake Depth	(From TOC)	0.00 m	Туре	M	ake	H.P.	
					Model	(Output Rating)	
Did you Encounter Saline Water	>4000 ppm TDS)	Depth	m	Well Disinfecte	ed Upon Completic	on	
	Gas	Depth	m	Geophys	sical Log Taken		
				Subi	mitted to ESRD		
Additional Comments on Well			Sample Co	ollected for Potal	pility	Submitted	to ESRD
Yield Test				Taken	From Ground Le	evel Me	easurement in Metric
Test Date Start Ti	ne Stati	c Water Level	Draw	down (m)	Elansed Tin	ne	Recovery (m)
1990/03/09 12:00 A	M	15.24 m		down (m)	Minutes:Se	ec	
Method of Water Removal							
Type Bailer							
Removal Rate	54.55 L/min						
Depth Withdrawn From	0.00 m						
If water removal period was < 2 ho	ırs, explain why						
Water Diverted for Drilling							
Water Source	Am	ount Taken L			Diversion Date &	Time	

Contractor Certification
Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER
Company Name

LOU'S WATER WELL DRILLING

Government

of Alberta 🗖

Certification No 1

## Water Well Drilling Report

View in Imperial Export to Excel

GIC Well ID 360164 GoA Well Tag No. The driller supplies the data contained in this report. The Province disclaims responsibility for its Drilling Company Well ID accuracy. The information on this report will be retained in a public databas Date Report Received 1991/10/24 Well Identification and Location Measurement in Metric Address Town Postal Code Owner Name Province Country BARGETZI, ERNIE 233 RATCLIFF PLACE SE, CALGARY SEC TWF W of MER 1/4 or LSD RGE Block Plan Additional Description Location Lot SE 06 027 03 2 9110979 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Longitude -114.405998 Elevation Latitude 51.274744 m m from How Elevation Obtained How Location Obtained m from Not Verified Not Obtained **Drilling Information** Method of Drilling Type of Work Rotarv New Well **Proposed Well Use** Domestic Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate 136.38 L/min Water Depth from Lithology Description Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 9.45 Till & Clay 1991/10/08 136.38 33.53 21.64 Gravel Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 25.30 Brown Shale 73.15 m 1991/10/08 1991/10/08 34.75 Gray Shale **Borehole** Gray Sandstone 39.62 Diameter (cm) From (m) To (m) 44.20 Gray Shale 0.00 0.00 73.15 51.82 Gray Sandstone Surface Casing (if applicable) Well Casing/Liner 59.74 Gray Shale Steel Steel Size OD : 14.12 cm Size OD : 11.43 cm 66.75 Gray Sandstone 0.396 cm Wall Thickness : 0.620 cm Wall Thickness : 73.15 Gray Shale Bottom at : 24.99 m Top at : 18.29 m Bottom at : 73.15 m Perforations Diameter or Slot Hole or Slot Slot From (m) To (m) Width(cm) Length(cm) Interval(cm) 36.58 67.06 0.157 15.24 Perforated by Torch Annular Seal Drive Shoe Placed from 0.00 m to 24.99 m Amount Other Seals At (m) Type Screen Type Size OD : 0.00 cm From (m) To (m) Slot Size (cm) Attachment Bottom Fittings Top Fittings Pack Grain Size Type

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name AERO DRILLING & CONSULTING LTD.

Certification No 1

Amount

0.00

# Water Well Drilling ReportView in Imperial<br/>GIC Well ID<br/>GoA Well Tag No.Export to Excel<br/>360164

Alber	rta 🗖	The dr accura	iller supplies t acy. The inform	the data conta nation on this	ained in this report report will be reta	. The Province ined in a publi	e disclaims re ic database.	esponsibility for	its	Drilling Company	Well ID ived	1991/10/24
Nell Identifica	ation and Lo	ocation								-	Mea	asurement in Me
<mark>Owner Name</mark> BARGETZI, ER	RNIE		Address 233 RATCL	.IFF PLACE	E SE, CALGARY	Town			Province	Country	/	Postal Code
Location 1/ S	/4 or LSD E	SEC 06	<i>TWP</i> 027	RGE 03	W of MER 5	Lot	Block 2	<i>Plan</i> 9110979	Additio	nal Description		
Measured from	ו Boundary of ו ו	f m from m from			GPS Coordin Latitude <u>5</u> How Location Not Verified	ates in Deci 1.274744 n Obtained	imal Degree Longi	es (NAD 83) itude <u>-114.40</u>	5998	Elevation How Elevation Or Not Obtained	btained	<u>m</u>
Additional Info	ormation										Mea	asurement in Me
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Ra	ate		L/min					Describe				
Recommended	d Pump Rate	) 			136.38 L/min	Pump	Installed			Depth	m	
Recommended	d Pump Intak	ke Depth (F	rom TOC)		0.00 m	lype			Make		Н.Р.	
		14/ / / /	1000 T							Model (Output I	Rating)	
Did you Enco Additional C	counter Saline Comments on	e Water (>4 n Well	2000 ppm TL G	DS) Gas	Depth Depth		m m Sample Co	Well Disinfe Geop S Dllected for Pc	ected Upon hysical Log ubmitted to otability	Model (Output I Completion g Taken DESRD Sub	Rating)	) ESRD
Did you Enco Additional C Yield Test	counter Saline	ə Water (>4 n Well	1000 ppm TE G	DS) Gas	Depth Depth		m m Sample Co	Well Disinfe Geop S Dillected for Pc	ected Upon hysical Log ubmitted to btability	Model (Output I Completion Taken DESRD Sub Ground Level	Rating)	ESRD
Did you Enco Additional C Yield Test Test Date 1991/10/08	counter Saline	e Water (>4 n Well Start Time 12:00 AM	1000 ppm TL G	DS) Gas Static	Depth Depth		m Sample Co	Well Disinfe Geop S ollected for Pc <b>Take</b> down (m)	ected Upon hysical Log cubmitted to otability en From G Depti	Model (Output I Completion Taken DESRD Sub Stround Level h to water level Elapsed Time Minutes:Sec	Rating)	ESRD asurement in Me accovery (m)
Did you Enco Additional C Yield Test Test Date 1991/10/08 Method of Wa Rem Depth Withdra If water remove	counter Saline Comments on Ater Remova Type <u>Ai</u> noval Rate awn From ral period was	e Water (>4 a Well Start Time 12:00 AM 1 13: 3: 3: 5 < 2 hours	5.38 L/min 9.62 m	DS) Gas Static	Depth Depth		m Sample Co	Well Disinfe Geop S ollected for Pc Take	ected Upon hysical Log cubmitted to btability en From C Dept E	Model (Output I Completion g Taken b ESRD Sub Ground Level h to water level Elapsed Time Minutes:Sec	Rating)	asurement in Me
Did you Enco Additional C Yield Test Test Date 1991/10/08 Method of Wa Remo Depth Withdra If water remova	counter Saline Comments on Ater Remova Type <u>Ai</u> noval Rate awn From val period was	e Water (>4 9 Well 12:00 AM 13 13 13 13 5 < 2 hours	5.38 L/min 9.62 m	DS) Gas Static	Depth Depth		m Sample Co	Well Disinfe Geop S ollected for Po <b>Take</b> down (m)	ected Upon hysical Log bubmitted to bability en From G Depti	Model (Output I Completion g Taken b ESRD Sub Ground Level h to water level Elapsed Time Minutes:Sec	Rating)	asurement in Me
Did you Enco Additional C Yield Test Test Date 1991/10/08 Method of Wa Remu Depth Withdra If water remove	counter Saline Comments on Ater Remova Type Ai avan From awn From ral period was ed for Drillin	e Water (>4 9 Well 12:00 AM 11 130 130 130 130 130 130 130	6.38 L/min 9.62 m 9.62 m	DS) Gas Static	Depth Depth		m Sample Co	Well Disinfe Geop S Dillected for Pc Take	ected Upon hysical Log cubmitted to otability en From G Dept E	Model (Output I Completion g Taken b ESRD Sub Sround Level h to water level Elapsed Time Minutes:Sec	Rating)	asurement in Me

Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name AERO DRILLING & CONSULTING LTD. Certification No 1

Copy of Well report provided to owner Date approval holder signed

Government

## Water Well Drilling Report

View in Imperial Export to Excel

GIC Well ID 387449 GoA Well Tag No. The driller supplies the data contained in this report. The Province disclaims responsibility for its Drilling Company Well ID accuracy. The information on this report will be retained in a public database Date Report Received Well Identification and Location Measurement in Metric Address Postal Code Owner Name Town Province Country BRISTOW, C.R. COCHRANE 1/4 or LSD SEC TWP W of MER RGE Block Plan Additional Description Location Lot NE 36 026 04 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.267032 Longitude -114.426119 1292.35 m m from How Location Obtained How Elevation Obtained m from Map Estimated **Drilling Information** Method of Drilling Type of Work Cable Tool New Well Proposed Well Use Unknown Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate 0.00 L/min Water Depth from Lithology Description Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 21.95 4.88 Yellow Clay 1962/08/10 72.74 21.03 Gravel Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 23.77 Fine Grained Sand 33.83 m 1962/08/10 25.91 Yellow Clay **Borehole** 26.82 Blue Clay Diameter (cm) From (m) To (m) 27.13 Hard Shale 0.00 0.00 33.83 28.04 Sand Surface Casing (if applicable) Well Casing/Liner 32.00 Blue Shale & Sandstone Ledges Size OD : 0.00 cm Size OD : 0.00 cm 33.83 Gray Shale 0.000 cm 0.000 cm Wall Thickness : Wall Thickness : 0.00 m Bottom at : Top at : 0.00 m Bottom at : 0.00 m Perforations Diameter or Slot Hole or Slot Slot From (m) To (m) Width(cm) Length(cm) Interval(cm)

Perforated by

Annular Seal				
Placed from	0.00 m to	0.00 m		
Amount				
Other Seals				
Тур	e		At (m)	
Screen Type				
Size OD :	0.00 cm			
From (m)	То	(m)	Slot Size (cm)	
Attachment				
Top Fittings		Bottom Fitt	ings	

Pack Туре

Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PARSONS DRLG

Certification No 1

Copy of Well report provided to owner Date approval holder signed

Grain Size

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No. Drilling Company Well ID

View in Imperial Export to Excel

387449

ag No. pany Well ID Received

					Date Report Re	
Well Identification an	nd Location					Measurement in Met
Owner Name BRISTOW, C.R.	Address COCHRANE		Town	Prov	vince Cour	ntry Postal Code
Location 1/4 or LS. NE	D SEC TWP R 36 026 04	CGE W of MER 4 5	Lot Block	Plan A	dditional Description	
Measured from Bounda	ary of m from m from	GPS Coordinate Latitude 51.2 How Location O Map	es in Decimal Degree 267032 Longitu Ibtained	s (NAD 83) ude <u>-114.426119</u>	Elevation How Elevation Estimated	1292.35 m n Obtained
Additional Informatio	n					Measurement in Me
Distance From Top of Is Artesian Flow Rate	Casing to Ground Level	cm	Is Flow Conti	ol Installed Describe		
Recommended Pump	Rate	0.00 L/min	Pump Installed		Depth	m
Recommended Pump	Intake Depth (From TOC)	0.00 m	Туре	Mak	e	H.P.
					Model (Outp	ut Rating)
Dia you Encounter S	Gas	Depth	m	Geophysic	upon Completion al Log Taken	
Additional Commen	ts on Well		Sample Co	lected for Potabili	y	Submitted to ESRD
Additional Commen	ts on Well		Sample Co.	llected for Potabili	m Ground Level	Submitted to ESRD
Additional Commen Yield Test Test Date 1962/08/10	ts on Well Start Time 12:00 AM	Static Water Level 21.95 m	Sample Co.	lected for Potabilit	om Ground Level Depth to water level Elapsed Time Minutes:Sec	Submitted to ESRD Measurement in Me Recovery (m)
Additional Commen Yield Test Test Date 1962/08/10 Method of Water Rem Typ Removal Rai Depth Withdrawn Frod	ts on Well          Start Time         12:00 AM         noval         Bailer         te       72.74 L/min         m       0.00 m	Static Water Level 21.95 m	Sample Co.	Ilected for Potabilit	byS byS com Ground Level Depth to water level Elapsed Time Minutes:Sec	Submitted to ESRD
Additional Commen Yield Test Test Date 1962/08/10 Method of Water Ren Typ Removal Rat Depth Withdrawn Fro If water removal period	ts on Well          Start Time         12:00 AM         noval         be         Bailer         te       72.74 L/min         m       0.00 m         d was < 2 hours, explain why	Static Water Level 21.95 m	Sample Co.	lected for Potabili	pm Ground Level Depth to water level Elapsed Time Minutes:Sec	Submitted to ESRD Measurement in Me Recovery (m)
Additional Commen Yield Test Test Date 1962/08/10 Method of Water Ren Typ Removal Rat Depth Withdrawn Frod If water removal period Water Diverted for D	ts on Well          Start Time         12:00 AM         noval         be         Bailer         te       72.74 L/min         m       0.00 m         d was < 2 hours, explain why	Static Water Level 21.95 m	Sample Co.	Iected for Potabilit	by S	Submitted to ESRD Measurement in Me Recovery (m)

Contractor Certification
Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Company Name PARSONS DRLG

Government

of Alberta

Certification No 1

## Water Well Drilling Report

View in Imperial Export to Excel

390998

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

	The driller supp accuracy. The i	lies the data con nformation on thi	tained in this reports reports report will be retained	t. The Provinc ained in a publ	e disclaims re ic database.	esponsibility fo	r its	Drilling Company Well Date Report Received	ID 1987/03/05
Well Identification and Lo	cation								Measurement in Metric
Owner Name STRANGE, R.	Addres P.O. BO	s DX 981 COCH	RANE	Town			Province	Country	Postal Code TOL 0W0
Location 1/4 or LSD SE	SEC TWP 06 027	RGE 03	W of MER 5	Lot	Block	Plan	Additio	nal Description	
Measured from Boundary of m m	1 from		GPS Coordir Latitude 5 How Location Not Verified	nates in Dec i1.274744 n Obtained	imal Degree Longi	es (NAD 83) tude <u>-114.4</u>	05998	Elevation How Elevation Obtain Not Obtained	m Ned

Drilling Informat	ion								
Method of Drillin	g		Type of Work						
Rotary	-		New Well						
Proposed Well U Domestic & Stock	lse								
Formation Log			Measurement in Metric	Yield Test Sur	mmary			М	easurement in Metric
Depth from	Water	Lithology Description		Recommended	Pump Rat	e 27	.28 L/min	_	
ground level (m)	Bearing			Test Date	Water F	Removal Rate	(L/min)	Stati	ic Water Level (m)
7.62		Till		1987/02/11		36.37			45.72
10.36		Gravel		Well Completi	on			М	easurement in Metric
11.58		Silty Clay		Total Depth Drill	led Finisł	ned Well Dep	th Start	Date	End Date
17.68		Weathered Shale		Barabala			1907/	02/10	1907/02/11
27.43		Shale		Diamoter	(cm)	E	m (m)		To (m)
39.62		Sandstone		0.00			0.00		65.53
48.77		Shale		Surface Casing	g (if applic	able)	Well Ca	sing/Line	r
60.96		Sandstone		Steel	<b>-</b>	6.94 677	Plastic		40.70
62.48		Shale		Size OL Wall Thickness	): <u>1</u>	0.04 CM	W/2// T	SIZE UD :	0.630 cm
63.70		Sandstone		Rottom a	3. 0 nt· 1	8 29 m	vvail I	Ton at .	16.76 m
65.53		Shale		Dottoill a		0.20 111	F	Rottom at :	65.53 m
				From (m) 1 47.24 Perforated by Annular Seal Placed from Amount Other Seals Screen Type Size OL From (n Attachmer Top Fitting Pack Type	To (m) 59.44 Machir Driven 0.0 Type D: n) nt s	0.00         cm           0.000         cm           0         m         to           0.000         cm         cm	Slo Lengtr 11.58	n Fittings	Hole or Slot Interval(cm) 0.10
				Amount					

#### Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name ALBERTA SOUTHERN EXPLORATION DRILLING LTD.

Certification No 1

The driller supplies the data contained in this report. The Province disclaims responsibility for its

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390998

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

	accu	iracy. The information	on on this report will be reta	ained in a publi	c database.			Date Report Recei	ved 1987/03/05
Well Identifica	ation and Location								Measurement in M
<i>Owner Name</i> STRANGE, R.		Address P.O. BOX 981	COCHRANE	Town			Province	Country	Postal Co T0L 0W0
Location 1/4 SE	/4 or LSD SEC E 06	<i>TWP F</i> 027 0	RGE W of MER 3 5	Lot	Block	Plan	Additio	nal Description	
Measured from	Boundary of m from m from		GPS Coordir Latitude How Location Not Verified	nates in Decl 51.274744 n Obtained	imal Degre Longi	es (NAD 83) itude <u>-114.4</u> 0	05998	Elevation How Elevation Of Not Obtained	m
Additional Info	ormation								Measurement in M
Distance From Is Artesian Flo Ra	n Top of Casing to Gro ow ate	und Level	cm	ls	s Flow Con	trol Installed Describe			
Recommended	d Pump Rate		27.28 L/mir	n Pump	Installed			Depth	m
Recommended	d Pump Intake Depth	(From TOC)	62.48 m	Туре			Make	·	H.P.
				-				Model (Output F	Rating)
Did you Enco Additional Co	ounter Saline Water (: Comments on Well	>4000 ppm TDS) Gas	Depth	nn	m m Sample Co	Well Disini Geo ollected for F	fected Upon physical Log Submitted to Potability	Completion g Taken b ESRD Sub	mitted to ESRD
Yield Test						Tak	en From G	Ground Level	Measurement in M
Test Date	Start Tin	ne	Static Water Level				Dept	h to water level	
1987/02/11	12:00 AM	Λ	45.72 m		Draw	/down (m)	E	lapsed Time Minutes:Sec	Recovery (m)
Method of Wa Remo Depth Withdra	nter Removal Type <u>Air</u> oval Rate awn From	<u>36.37 L/mi</u> n 0.00 m							
lf water remova	al period was < 2 hou	rs, explain why							
Water Diverte	ed for Drilling								
Water Source			Amount Taken				Diversio	n Date & Time	
Water Diverte	ed for Drilling		Amount Taken	<u>.</u>			Diversio	n Date & Time	

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER	Certification No 1	
Company Name ALBERTA SOUTHERN EXPLORATION DRILLING LTD.	Copy of Well report provided to owner	Date approval holder signed

Government

of Alberta 🗖

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# Government Water Well Drilling Report View in Imperial Export to Excel 30099

AIDCI	ld 🗖	The	driller supplies	the data cor	ntained in this repor	t. The Provinc	ce disclaims re	esponsibility	for its	Drilling Compa	iny Well	ID
Nell Identifica	tion and I	ocation								Date Report R	eceived	1987/12/02 Measurement in Me
Owner Name		ocation	Address			Town			Province	Cou	ntrv	Postal Code
STRANGE, R.			P.O. BOX	981 COCH	IRANE	TOWN			TTOVINCE	000	IIIIy	TOL OWO
Location 1/- SE	4 or LSD	SEC 06	<i>TWP</i> 027	RGE 03	W of MER 5	Lot	Block	Plan	Additio	nal Description		
Measured from	Boundary o	of			GPS Coordir	nates in Dec	cimal Degree	es (NAD 8	3)	<b>[</b> ]		
		m from				01.274744	Longi	uae -114	.405998	Elevation	n Obtai	m
		m from			Not Vorified	n Oblaineu				Not Obtained	n Oblan	ieu
				1	Not vermed							
Drilling Informa	ation											
Method of Drill	ing				Type of Wor	rk						
Rotary					New Well							
Proposed Well Stock	Use											
Formation Log	1			Me	easurement in l	Metric	Yield Tes	st Summ	ary			Measurement in Me
Depth from	Water	Litholo	gy Descriptio	n			Recomme	ended Pun	np Rate	31.82 L/min	-	
ground level (m	) Bearing						Test D	ate V	later Removal	Rate (L/min)	St	atic Water Level (m)
5.79		Till					1987/11	/19	45.4	16		39.62
8.84		Grave	el				Well Con	npletion				Measurement in Me
9.75		Till					Total Dep	th Drilled	Finished Wel	I Depth Start	Date	End Date
16.76		Yellow	Sandstone				Porcholo			1907/	11/10	1907/11/19
20.12		Gray S	Sandstone				Diar	neter (cm`	)	From (m)		To (m)
30.48		Shale	2				Diai	0.00		0.00		73.15
36.88		Sands	stone				Surface C	Casing (if	applicable)	Well Ca	sing/Li	ner
39.62		Shale	-				Steel	iza OD ·	16.84 cr	Plastic	Siza ()	D: 12.70 cm
40.23		Moist	Sandstone				Wall Thi	ckness :	0.478 cr	m Wall T	hicknes	s: 0.630 cm
50.29		Shale					Во	ttom at :	11.89 m	<u> </u>	Тор а	at: 9.14 m
51.82		Sand	stone					-		E	Bottom a	at: 73.15 m
58.22		Shale					Perforatio	ons				
04.01	Vaa	Shale	Desuine Con	ماملام					Diamete	er or t Slo	t	Hole or Slot
73.15	res	Shale	bearing San	astone			From (m 39.62	) To (1	m) Width( 15 0.15	(cm) Length	i(cm)	Interval(cm) 15.24
							Perforated	dby (	Other			
							Appular					
							Placed	from	0.00 m	to 9.75	m	
							Am	nount				
							Other Sea	als				
								Ту	pe			At (m)
							Screen T	ype				
							S	ize OD :	0.00 cr	m		
							FI	rom (m)		To (m)		Slot Size (cm)
							Atta	chmont				
							Top	Fittinas		Botto	n Fittinc	is.
							Pack					·
							Type			Grain	Size	
							Amoun	1		0.011		
						'						
·												

Company Name ALBERTA SOUTHERN EXPLORATION DRILLING LTD.

## Government Water Well Drilling Report View in Imperial Export to Excel 300999

f Alber	ta 🗖	The d	riller supplies acy. The info	the data cor rmation on th	ntained in this repo is report will be ret	ort. The Provinc tained in a publ	e disclaims relic database.	esponsibility for	rits	GoA Well Tag No. Drilling Company V Date Report Recei	Well ID ived	1987/12/02
Well Identifica	ation and Lo	ocation									Mea	asurement in Me
<del>Owner Name</del> STRANGE, R.			Address P.O. BOX	981 COCH	IRANE	Town			Province	Country	r	Postal Code T0L 0W0
Location 1/ S	/4 or LSD E	SEC 06	<i>TWP</i> 027	RGE 03	W of MER 5	Lot	Block	Plan	Additio	nal Description		
Measured from	Boundary of				GPS Coord	inates in Dec	imal Degre	es (NAD 83)				
	n	n from			Latitude	51.2/4/44	Longi	tude -114.40	05998	Elevation		m
	n	n from			How Locatio	on Obtained				How Elevation O	btained	
					Not Verified				I	Not Obtained		
dditional Info	ormation										Mea	surement in Me
Distance From	Top of Casir	na to Grou	ind Level		cm							
Is Artesian Flo	ow	19 10 0100	-		GIII		s Flow Con	trol Installed				
Ra	ate		L/min					Describe				
Pecommende	d Pump Rate				31.82   /mi	in Pumr	Installed			Depth	m	
Recommende	d Pump Intak	o Donth (I			60.96 m	Type			Mako	Deptin	нр	
(econninende)	a r unip intak	e Depuii (i	10111 100)		00.90 111				Make	Model (Output I	Ratina)	
											(dung)	
Did you Enco	ounter Saline	Water (>4	4000 ppm 1	DS)	Dept	h	m	Well Disinf	ected Upon	Completion		
				Gas	Dept	h	m	Geop	physical Log	g Taken		
									Submitted to	o ESRD		
Additional C	comments on JRES AT 130	Well )-132' @ 1	GPM, 210	-234' @ 8-	10 GPM.		Sample Co	ollected for P	otability	Sub	omitted to	ESRD
ield Test								Tak	en From C	Ground Level	Mea	surement in Me
Taat Data		Ctort Time		Ctat	a Matar Laval				Dept	h to water level		
1987/11/19		12:00 AM	7	Stati	39.62 m		Draw	/down (m)	E	Elapsed Time Minutes:Sec	R	ecovery (m)
<b>Wethod of Wa</b> Rem	<b>iter Removal</b> Type <u>Air</u> oval Rate	/ r4	5.46 L/min									
Depth Withdra	awn From		0.00 m									
lf water remov	al period was	s < 2 hours	s, explain w	hy								
Vater Diverte	ed for Drilling	g										
Water Source				Am	ount Taken	L			Diversio	on Date & Time		

Contract	or Centifica	tion		
Name of	lournovman	responsible	for d	rillina

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Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name ALBERTA SOUTHERN EXPLORATION DRILLING LTD. Certification No 1

Location

## Water Well Drilling Report

View in Imperial Export to Excel

GIC Well ID

391000

Static Water Level (m)

28.96

Measurement in Metric End Date

1984/11/07

To (m)

40.23

11.43 cm 0.318 cm

0.00 m

40.23 m

Hole or Slot Interval(cm) 25.40

At (m)

Slot Size (cm)

GoA Well Tag No. The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database. Drilling Company Well ID Date Report Received 1984/12/05 Well Identification and Location Measurement in Metric Address Town Postal Code Owner Name Province Country CIRCLE J RANCHES **RR2, COCHRANE** 1/4 or LSD SEC TWP W of MER Additional Description RGE Block Plan Lot 04 06 027 03 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Latitude 51.272936 Longitude -114.420414 Elevation m m from How Elevation Obtained How Location Obtained m from Мар Not Obtained **Drilling Information** Method of Drilling Type of Work New Well Cable Tool Proposed Well Use Domestic & S Formation Measurement in Metric

Domestic & Stock	<b>K</b>							
Formation Log		Measuremei	nt in Metric	Yield Test Su	mmary			Me
Depth from	Water	Lithology Description		Recommended	l Pump Ra	te 0.0	00 L/min	
ground level (m)	Bearing			Test Date	Water	Removal Rate (	(L/min)	Statio
3.05		Yellow Clay		1984/11/07		68.19		
7.32		Cemented Gravel		Well Complet	ion			Me
19.51		Gravel		Total Depth Dri	illed Finis	hed Well Deptl	h Start Dat	e
20.12		Cemented Gravel		40.23 m			1984/10/ <sup>,</sup>	15
29.87		Gravel & Boulders		Borehole				
32.92		Brown Shale & Sandstone		Diameter	(cm)	Fron	n (m)	
40.23	Yes	Brown Water Bearing Sandstone		Surface Casin	a (if annli	(cable)	Well Casin	a/Liner
				Steel	g (ii appii	cabic)	Steel	g/Linci
				Size O	D :	13.97 cm	Siz	e OD :
				Wall Thicknes	ss :	0.620 cm	Wall Thick	(ness :
				Bottom a	at:	31.09 m	Т	op at :
				Deuteurstiene			Botte	om at :
				Perforations		Diameter or		
						Slot	Slot	
				From (m)	To (m)	Width(cm)	Length(cm	1)
				33.33	39.02	0.390		
				Perforated by	Torch			
				Annular Seal	Driven			
				Placed from	0.	00 m to	1.22 m	_
				Amount			_	
				Other Seals	<b>T</b>			
					Type			At
				Screen Type	D /	0.00		
				Size U	D		(m)	
					iii)	10	(11)	-
				Attachme	nt			
				Top Fitting	gs		Bottom Fi	ittings
				Pack				_
				Туре			Grain Siz	е
				Amount				

#### Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name **DIVERSIFIED DRILLING & EXPLORATION CO.** 

Certification No 1

#### The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GoA Well Tag No. Drilling Cor

View in Imperial Export to Excel

391000

GIC Well ID

ort Received	1984/12/05
mpany Well ID	

Well Identification	n and Location								Measurement in Metr
Owner Name CIRCLE J RANCHE	S	Address RR2, COCH	IRANE		Town		Province	Country	Postal Code
Location 1/4 or 04	LSD SEC 06	<i>TWP</i> 027	<i>RGE</i> 03	W of MER 5	Lot Block	Plan	Addition	al Description	
Measured from Bou	indary of m from m from			GPS Coordinate Latitude 51.2 How Location O Map	es in Decimal Degr 272936 Long btained	ees (NAD 83) jitude114.42	20414	Elevation How Elevation Ob Not Obtained	m tained
Additional Informa	ation								Measurement in Metr
Distance From Top Is Artesian Flow Rate	o of Casing to Gro	und Level		cm	Is Flow Co.	ntrol Installed Describe			
Recommended Pu	mp Rate			0.00 L/min	Pump Installed			Depth	m
Recommended Pu	mp Intake Depth	(From TOC)		0.00 m	Туре		Make		H.P.
								Model (Output R	ating)
Did you Encount	er Saline Water (:	-4000 ppm TE	DS)	Depth	m	Well Disinfe	ected Upon (	Completion	
		G	as	Depth	m	Geop	ohysical Log Submitted to	Taken ESRD	
Additional Comn	nents on Well	G	as	Depth	m Sample C	Geop S Collected for Po	ohysical Log Submitted to otability	Taken ESRD Subr	nitted to ESRD <u>Yes</u>
Additional Comn	nents on Well	G	sas	Depth	m Sample (	Geop S Collected for Po Take	ohysical Log Submitted to otability en From Gr	TakenSubr	nitted to ESRD <u>Yes</u> Measurement in Metr
Additional Comm Yield Test Test Date 1984/11/07	nents on Well Start Tin 12:00 AM	ne A	static	Depth Water Level 28.96 m	m Sample C	Geop S Collected for Po Take wdown (m)	ohysical Log Submitted to otability en From Gr Depth Ela M	TakenSubr Subr Tound Level to water level apsed Time inutes:Sec	nitted to ESRD <u>Yes</u> Measurement in Metr Recovery (m)
Additional Comm Yield Test Test Date 1984/11/07 Method of Water I Removal Depth Withdrawn	nents on Well Start Tin 12:00 AN Removal Type <u>Bailer</u> Rate From	68.19 L/min 32.00 m	Static	Depth Water Level 28.96 m	m Sample C	Geop S Collected for Po Take wdown (m)	ohysical Log Submitted to otability en From Gr Depth Ela M	TakenSubra ESRDSubra Tound Level to water level apsed Time inutes:Sec	nitted to ESRD <u>Yes</u> Measurement in Metr Recovery (m)
Additional Comm Yield Test Test Date 1984/11/07 Method of Water I Removal Depth Withdrawn If water removal pe	nents on Well Start Tin 12:00 AM Removal Type Bailer Rate From eriod was < 2 hou	68.19 L/min 32.00 m	Static \	Depth Water Level 28.96 m	m Sample C	Geop S Collected for Po Take wdown (m)	ohysical Log Submitted to otability en From Gr Depth Ela M	TakenSubri ESRDSubri Tound Level to water level apsed Time inutes:Sec	nitted to ESRD <u>Yes</u> Measurement in Metr Recovery (m)
Additional Comm Yield Test Test Date 1984/11/07 Method of Water I Removal Depth Withdrawn If water removal per Water Diverted for	nents on Well Start Tin 12:00 AN Type Bailer Rate From eriod was < 2 hou	68.19 L/min 32.00 m	static	Depth Water Level 28.96 m	m Sample C	Geop S Collected for Po Take wdown (m)	ohysical Log Submitted to otability en From Gr Depth Ela M	TakenSubri ESRDSubri Tound Level to water level apsed Time inutes:Sec	nitted to ESRD <u>Yes</u> Measurement in Metr Recovery (m)

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER	Certification No 1	
Company Name DIVERSIFIED DRILLING & EXPLORATION CO.	Copy of Well report provided to owner	Date approval holder signed

Government

of Alberta 🗖

# Water Well Drilling ReportView in Imperial<br/>GIC Well ID<br/>GoA Well Tag No.Export to Excel<br/>391598

The driller supplies the data c accuracy. The information on	ontained in this report. this report will be retain	The Provinc ned in a publ	e disclaims re ic database.	sponsibility fo	or its	Drilling Company W Date Report Receiv	/ell ID /ed
Well Identification and Location							Measurement in Metric
Owner NameAddressMURRAY, R.J.511 19ST NW, CAL	GARY	Town			Province	Country	Postal Code
Location         1/4 or LSD         SEC         TWP         RGE           NW         31         026         03	W of MER 5	Lot	Block	Plan	Additior	nal Description	
Measured from Boundary of m from m from	GPS Coordina Latitude 51 How Location Map	ates in Dec 1.267033 Obtained	imal Degree Longit	es (NAD 83) ude <u>-114.4</u>	14280	Elevation How Elevation Ob Estimated	1290.83 m tained
Drilling Information							
Method of Drilling Cable Tool	<b>Type of Worl</b> New Well	k					
Proposed Well Use Domestic & Stock							
Formation Log	leasurement in M	/letric	Yield Tes	t Summar	у		Measurement in Metric
Depth from ground level (m) Water Bearing Lithology Description			Recomme Test Da	nded Pump ate Wat	Rate ter Removal	L/min Rate (L/min)	Static Water Level (m)
			Mall Car				Management in Matria
			Total Depa 39.62 m Borehole	h Drilled F	inished Well	From (m)	End Date
			Surface C	0.00 asing (if ar	oplicable)	0.00 Well Casing	39.62
			Steel	using (ii up		Steel	
			Si Wall Thi	ze OD :	17.78 cm	n Size n Wall Thickn	OD: <u>12.70 cm</u>
			Boi	tom at :	26.82 m	To	p at : 0.000 m
						Bottor	mat: 39.62 m
			From (m 31.09	) To (m) 38.10	Diamete Slot Width(0	er or Slot cm) Length(cm) 0	Hole or Slot Interval(cm) 0.00
			Perforated Annular S Placed Am	I by Seal Drive from ount	Shoe 0.00 m t	o0.00 m	
				Туре	2		At (m)
			Screen Ty Si	<b>/pe</b> ze OD :	0.00 cm	n	
			Fr	om (m)		To (m)	Slot Size (cm)
			Attao	chment			
			Тор	-ittings		Bottom Fitt	ings
			<b>Pack</b> Type			Grain Size	
			Amount	_			

#### Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PARSONS DRILLING Certification No 1

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No. Drilling Company Well

View in Imperial Export to Excel

391598

	Magguramont	Ξ.
ort Received		
ompany Well	ID	
Tag No.		

					Date Report Receiv	red
Well Identification and	Location					Measurement in Metric
<i>Owner Name</i> MURRAY, R.J.	Address 511 19ST NW, CAL	.GARY	NN	Province	Country	Postal Code
Location 1/4 or LSD NW	SEC         TWP         RGE           31         026         03	W of MER Lot 5	Block	Plan Additio	nal Description	
Measured from Boundary	of m from m from	GPS Coordinates in E Latitude <u>51.267033</u> How Location Obtaine Map	Decimal Degrees 3 Longitud ed	(NAD 83) de <u>-114.414280</u>	Elevation How Elevation Ob Estimated	1290.83 m tained
Additional Information						Measurement in Metric
Distance From Top of Ca Is Artesian Flow Rate	ising to Ground Level	cm	Is Flow Contro	l Installed Describe		
Recommended Pump Ra Recommended Pump Inf	ite	L/min Pu m Tj	mp Installed /pe	Make	Depth Model (Output R	m H.P ating)
Did you Encounter Sali	ne Water (>4000 ppm TDS) Gas	Depth Depth	m m	Well Disinfected Upon Geophysical Log Submitted to	Completion g Taken o ESRD	
Additional Comments of	on Well		Sample Colle	ected for Potability	Subr	nitted to ESRD
Yield Test				Taken From C	Ground Level	Measurement in Metrie
Test Date	Start Time Sta	atic Water Level m				
Method of Water Remo	val					
Removal Rate	L/min					
Depth Withdrawn From	m					
If water removal period w	/as < 2 hours, explain why					
Water Diverted for Drill	ling					
Water Source	A	mount Taken L		Diversio	on Date & Time	

C	on	tract	tor C	Cer	tific	cati	on	

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PARSONS DRILLING

Government

of Alberta 🗖

Certification No 1

## Water Well Drilling Report

View in ImperialExport to ExcelGIC Well ID391599GoA Well Tag No.391599

	The	driller supplies racy. The infor	the data cont mation on this	ained in this report. The Pro- s report will be retained in a p	ublic database.	y for its	Date Report Receive	ell ID ed
ion and L	ocation							Measurement in Me
		Address P.O. BOX	123 COCHF	To	งท	Province	Country	Postal Code T0L 0W0
or LSD	SEC 31	<i>TWP</i> 026	RGE 03	W of MER Lot 5	Block Plan	Addition	al Description	
Boundary o	f m from m from			GPS Coordinates in L Latitude <u>51.26703</u> How Location Obtaine Map	Decimal Degrees (NAD 8 Longitude <u>-114</u> ad	83) 4.402748	Elevation How Elevation Obta	1295.40 m ained
ition								
ng Use				<b>Type of Work</b> New Well-Abandonec				
			Mea	asurement in Metric	Yield Test Summ	nary		Measurement in Me
Water Bearing	Litholog	Jy Description	n		Recommended Put Test Date	mp Rate Water Removal	0.00 L/min Rate (L/min)	Static Water Level (m)
	Topso	<i>i</i> l			1981/10/10			0.00
	Gray C	lay			Well Completion			Measurement in Me
	Brown	Clay			Total Depth Drilled	Finished Well	Depth Start Date	End Date
	Brown	Sandy Clay			49.38 m			
	Sandy	Gravel			Borehole	,	-	- ( )
	Mediur	n Grained Gr	ravel		Diameter (cm 0.00	1)	From (m) 0.00	lo (m) 49.38
	Fine G	rained Grave	1		Surface Casing (in	f applicable)	Well Casing/	Liner
	Sands	tone						
	Fine G	rained Sand			Size OD :	0.00 cm	Size	OD : 0.00 cm
	Fine G	rained Grave	1		VVall Thickness :	0.000 cm		ess: 0.000 cm
	Shale				Bollom at .	0.00 11	Botton	nat: 0.00 m
	Dark S	hale			Perforations		Dottoli	
	Clay 8	Shale				Diamete	r or	
	Unkno	ywn			From (m) To	Slot (m) Width(d	Slot cm) Length(cm)	Hole or Slot Interval(cm)
					Perforated by Annular Seal Dri Placed from Amount Other Seals T	ven 0.00 m to ype	0.00 m	At (m)
					Screen Type Size OD :	0.00 cm	1	
					From (m)		— To (m)	Slot Size (cm)
					Attachment Top Fittings		Bottom Fitti	ngs
					<b>Pack</b> Type		Grain Size	
	on and Lo or LSD boundary of tion 1g Jse Water Bearing	on and Location  or LSD SEC 31  boundary of m from m from  from  Jse  Water Bearing Water Bearing Kutholog Brown Brown Brown Brown Sandy Mediur Sandy Mediur Sands Fine G Sands Fine G Shale Dark S Clay 8 Unkno	on and Location  Address P.O. BOX  or LSD SEC TWP 31 026  loundary of m from m from  fion  g  Jse  Vater Bearing Vater Bearing Gray Clay Gray Clay Gray Clay Brown Clay Brown Sandy Clay Brown Sandy Clay Sandy Gravel Medium Grained Grave Sandstone Fine Grained Grave Sandstone Fine Grained Grave Shale Clay & Shale Medium Grained Grave Clay & Shale Clay & Sh	on and Location  Address P.O. BOX 123 COCHF or LSD SEC TWP RGE 31 026 03  coundary of m from m from from Mereive  fion  g Jse  Mean Gravel Gray Clay Gray Clay Gray Clay Gray Clay Brown Sandy Clay Brown Sandy Clay Brown Sandy Clay Fine Grained Gravel Fine Grained Gravel Sandstone Fine Grained Gravel Shale Dark Shale Clay & Shale	on and Location       Address       Tov         Or LSD       SEC       TWP       RGE       W of MER       Lat         or LSD       SEC       TWP       RGE       W of MER       Lat         ioundary of       GPS Coordinates in E       Latitude       51.267033         m from       Map       Map         tion       Type of Work         ng       Type of Work         New Well-Abandoned         Jse       Measurement in Metric         Water       Lithology Description         Bearing       Topsoil         Gray Clay       Brown Clay         Brown Sandy Clay       Sandy Gravel         Medium Grained Gravel       Fine Grained Gravel         Fine Grained Gravel       Sandstone         Fine Grained Gravel       Shale         Dark Shale       Clay & Shale         Unknown       Unknown	On and Location       Address       Town         P.O. BOX 123 COCHRANE       Town         or LSD       SE       W of MER       Lot       Block       Plan         or LSD       S1       026       03       S       S         bundary of m from       GPS Coordinates in Decimal Degrees (NAD)       Latitude 51.267033       Longitude -11:         im from       How Location Obtained       Map       Map         tion       Type of Work       New Well-Abandoned         ise       Measurement in Metric       Recommended Puters in 1981/10/10         Water       Lithology Description       Recommended Puters in 1981/10/10         Brown Clay       Brown Sandy Clay       Borehole       Mealum Grained Gravel         Sandy Gravel       Medium Grained Gravel       Size OD :       Well Thickness :         Dark Shale       Unknown       Size OD :       Wall Thickness :         Dark Shale       Unknown       From (m)       To         Perforated by       Annuular Seal Dri       Placed from _Annuular Seal Dri         Placed from _Annuular Seal Dri       Top Fittings       Pack	on and Location       Address       Town       Province         P.O. BOX 123 COCHRANE       Town       Province         or LSD       SEC       TWP       RCE       W of MER       Lot       Block       Plan       Addition         or LSD       SEC       TWP       RCE       W of MER       Lot       Block       Plan       Addition         im from       GPS Coordinates in Decimal Degrees (MAD 83)       Longitude -114.402748       How Location Obtained       Mage         ition       Trype of Work       New Well-Abandoned       Map       Eatinude 51.267033       Longitude -114.402748       How Location Obtained         gray       Type of Work       New Well-Abandoned       Map       Eatinude State       Image: State State       Image: State State State State       Image: State       Image: State State       Image: State Sta	Address     Town     Province     Country       or LSD     SEC     TWP     RGE     W of MER     Lot     Block     Plan     Additional Description       or LSD     SEC     TWP     RGE     W of MER     Lot     Block     Plan     Additional Description       or LSD     SEC     TWP     RGE     W of MER     Lot     Block     Plan     Additional Description       m from     GPS Coordinates in Decimal Degrees (NAD 83)     Longitude -114.402748     Elevation     How Elevation Obt       m from     Map     Latitude SI.287033     Longitude -114.402748     Elevation     How Elevation Obt       m from     Map     Map     Recommended Pump Rate     0.00 L/min     Test Date     Water       Water     Lithology Description     Measurement in Metric     Water New Weil-Abandoned     Water New Veil-Abandoned       Water     Lithology Description     Measurement in Metric     Water Test Date     Water Newowal Rate (L/min)     198.1/10/10       Bearing     Topsoil     Topsoil     Water Reinoval Rate (L/min)     198.2/10/10     Well Completion     Noter       Bearing     Sandy Gravel     Dianeter Gravel     Sandy Gravel     Dianeter (cm)     From (m)     0.00 m       Sandy Gravel     Dark Shale     Dark Sha

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name KRIEGER DRILLING LTD. Certification No 1

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GIC Well ID GoA Well Tag No. Drilling Company Well ID Date Report Received

View in Imperial Export to Excel

391599

						Measure	ement in Metric	
NE	Town			Province	Сог	untry	Postal Code T0L 0W0	
W of MER 5	Lot	Block	Plan	Additic	nal Description			
GPS Coord	dinates in Deci	mal Degree	es (NAD 83)	)				
Latitude	51.267033	Longi	ude -114.4	02748	Elevation	1295.40 m		
How Location Obtained					How Elevation Obtained			
Мар					Estimated			
						Measure	ement in Metric	
cm		<b>E</b> law <b>O</b> am		1				
	10		$r_{\alpha}$					

	m from m from	Latitude <u>51.20</u> How Location Ol Map	57033 Long btained	itude -114.402748	Elevation How Elevation Estimated	1295.40 m Obtained
Additional Inform	ation					Measurement in Metric
Distance From Top Is Artesian Flow Rate	p of Casing to Ground Level	cm	Is Flow Cor	ntrol Installed Describe		
Recommended Pu	ump Rate	0.00 L/min	Pump Installed		Depth	m
Recommended Pu	ump Intake Depth (From TOC)	0.00 m	Туре	Make		Н.Р.
					Model (Output	t Rating)
Did you Encount	ter Saline Water (>4000 ppm TDS)	Depth	m	Well Disinfected U	pon Completion	
	Gas	Depth	m	Geophysical	Log Taken	
				Submitte	ed to ESRD	
Additional Com DRILLER REPOR Yield Test	ments on Well TS MED HARD WATER, NO SPE	CS FOR SURFACE CASIN	G	Taken Fro	m Ground Level	Measurement in Metric
Test Date	Start Time	Static Water Level		Ĺ	Depth to water level	
1981/10/10	12:00 AM	0.00 m	Drav	vdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
Method of Water Removal Depth Withdrawn If water removal pe	Removal Type Air I Rate L/min From 0.00 m eriod was < 2 hours, explain why					
Water Diverted for	or Drilling					
Water Source		Amount Taken		Dive	ersion Date & Time	

Government

of Alberta

Owner Name

PARKER, G.L.

Location

Well Identification and Location

1/4 or LSD

NE

Measured from Boundary of

Address

TWP

026

SEC

31

P.O. BOX 123 COCHRANE

RGE

03

L

Diversion Date & Time

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name KRIEGER DRILLING LTD.

Certification No 1
### Government Albarta

### Water Well Drilling ReportView in Imperial<br/>GIC Well IDExport to Excel<br/>391600

I Albert	d 🗖	The driller supplies the data co accuracy. The information on the section of the	ntained in this report. The Pro his report will be retained in a l	vince disclaims responsibility for its public database.	Drilling Company Well ID Date Report Received 1981/11/25
Well Identification	on and Loo	cation			Measurement in Metr
<i>Owner Name</i> PARKER, G.L.		Address P.O. BOX 123 COCH	To	wn Province	e Country Postal Code TOL 0W0
Location 1/4 NE	or LSD	SEC         TWP         RGE           31         026         03	W of MER Lot 5	Block Plan Additio	onal Description
Measured from B	oundary of m m	from	GPS Coordinates in L Latitude <u>51.26703</u> How Location Obtaine Map	Decimal Degrees (NAD 83) 3 Longitude <u>-114.402748</u> ad	Elevation <u>1295.40 m</u> How Elevation Obtained Estimated
Drilling Informat	tion				
Method of Drillin Rotary	g		<b>Type of Work</b> New Well-Abandoned	Plugged Plugged with	1981/10/14 Unknown
Proposed Well U Domestic	lse			Amount	
Formation Log		М	easurement in Metric	Yield Test Summary	Measurement in Metr
Depth from ground level (m)	Water Bearing	Lithology Description		Recommended Pump Rate Test Date Water Remova	L/min al Rate (L/min) Static Water Level (m)
0.30		Topsoil			
10.06		Sandy Till		Well Completion	Measurement in Metr
17.68		Clay & Shale		Total Depth Drilled Finished We	ell Depth Start Date End Date
20.12		Clay & Gravel		27.43 m	1981/10/11 1981/10/14
21.03		Shale		Borehole	
22.86		Clay & Silt		0.00	0.00 27.43
24.08		Gray Clay		Surface Casing (if applicable)	Well Casing/Liner
26.82		Clay & Gravel			
27.43		Lost Circulation			Size OD :         0.00 cm
				Bottom at : 0.000 r	m Top at : 0.00 m
					Bottom at : 0.00 m
				Perforations	
				Diame	ter or
				From (m) To (m) Width	n(cm) Length(cm) Interval(cm)
				Perforated by	
				Annular Seal Placed from 0.00 m	to0.00 m
				Other Seals	
				Туре	At (m)
				Screen Type	
				From (m)	io (m) Slot Size (cm)
				Attachment	
				Top Fittings	Bottom Fittings
				Pack	
				Туре	Grain Size
				Amount	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name KRIEGER DRILLING LTD. Certification No 1

### Water Well Drilling Report

View in ImperialExport to ExcelGIC Well ID391600GoA Well Tag No.391600

f Alber	rta 🗖	The c	driller supplies racy. The infor	the data cor mation on th	ntained in this rep is report will be r	port. The Provin retained in a pul	ice disclaims riblic database.	esponsibility fo	or its	GoA Well Tag No. Drilling Company V Date Report Recei	Vell ID ved 19	981/11/25
Well Identifica	ation and Lo	ocation									Measu	urement in Metric
<i>Owner Name</i> PARKER, G.L.			Address P.O. BOX	123 COCH	IRANE	Towr	7		Province	Country		Postal Code T0L 0W0
Location 1	1/4 or LSD NE	SEC 31	<i>TWP</i> 026	RGE 03	W of MER 5	? Lot	Block	Plan	Additio	nal Description		
Measured from	n Boundary o	f m from m from			GPS Coor Latitude How Loca Map	dinates in De 51.267033 tion Obtained	cimal Degre Longi	es (NAD 83, itude <u>-114.4</u>	) 402748	Elevation How Elevation OL Estimated	1295.40 i otained	<u>m</u>
Additional Inf	ormation										Measu	rement in Metric
Distance Fron Is Artesian Fi R	n Top of Casi low Pate	ng to Grou	und Level		cm	-	ls Flow Con	trol Installec Describe	d			
Recommende	ed Pump Rate	>			L/r	min Pum	np Installed			Depth	m	
Recommende	ed Pump Intal	ke Depth (	From TOC)		m	Тур	е		Make	Model (Output F	H.P. Rating)	
Did you Enc	counter Saline	∍ Water (>	4000 ppm T	DS) Gas	Dej Dej	pth pth	m m	Well Disin Geo	nfected Upon ophysical Log Submitted to	Completion g Taken c ESRD		
Additional (	Comments or	ı Well					Sample Co	ollected for H	Potability	Sub	mitted to E	SRD
Yield Test								Tal	ken From C	Ground Level	Measu	rement in Metric
Test Date		Start Tim	е	Stati	ic Water Level m	1						
Method of Wa Rem Depth Withdr	<b>ater Remova</b> Type noval Rate rawn From	1	L/min m									
If water remov	/al period wa	s < 2 hour	s, explain wl	лу								
Water Diverte	ed for Drillin	ıg										
Water Source				Am	ount Taken	L			Diversio	on Date & Time		

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER	

Company Name KRIEGER DRILLING LTD.

Government

Certification No 1

#### Water Well Drilling Report The deille

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AIDELL	.a 🗖	The driller accuracy.	supplies th The inform	ne data conta ation on this	ined in this report. The report will be retained	e Province in a public	e disclaims respo c database.	onsibility f	or its	Drilling Compa Date Report R	any Well ID eceived	1982/02/02
Well Identificati	on and Lo	ocation									Me	easurement in Met
Owner Name		Add	dress			Town			Province	Сог	intry	Postal Code
Location 1/4	or LSD	SEC 7 31 0	7. BOX 12 FWP 026	RGE 03	W of MER L	ot	Block	Plan	Additio	nal Description		
Measured from E	Boundary of r r	n from n from	_		GPS Coordinates Latitude 51.26 How Location Ob Map	s in Decii 67033 otained	mal Degrees Longitud	(NAD 83 e114.4	) 402748	Elevation How Elevation Not Obtained	n Obtaineo	m
Drilling Informa Method of Drillin Cable Tool Proposed Well U	tion ng Jse				<i>Type of Work</i> New Well							
Domestic & Stock	<											
Formation Log				Mea	surement in Met	ric	Yield Test S	Summa	ry	0.00 1.4 1	Me	easurement in Meti
Depth from ground level (m)	Water Bearing	Lithology De	scription				Recommend Test Date	led Pumj Wa	o <i>Rate</i> ater Removal	Rate (L/min)	Statio	: Water Level (m)
1.83		Brown Clay	& Boulde	rs			1981/11/1	9	68.1	.9		48.77
3.35		Gray Clay &	Boulders	6			Well Comp	letion			Me	easurement in Metr
3.96		Boulders					Total Depth	Drilled	Finished Wel	Depth Start	Date	End Date
10.97		Brown Clay	& Gravel				62.48 m			1981	/11/05	1981/11/19
13.72		Gravel					Borehole					
15.54		Brown Shale	e				Diamet	er (cm)		From (m)		To (m) 62 48
21.64		Gray Hard S	hale				Surface Cas	sing (if a	oplicable)	Well Ca	asina/Line	02.40
23.16		Gray Hard S	andstone				Steel		<i>pp:::cac)</i>	Steel		
25.30		Gray Shale					Size	OD :	17.78 cr	n	Size OD :	12.70 cm
26.82		Gray Sands	tone				Wall Thickr	ness :	0.587 cr	n Wall 7	hickness :	0.556 cm
27.74		Gray Shale					Bottor	m at :	13.72 m	_	Top at :	0.00 m
28.65		Gray Sandst	tone				Derferetion			l	Bottom at :	62.48 m
29.26		, Grav Soft Sa	indstone				Periorations	5	Diamete	or or		
30.78		Grav Hard S	andstone						Slot	Slo	ot	Hole or Slot
34.75		, Grav Firm Sh	nale				From (m)	To (m	i) Width(	cm) Lengtl	n(cm)	Interval(cm)
36.88		Grav Hard S	andstone				40.10	01.07	0.95	5		+0.0F
43.89		, Grav Firm Sh	nale				Perforated b	у то	orch			
45.11		Grav Hard S	andstone				Annular Sea	Drive	Shoe		_	
54.86		Grav Shale					Placed fro	m	0.00 m t	to <u>13.72</u>	2 m	
56.39	Yes	Gray Water	Rearing S	andstone			Amou	int				
67.48	103	Gray Shale	bearing 5	anastone			Other Seals	Tvn	0		Δ+	· (m)
02.40		Giay Silale						τyμ			AL	. (111)
							Screen Type Size From Attachr Top Fitt Pack Type Amount	e OD : n (m)  nent tings 0	0.00 cr	n_ To (m) Botto Grain	m Fittings _ Size	Slot Size (cm)
Contractor Cert Name of Journey JNKNOWN NA E Company Name PARSONS DRILI	tification man responded to the second secon	nsible for drillii	ng/constra	uction of w	ell		Ce 1 Ce	ertificatic	on No 'ell report pro	vided to owner	Date ap	proval holder signed

### Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

GIC Well ID GoA Well Tag No.

View in Imperial Export to Excel

395786

Drilling Company Well ID

Well Identif	fication and L	ocation								Measurement in Metri
<i>Owner Nam</i> PARKER, G	e i.L.	Ad P.C	dress 9. BOX 123 COC	HRANE	Town			Province	Country	Postal Code
Location	1/4 or LSD NE	SEC 7 31 0	WP RGE 26 03	W of MER 5	Lot	Block	Plan	Additional D	escription	
Measured fr	rom Boundary c	of m from m from	_	GPS Coord Latitude How Locat Map	dinates in Dec. 51.267033 ion Obtained	imal Degree Longit	es (NAD 83) iude <u>-114.4027</u>	7 <u>48</u> Ho Not	vation v Elevation Obt Obtained	mtained
Additional I	Information									Measurement in Metri
Distance Fr Is Artesian	rom Top of Cas n Flow Rate	sing to Ground I	.evel	cm	/:	s Flow Cont	rol Installed		_	
Recommen Recommen	nded Pump Rate	e ike Depth (Fron	n TOC)	0.00 L/m 60.96 m	nin Pump Type	nstalled		Dep Make M	th odel (Output Ra	m H.P ating)
Did vou F	Encountor Salin	0 Mator (> 1000	DOM TOS	Don	th	m	Well Disinfec	ted Unon Com	plation	
Additiona DRILLER R	al Comments of	n Well	Gas	Dep	th	m Sample Co	Geoph Su	ysical Log Tak bmitted to ESF ability	n PDSubn	nitted to ESRD
Additiona DRILLER R Yield Test	al Comments of	n Well	Gas	Dep	th	m Sample Co	Geoph Geoph Su Illected for Pote	ysical Log Tak bmitted to ESF ability	sp Subn	nitted to ESRD
Additiona DRILLER R Yield Test Test Date 1981/11/19	al Comments or	n Well FER QUALITY / Start Time 12:00 AM	Gas	ntic Water Level 48.77 m		m Sample Co	Geoph Su Illected for Pote Taker	vsical Log Tak bmitted to ESF ability From Grour Depth to v Elapse Minut	d Level rater level d Time es:Sec	nitted to ESRD Measurement in Metr Recovery (m)
Additiona DRILLER R Yield Test Test Date 1981/11/19 Method of Re Depth With	al Comments or REPORTS WAT Water Remova Type E Pernoval Rate hdrawn From noval period wa	n Well TER QUALITY / Start Time 12:00 AM al Bailer 68.19 48.77 as < 2 hours, ex	Gas Gas AS TURBID Sta L/min m plain why	ntic Water Level 48.77 m		m Sample Co	Geoph Su Illected for Pota	vsical Log Tak bmitted to ESF ability Depth to v Elapse Minut	d Level ad Level ad Level ater level d Time es:Sec	nitted to ESRD
Additiona DRILLER R Yield Test Test Date 1981/11/19 Method of R Depth With If water rem	al Comments or REPORTS WAT Water Remove Type <u>B</u> Permoval Rate hdrawn From noval period wa	n Well TER QUALITY / Start Time 12:00 AM al Bailer 68.19 48.77 as < 2 hours, ex	Gas Gas AS TURBID Sta L/min m plain why	ntic Water Level 48.77 m		m Sample Co	Geoph Su Illected for Pote	vsical Log Tak bmitted to ESF ability From Grour Depth to v Elapse Minut	an	nitted to ESRD

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PARSONS DRILLING

Government

of Alberta

Certification No 1

### Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database

GIC Well ID GoA Well Tag No. Drilling Company Well ID

View in Imperial Export to Excel

395793

		· ·		Date Report Received	
Well Identification and Locat	ion			Me	easurement in Metric
Owner Name KIRK, S.	Address P.O. BOX 1295 COCH	Town	Prov	ince Country	Postal Code TOL 0W0
Location 1/4 or LSD SE NE 31	EC TWP RGE 026 03	W of MER Lot 5	Block Plan Ac	lditional Description	
Measured from Boundary of m fro m fro	om	GPS Coordinates in Dec Latitude 51.267033 How Location Obtained Not Verified	imal Degrees (NAD 83) Longitude <u>-114.402748</u>	Elevation How Elevation Obtained Not Obtained	
Drillio e lafores otion					
Drilling Information Method of Drilling Unknown Proposed Well Use Domestic		Type of Work Chemistry			
Formation Log	Mea	asurement in Metric	Yield Test Summary	Me	easurement in Metric
Depth from Water Lit ground level (m) Bearing	hology Description		Recommended Pump Rate Test Date Water Rem	L/min Ioval Rate (L/min) Statio	c Water Level (m)
			Well Completion Total Depth Drilled Finished 62.48 m Borehole	Me Well Depth Start Date	easurement in Metric End Date
			Diameter (cm) 0.00 Surface Casing (if applicab	From (m) 0.00 Ie) Well Casing/Liner	To (m) 62.48
			Size OD : 0.0 Wall Thickness : 0.00 Bottom at : 0.0 Perforations	0 cm     Size OD :       0 cm     Wall Thickness :       0 m     Top at :       Bottom at :	0.00 cm 0.000 cm 0.00 m 0.00 m
			From (m) To (m) W	meter or Slot Slot 'idth(cm) Length(cm)	Hole or Slot Interval(cm)
			Perforated by Annular Seal Placed from 0.00 Amount Other Seals Type	<u>n to 0.00 m</u> At	: (m)
			Screen Type Size OD : 0.0 From (m) Attachment Top Fittings Pack Type Amount	IO cm To (m) Bottom Fittings Grain Size	Slot Size (cm)
Contractor Certification Name of Journeyman responsib UNKNOWN NA DRILLER	le for drilling/construction of w	rell	Certification No		

Company Name

UNKNOWN DRILLER

### Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

GIC Well ID GoA Well Tag No. Drilling Company Well ID

View in Imperial Export to Excel

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		accura	acy. The inform	ation on this	s report will be	retained	in a public	database.			Date Report	Received	
Well Identifie	cation and Lo	ocation										Me	asurement in Metr
<del>Owner Name</del> KIRK, S.			Address P.O. BOX 12	295 COCH	IRANE		Town			Province	Со	untry	Postal Code T0L 0W0
Location	1/4 or LSD NE	SEC 31	<i>TWP</i> 026	RGE 03	W of ME 5	R I	Lot	Block	Plan	Additic	onal Description	า	
Measured from	m Boundary of r r	n from n from			GPS Coo Latitude How Loc Not Verif	51.20 51.20 ation Ol	s in Decim 67033 btained	al Degree Longit	es (NAD 83 tude114.4	) 402748	Elevation How Elevati Not Obtaine	ion Obtained d	m
Additional In	formation											Me	asurement in Metri
Distance Fro Is Artesian I	om Top of Casi Flow	ng to Grou	nd Level		cm		ls F	-low Cont	rol Installed	1			
I	Rate		L/min						Describe	9			
Recommend	led Pump Rate	)	_		L	/min	Pump Ir	nstalled			Depth	m	
Recommend	led Pump Intak	e Depth (F	From TOC)		n	<u>n</u>	Туре			Make	Model (Ou	H.P. tput Rating)	
Did you En	ncounter Saline	e Water (>4	1000 ppm TD G	S) as	D	epth epth		<u>m</u>	Well Disir Geo	nfected Upor ophysical Lo Submitted t	n Completion _ g Taken o ESRD		
Additional	Comments on	Well					S	ample Co	llected for	Potability		Submitted t	o ESRD
Yield Test									Та	ken From (	Ground Leve	l Me	asurement in Metri
Test Date		Start Time	)	Statio	c Water Leve n	e/ n							
Method of V	Vater Remova	I											
Rei	I ype moval Rate		I /min										
Depth Withd	drawn From		m										
lf water remo	oval period was	s < 2 hours	, explain why	/									
Water Diver	ted for Drillin	g											
Water Source	9			Amo	ount Taken	L				Diversi	on Date & Time	9	

I	Contractor Certification	
	Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER	Cen 1
	Company Name UNKNOWN DRILLER	Сор

tification No

by of Well report provided to owner Date approval holder signed

Government

of Alberta 🗖

## Water Well Drilling Report

View in Imperial Export to Excel GIC Well ID 494773 GoA Well Tag No. The driller supplies the data contained in this report. The Province disclaims responsibility for its Drilling Company Well ID accuracy. The information on this report will be retained in a public databas Date Report Received 1999/11/25 Well Identification and Location Measurement in Metric Address Postal Code Owner Name Town Province Country RR1, AIRDRIE GOETJEN, MORRIE CANADA T4B 2A3 SEC TWP W of MER Additional Description 1/4 or LSD RGE Block Plan Location Lot NE 36 26 4 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.267032 Longitude -114.426119 m m from How Location Obtained How Elevation Obtained m from Not Verified Not Obtained **Drilling Information** Type of Work Method of Drilling Rotarv New Well Proposed Well Use Stock Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate 36.37 L/min Lithology Description Water Depth from Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 3.05 Brown Clay 1999/11/16 63.65 22.25 23.16 Coarse Grained Gravel Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 29.26 Yes Water Bearing Gravel 30.48 m 1999/11/15 1999/11/16 30.48 Brown Shale **Borehole** Diameter (cm) From (m) To (m) 0.00 0.00 30.48 Surface Casing (if applicable) Well Casing/Liner Steel Size OD : 13.97 cm Size OD : 0.00 cm 0.620 cm 0.000 cm Wall Thickness : Wall Thickness : Bottom at : 28.04 m Top at : 0.00 m Bottom at : 0.00 m Perforations Diameter or Slot Hole or Slot Slot From (m) To (m) Width(cm) Length(cm) Interval(cm) Perforated by Annular Seal Driven & Bentonite Placed from 0.00 m to 28.04 m Amount Other Seals At (m) Type Screen Type Size OD : 0.00 cm From (m) To (m) Slot Size (cm)

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name ALKÉN BASIN DRILLING LTD.

Certification No 1

Attachment

Top Fittings

Pack

Туре Amount

Copy of Well report provided to owner Date approval holder signed

Bottom Fittings

Grain Size

### Water Well Drilling ReportView in Imperial<br/>GIC Well IDExport to Excel<br/>494773

of Alberta 🗖	The driller supplies the data co accuracy. The information on th	ntained in this report. The his report will be retained in	Province disclaims responsi n a public database.	bility for its	GoA Well Tag No. Drilling Company V Date Report Receiv	/ell ID /ed 1999/11/25
Well Identification and Location	n					Measurement in Metric
<i>Owner Name</i> GOETJEN, MORRIE	Address RR1, AIRDRIE		Town	Province	Country CANADA	Postal Code T4B 2A3
Location 1/4 or LSD SEC NE 36	C <i>TWP RGE</i> 26 4	W of MER Lo 5	ot Block Pla	n Additio	nal Description	
Measured from Boundary of m fron m fror	n n	GPS Coordinates Latitude 51.267 How Location Obt Not Verified	in Decimal Degrees (NA 1032 Longitude _ ained	114.426119	Elevation How Elevation Ob Not Obtained	m tained
Additional Information						Measurement in Metric
Distance From Top of Casing to Is Artesian Flow Rate	Ground Level	cm	Is Flow Control Ins	stalled		
Recommended Pump Rate		36.37 L/min	Pump Installed		Depth	
Recommended Pump Intake Dep	oth (From TOC)	27.43 m	Туре	Make	Madal (Outant D	H.P.
Additional Comments on Well DRILLER REPORTS DISTANCE	Gas Yes	TO GROUND LEVEL:	m Sample Collected	Geophysical Log Submitted to d for Potability	g Taken > ESRD Subr	nitted to ESRD
Yield Test				Taken From G	Ground Level	Measurement in Metric
Test Date Start	Time Stat	tic Water Level		Dept	h to water level	
1999/11/16 12:00	) AM	22.25 m	Drawdown	(m) E	lapsed Time Minutes:Sec	Recovery (m)
Method of Water Removal Type Air Removal Rate Depth Withdrawn From	63.65 L/min 30.48 m nours, explain why				1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 10:00	26.82 24.38 23.16 22.71 22.56 22.40 22.25 22.25 22.25 22.25
Motor Divorted for Drilling						
Water Source	An	nount Taken L		Diversio	n Date & Time	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name ALKÉN BASIN DRILLING LTD.

Government

Certification No 1

### Water Well Drilling Report

View in Imperial Export to Excel

498400

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database. Date Report Received 2001/06/22 Well Identification and Location Measurement in Metric Address Postal Code Town Owner Name Province Country P.O. BOX 1773 SPRUCE VIEW GIBBS, DAVE T0M 1V0 1/4 or LSD SEC TWP W of MER Block RGE Lot Plan Additional Description Location NW 31 026 03 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.267033 Longitude -114.414280 m m from How Elevation Obtained How Location Obtained m from Not Verified Not Obtained **Drilling Information** Method of Drilling Type of Work New Well Cable Tool Proposed Well Use

Domestic			
Formation Log			Measurement in Metric
Depth from ground level (m)	Water Bearing	Lithology Description	
4.57		Brown Clay & Rocks	
8.23		Gray Sandstone	
13.72		Gray Shale	
19.51		Gray Sandy Shale	
22.86		Gray Shale	
24.08		Gray Sandstone	
29.87		Gray Shale	
30.78		Blue Shale	
34.14		Gray Silty Shale	
54.56		Gray Shale	
57.30		Gray Sandstone	
67.67		Gray Shale	
71.63		Gray Sandy Shale	
74.68		Gray Shale	

Yield Test Sum	nmary			Ν	leasurement in l	<b>Metric</b>
Recommended F	Pump Ra	ate g	9.09 L/mir	<u>1</u>		
Test Date	Water	Removal Rate	e (L/min)	Sta	tic Water Level (m)	)
2001/05/14		9.09			10.82	
Well Completic	on			Ν	leasurement in l	<b>Metric</b>
Total Depth Drille	ed Finis	shed Well Dep	oth Start	Date	End Date	
74.68 m			2001	/05/07	2001/05/14	
Borehole						
Diameter (	cm)	Fre	om (m)		To (m)	
0.00	(if annl	icable)	Well C	asina/l in	74.00	
Steel	(ii appi		Plastic	asing/Lin	ei	
Size OD	:	13.97 cm		Size OD	: 11.43 cm	
Wall Thickness	::	0.620 cm	Wall	Thickness	: 0.602 cm	
Bottom at	t:	24.69 m		Top at	: 19.81 m	
				Bottom at	: 74.68 m	
Perforations		Diamatan an				
		Diameter or Slot	Slo	ot	Hole or Slot	
From (m) T	o (m)	Width(cm)	Lengt	h(cm)	Interval(cm)	
24.69 7	74.68	0.635			20.32	
Perforated by	Saw					
Annular Seal	Driven					
Placed from	0.	.00 m to	24.6	9 m		
Amount						
Other Seals						
	Туре		_		At (m)	
Screen Type						
Size OD	:	0.00 cm				
From (m	1)	Т	o (m)		Slot Size (cm)	
Attachmen	t					
Top Fittings	5		Botto	m Fittings		•
Pack				0		_
Type			Grain	Size		
Amount			- Crain			

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name MEDICINE VALLEY WATER WELLS

Certification No 1

### Water Well Drilling Report View in Imperial GIC Well ID Export to Excel 498400

	accu	uracy. The info	rmation on th	is report will be reta		lic database.			Date Report Rec	eived	2001/06/22
Vell Identification and	d Location								•	Mea	asurement in I
wner Name		Address			Town			Province	Countr	У	Postal Co
BIBBS, DAVE		P.O. BOX	1773 SPR	UCE VIEW							T0M 1V0
ocation 1/4 or LSD NW	SEC 31	<i>TWP</i> 026	RGE 03	W of MER 5	Lot	Block	Plan	Additic	onal Description		
leasured from Boundar	y of			GPS Coordir	nates in Dec	cimal Degre	es (NAD 83)				
	m from			Latitude 5	1.267033	Long	itude -114.4	14280	Elevation		m
	m from			How Location	n Obtained				How Elevation (	Obtained	
				Not Verified					Not Obtained		
dditional Information	1									Меа	asurement in M
Distance From Top of C	Casing to Gro	ound Level		cm							
Is Artesian Flow					I	s Flow Con	trol Installed				
Rate		L/min					Describe				
Recommended Pump F	Rate			9.09 L/mir	n Pum	o Installed			Depth	m	
Recommended Pump li	ntake Depth	(From TOC)		71.63 m	Туре	ə		Make		H.P.	
					-				Model (Output	Rating)	
Did you Encounter Sa	aline Water (:	>4000 ppm 1	TDS)	Depth	1	m	Well Disin	fected Upor	n Completion		
2	·		Gas	 Depth		m	Geo	, physical Lo	a Taken		
							000	Submitted t			
DRILLER REPORTS DI	s on Well	ROM TOP O	F CASING	TO GROUND LE	EVEL: 1'.		Tak	en From (	Ground Level	Меа	asurement in M
DRILLER REPORTS D	s on Well ISTANCE FF Start Tin	ROM TOP O	F CASING	TO GROUND LE	EVEL: 1'.		Tak	en From ( Dep	Ground Level th to water level	Меа	asurement in M
Test Date 2001/05/14	s on Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	F CASING Stat	TO GROUND LE ic Water Level 10.82 m	EVEL: 1'.	Drav	Tak vdown (m)	en From ( Dep	Ground Level th to water level Elapsed Time Minutes:Sec	Mea	asurement in M ecovery (m)
Tield Test Test Date 2001/05/14	s on Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)	en From ( Dep	Ground Level th to water level Elapsed Time Minutes:Sec 1:00	Mea	asurement in M lecovery (m)
Tield Test Test Date 2001/05/14	s on Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)	en From ( Dep	Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00	R	Assurement in Mecovery (m) 54.32 53.77 53.28
Tield Test Test Date 2001/05/14 Method of Water Removed Type Pamaved Pate	Son Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)	en From ( Dep	Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00	R	asurement in M lecovery (m) 54.32 53.77 53.28 52.88
Additional Comments DRILLER REPORTS D Tield Test Test Date 2001/05/14 Method of Water Removal Removal Rate	Son Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)	en From ( Dep	Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00	R	asurement in M lecovery (m) 54.32 53.77 53.28 52.88 52.40
Additional Comments DRILLER REPORTS D Test Date 2001/05/14 Method of Water Removal Removal Rate Depth Withdrawn From	Son Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O ne M 9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'	Drav	Tak vdown (m)		Ground Level           th to water level           Elapsed Time           Minutes:Sec           1:00           2:00           3:00           4:00           5:00           6:00           7:00	R	asurement in M secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09
Additional Comments DRILLER REPORTS D Tield Test Test Date 2001/05/14 Method of Water Remov Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Oval Bailer	ROM TOP O ne M 9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)		Ground Level           th to water level           Elapsed Time           Minutes:Sec           1:00           2:00           3:00           4:00           5:00           6:00           7:00           8:00	R	asurement in M ecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58
Additional Comments DRILLER REPORTS D Tield Test Test Date 2001/05/14 Method of Water Removal Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Oval Bailer Bailer Was < 2 hou	ROM TOP O ne M 9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00	Mea	Assurement in M Secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Removal Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Oval Bailer Bailer was < 2 hou	ROM TOP O ne M 9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00	Mea R I I I I I I I I I I I I I I I I I I	asurement in M Secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remo Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Dval Bailer Bailer Was < 2 hou	ROM TOP O ne 9.09 L/mir 0.00 m rs, explain w	F CASING Stat	TO GROUND LE	EVEL: 1'.	Draw	Tak vdown (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00	Mea R I I I I I I I I I I I I I I I I I I	asurement in M Secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38
Additional Comments DRILLER REPORTS D Tield Test Test Date 2001/05/14 Method of Water Removal Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Oval Bailer Bailer Was < 2 hou	ROM TOP O ne M 9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'.	Drav	Tak vdown (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00	Mea R I I I I I I I I I I I I I I I I I I	asurement in M Secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.58 51.19 50.81 50.81 50.38 50.05
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remo Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN Oval Bailer Bailer was < 2 hou	ROM TOP O ne 9.09 L/mir 0.00 m rs, explain w	F CASING Stat	TO GROUND LE	EVEL: 1'.	Draw	Tak /down (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00	Mea R I I I I I I I I I I I I I I I I I I	Asurement in M Elecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38 50.05 49.50 49.05
Additional Comments DRILLER REPORTS DI ield Test Test Date 2001/05/14 Method of Water Remu- Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer Bailer was < 2 hou	ROM TOP O	Stat	to GROUND LE	EVEL: 1'.	Draw	Tak /down (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00	Mea R 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Assurement in M Elecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38 50.05 49.50 48.05 46.00
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remo Type Removal Rate Depth Withdrawn From	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer 2 was < 2 hou	9.09 L/mir 0.00 m	Stat	TO GROUND LE	EVEL: 1'.	Draw	Tak /down (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 14:00 16:00 20:00 25:00 30:00	Mea R 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	asurement in M secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38 50.05 49.50 48.05 46.09 44.84
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remu Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer Bailer was < 2 hou	9.09 L/mir 0.00 m	F CASING Stat	TO GROUND LE	EVEL: 1'.		Tak /down (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 35:00	Mea	asurement in M secovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38 50.05 49.50 48.05 46.09 44.84 43.08
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Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remon Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer Bailer was < 2 hou	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.		Tak vdown (m)		Ground Level           th to water level           Elapsed Time           Minutes:Sec           1:00           2:00           3:00           4:00           5:00           6:00           7:00           8:00           9:00           10:00           12:00           14:00           16:00           20:00           35:00           40:00           50:00	Mea	Asurement in N 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.81 50.05 49.50 48.05 46.09 44.84 43.08 41.53 39.01
Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remo Type Removal Rate Depth Withdrawn From f water removal period	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer Bailer was < 2 hou	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.		Tak vdown (m)		Ground Level           th to water level           Elapsed Time           Minutes:Sec           1:00           2:00           3:00           4:00           5:00           6:00           7:00           8:00           9:00           10:00           12:00           14:00           16:00           20:00           25:00           30:00           40:00           50:00           60:00	Mea	Asurement in N tecovery (m) 54.32 53.77 53.28 52.88 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.38 50.05 49.50 48.05 46.09 44.84 43.08 41.53 39.01 36.32
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Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remo Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN	ROM TOP O	Stat	TO GROUND LE	EVEL: 1'.	Draw	Tak /down (m)	ien From ( Dep. 2007) 2007 2007 2007 2007 2007 2007 200	Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00	Mea	Asurement in M Elecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.81 50.81 50.38 50.05 49.50 48.05 46.09 44.84 43.08 41.53 39.01 36.32 33.19 30.57 28.79
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Additional Comments DRILLER REPORTS D ield Test Test Date 2001/05/14 Method of Water Remu Type Removal Rate Depth Withdrawn From If water removal period	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer Bailer was < 2 hou	ROM TOP O	F CASING Stat	TO GROUND LE	EVEL: 1'.		Tak /down (m)	ien From ( Dep: 	Ground Level           th to water level           Elapsed Time           Minutes:Sec           1:00           2:00           3:00           4:00           5:00           6:00           7:00           8:00           9:00           10:00           12:00           14:00           16:00           20:00           30:00           35:00           40:00           50:00           60:00           75:00           90:00           105:00           120:00	Mea	Asurement in M Elecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.38 50.05 49.50 48.05 46.09 44.84 43.08 41.53 39.01 36.32 33.19 30.57 28.79 26.93
Additional Comments DRILLER REPORTS DI ield Test Test Date 2001/05/14 Method of Water Remu- Type Removal Rate Depth Withdrawn From If water removal period If water removal period Vater Diverted for Dr Vater Source	s on Well ISTANCE FF Start Tin 12:00 AN oval Bailer 2 was < 2 hou	P.OP L/mir 0.00 m vrs, explain w	F CASING Stat	TO GROUND LE	EVEL: 1'.		Tak /down (m)		Ground Level th to water level Elapsed Time Minutes:Sec 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	Mea	Asurement in M Elecovery (m) 54.32 53.77 53.28 52.88 52.40 52.09 51.82 51.58 51.19 50.38 50.05 49.50 48.05 46.09 44.84 43.08 41.53 39.01 36.32 33.19 30.57 28.79 26.93

Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER Certification No 1 Company Name Copy of Well report provided to owner Date approval holder signed MEDICINE VALLEY WATER WELLS

Government

## Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No. Drilling Company Well ID

Drilling Company Well ID Date Report Received

View in ImperialExport to ExcelGIC Well ID1022436

Date Report Received 2014/09/24 Well Identification and Location Measurement in Metric Address Postal Code Owner Name Town Province Country LAFARGE CANADA INC T2C 5G9 115 QUARRY PARK BLVD CALGARY ALBERTA CANADA 1/4 or LSD SEC TWP W of MER Additional Description RGE Block Plan Location Lot 9 36 26 4 5 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.265686 Longitude -114.424418 m m from How Location Obtained How Elevation Obtained m from Hand held autonomous GPS 20-30m Hand held autonomous GPS 20-30m **Drilling Information** Type of Work Method of Drilling Rotary - Air New Well Proposed Well Use Investigation Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate L/min Water Depth from Lithology Description Water Removal Rate (L/min) ground level (m) Bearing Static Water Level (m) Test Date 0.30 Topsoil 4.27 Brown Moist Clay Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 25.30 Gravel 30.48 m 28.35 m 2014/05/01 2014/05/05 28.35 Moist Gravel Borehole 29.26 Sandstone Diameter (cm) From (m) To (m) 30.48 Shale 20.02 0.00 25.60 15.56 25.60 30.48 Surface Casing (if applicable) Well Casing/Liner Steel 16.81 cm Size OD : Size OD : cm Wall Thickness : Wall Thickness : 0.478 cm cm m Bottom at : 25.60 m Top at :

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)

Bottom at :

m

Penoraleu by				
Annular Seal	Cement/Grout			
Placed from	0.00 m	to	25.60	m
Amount	150.00	Gallons		
Other Seals				

 Type
 At (m)

 Driven
 25.60

 Screen Type
 Stainless Steel

 Size OD :
 14.12 cm

 From (m)
 To (m)
 Slot Size (cm)

 26.21
 27.43
 0.025

		10 (11)	SIOL SIZE (CIII)	
26.21		27.43	0.025	
Attachment	Telescop	ed		
Top Fittings	Top Fittings Packer		ings Tail Pipe	
Pack				
Type Natural		Grain Size		

Amount

 Contractor Certification

 Name of Journeyman responsible for drilling/construction of well
 Certification No

 CHRIS QUINLAN
 48135A

 Company Name
 Copy of Well report provided to owner

 AARON DRILLING INC.
 Date approval holder signed

# Government of Alberta Water Well Drilling Report View in Imperial GIC Well ID 1022436

Diversion Date & Time

2014/04/29 8:00 AM

f Albe	erta 🗖	The	driller supplies Iracy. The info	the data con mation on thi	tained in this reports reports will be ret	t. The Provin ained in a pul	ce disclaims i blic database.	esponsibility for	r its	GoA Well Tag No Drilling Company Date Report Rece	Well ID eived 2	014/09/24
Well Identi	fication and L	ocation									Meas	urement in Metr
Owner Nam LAFARGE (	10 CANADA INC		Address 115 QUAR	RY PARK I	BLVD	Towr CALC	GARY		Province ALBERTA	Country	y DA	Postal Code T2C 5G9
Location	1/4 or LSD 9	SEC 36	<i>TWP</i> 26	RGE 4	W of MER 5	Lot	Block	Plan	Addition	al Description		
Measured f	rom Boundary c	of m from m from			GPS Coordi Latitude	nates in De 51.265686 n Obtained utonomous	Cimal Degree Long	ees (NAD 83) itude <u>-114.42</u> m	24418	Elevation How Elevation C Hand held auton	Detained	<u>m</u> 5 20-30m
Additional	Information										Meas	urement in Met
Distance F Is Artesial	rom Top of Cas n Flow	ing to Gro	ound Level		91.44 cm		Is Flow Cor	ntrol Installed				
	Rate		L/min					Describe				
Recomme	nded Pump Rat	е			L/mi	n Pum	p Installed			Depth	m	
Recomme	nded Pump Inta	ke Depth	(From TOC)		m	Тур	e		Make	Model (Output	H.P. Rating)	
Did you l	Encounter Salin	e Water (:	>4000 ppm 7	TDS) Gas	Deptl Deptl	ו 	m m	Well Disinf Geoj	fected Upon physical Log Submitted to	Completion <u>Yes</u> Taken ESRD		
Addition	al Comments of	n Well D BY WA	TERLINE RE	SOURCES	3		Sample C	ollected for P	Potability	Su	bmitted to E	ESRD

Yield Test			Taken From Ground Level	Measurement in Metric
Test Date	Start Time	Static Water Level m		
Method of Water R	<b>Removal</b>			
' Removal F	Rate L/n	nin		
Depth Withdrawn F	rom m	_		
lf water removal per	riod was < 2 hours, explair	n why		
Water Diverted for	· Drilling			

Amount Taken

L

9092.18

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well CHRIS QUINLAN	Certification No 48135A	
Company Name AARON DRILLING INC.	Copy of Well report provided to owner Yes	Date approval holder signed 2014/09/24

Water Source

CITY OF CALGARY

### Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

GIC Well ID GoA Well Tag No. Drilling Company Well ID

View in Imperial Export to Excel

1475698

Viel Identification and Location         Address         Town         Power Name         County         Power Name           Duck Water Away FARME LTD         PO. 60X 11/10         BROKS         Address         Camp         This 105           Stocation         114 of 15D         SEC         The Right         Lot Block Pan         Address Description         n           10         31         2026         5         Stocation         114 control         Elevation         n           10         2026         5         5         Decimal Decompton         n         Hold Stocation         Not Obtained           10         2026         03         5         More The Normal Decompton         Not Obtained         Not Obtained         Not Obtained           Method of Drifting Torgend Work         State Mark Rennoal Rate (Unim)         State Water Level (n)         2030 U1/10         2030 U1/10 <td< th=""><th></th><th></th><th>accu</th><th>aracy. The inform</th><th>mation on thi</th><th>s report will be retained in a pu</th><th>blic database.</th><th></th><th>Date Report Re</th><th>ceived</th></td<>			accu	aracy. The inform	mation on thi	s report will be retained in a pu	blic database.		Date Report Re	ceived
Construction         Address         Torm         Province         County         Product Doc Database           DUCK WAY FAMMS LTD         P.O. BOX 173         BEOOKS         Address         County         THE CS           State State         State         Direction         Address         County         THE CS           State         Direction         Micro         Direction         Address         County         THE CS           State         Direction         Micro         Direction         Direction         Address         The County         The County of the County of the County         The County of the County of the County         The County of the Coun	Well Identification	on and I c	cation							Measurement in M
DUCK WAY FAMUS LTD     P.O. BOX 11/19     BROOKS     As     Calmon	Owner Name		oution	Address		Тож	n	Province	Cour	ntry Postal Cod
Liceation       14 or LSD       SEC       TWP       REC       Word MER       Lot       Block       Plan       Additional Description	QUICK WAY FAR	MS LTD		P.O. BOX 1	1719	BRC	OKS	AB	CA	T1R 1C5
Veasured from Boundary of mitram     GPS Coordinates in Decimal Degrees (MAD S3) Latitude 51 2207444     Elevation	Location 1/4 16	or LSD	SEC 31	<i>TWP</i> 026	RGE 03	W of MER Lot 5	Block Pla	n Additio	nal Description	
Image: miton     Latitude 5128744     Longlude 114.40059     Elevited m     m       Milling Information     Hand held autonomous GPS 20-30m     Not Ditained     Not Ditained       Webled of Dulling     Type of Work     New Well       Steppes Mull Use     New Well       Sometic Log     Measurement in Metric       Path from     Water Lithology Description       2.13     Clay       2.14     Clay Scruet       2.15     Clay       2.16     Clay       2.82     Gray Shale       3.39     Gray Shale       3.170     Sandstone       3.180     Gray Shale       Dameter (cm)     Term (m)       3.170     Sandstone       3.180 <td>Measured from B</td> <td>oundary of</td> <td></td> <td></td> <td></td> <td>GPS Coordinates in De</td> <td>ecimal Degrees (NA</td> <td>D 83)</td> <td>_</td> <td></td>	Measured from B	oundary of				GPS Coordinates in De	ecimal Degrees (NA	D 83)	_	
m from     Prov     Losition Obland     Not Elevision Obland       Hand held autonomous GPS 20-30m     Not Obtained       Strilling Information     Type of Work       Velocition Cog     New Well       Proposed Well Use     Domastic       Somation Log     Measurement in Metric       Segminic Log     Measurement in Metric       Somation Display     Type of Work       21.03     Cay & Gravel       23.16     Cay       23.65     Gray Shale       33.39     Gray Shale       33.39     Gray Shale       33.33     Shale       33.57     Sandsone       33.62     Shale       Ster Display     Well Completion       Well Their New Kell     Well Completion       Mode Stering (It applicable)     Well Completion       Well Completion     Measurement in Metric       33.53     Gray Shale     Bottom at:       33.53     Shale     Bottom at:       33.62     Stride Carsing (It applicable)     Well Carsing/Liner       Uhinown     Stero OD:     On       33.62     Shale     Stero OD:       33.62     Shale     Stero OD:       Stero OD:     On     Measurement in Metric       Measurement in Metric     Stero OD:		r	n from			Latitude 51.267444	Longitude -	114.400639	Elevation	<u> </u>
Type of Work New Weil     Type of Work New Weil       Propaged Well Use Domestic     Measurement in Metric Sommation Log     Yield Test Summary     Measurement in Metric Recommended Pump Rate       2.13     Clay     36.37     Linin Test Date Wate Removal Rate (Umin)     Statc Water Level (m)       2.13     Clay     30.30     Statc Water Level (m)     Measurement in Metric Recommended Pump Rate     Measurement in Metric Test Date Water Removal Rate (Umin)     Measurement in Metric Water Removal Rate (Umin)     Measurement in Metric Test Date Water Removal Rate (Umin)     Measurement in Metric Water Removal Rater (Water		r	n from			How Location Obtained			How Elevation	i Obtained
Vector       Type of Work New Weil         Vector       Measurement in Metric         Operation       Measurement in Metric         Operation       Measurement in Metric         21.03       Clay & Gravel         21.03       Clay & Gravel         22.03       Clay & Gravel         22.03       Clay & Gravel         26.82       Grav Shale         26.82       Grav Shale         23.33       Shale         33.30       Grav Shale         33.57       Sandstone         35.57       Sandstone         35.57       Sandstone         35.57       Sandstone         35.57       Sandstone         35.57       Sandstone         35.57       Sandstone         32.60       Grav Shale         35.97       Sandstone         32.00       35.97         Sandstone       Size OD:         Mithickness:       Ontherest (m)         Bottom at:       m         Bottom at:       m <td< td=""><td></td><td></td><td></td><td></td><td>I</td><td>Hand held autonomous</td><td>GPS 20-30m</td><td></td><td>Not Obtained</td><td></td></td<>					I	Hand held autonomous	GPS 20-30m		Not Obtained	
Wethed of Drilling Statay         Type of Work New Weil           Sorpased Well Use Domesic         Sormation Log         Measurement in Metric Command Log         Measurement in Metric Test Date Water Removal Rate (L/min)         Static Water Level (m) 203/01/15         45.47         Limin Test Date           2.13         Clay         Clay         Static Water Level (m) 203/01/15         45.46         32.00           2.14         Clay         Task Date Mather Removal Rate (L/min)         Static Water Level (m) 203/01/15         45.46         32.00           2.13         Clay         Task Date Mather Removal Rate (L/min)         Static Water Level (m) 203/01/10         2003/01/10         2003/01/10         2003/01/10         2003/01/10         2003/01/10         2003/01/10         2003/01/14           2.6.82         Gray Shale         Dane         Task Date         Mell Dane         Task Date         Task Da	Drilling Informat	ion								
Deparation         Measurement in Metric         Yield Test Summary         Measurement in Mesourement in Metric           Depth from         Water         Litbology Description         Test Date         Water Renoval Rate (Unini)         Static Water Level (m)           2.13         Cley         2.13         Cley         Static Water Level (m)           2.13         Cley         Static Water Level (m)         2003/01/15         45.46         32.00           2.13         Cley         Static Water Level (m)         2003/01/14         Boston Rate         2003/01/14           2.6.52         Gray Shale         Gray Shale         2003/01/14         2003/01/14         2003/01/14           2.8.65         Gray Shale         Diameter (cm)         From (m)         To (m)         39.62           31.70         Sandstone         State OD:	Method of Drillin Rotary	g				<b>Type of Work</b> New Well				
Measurement in Metric         Operating (m) provide level (m) conditioned (m) for (m) and (m)	Proposed Well U Domestic	lse								
Depth from ground level (m) Bearing       Uthology Description       Reacommended Pump Rate       38.37 L/min.         21.03       Clay       Test Date       Water Removal Rate (L/min)       Static Water Level (m)         21.03       Clay & Gravel       Water Removal Rate (L/min)       Static Water Level (m)         23.16       Clay       32.00       2003/01/15       45.46       32.00         26.82       Gray Shale       Gray Shale       2003/01/10       2003/03/17       2003/01/10       2003/01	Formation Log				Me	asurement in Metric	Yield Test Sur	nmary		Measurement in Me
pround level (m)       Bearing       Image: constraint of the second sect (L/min)       Static Water Level (m)         2.1.3       Clay       Clay       45.46       32.00         21.03       Clay & Gravel       Image: constraint of the second sect (L/min)       Static Water Level (m)       Static Water Level (m)         21.03       Clay & Gravel       Image: constraint of the second sect (L/min)       Static Water Level (m)       Static Water Level (m)         21.03       Clay & Gravel       Image: constraint of the second sect (L/min)       Static Water Level (m)       Static Water Level (m)         21.03       Clay & Gravel       Image: constraint of the second sect (L/min)       Static Water Level (m)         21.03       Clay & Gravel       Image: constraint of the second se	Depth from	Water	Litholoc	gy Descriptior	1		Recommended	Pump Rate	36.37 L/min	
2.13       Cay       2003/01/15       45.46       32.00         21.03       Clay & Gravel       Measurement in M       Measurement in M         23.16       Clay       Gray Shale       Date       2003/01/15       45.46       32.00         26.82       Gray Shale       Gray Shale       2003/01/16       Frished Well Depth       Star Date       Base Date         31.39       Gray Shale       2003/01/16       Star Date       From (m)       To (m)       2003/01/14         33.53       Shale       Shale       Star Dot (m)       Yell Casing/Liner       Unknown         33.62       Shale       Star OD :	ground level (m)	Bearing					Test Date	Water Removal	Rate (L/min)	Static Water Level (m)
21.03       Clay & Gravel         23.16       Clay       Clay & Gravel         26.82       Gray Shale       200301/10       200301/14         28.65       Gray Shale       200301/14       Borehole         31.39       Gray Shale       22.23       0.00       39.62         33.53       Shale       Stratone       Well Casing/Harer       Unknown         35.97       Sandstone       Stratone       Well Casing/Liner       Unknown         35.97       Sandstone       Stre OD :       41.13 cm       Size OD :       cm         39.62       Shale       Size OD :       14.13 cm       Size OD :       cm         Bottom at :       35.97 m       Top at :       m       m         Bottom at :       35.97 m       Top at :       m       m         Bottom at :       35.97 m       Top at :       m       m         Bottom at :       35.97 0.318       Z5.40       Perforations       Extended by       Torch         Annualar Seel       Driven & Bentonite       Perforated by       Torch       Annualar Seel       Torch         Annualar Seel       Torm (m)       To (m)       Stot Size (cm)       Attachment         Cher Seals	2.13		Clay				2003/01/15	45.4	6	32.00
23.16       Clay         26.82       Gray Shale         26.63       Gray Shale         31.39       Gray Shale         31.30       Gray Shale         33.33       Shale         33.53       Shale         39.62       Shale         Well Casing(Line)       Well Casing(Line)         Well Casing(Line)       Well Casing(Line)         Well Casing(Line)       Well Casing(Line)         Stee OD:       mt         Bottom at:       ms         Bottom at:       ms         Perforations       Bottom at:         Perforations       Bottom at:         Perforated by       Torch         Annular Seal Oriven & Bentonite         Planeter or       State OD:         State OD:       an         Bottom at:       25.40         Perforated by       Torch         Annular Seal Oriven & Bentonite         Planeter or       31.39 m         Amount       Mell Thickness:         Other Seals       ms         Perforated by       Torch         Annuar Seal Oriven & Bentonite         Planeter       Type         Stree OD:       m <tr< td=""><td>21.03</td><td></td><td>Clay 8</td><td>k Gravel</td><td></td><td></td><td>Well Completi</td><td>on</td><td></td><td>Measurement in Me</td></tr<>	21.03		Clay 8	k Gravel			Well Completi	on		Measurement in Me
26.82       Gray Shale       2003/01/10       2003/01/14         28.65       Gray Shale       2003/01/14       2003/01/14         28.65       Gray Shale       2003/01/10       2003/01/14         31.70       Sandstone       33.53       Shale       35.97         33.53       Shale       Strateo Casing (if applicable)       Well Casing/Liner       Unknown         35.97       Sandstone       Strateo Casing (if applicable)       Well Casing/Liner       Unknown         39.62       Shale       Strateo Casing (if applicable)       Well Casing/Liner       Unknown         39.62       Shale       Strateo Casing (if applicable)       Well Casing/Liner       Unknown         Strateo Casing (if applicable)       Well Thickness :Om       Mell Thickness :Om       Mell Thickness :Om         39.62       Shale       Strateo Casing (if applicable)       Well Thickness :Om       Top at :	23.16		Clay				Total Depth Drill	led Finished Wel	Depth Start D	Date End Date
28.65       Gray Sandy Shale         31.39       Gray Shale         31.39       Gray Shale         31.30       Gray Shale         31.33       Sandstone         33.53       Shale         35.97       Sandstone         39.62       Shale         Shale       Size OD:         41.13 cm       Size OD:         Mail Thickness:       0.478 cm         Bottom at:       35.97 m         Bottom at:       36.00         Stread to the set of	26.82		Gray S	hale			39.62 m		2003/0	)1/10 2003/01/14
31.39       Gray Shale       Diameter (cm)       To (m)       39.62         31.70       Sandstone       30.62       Surface Casing (il applicable)       Well Casing/Liner         33.53       Shale       Size OD:       14.13 cm       Size OD:       cm         39.62       Shale       Shale       Size OD:       14.13 cm       Size OD:       cm         39.62       Shale       Shale       Size OD:       14.13 cm       Size OD:       cm         Bottom at:       35.97 m       To p at :       m       m       Bottom at :       m         Bottom at:       0.00 35.97 m       To p at :       m       m       Bottom at :       m         Perforations       To (m)       Vieltft(cm)       Length(cm)       Interval(cm)       interval(cm)         Size OD:       0.00 35.97 0.318       To ch       Annount       Chere Seals       Cm         Type       At (m)       Size OD:       cm       Size OD:       cm       Size OD:       Size (cm)         Annount       Type       At (m)       Size (cm)       Attachment       To p. Fittings       Feck         Type Unknown       Grain Size       Moount       Grain Size       Moount       Moount       Moo	28.65		Gray Sa	andy Shale			Borehole			
31.70       Sandstone       39.62         33.53       Shale       Size OD :	31.39		Gray S	ihale			Diameter (	(cm)	From (m)	To (m)
33.53       Shale         35.97       Sandstone         39.62       Shale         Direct Casing (if applicable)         Wall Thickness:	31.70		Sands	tone			22.23	r (if applicable)	0.00	39.62
35.97       Sandstone         39.62       Shale         Size 0D :       14.13 cm       Size 0D :       cm         Wall Thickness :       0.478 cm       Wall Thickness :       cm         Bottom at :       35.97 m       Top at :       m         Bottom at :       35.97 m       Slot       Hole or Slot         From (m)       To (m)       Width(cm)       Length(cm)       Interval(cm)         Bottom at :       35.97 m       0.318       25.40         Perforated by       Torpat       25.40         Perforated by       Torpat       25.40         Perforated by       Torpat       25.40         Perforated by       Toren &       31.39 m         Amount       0.00 m       10       31.39 m         Other Seals       Type       At (m)       Screen Type         Size 0D :       cm       m       To (m)       Slot Size (cm)         Attachment       Top Pittings       Bottom Fittings       Mount       Amount         Type Unknown       Grain Size       Mount       Amount       Mount       Mount	33.53		Shale				Steel	(II applicable)	Unknowr	אווק/בווופו ו
39.62       Shale         39.62       Shale         Wall Thickness :       0.478 cm       Wall Thickness :       cm         Bottom at :       35.97 m       Top at :       m         Bottom at :       0.478 cm       Wall Thickness :       cm         Bottom at :       35.97 m       Top at :       m         Bottom at :       0.01 m       Slot       Hole or Slot         From (m)       To (m)       Width(cm)       Length(cm)       1.1eeval(cm)         32.00       35.97       0.318       25.40         Perforated by       Torch       Annular Seal       Driven & Bentonite         Placed from0.00 m       to	35.97		Sands	stone			Size OL	): 14.13 cr	<u>n</u> 3	Size OD : cm
Bottom at:       35.97 m       Top at:       m         Bottom at:       m       Bottom at:       m         Perforations       State       Hole or Slot         From (m)       To (m)       Slott       Hole or Slot         32.00       35.97       0.318       25.40         Perforated by       Torch       Annular Seal       Driven & Bentonite         Placed from       0.00 m       to       31.39 m         Amount       0.00 m       to       31.39 m         Other Seals       Type       At (m)         Screen Type       Size OD :       cm         Size OD :       cm       To p Fittings         Pack       Type Unknown       Grain Size         Type Unknown       Grain Size       Mount	39.62		Shale				Wall Thickness	s: 0.478 cr	n Wall Th	nickness : cm
Bottom at :       m         Perforations         From (m)       To (m)         Slot       Slot         Hole or Slot         J32.00       35.97         O 35.97       0.318         Diven & Bentonite         Placed from       0.00 m         Annular Seal       Driven & Bentonite         Placed from       0.00 m         Other Seals       Type         Screen Type       Size OD :         Size OD :       cm         From (m)       To (m)       Slot Size (cm)         Attachment       m         Top Fittings       Bottom Fittings         Pack       Type Unknown       Grain Size							Bottom a	<i>t :</i> 35.97 m	_	Top at : m
Perforations         From (m)       To (m)       Vidth(cm)       Length(cm)       Interval(cm)         32.00       35.97       0.318       25.40         Perforated by       Torch         Annular Seal       Driven & Bentonite         Placed from       0.00 m       to         Amount							Deufenetiene		B	ottom at : m
From (m)       To (m)       Slot       Hole or Slot         32.00       35.97       0.318       25.40         Perforated by       Torch         Annular Seal       Driven & Bentonite         Placed from       0.00 m to       31.39 m         Amount       0.00 m to       31.39 m         Other Seals							Perforations	Diamete	or or	
Perforated by       Torch         Annular Seal       Driven & Bentonite         Placed from       0.00 m       to         Mount							From (m) 1	Slot 50 (m) Width( 35.97 0.31	cm) Length	Hole or Slot (cm) Interval(cm) 25.40
Annular Seal       Driven & Bentonite         Placed from       0.00 m to       31.39 m         Amount							Perforated by	Torch	0	
Placed from0.00 m to31.39 m         Amount         Other Seals         TypeAt (m)         Screen Type         Size OD :         From (m)To (m)Slot Size (cm)         Attachment         Top Fittings         Bottom Fittings         Pack         Type Unknown         Amount							Annular Seal	Driven & Bentonit	9	
Amount							Placed from	0.00 m	to 31.39	m
Other Seals         Type       At (m)         Screen Type         Size OD :cm         From (m)       To (m)         Slot Size (cm)         Attachment         Top Fittings         Bottom Fittings         Pack         Type       Unknown         Amount       Unknown							Amount			
Type       At (m)         Screen Type         Size OD :Cm         From (m)       To (m)         Slot Size (cm)         Attachment         Top Fittings         Bottom Fittings         Pack         Type Unknown       Grain Size         Amount       Unknown							Other Seals		-	
Screen Type         Size OD :       cm         From (m)       To (m)       Slot Size (cm)         Attachment								Туре		At (m)
Size OD .							Screen Type			
Attachment         Top Fittings       Bottom Fittings         Pack         Type       Unknown         Amount       Unknown							From (n	n)	To (m)	Slot Size (cm)
Attachment         Top Fittings       Bottom Fittings         Pack         Type       Unknown         Amount       Unknown							A 44 1			
Pop Fittings     Bottom Fittings       Pack     Type Unknown       Grain Size       Amount							Attachmen		Dotto	Fittings
Pack       Type Unknown     Grain Size       Amount     Unknown							i op Hitting	3	Βοποη	r Filuliys
Type Unknown Grain Size Amount Unknown							Pack			
Amount Unknown							Type Unknow	wn	Grain S	Size
							Amount	Unknowr	1	

Name of Journeyman responsible for drilling/construction of well WILLIAM PENROD

Company Name

M&M DRILLING CO. LTD.

Certification No A000187 Copy of Well report provided to owner Date approval holder signed

## Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be ratained in a public database

GIC Well ID GoA Well Tag No. Drilling Company Well ID

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1475698

		Date Report Receiv	) Dé
Well Identification and Location			Measurement in Metric
Owner Name Address	Town Pro	ovince Country	Postal Code
QUICK WAY FARMS LTD P.O. BOX 1719	BROOKS AB	CA	T1R 1C5
Location 1/4 or LSD SEC TWP RGE	W of MER Lot Block Plan	Additional Description	
16 31 026 03	5		
Measured from Boundary of	GPS Coordinates in Decimal Degrees (NAD 83)		
m from	Latitude 51.267444 Longitude -114.400639	Elevation	m
m from	How Location Obtained	How Elevation Obt	ained
	Hand held autonomous GPS 20-30m	Not Obtained	
Additional Information			Measurement in Metric
Distance From Top of Casing to Ground Level	60.06 cm		
le Artesian Flow	Is Flow Control Installed		
Kate L/min	Describe		
Recommended Pump Rate	36.37 L/min Pump Installed	Depth	m
Recommended Pump Intake Depth (From TOC)	35.05 m <i>Type Ma</i>	ke	H.P.
		Model (Output R	atina
		1110001 1000000000000000000000000000000	ung)
Did you Encounter Saline Water (>4000 ppm TDS)	Depth Well Disinfected	Upon Completion	
Gas	 Depth m Geophysi	cal Log Taken	
—	Subm	itted to ESRD	
	Sample Collected for Potabi	lity Subn	itted to ESRD
Additional Comments on Well			
FIELD TEST HARD WATER TDS 250, GPS # 51.267133	33, N-51-16.0-2.8, W-114-24-2.3, -114.40038333, BORE	HOLE DIAMETER 8.75" TO	103' & 6.25" TO 130'
Yield Test	Taken F	rom Ground Level	Measurement in Metric
Test Date Start Time St	atic Water Level	Depth to water level	
2003/01/15 12:00 AM	32.00 m Drawdown (m)	Elapsed Time	Recovery (m)
	22.20	Minutes:Sec	22.01
Method of Water Removal	32.39	2:00	32.81
	32.53	2.00	32.09
	32.75	4:00	32.61
Removal Rate 45.46 L/MIn	32.83	5:00	32.60
Depth Withdrawn From 35.05 m	32.85	6:00	32.56
	32.89	7:00	32.51
If water removal period was < 2 hours, explain why	32.90	8:00	32.49
	32.92	9:00	32.47
	32.94	10:00	32.45 32.40
	33.02	14.00	32.40
	33.05	16:00	32.34
	33.08	20:00	32.32
	33.13	25:00	32.28
	33.06	30:00	32.26
	33.19	35:00	32.23
	33.19 33.24	35:00 40:00	32.23 32.21
	33.19 33.24 33.27 33.28	35:00 40:00 50:00	32.23 32.21 32.20 32.16
	33.19 33.24 33.27 33.28 33.31	35:00 40:00 50:00 60:00 75:00	32.23 32.21 32.20 32.16 32.12
	33.19 33.24 33.27 33.28 33.31 33.32	35:00 40:00 50:00 60:00 75:00 90:00	32.23 32.21 32.20 32.16 32.12 32.10
	33.19 33.24 33.27 33.28 33.31 33.32 33.34	35:00 40:00 50:00 60:00 75:00 90:00 105:00	32.23 32.21 32.20 32.16 32.12 32.10 32.09
	33.19 33.24 33.27 33.28 33.31 33.32 33.34 33.35	35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	32.23 32.21 32.20 32.16 32.12 32.10 32.09 32.06
	33.19 33.24 33.27 33.28 33.31 33.32 33.34 33.35	35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	32.23 32.21 32.20 32.16 32.12 32.10 32.09 32.06
Water Diverted for Drilling	33.19 33.24 33.27 33.28 33.31 33.32 33.34 33.34 33.35	35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	32.23 32.21 32.20 32.16 32.12 32.10 32.09 32.06
Water Diverted for Drilling	33.19 33.24 33.27 33.28 33.31 33.32 33.34 33.34 33.35	35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	32.23 32.21 32.20 32.16 32.12 32.10 32.09 32.06
Water Diverted for Drilling         Water Source       A	33.19       33.24       33.27       33.28       33.11       33.32       33.34       33.35	35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00 iversion Date & Time	32.23 32.21 32.20 32.16 32.12 32.10 32.09 32.06

Contractor Certification Name of Journeyman responsible for drilling/construction of well WILLIAM PENROD Company Name M&M DRILLING CO. LTD.

Certification No A000187

Copy of Well report provided to owner Date approval holder signed

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Government

of Alberta 🗖

## Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No.

View in Imperial Export to Excel

1475699

Drilling Company Well ID

Wall Identificati	on and Lo	cation					Date Report Recel	Measurement in Metric
Owner Name		Address		Том	7	Province	Country	Postal Code
QUICK WAY FAR	MS LTD	P.O. BOX	( 1719	BRO	OKS	AB	CA	T1R 1C5
Location 1/4 15	or LSD	SEC         TWP           31         026	RGE 03	W of MER Lot 5	Block Pla	Addition	al Description	
Measured from B	oundary of n n	n from n from		GPS Coordinates in De Latitude <u>51.267556</u> How Location Obtained Hand held autonomous	Longitude Longitude GPS 20-30m	114.405667	Elevation How Elevation Ob Not Obtained	mbtained
Drilling Informat Method of Drillin Rotary Proposed Well U Domestic	tion Ig Ise			Type of Work New Well				
Formation Log			Me	asurement in Metric	Yield Test Sun	nmarv		Measurement in Metric
Depth from	Watar	Lithology Description			Recommended	Pump Rate	27.28 L/min	
ground level (m)	Bearing	Liuiology Descripti	UII		Test Date	Water Removal F	Rate (L/min)	Static Water Level (m)
2.44	, j	Clay & Rocks			2003/01/20	24.55	5	32.64
27.43		Lost Circulation G	ravel		Well Completion	on		Measurement in Metric
28.96		Shattered Shale			Total Depth Drill	ed Finished Well	Depth Start Date	End Date
32.92		Brown Sandstone			53.95 m		2003/01/1	5 2003/01/17
34.75		Gray Sandstone			Borehole			
45.72		Shale & Sandstor	ne Ledges		Diameter (	(cm)	From (m)	To (m)
47.24	Yes	Water Bearing Sa	ndstone		Surface Casing	(if applicable)	Well Casing	כע.ככ ארכי ז/Liner
50.29	Yes	Water Bearing Sha	ale		Steel	,pp://doi//	Plastic	·
50.90	Yes	Water Bearing Sa	ndstone		Size OL	): 14.13 cm	_ Size	e OD : 11.43 cm
53.95		Shale			Wall Thickness	s: 0.478 cm	- Wall Thick	mess : 0.544 cm
					Bottom a	at : 30.18 m	Botto	op at : 23.47 m om at : 53.95 m
					From (m) T 43.28	Diameter Slot 50.90 0.635	or Slot m) Length(cm	Hole or Slot ) Interval(cm) 25.40
					Perforated by Annular Seal Placed from Amount Other Seals	Saw Driven & Bentonite 0.00 m to	) 30.18 m	- Δt (m)
						туре		
					Screen Type Size OL From (m	0 : cm n) !t	- To (m)	Slot Size (cm)
					Top Fitting: <b>Pack</b>	S	Bottom Fi	ttings
					Type Unknow	<u>Nn</u> Linknown	Grain Size	€
					, anount	GUNUOWI		

#### Contractor Certification

Name of Journeyman responsible for drilling/construction of well WILLIAM PENROD

Company Name M&M DRILLING CO. LTD.

Certification No A000187 Copy of Well report provided to owner Date approval holder signed

#### Water Well Drilling Report View in Imperial GIC Well ID Export to Excel 1475699 Government

wner Name UICK WAY FARMS LTD cation 1/4 or LSD SE 15 31 leasured from Boundary of	Address P.O. BOX 17		Town	F	Province	Country	Dootal Co
UICK WAY FARMS LTD Decation 1/4 or LSD SE 15 31 leasured from Boundary of m from	P.O. BOX 17				1011100	oounuy	FUSIAI CU
ocation 1/4 or LSD SE 15 31 leasured from Boundary of		19	BROOKS	Α	В	CA	T1R 1C5
leasured from Boundary of	C TWP 026	RGE W of MER 03 5	Lot Block	Plan	Additional STOCK	al Description WELL	
m from		GPS Coordinat	tes in Decimal Degre	es (NAD 83)	67	Flowetion	
	n		207550 Long	-114.4056	<u>67</u>		tainad
m fro	<u>n</u>	How Location (	Dotained	m		Not Obtained	tained
dditional Information			inomous GF 3 20-30			Not Obtained	Macaurament in N
	Oracia de la const	60.00					Measurement in M
Jistance From Top of Casing to Is Artesian Flow	Ground Level	60.96 CM	Is Flow Cor	ntrol Installed			
Rate	l /min		1011011 001	Describe			
	2,	07.00.1/.:				D //	
Recommended Pump Rate		27.28 L/min	Pump Installed			Depth	
lecommended Pump Intake De	pth (From TOC)	42.67 M	Type	N	Лаке	Madal (Output	H.P.
						wodel (Output R	ating)
Did you Encounter Saline Wat	er (>4000 ppm TDS	S) Depth	m	Well Disinfect	ed Upon C	Completion	
	Ga	Depth	m	Geophy	sical Log	Taken	
				Sub	omitted to l	ESRD	
eld Test				Taken	From Gr	ound Level	Measurement in M
Fest Date Star	Time	Static Water Level			Depth	to water level	
:003/01/20 12:0	D AM	32.64 m	Drav	vdown (m)	Ela M	apsed Time inutes:Sec	Recovery (m)
Nethod of Water Removal				35.07		1:00	36.99
				35.83		3:00	36.20
Pomoval Pato	24.55 L/min		_	36.01		4:00	36.02
	24.33 L/IIIII			36.22		5:00	35.91
Depth Withdrawn From	53.34 m			36.37		6:00	35.79
				36.49		7:00	35.72
water removal period was < 2	nours, explain wny			36.62		8:00	35.61
				31.24		9:00	35.45
				30.80		10:00	35.41
				30.90		12:00	35.29
				26.01		14:00	35.10
				27.40		20:00	33.05
				37.40		20.00	34.00
				37.50		30.00	34.59
				37.00		35.00	34.50
				38.01		40:00	34.40
				38.28		50:00	34.27
				38.43		60:00	34.14
				38.71		75:00	34.03
				38.91		90:00	33.91
				39.09		105:00	33.83
				39.24		120:00	33.74
ater Diverted for Drilling							
/ater Source		Amount Taken			Diversion	Date & Time	
		L					

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M&M DRILLING CO. LTD.

Company Name

Page: 2 / 2

## Water Well Drilling Report

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GoA Well Tag No. Drilling Company Well ID

GIC Well ID

1556533

	accuracy. The information on the	iis report will be retained in a pu	DIIC UAIADASE.	C	Date Report Received	2014/06/04
Well Identification and Lo	ocation				Ν	Measurement in Metric
Owner Name SOUTH ROCK LTD	Address P.O. BOX 460	Towr MED	י ICINE HAT	Province ALBERTA	Country CANADA	Postal Code T1A 7G2
Location 1/4 or LSD 4	SEC         TWP         RGE           32         26         3	W of MER Lot 5	Block Plan	Additiona OBSERV	al Description ATION HOLE #5	
Measured from Boundary o	f m from m from	GPS Coordinates in De Latitude 51.258118 How Location Obtained Differential corrected ha	cimal Degrees (NAD 8 Longitude -114.	3) .396505	Elevation 127 How Elevation Obtaine Differential corrected h	0.00 m ed nandheld GPS 5-10m
Drilling Information						
Method of Drilling Rotary - Mud		<b>Type of Work</b> Other				
Proposed Well Use Monitoring						
Formation Log	М	easurement in Metric	Yield Test Summa	ary	Ν	leasurement in Metric
Depth from Water ground level (m)	Lithology Description		Recommended Pun Test Date W	np Rate /ater Removal R	L/min ate (L/min) Sta	tic Water Level (m)
0.30	Black Topsoil					
6.40	Brown Clay		Well Completion		Ν	leasurement in Metric
11.89	Gray Gravel		Total Depth Drilled	Finished Well L	Depth Start Date	End Date
13.72	Gray Shale		Borehole	13.72111	2014/05/08	2014/05/08
U	NV	AL	14.29         Surface Casing (if         Size OD :         Wall Thickness :         Bottom at :         Perforations         From (m)       To (r         Perforated by         Annular Seal       Ben         Placed from	applicable) cm cm cm m Diameter Slot Width(cr tonite Chips/Tat 0.91 m to 300.00 Pc pe ted PVC	0.00 Well Casing/Lin Plastic Size OD Wall Thickness Top at Bottom at or n) Slot Length(cm) Delets 9.75 m	13.72         er         :       0.35 cm         :       0.516 cm         :       -0.91 m         :       13.72 m         Hole or Slot       Interval(cm)
Contractor Certification			Size OD : _ From (m) 10.67 Attachment <u>Ai</u> Top Fittings <u>R</u> Pack Type <u>Sand</u> Amount 200	6.35 cm 6.35 cm ttached To Casi iser Pipe 0.00 Pounds	To (m) 13.72 ng Bottom Fittings Grain Size 10-	Slot Size (cm) 0.254

NIEMANS DRILLING (1980) LTD.

Company Name

Page: 1 / 2

Date approval holder signed

2014/06/04

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Yes

#### Government Water Well Drilling Report of Alberta

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GIC Well ID GoA Well Tag No

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10.	
y Well ID	

	accu	racy. The inform	nation on this rep	ort will be ret	ained in a publi	ic database.	coponoionity re		Date Report Receive	en 12 ed 2	014/06/04
Well Identification and	Location								· · ·	Meas	urement in Metri
Owner Name SOUTH ROCK LTD		Address P.O. BOX 4	160		Town MEDIC	CINE HAT		Province ALBERTA	Country CANADA		Postal Code T1A 7G2
Location 1/4 or LSD 4	SEC 32	TWP 26	RGE V 3 5	V of MER	Lot	Block	Plan	Additior OBSER	al Description VATION HOLE #5		
Measured from Boundary	r of m from m from		C L F D	PS Coordi atitude	inates in Deci 51.258118 on Obtained corrected han	imal Degre Long	es (NAD 83) itude <u>-114.3</u> \$ 5-10m	96505	Elevation How Elevation Obta Differential correcte	1270.00 ained ed handh	m eld GPS 5-10m
Additional Information										Meas	urement in Metrie
Distance From Top of Ca Is Artesian Flow Rate	asing to Gro	und Level	91	.44 cm	ls	s Flow Cor	trol Installeo Describe	l			
Recommended Pump Ra	ate			L/mi	n Pump	Installed			Depth	m	
Recommended Pump In	take Depth (	(From TOC)		m	Туре			Make		H.P.	
									Model (Output Ra	nting)	
Additional Comments	on Well	TALLED AN	Gas	Depti		m Sample C	Gec Gec	physical Log Submitted to Potability	TakenSubm	itted to I	ESRD
Viold Test							Tal	(en From G	round Level	Meas	urement in Metri
Test Date	Start Tim	e	Static Wa	iter Level m			Ta			Wedd	
Method of Water Remo Type Removal Rate	val	L/min									
Depth Withdrawn From If water removal period v	vas < 2 houi	m rs, explain wh	ıy								
Water Diverted for Dril	ling										
Water Source TOWN OF OKOTOKS			Amount 1818.44	Taken	L			Diversio 2014/05/	n Date & Time 08 7:00 AM		

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well CHAD NIEMANS	Certification No 46340A	
Company Name NIEMANS DRILLING (1980) LTD.	Copy of Well report provided to owner Yes	Date approval holder signed 2014/06/04

## Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

View in Imperial Export to Excel 1556534

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

		acc	uracy. The inforr	nation on th	is report will be retained in a	oublic database.	2	Date Report Receiv	ved 2014/06/04	
Well Identificati	on and Lo	cation							Measurement in Metric	
Owner Name SOUTH ROCK L <sup>-</sup>	TD		Address P.O. BOX 4	60	To ME	WIN Province Country Pos EDICINE HAT ALBERTA CANADA TIA				
Location 1/4	or LSD	SEC	TWP	RGE	W of MER Lot	Block Pla	n Additio	nal Description		
4 Measured from B	Roundary of	52	20		GPS Coordinates in I	Decimal Degrees (NA	D 83)	WATION WELL #0		
	n	n from			Latitude 51.25715	5 Longitude -	114.394328	Elevation	1277.00 m	
	n	n from			How Location Obtain	ed		How Elevation Ob	tained	
					Differential corrected	handheld GPS 5-10m	ו	Differential correct	ed handheld GPS 5-10m	
Drilling Informat	tion									
Method of Drillin Rotary - Mud	ng				<b>Type of Work</b> Other					
<b>Proposed Well L</b> Monitoring	Jse									
Formation Log				Me	asurement in Metric	Yield Test Sun	nmary		Measurement in Metric	
Depth from ground level (m)	Water Bearing	Litholo	gy Description	1		Recommended I Test Date	Pump Rate Water Removal	L/min Rate (L/min)	Static Water Level (m)	
5.79		Brown	Sandy Clay &	Rocks						
8.84		Gray (	Gravel			Well Completion	on		Measurement in Metric	
10.97		Gray S	Shale			Total Depth Drill	ed Finished Wel	I Depth Start Date	End Date	
						Borehole	10.37 11	2014/03/12	2014/03/12	
						Diameter (	cm)	From (m)	To (m)	
						14.29		0.00	10.97	
						Surface Casing	(if applicable)	Plastic	/Liner	
						Size OD	) : cr	nSize	OD : 6.35 cm	
						Wall Thickness	: cr	m Wall Thickn	ness : 0.518 cm	
						Bottom at	r:m	To	pat: -0.91 m mat: 10.97 m	
						Perforations		Botto		
							Diamete	er or	Hole or Slot	
						From (m) T	o (m) Width(	cm) Length(cm)	Interval(cm)	
						Perforated by				
						Annular Seal	Bentonite Chips/T	ablets		
						Placed from	0.91 m	to <u>7.01 m</u>	-	
						Amount	200.00	Pounds		
						Ourier Sears	Туре		At (m)	
						Screen Type	Slotted PVC			
						Size OD	6.35 cr	<u>n</u>		
						From (m	1)	To (m)	Slot Size (cm)	
						Attachmen	t Attached To Ca	sing		
						Top Fittings	Riser Pipe	Bottom Fitt	ings Plug	
						Pack				
						Type Sand	200.00 D	Grain Size	10-20	
						Amount	200.00 Pounds			
Contractor Cert	tification					_				
Name of Journey CHAD NIEMANS	man respor S	nsible fo	r drilling/const	ruction of	well	<i>Certifi</i> 46340	ication No IA			

NIEMANS DRILLING (1980) LTD.

Company Name

Page: 1 / 2

Date approval holder signed

Copy of Well report provided to owner

Yes

## Government Water Well Drilling Report

GIC Well ID GoA Well Tag No.

View in Imperial Export to Excel

1556534

of Alb	erta 🗖	The d accur	friller supplies acy. The inform	the data con mation on th	ntained in this report.	The Province dia	sclaims respo atabase.	onsibility for it	6	GIC Well ID GoA Well Tag No. Drilling Company Wel Date Report Received	1556534 I ID I 2014/06/04	4	
Well Ident	ification and L	ocation									Measurement	in Metric	
Owner Nar SOUTH RC	Owner NameAddressSOUTH ROCK LTDP.O. BOX 460			460	Town Province MEDICINE HAT ALBERT			Province ALBERTA	Country CANADA	Posta T1A	al Code 7G2		
Location	1/4 or LSD <b>4</b>	SEC 32	TWP 26	RGE 3	W of MER 5	Lot	Block Plan Additional Description OBSERVATION WELL #6						
Measured	Measured from Boundary of m from m from					GPS Coordinates in Decimal Degrees (NAD 83)         Latitude       51.257155         Longitude       -114.394328         How Location Obtained         Differential corrected handheld GPS 5-10m					Elevation <u>1277.00 m</u> How Elevation Obtained Differential corrected handheld GPS 5-10m		
Additional	Information										Measurement	in Metri	
Distance I Is Artesia	rom Top of Cas n Flow	sing to Grou	und Level		91.44 cm	ls Fl	ow Control	Installed					
	Rate		L/min				l	Describe					
Recomme	nded Pump Rat	te			L/min	Pump Ins	stalled			Depth	m		
Recomme	nded Pump Inta	ake Depth (I	From TOC)		m	Туре			Make	H Model (Output Rati	I.P		
Did you	Encountor Salir	o Wator (>	4000 ppm Ti	ופח	Denth		<b>m</b> 14	All Disinfer	ted I Inon	Completion Ves			

() 14 T + +				Management in Martin
INSTALLED LOCKABLE PROTECTOR CASING	AND CONCRETED INTO THE GR	ROUND.		
Additional Comments on Well				
		Sample C	ollected for Potability	Submitted to ESRD
	/ A		Submitted to ESRD	
(	Gas Depth	m	Geophysical Log Taken	
Did you Encounter Saline Water (>4000 ppm T	DS) Depth	m	Well Disinfected Upon Completion Y	es

			Taken From Ground Level	Measurement in Metric
Test Date	Start Time	Static Water Level m		
Method of Water Remov	val			
Туре				
Removal Rate	L/min			
Depth Withdrawn From	m			

Water Source	Amount Taken	Diversion Date & Time	
TOWN OF OKOTOKS	2727.66 L	2014/05/12 7:00 AM	
Water Diverted for Drilling			

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well CHAD NIEMANS	Certification No 46340A	
Company Name NIEMANS DRILLING (1980) LTD.	Copy of Well report provided to owner Yes	Date approval holder signed 2014/06/04

# Government

## Water Well Drilling Report View in Imperial Export to Excel

2014/05/13

Well Casing/Liner

Wall Thickness :

Slot

Length(cm)

Size OD

Top at :

Bottom at :

From (m)

cm

cm

m

Diameter or Slot

Width(cm)

Plastic

2014/05/13

To (m)

6.35 cm

0.518 cm

-0.91 m 12.19 m

Hole or Slot

Interval(cm)

f Albe	rta 🗖	The	driller supplies iracy. The info	s the data con rmation on th	ntained in this report. The second	he Provinc d in a pub	ce disclaims res lic database.	ponsibility fo	G or its D D	oA Well Tag No. rilling Company Well ate Report Received	ID 2014/06/04
Well Identific	cation and L	ocation									Measurement in Metri
Owner Name SOUTH ROCI	K LTD		<i>Address</i> P.O. BOX	460		Town MEDI	CINE HAT		Province ALBERTA	Country CANADA	Postal Code T1A 7G2
Location	1/4 or LSD <b>4</b>	SEC 32	<i>TWP</i> 26	RGE 3	W of MER 5	Lot	Block	Plan	Additional OBSERV	Description	
Measured from	m Boundary o	of			GPS Coordinate	es in Dec	cimal Degree	s (NAD 83,	)		
_		m from			Latitude 51.2	255906	Longitu	Ide -114.3	92635	Elevation 12	73.00 m
-		m from			How Location C	)btained			1	low Elevation Obtain	ned
-					Differential corre	ected ha	ndheld GPS	5-10m	1	Differential corrected	handheld GPS 5-10m
Method of Dr Rotary - Mud Proposed We	rilling ell Use				<b>Type of Work</b> Other						
Monitoring											
Formation L	og			Me	easurement in Me	etric	Yield Tes	Summa	ſy		Measurement in Metr
Depth from ground level (	Water (m) Bearing	Litholog	gy Descriptio	n			Recommen Test Da	nded Pump te Wa	o Rate iter Removal Ra	L/min ate (L/min) St	atic Water Level (m)
3.66		Brown	Clay & Rock	s							
11.28		Gray G	iravel			Ī	Well Com	pletion			Measurement in Metr
12.19		Gray S	hale				Total Depti	Drilled I	inished Well D	epth Start Date	End Date

Perforated by

From (m)

Perforations

12.19 m

Borehole

Diameter (cm)

Size OD :

Bottom at .

Wall Thickness :

Surface Casing (if applicable)

#### Annular Seal Bentonite Chips/Tablets

To (m)

12.19 m

Placed from	0.91 m	to	8.23 m	_					
Amount	250.00	Pounds	3						
Other Seals									
	Туре		At (m)						
<b>Screen Type</b> Size OL	Plastic	:m_							
From (n 9.14	n)	To 12	(m) .19	Slot Size (cm)					
Attachmen	Attached To C	asing							
Top Fitting	s Riser Pipe		Bottom Fitt	tings Plug					
Pack									
Type Sand			Grain Size	10-20					
Amount	200.00 Pounds								

Contractor Certification Name of Journeyman responsible for drilling/construction of well

Ur

**NVA** 

CHAD NIEMANS Company Name

NIEMANS DRILLING (1980) LTD.

Certification No 46340A Copy of Well report provided to owner Date approval holder signed 2014/06/04 Yes

Printed on 1/13/2015 4:52:27 PM

#### Water Well Drilling Report Government

View in ImperialExport to ExcelGIC Well ID1556535GoA Well Tag No.1556535

	_	-	_	_	_	-	

of Alb	erta 🗖	The c	driller supplies acy. The info	s the data cor rmation on th	ntained in this report. his report will be retain	The Provin ned in a put	ce disclaims re blic database.	esponsibility fo	r its	GoA Well Tag No. Drilling Company Well Date Report Received	I ID I 2014/06/04
Well Ident	tification and L	ocation									Measurement in Metric
Owner Nar SOUTH RC	Owner NameAddressSOUTH ROCK LTDP.O. BOX 460				Town Province MEDICINE HAT ALBERT				Country CANADA	Postal Code T1A 7G2	
Location	1/4 or LSD <b>4</b>	SEC 32	TWP 26	RGE 3	W of MER 5	Lot	Block	Plan	Additior OBSER	nal Description RVATION WELL #7	
Measured	Measured from Boundary of m from m from				GPS Coordina Latitude <u>51</u> How Location Differential cor	GPS Coordinates in Decimal Degrees (NAD 83) Latitude 51.255906 Longitude -114.392635 How Location Obtained Differential corrected bandheld GPS 5-10m					273.00 m ned handheld GPS 5-10m
Additional	Information										Measurement in Metric
Distance I Is Artesia	From Top of Cas In Flow Rate	sing to Grou	L/min		91.44 cm		Is Flow Con	rol Installed Describe			
Recomme	ended Pump Ra	te			L/min	Pum	p Installed			Depth	

Recommended Pump In	take Depth (From TOC)	m	Туре		Make	H.P.
					Model	(Output Rating)
Did you Encounter Sal	ine Water (>4000 ppm TDS	S) Depth	1	m Well Disir	nfected Upon Completi	on Yes
	Ga	ns Depth		m Geo	ophysical Log Taken	
	I. B. I. N.	/ A I			Submitted to ESRD	
			Sa	ample Collected for I	Potability	Submitted to ESRD
Additional Comments	on Well					
INSTALLED LOCKABLE	PROTECTOR CASING A	ND CONCRETED INTO	THE GROUND	).		
Yield Test				la	ken From Ground Lo	evel Measurement in Metric
Test Date	Start Time	Static Water Level				
		m				
Method of Water Remo	val					
Туре						
Removal Rate	L/min					
Depth Withdrawn From	m					
If water removal period v	vas < 2 hours, explain why					

Water Diverted for Drilling		
Water Source	Amount Taken	Diversion Date & Time
TOWN OF OKOTOKS	1818.44 L	2014/05/12 7:00 AM

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well CHAD NIEMANS	Certification No 46340A	
Company Name NIEMANS DRILLING (1980) LTD.	Copy of Well report provided to owner Yes	Date approval holder signed 2014/06/04

## Water Well Drilling Report

#### View in Imperial Export to Excel

2095665

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database. Date Report Received 2014/12/04 Well Identification and Location Measurement in Metric Address Postal Code Town Owner Name Province Country CIRCLE J RANCHES LTD COCHRANE RR 2 ALBERTA CANADA TOL OWO 1/4 or LSD SEC TWP RGE W of MER Block Additional Description Lot Plan Location SW 6 27 3 5 M. GILES GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 51.274608 Longitude -114.417737 m m from How Elevation Obtained How Location Obtained m from Not Verified Not Obtained **Drilling Information** Method of Drilling Type of Work Unknown Well Inventory Proposed Well Use Domestic & Stock Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate L/min Water Lithology Description Depth from Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 25.60 Old Well Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 25.60 m 1934/06/30 **Borehole** Diameter (cm) From (m) To (m) Surface Casing (if applicable) Well Casing/Liner Size OD : Size OD : cm cm Wall Thickness : cm Wall Thickness : cm m Bottom at : Top at : m Bottom at : m Perforations Diameter or Slot Hole or Slot Slot Width(cm) Interval(cm) To (m) Length(cm) From (m) Perforated by Annular Seal Placed from <u>m</u> to \_\_\_\_\_ m Amount Other Seals Туре At (m) Screen Type Size OD : cm From (m) To (m) Slot Size (cm) Attachment Top Fittings Bottom Fittings Pack Туре Grain Size Amount Contractor Certification Name of Journeyman responsible for drilling/construction of well Certification No UNKNOWN DRILLER11 11 Company Name Copy of Well report provided to owner Date approval holder signed

UNKNOWNDRILLINGCOMP11

Government

of Alberta

## Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

View in Imperial Export to Excel 2095665

GoA Well Tag No. Drilling Co

GIC Well ID

Tag No.	
ompany Well ID	
	004

abbaraby: the internation of a	is report will be retained in a public dat	abase.	Date Report Received	2014/12/04
Well Identification and Location			N	leasurement in Metric
Owner NameAddressCIRCLE J RANCHES LTDRR 2	<i>Town</i> COCHRAN	E Province E ALBER	e Country TA CANADA	Postal Code T0L 0W0
Location1/4 or LSDSECTWPRGESW6273	W of MER Lot Bi 5	ock Plan Additi M. Gl	ional Description LES	
Measured from Boundary of m from m from	GPS Coordinates in Decimal Latitude 51.274608 How Location Obtained Not Verified	Degrees (NAD 83) Longitude <mark>-114.417737</mark>	Elevation How Elevation Obtaine Not Obtained	m ed
Additional Information			N	leasurement in Metric
Distance From Top of Casing to Ground Level Is Artesian Flow RateL/min	Is Flo	v Control Installed Describe		
Recommended Pump Rate	L/min Pump Inst	alled	Depth	m
Recommended Pump Intake Depth (From TOC)	m Type	Make	H.F	2.
			Model (Output Rating	y)
Did you Encounter Saline Water (>4000 ppm TDS) Gas	Depth m Depth m	Well Disinfected Upo Geophysical Lo Submitted	on Completion og Taken to ESRD	
Additional Comments on Well ORIGINAL WELL REPORT NOT IN GIC. THE FOLLOWIN APPLICATION RECEIVED ON DECEMBER 04, 1984. OW WERE GETTING 1 GPM CONSISTENTLY. OWNER REPO DEEP. ALREADY DRILLED ANOTHER WELL 391000.	San G INFORMATION WAS TAKEN F NER REPORTS THIS WELL WAS NRTS THAT WELL WAS CONSTI	Ple Collected for Potability ROM DROUGHT EMERGEN S BAILED OUT TO 4 FEET C RUCTED IN APPROXIMATE	Submitter NCY GROUNDWATER TE DF WATER, TOOK 1 DAY LY 1934 AND IS APPROX	d to ESRD STING PROGRAM TO RECOVER, IMATELY 84 FEET
Viold Test		Takan Fran		An annual ann an t-im Martuia
Test Date Start Time Stat	ic Water Level m	Taken From	Ground Level IV	reasurement in Metric
Method of Water Removal Type				
Removal Rate				
Depth Withdrawn From m				
If water removal period was < 2 hours, explain why				
Water Diverted for Drilling				
Water Source Arr	ount Taken L	Divers	ion Date & Time	

Contractor Certification
Name of Journeyman responsible for drilling/construction of well UNKNOWN DRILLER11
Company Name

UNKNOWNDRILLINGCOMP11

Government

of Alberta 🗖

Certification No

11

#### APPENDIX D Residential Well Assessment Questionnaires

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003



Water Well Reconnaissance Survey

	SITE RECONNAISSANCE CHECKLIST
Project Name:	WATERMAN AGGREGATE RESOURCE
Project Number:	203.50065.00001 SLR Staff: K.Tu
Street Address:	3 - MW31-26-3 WER - 35181 BIG HILL SPRINGS FOAD
Property Type:	Private Residence Commerical/Industrial Other
Person/Resident Interviewed:	THUE THORESON, BRUCE WATERMAN
Date of Visit:	29 OCT 2014 Time: 10115
1. Well Owner Information	
Name:	BRUCE WATCRMAN
Street Address:	
Contact Number:	Home: Business: Cell:
Email Address:	
2. Well User/Occupant of t	he Residence Using the Well
	Same as Well Owner
If different from well owner ple	ease fill out details below:
Name:	JULIE THORESON
Street Address:	
Contact Number:	Home: Business: Cell:
Email Address:	
3. Well Details	
Well Location	Lot: NW 31-26-3 WSA Concession: Township:
3A. Well Use	· ·
Water Use: NO DRINKING	, Domestic: No. of people using water from the well:
WATER	Livestock: No. of livestock using water from the well: 7 Horses + Sheef + Ger
	Lawn Watering: Acres/area covered: Approximate Amount:
	Irrigation: Acres/area covered:Approximate Amount:

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	SLR
3A. Well Use Continued	
Additional Equipment:	Pool:  Jacuzzi/Hot Tub:  Landscape water feature/fountain:    Other:
Private waste and water dispo	sal: Type (ex. Speotic tank): SLOTIC TANK
System description:	1006 GAL TANK
Distance to Well	75@ft     Direction from well (N, S, E, or W)
Well is	Uphill Downhill Same Grade as the waste water system
3B. Well Construction Deta	ails
Construction/Installation Date:	LNKNOWN PRE-1960 Contractor:
Type of Installation:	Drilled Dug Dug Other:
Diameter:	6/8 www Well Depth (m): 3~ 400ft
Screen? WNKNOWN	YES NO MOE Record Number:
	Screen length (m)
	Depth to top of screen (m)
Is the well accesible for sampl	ing? YES NO Confirmed Inferred
If no provide details:	WELL HEAD APPROXIMATELY EF 2n BELOW EROND LEVEL IN A PIT
Location of measurement (top	of pipe (TOP), ground surface):
SLR staff member collecting the	ne measurement:
Date of <u>original</u> measurement:	Original/initial water level depth (m)
Subsequent water level measu	rements
	Date Depth (m)
a	Staff
3C. Pumping Equipment	
Pump Type:	Suction-lift  Pumping Capacity
	Positive-submergence Age
How is the pump lubricated?	
Depth of intake setting:	Original (m) Present (m) <u>100+ ft</u> Pumping Rate (L/s)
Storage Tank:	Type: <u>CISTERN</u> Capacity: 1000 GAL
Additional Features:	Chlorinator Water softener Water filter Filter type:
	WD TREATMENT

~

x1/105

			<i>*</i>
а 4	x		<i></i>
38		(	SLR 🖤
4. Well History			
How long have you owned, operated or lived on the	his property? 7 MGA	RS	
Have you ever experienced any previous problem	s with your well?	A wowen	
If so, when?			
What was the cause of the previous problem:	Drought	Pump Failure	
	Plugging	Increased usage	
	Interference	Contamination _	<u> </u>
If the problem was contamination, what water qua	ility changes were apparent? (Note	any differences in taste,	odour, colour or clarity)
SAND IN CISTERN, PIPES	ETC		
What action was taken to overcome this problem?	Phansmund + Ci	ilord Ated	
	(Sana D Back Co	A A2 -0	Store Danas
What were the effects of this action?	CLEMCED INSULA	NO T	that by the
Did you ever have your well?	deepend, YES		~
	or a new		0
		NO	
if so why?			
Outline briefly any previous repairs or changes in	pumping equipment, and dates	ie a	
	,,,,,,,,,,		
5. Sample Details - TAKEN AZON KIT	chen tap - (no treatm	GAT ON SITE)	
Date: $\frac{29}{10}/14$	Sample Collected?	YES MO	
Sample Name/Number:	Number of Bottles:	<u> </u>	
Field Analysis Harness	Iron		Conductivity
pH	Temperature		Other
6. Contact Details	Ĵ		
Permission for future monitoring?	YES 🔽 NO 🗌		
Well Aware Booklet:			11
Perferred contact time/method:	call/contact ahead	site visit 🗌	
Contact by:	email 🗌 phone 🗹	perferred contact numbe	r:
preferred contact	time (evening, weekday, morning, e	tc.): Awin Ti	ME DURING MY



Roadways and Lanes

A=Agricultural (Not a Barn)

Note: R= Residental B=Barn C=Commercial I=Irrigation

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7. Well Location Sketch Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend. N 45 Terris House To thomas 10 VIIGNWAM mp To TRONGUS 0 Tienst 1 LEGEND 7 North Building o Well

SLR Consulting (Canada) Ltd.

Well GPS

Number of Photos Taken:

Description

Not to Scale

8. Site Photograph Log

Photograph Number/Name



Water Well Reconnaissance Survey

	SITE RECON	NAISSANCE CHECKLIST	
Project Name:	WATERMAN AGER	EGATE RESOLACE	
Project Number:	203.50065.00001	SLR Staff: R.T.L	
Street Address:	SE 31-26-3 WSI	ч	,
Property Type:	Private Residence	Commerical/Industrial Othe	r
Person/Resident Interviewed:	MRS PARKER		
Date of Visit:	PHONE CALL 10 DEC 2014	Time:16-30	
1. Well Owner Information			
Name:	MAS PARKER		
Street Address:	Box 123 5	6 31 26 3 WSH	1
Contact Number:	Home:	Business:	Cell:
Email Address:			·
2. Well User/Occupant of t	ne Residence Using the Well		аланын алан алан алан алан алан алан ала
	Same as Well Owner		
If different from well owner ple	ase fill out details below:		
Name:			
Street Address:			6
Contact Number:	Home:	Business:	Cell:
Email Address:			
3. Well Details			1
Well Location	Lot: IN House Si	E 31-26-3 WSM Concession:	Township:
3A. Well Use	whites)		
Water Use:	Domestic:	No. of people using water from t	he well: 2
	Livestock:	No. of livestock using water from	the well: 100 HEAD CATTLE
	Lawn Watering:	Acres/area covered:	Approximate Amount:
	Irrigation:	Acres/area covered:	Approximate Amount:
3	ARTESIAN WELLS		

a

					SLR
3A. Well Use Continued	-				
Additional Equipment:	Pool:	Jacuzzi/Hot	Tub:	Landscape water	feature/fountain:
	Other:			548	
Private waste and water dispo	sal:	Type (ex. S	pectic tank): 54 PT	ic TANK	
System description:					
Distance to Well	100 FE		Direction from well (N	, S, E, or W)	\$ DEPENDS ON WELL
Well is	Uphill 🗹 💡		Downhill	Same Grade	as the waste water system
3B. Well Construction Deta	ils				
Construction/Installation Date:	1920 5		_ Contractor:	OWNER	
Type of Installation:	Drilled	Dug 🗹	Other:		
Diameter:	6" 012 8"		Well Depth (m):	20-25 fee	.T
Screen?	YES 🗹	NO 🗌		MOE	Record Number:
	Screen length (m) _		_		
	Depth to top of scre	een (m)			
Is the well accesible for sampli	ng?	YES	NO 🗹	Confi	rmed Inferred .
If no provide details:	IN THE	hon	56	100000	
Location of measurement (top	of pipe (TOP), groun	d surface):			•
SLR staff member collecting th	e measurement:				
Date of <u>original</u> measurement:			_ Original/initial water	level depth (m)	3 ARTESIAN - 10/+ BE
Subsequent water level measu	rements				6 Correst
	Date				
	Depth (m)				
2.			I		
3C. Pumping Equipment	a an				
Pump Type:	Suction-lift	Subrea	SIBLE	Pumping Capacity	y
20	Positive-submerger	nce 🗌		Age	
How is the pump lubricated?					
Depth of intake setting:	Original (m)		Present (m)	Pump	ing Rate (L/s)
Storage Tank: 🛛 🕖	Туре:			Capacity:	
Additional Features: NO	Chlorinator		Water softener	Water filter 🗌	Filter type:

		SLR
4. Well History		
How long have you owned, operated or lived or Have you ever experienced any <u>previous</u> proble	n this property? ms with your well?	
What was the cause of the previous problem: If the problem was contamination, what water q	Drought Pump Failure Plugging Increased usage Interference Contamination uality changes were apparent? (Note any differences in ta	aste, odour, colour or clarity)
What action was taken to overcome this probler	n?	
What were the effects of this action?		
Did you ever have your well?	deepend,   YES   NO     cleaned,   YES   NO     or a new   YES   NO     well   YES   NO	
If so why?		
Outline briefly any previous repairs or changes i	n pumping equipment, and dates <u>1966/67 Pr</u>	ing 5
5. Sample Details		
Date:	Sample Collected? YES NO	
Field Analysis Harnes	rs Iron H Temperature	Conductivity
6. Contact Details		
Permission for future monitoring? Well Aware Booklet:	YES NO V - NOT MUTIL	AFTER XMAS
Perferred contact time/method: Contact by:	call/contact aheadsite visit email phone perferred contact nu	imber:
preferred contac	t time (evening, weekday, morning, etc.):	

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#### 7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.

		LEGEND 7
		V North
		• Well
		册 Septic Tank and Bed
		Roadways and Lanes
		R= Residental
		B=Barn C=Commercial
Not to Scale		I=Irrigation A=Agricultural (Not a Barn)
Well GPS		
8. Site Photograph Log		
Number of Photos	Taken:	
Photograph Number/Name	Description	

Water Well Reconnaissance Survey



	SITE RECON	NAISSANCE CHECKL	.IST		
Project Name:	WATGEMAN E	AGGLEGATE	Resonace	·	
Project Number:	203-50065-00001	SLR Staff:	R. Tim		
Street Address:	NE 31 - 26 - 3 . h	ISM			
Property Type:	Private Residence	Commerical/Industrial	Other		
Person/Resident Interviewed:	CALVEN &	RAWN.			
Date of Visit:	29 000 2014	Time:	12:00	-	
1. Well Owner Information					
Name:	CALVIN RAWN		1441-041) (14-051) (15-054-041) (15-055-054-041) (15-055-054-041)		
Street Address:	As above				
Contact Number:	Home:	Business:	Cell: (		
Email Address:				31	
2. Well User/Occupant of t	he Residence Using the Well	[			
	Same as Well Owner	2			
If different from well owner ple	ase fill out details below:				
Name:					
Street Address:					
Contact Number:	Home:	Business:	Cell:		
Email Address:					
3. Well Details	-1	0			
Well Location	Lot: NE 31-26-3 WSM	Concession:	Township:		
3A. Well Use - 2	wens				
Water Use:	Domestic:	No. of people using wa	ter from the well:	\$ 5	(ww 2)
×	Livestock:	No. of livestock using v	water from the well:	40 HURSES	(ww3)
	Lawn Watering:	Acres/area covered: _	Approxima	te Amount:	
	Irrigation:	Acres/area covered: _	Approxima	te Amount:	

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3A. Well Use Continued					
Additional Equipment:	Pool: Other:	Jacuzzi/Hot	Tub:	Landscape wate	r feature/fountain:
Private waste and water dispo	sal:	Type (ex. S	pectic tank): Se	Pric TANK	<u>.</u>
System description:					49
Distance to Well	-300 /1	÷	Direction from well (	N, S, E, or W)	EAST
Well is	Uphill		Downhill	Same Grade 🔽	as the waste water system
3B. Well Construction Deta	ails				
Construction/Installation Date:			Contracto	r:	
Type of Installation:	Drilled 📝	Dug 🗌	Othe	r:	14
Diameter:	6 war	_	Well Depth (m	): 177 + 13	is A
Screen?	YES	NO 🗌	đ	MOE	Record Number:
	Screen length (m)	Anantina	-		
	Depth to top of sc	reen (m)			
Is the well accesible for sampl	ing?	YES 🚺 (w	ω2) NO 🗹 (ω	ر Sonf	ïrmed 🗌 Inferred 🗌
If no provide details:	WW3 BLO	cked @	27.5mbTol	Gette Bassic Marcola	12
Location of measurement (top	of pipe (TOP), grou	nd surface):	TOP		
SLR staff member collecting the	ne measurement:	Rober	t Ticc		M.
Date of original measurement:	29/007/201	4	Original/initial wate	er level depth (m)	29.65 mb Top (wwz)
Subsequent water level measu	<u>rements</u> – Ww 2	60666	r installed	-T	
	Date				
	Staff				
3C. Pumping Equipment		•			
Pump Type:	Suction-lift	SUBM	GRSIBLE	Pumping Capacif	V street
	Positive-submerge	ence		Age	10 YRS + SYRS
How is the pump lubricated?					
Depth of intake setting:	Original (m)		Present (m)	WW2 WW3 160A + 125(APum)	ping Rate (L/s)
Storage Tank:	Туре:	CISTER	<b>.</b>	_ Capacity:	WW2 WW3 10 GAZ (HOWSE) + "PSO GAZ
Additional Features:	Chlorinator		Water softener 📝	Water filter 🗹	Filter type: MARTICILATE
			house	tionse	

16 Mar.

-1. . x				
				SLR
4. Well History				
How long have you owned, operated or live	ed on this property?	10 4	res s	
Have you ever experienced any previous p	roblems with your w	vell? 10	6	
If so, when?				
What was the cause of the previous proble	m: Drought	r:129.44	Pump Failure	A 1999 A 1997 - 1
	Plugging		Increased usage	And the second se
	Interference	F Maggadate (SVIX2-11) - 14	Contamination	All Dirana
If the problem was contamination, what wa	ter quality changes	were apparent? (No	ote any differences in ta	ste, odour, colour or clarity)
N/A		e Model al resultant de la consecuencia		
What action was taken to overcome this pr	oblem? N/A			·
	54			
What were the effects of this action?	N/A			
Did you ever have your well?	deepend,	YES	NO	
	cleaned,	YES	NO 🗾	
	well	YES	NO	
lf so why?				
			Acones 11	
Outline brieny any previous repairs or chan	iges in pumping equi	ipment, and dates	KALCICAD H	ouse sump
5 Sample Details (10.) 5 - 54.0	AT BATH TO A TO	110 DC 1117		(
or outline peraits WW 2 - STADDITE	at date of the	House, wws-	NOSE IN STABLES	(NO TREATMENT)
Date: 29 oct 2	2014	Sample Collected	? YES 🔽 NO 🗌	
Sample Name/Number: <u>WWL + U</u>	WWS	Number of Bottles	s: <u>L EACH</u>	
Field Analysis H	arness	. Ir	on	Conductivity 577 hS/cm
	pH_7.62	Temperatu	ire_ <u>6,4°C</u>	Other
6. Contact Details				
Permission for future monitoring?	YES	NO 🗌		
Nell Aware Booklet:	and the second s			
Perferred contact time/method:	call/contact a	ahead	site visit	
Contact by:	email	phone	perferred contact nu	imber:
preferred co	ontact time (evening,	, weekday, morning	, etc.): Durker	OG DAY - ANY REASONAN
			Nor	1 15
### SLR®

#### 7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.



Water Well Reconnaissance Survey



	SITE RECONI	VAISSANCE CHECKLIST	
Project Name:	WATERMAN AGG	LEGATE RESOURCE	
Project Number:	203.50065.0000	SLR Staff: R.TILC	
Street Address:	SW 31-26-03.	SWSM	
Property Type:	Private Residence	Commerical/Industrial Other	
Person/Resident Interviewed:	JOHN NULGTER	2	
Date of Visit:	30 OCTOBER 2014		
1. Well Owner Information			
Name:	JOHN NUGTER	2	
Street Address:	AS AGOVE	ć.	×
Contact Number:	Home:	Business: Cell:	
Email Address:			
2. Well User/Occupant of th	he Residence Using the Well	[	
	Same as Well Owner		
If different from well owner ple	ase fill out details below:		
Name:			
Street Address:			
Contact Number:	Home:	Business: Cell:	
Email Address:			
3. Well Details			
Well Location	Lot: 5W.31-26-03 WSM	Concession: Town	nship:
3A. Well Use			
Water Use:	Domestic:	No. of people using water from the we	II: 3
	Livestock:	No. of livestock using water from the v	vell: 25 CATTLE, 5 Hollses
	Lawn Watering:	Acres/area covered:Appr	oximate Amount:
i.	Irrigation:	Acres/area covered: Appr	oximate Amount:
ii.			Ξ.

J.

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					SLR
3A. Well Use Continued					
Additional Equipment:	Pool:	Jacuzzi/Ho	t Tub:	Landscape water fea	ture/fountain:
	Other:		in the Br	82	
Private waste and water dispo	sal:	Type (ex. S	pectic tank): Ser-	TIC TANKS (2	TANKS)
System description:	1 TANK	for hi	MSE + 1 G	in RENTON	house
Distance to Well		_	Direction from well (N	N, S, E, or W)	
Well is	Uphill 🗌		Downhill	Same Grade	as the waste water system
3B. Well Construction Deta	nils				
Construction/Installation Date:	1990		Contractor	: Lon's whiter	wer DRILLING
Type of Installation:	Drilled	Dug 🗌	Other	:	
Diameter:		=6	Well Depth 📢	: IISA-	
Screen?	YES 🖌	NO 🗌		MOE Rec	ord Number:
	Screen length (m)		— :	350	194
×	Depth to top of sc	reen (m)	1. <del></del>		
Is the well accesible for sampli	ng?	YES √	NO	Confirme	d 🗹 Inferred 🗌
If no provide details:					
Location of measurement (top	of pipe (TOP), grou	nd surface):	TOP		
SLR staff member collecting the	e measurement:	RSB6R-	r Tim		
Date of <u>original</u> measurement:	30 OCTOBER	2014	Original/initial wate	r level depth (m)	734 mb Toc
Subsequent water level measu	rements	1	3	<b></b>	
	Date				
	Staff			1	
3C. Pumping Equipment					
Pump Type:	Suction-lift		6	Pumping Capacity	30 GAZ/MIN
	Positive-submerge	ence	DUBMGKSIBLE	Age	2006
How is the pump lubricated?				marks marks	
Depth of intake setting:	Original (m)		_ Present (m)	100ft ? Pumping	Rate (L/s)
Storage Tank:	Туре:	N/A		_ Capacity:	
Additional Features:	Chlorinator		Water softener	Water filter	Filter type:
		No	TREATMENT		

		SLR
4. Well History		
How long have you owned, operated or lived on Have you ever experienced any <u>previous</u> proble	this property? <u>17 764-R5</u> ms with your well? <u>NO</u>	
What was the cause of the previous problem: If the problem was contamination, what water q	Drought Pump Fa Plugging Increased Interference Contamir uality changes were apparent? (Note any differe	ilure 1 usage nation nces in taste, odour, colour or clarity)
What action was taken to overcome this problem	n?	
What were the effects of this action? Did you ever have your well?	deepend, YES NO	;
lf so why?		
Outline briefly any previous repairs or changes i	n pumping equipment, and dates	760 hund 2006
5. Sample Details		
Date: <u>3 oct 2014</u> Sample Name/Number: <u>Ww4-</u> Field Analysis Harnes p	Sample Collected? YES Number of Bottles: 2 Iron H 5.44? Temperature 5.1°C	NO  Conductivity 606 hS/cm Other
6. Contact Details		
Permission for future monitoring? Well Aware Booklet:	YES NO	
Perferred contact time/method: Contact by: preferred contac	call/contact ahead site visit email phone perferred c t time (evening, weekday, morning. etc.):	] ontact number:

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#### 7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.

HIGHWAM 567 SWAMIT 5	A 6-64EGATE 5 IT E	1 N
. (	HI WEDDEW GATGUNY HILL SLOPE PAIN HIML SLOPE HIMSE BRRU BRRU BUNNA	
	ал. Х	LEGEND
		↗ North □ Building
		○ Well 品 Septic Tank and Bed
		Roadways and Lanes
		R= Residental B=Barn
Not to Scale		C=Commercial I=Irrigation A=Agricultural (Not a Barn)
Well GPS Of 8 02	58 , 5682090	3
8. Site Photograph Log		
Number of P	hotos Taken:	
Photograph Number/Name	Description	
		•
		2
		,

### APPENDIX E Hydraulic Conductivity Test Analysis

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003













### APPENDIX F Groundwater Elevation Data

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003











### APPENDIX G Laboratory Analytical Reports

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003



#### ANALYTICAL REPORT

Client:	Client:       SLR Consulting (Canada) Ltd.         6940 Roper Rd NW         Edmonton, AB T6B 3H9         Attention:       Robert Till	KaizenLAB JOB #:	167115
	Edmonton, AB T6B 3H9	DATE RECEIVED:	30-Oct-2014
		DATE REPORTED:	05-Nov-2014
Attention:	Robert Till	PROJECT ID:	203.50065.00001
		LOCATION:	Summit Aggregates

#### KaizenLAB Sample # 167115\_001 Sample ID: WW1 Date Sampled 29-Oct-2014

ameter Description	Units	Result	Guideline Limits*	Comment
tine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	552		
рН		8.1	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	318	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	300.7		
Bicarbonate (as HCO3)	mg/L	366.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	70.3		
Dissolved Magnesium	mg/L	35.1		
Dissolved Potassium	mg/L	3.3		
Dissolved Sodium	mg/L	7.2	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	320.3		
Anions in Water				
Chloride	mg/L	4.29	250.00 (AO)	Acceptable
Fluoride	mg/L	0.12	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.67	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	ma/L	1.67		

#### KaizenLAB Sample # 167115\_001 Sample ID: WW1 Date Sampled 29-Oct-2014

arameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	6.95	500.00 (AO)	Acceptable
tal Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0068	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	0.00088	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000126	0.0100 (MAC)	Pass
Total Barium	mg/L	0.282	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.022	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000013	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0317	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.015	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00127	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00148		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00084	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.433		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.106		
Total Uranium	mg/L	0.001299	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

KaizenLAB Sample # 167115\_002 Sample ID: WW2 Date Sampled 29-Oct-2014

arameter Description	Units	Result	Guideline Limits*	Comment
outine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	566		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	328	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00300	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	312.2		
Bicarbonate (as HCO3)	mg/L	380.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	63.6		
Dissolved Magnesium	mg/L	37.3		
Dissolved Potassium	mg/L	2.8		
Dissolved Sodium	mg/L	13.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	312.2		
Anions in Water				
Chloride	mg/L	1.38	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	0.78	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	0.78		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	15.82	500.00 (AO)	Acceptable

# KaizenLAB

#### KaizenLAB Sample # 167115\_002 Sample ID: WW2 Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	0.00059	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000165	0.0100 (MAC)	Pass
Total Barium	mg/L	0.128	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.032	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000016	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0022	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.018	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0040	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00222		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00112	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.488		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.0971		
Total Uranium	mg/L	0.001023	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.024	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

KaizenLAB Sample # 167115\_003 Sample ID: WW3 Date Sampled 29-Oct-2014

Justice Potability Analysis (Potability pkg #2)           Electrical Conductivity (EC)         vS/cm         607           PH         7.9         6.5-8.5 (AO)         Acceptable           Total Dissolved Solids (calculated)         mg/L         349         500 (AO)         Acceptable           True Colour         TCU         <3         15 (AO)         Acceptable           True Colour         TCU         <3         15 (AO)         Acceptable           True Colour         TCU         <3         16 (AO)         Acceptable           Dissolved Metais in Water by ICP-MS         0.100.3/1.0 *** motes         See notes         See notes           Dissolved Manganese         mg/L         <0.0040         0.3000 (AO)         Acceptable           Alkalinity (phenolphthalein, as CaCO3)         mg/L         <2.0         Atkalinity (phanolphthalein, as CaCO3)         mg/L         <2.0           Alkalinity (total, as CaCO3)         mg/L         321.2         Secondate (as CO3)         mg/L         <3.1           Dissolved Calcium         mg/L         73.2         Secondate (as CO3)         mg/L         39.9           Dissolved Potassium         mg/L         3.1         Second (AO)         Acceptable           Hardness (calculated, as CaCO3)	arameter Description	Units	Result	Guideline Limits*	Comment
Electrical Conductivity (EC)uS/cm607pH7.96.5-8.5 (AC)AcceptableTotal Dissolved Solids (calculated)mg/L349500 (AC)AcceptableTrue ColourTCU<3	outine Water Potability Analysis (Potability pk	g #2)			
pH7.96.5-8.5 (AO)AcceptableTotal Dissolved Solids (calculated)mg/L349500 (AO)AcceptableTrue ColourTCU<3	Electrical Conductivity (EC)	uS/cm	607		
Total Dissolved Solids (calculated)mg/L349500 (AO)AcceptableTrue ColourTCU<3	рН		7.9	6.5-8.5 (AO)	Acceptable
True ColourTCU<315 (AO)AcceptableTurbidityNTU0.2 $0.1/0.3/1.0$ see notesSee notesDissolved Matais in Water by ICP-MS $0.0040$ $0.3000$ (AO)AcceptableDissolved Manganesemg/L<0.0040	Total Dissolved Solids (calculated)	mg/L	349	500 (AO)	Acceptable
TurbidityNTU0.20.1/0.3/1.0see notesSee notesDissolved Metals in Water by ICP-MSmg/L<0.00400.3000 (AO)AcceptableDissolved Manganesemg/L<0.000400.0500 (AO)AcceptableAkalinity parameters of water </td <td>True Colour</td> <td>TCU</td> <td>&lt;3</td> <td>15 (AO)</td> <td>Acceptable</td>	True Colour	TCU	<3	15 (AO)	Acceptable
Dissolved Metals in Water by ICP-MSDissolved Ironmg/L<0.0040	Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Iron         mg/L         <0040         0.3000 (AO)         Acceptable           Dissolved Manganese         mg/L         <0.00040	Dissolved Metals in Water by ICP-MS				
Dissolved Manganese         mg/L         <0.00040         0.0500 (AO)         Acceptable           Akalinity grameters of water         -	Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Akalinity parameters of water           Akalinity (phenolphthalein, as CaCO3)         mg/L         <2.0	Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity (phenolphthalein, as CaCO3)       mg/L       <2.0	Alkalinity parameters of water				
Alkalinity (total, as CaCO3)       mg/L       321.2         Bicarbonate (as HCO3)       mg/L       391.6         Carbonate (as CO3)       mg/L       <1.5	Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Bicarbonate (as HCO3)         mg/L         391.6           Carbonate (as CO3)         mg/L         <1.5	Alkalinity (total, as CaCO3)	mg/L	321.2		
Carbonate (as CO3)mg/L<1.5Hydroxide (as OH)mg/L<0.5	Bicarbonate (as HCO3)	mg/L	391.6		
Hydroxide (as OH)mg/L<0.5Cations in Watermg/L73.2Dissolved Calciummg/L39.9Dissolved Magnesiummg/L31.1Dissolved Potassiummg/L7.8200.00 (AO)Dissolved Sodiummg/L346.9Hardness (calculated, as CaCO3)mg/L346.9Chloridemg/L10.31250.00 (AO)AcceptableFluoridemg/L10.31250.00 (AO)AcceptableFluoridemg/L10.31250.00 (AO)AcceptableNitrate-Nmg/L1.8710.00 (MAC)PassNitrite-N + Nitrate-Nmg/L1.8710.00 (AO)AcceptableFluosphatemg/L3.103.00.00 (AO)AcceptableSulphatemg/L10.33500.00 (AO)Acceptable	Carbonate (as CO3)	mg/L	<1.5		
Cations in WaterDissolved Calciummg/L73.2Dissolved Magnesiummg/L39.9Dissolved Potassiummg/L3.1Dissolved Sodiummg/L7.8200.00 (AO)Hardness (calculated, as CaCO3)mg/L346.9Anions in WaterChloridemg/L10.31250.00 (AO)Fluoridemg/L10.31250.00 (AO)AcceptableFluoridemg/L10.31250.00 (AO)Nitrate-Nmg/L1.8710.00 (MAC)Nitrite-N + Nitrate-Nmg/L1.87Phosphatemg/L1.87Sulphatemg/L10.33500.00 (AO)Sulphatemg/L10.33500.00 (AO)	Hydroxide (as OH)	mg/L	<0.5		
Dissolved Calciummg/L73.2Dissolved Magnesiummg/L39.9Dissolved Potassiummg/L3.1Dissolved Sodiummg/L7.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)mg/L346.9	Cations in Water				
Dissolved Magnesiummg/L39.9Dissolved Potassiummg/L3.1Dissolved Sodiummg/L7.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)mg/L346.9	Dissolved Calcium	mg/L	73.2		
Dissolved Potassiummg/L3.1Dissolved Sodiummg/L7.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)mg/L346.9	Dissolved Magnesium	mg/L	39.9		
Dissolved Sodiummg/L7.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)mg/L346.9	Dissolved Potassium	mg/L	3.1		
Hardness (calculated, as CaCO3)mg/L346.9Anions in WaterChloridemg/L10.31250.00 (AO)AcceptableFluoridemg/L0.141.50 (MAC)PassNitrate-Nmg/L1.8710.00 (MAC)PassNitrite-Nmg/L<0.05	Dissolved Sodium	mg/L	7.8	200.00 (AO)	Acceptable
Anions in Water         Mission Mater           Chloride         mg/L         10.31         250.00 (AO)         Acceptable           Fluoride         mg/L         0.14         1.50 (MAC)         Pass           Nitrate-N         mg/L         1.87         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Hardness (calculated, as CaCO3)	mg/L	346.9		
Chloride         mg/L         10.31         250.00 (AO)         Acceptable           Fluoride         mg/L         0.14         1.50 (MAC)         Pass           Nitrate-N         mg/L         1.87         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Anions in Water				
Fluoride         mg/L         0.14         1.50 (MAC)         Pass           Nitrate-N         mg/L         1.87         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Chloride	mg/L	10.31	250.00 (AO)	Acceptable
Nitrate-N         mg/L         1.87         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrite-N         mg/L         <0.05         1.00 (AO)         Acceptable           Nitrite-N + Nitrate-N         mg/L         1.87	Nitrate-N	mg/L	1.87	10.00 (MAC)	Pass
Nitrite-N + Nitrate-N         mg/L         1.87           Phosphate         mg/L         <0.10           Sulphate         mg/L         10.33         500.00 (AO)         Acceptable	Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Phosphate         mg/L         <0.10           Sulphate         mg/L         10.33         500.00 (AO)         Acceptable	Nitrite-N + Nitrate-N	mg/L	1.87		
Sulphate mg/L 10.33 500.00 (AO) Acceptable	Phosphate	mg/L	<0.10		
	Sulphate	mg/L	10.33	500.00 (AO)	Acceptable

## KaizenLAB

#### KaizenLAB Sample # 167115\_003 Sample ID: WW3 Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0061	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000143	0.0100 (MAC)	Pass
Total Barium	mg/L	0.221	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000040	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.125	1.0000 (AO)	Acceptable
Total Iron	mg/L	<0.010	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00302	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0014	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00113		
Total Nickel	mg/L	0.00174		
Total Selenium	mg/L	0.00070	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.421		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.109		
Total Uranium	mg/L	0.001744	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.205	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

KaizenLAB Sample # 167115\_004 Sample ID: WW4 Date Sampled 30-Oct-2014

ameter Description	Units	Result	Guideline Limits*	Comment
utine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	596		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	339	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.6	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	304.9		
Bicarbonate (as HCO3)	mg/L	371.8		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	75.3		
Dissolved Magnesium	mg/L	35.2		
Dissolved Potassium	mg/L	3.1		
Dissolved Sodium	mg/L	7.1	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	333.1		
Anions in Water				
Chloride	mg/L	10.86	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.02	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	3.02		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	7.66	500.00 (AO)	Acceptable

## KaizenLAB

#### KaizenLAB Sample # 167115\_004 Sample ID: WW4 Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000192	0.0100 (MAC)	Pass
Total Barium	mg/L	0.385	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.00008	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0017	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.017	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00076		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00180	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.425		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.114		
Total Uranium	mg/L	0.001785	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.029	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

KaizenLAB Sample # 167115\_005 Sample ID: BHS1 Date Sampled 30-Oct-2014

ameter Description	Units	Result	Guideline Limits*	Comment
itine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	588		
рН		8.2	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	342	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.8	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	308.5		
Bicarbonate (as HCO3)	mg/L	376.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	74.1		
Dissolved Magnesium	mg/L	36.7		
Dissolved Potassium	mg/L	3.4		
Dissolved Sodium	mg/L	7.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	336.0		
Anions in Water				
Chloride	mg/L	9.60	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	2.83	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	2.83		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	9.36	500.00 (AO)	Acceptable

## KaizenLAB

#### KaizenLAB Sample # 167115\_005 Sample ID: BHS1 Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0182	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000153	0.0100 (MAC)	Pass
Total Barium	mg/L	0.304	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.024	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000032	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	<0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.027	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0019	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00141		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00218	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.443		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	0.0083		
Total Titanium	mg/L	0.115		
Total Uranium	mg/L	0.001953	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L



#### Test Methodologies

Alkalinity in Water: Modified from APHA 2320B Anions in Water: Modified from APHA 4110B Cations in Water: Modified from APHA 3030B and APHA 3120B Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B Electrical Conductivity in Water: Modified from APHA 2510B pH in Water: Modified from APHA 4500-H+ B Total Dissolved Solids (calculated): Modified from APHA 1030E Total Mercury in Water: Modified from EPA 200.2 and EPA 1631 Total Metals in Water: Modified from EPA 200.2 and APHA 3125B True Colour in Water: Modified from APHA 2120C Turbidity in Water: Modified from APHA 2130B

Final Review by:

Natalia Klink Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.



#### ANALYTICAL REPORT

Client:	SLR Consulting (Canada) Ltd. 6940 Roper Rd NW	KaizenLAB JOB #:	167823
	Edmonton, AB T6B 3H9	DATE RECEIVED:	21-Nov-2014
		DATE REPORTED:	27-Nov-2014
Attention:	Robert Till	PROJECT ID:	203,50065,00001
		LOCATION:	Summit Aggregates

#### KaizenLAB Sample # 167823\_001 Sample ID: MW 14-101 Date Sampled 20-Nov-2014

ameter Description	Units	Result	Guideline Limits*	Comment
utine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	596		
рН		7.9	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	337	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	9.6	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0400	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00400	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	313.6		
Bicarbonate (as HCO3)	mg/L	382.3		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	76.1		
Dissolved Magnesium	mg/L	33.7		
Dissolved Potassium	mg/L	4.8		
Dissolved Sodium	mg/L	6.0	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	328.6		
Anions in Water				
Chloride	mg/L	10.54	250.00 (AO)	Acceptable
Fluoride	mg/L	0.13	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.19	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	1.19		

#### KaizenLAB Sample # 167823\_001 Sample ID: MW 14-101 Date Sampled 20-Nov-2014

arameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	8.88	500.00 (AO)	Acceptable
tal Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.164	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000350	0.0100 (MAC)	Pass
Total Barium	mg/L	0.424	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000016	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	<0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.28	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00031	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0164	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00080		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	<0.00060	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.384		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	0.0182		
Total Titanium	mg/L	0.122		
Total Uranium	mg/L	0.001697	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

KaizenLAB Sam	ole #	167823_002	Sample ID:	MW 14-103
Date Sampled	20-No	v-2014		

utile Water Potability Analysis (Potability pkg #2)           Electrical Conductivity (EC)         uScm         610           pH         7.8         6.5.8.5 (AC)         Acceptable           Total Dissolved Solids (calculated)         mg/L         354         500 (AC)         Acceptable           True Colour         TCU         <3         15 (AC)         Acceptable           Dissolved Metals in Water by ICP-MS         Bisolved Metals in Water by ICP-MS         See notes         See notes           Dissolved Manganese         mg/L         <0.0400         0.3000 (AC)         Acceptable           Alkalinity parameters of water                Alkalinity (phenolphthalein, as CaCO3)         mg/L         <2.0              Alkalinity (phenolphthalein, as CaCO3)         mg/L         <1.5 <th>rameter Description</th> <th>Units</th> <th>Result</th> <th>Guideline Limits*</th> <th>Comment</th>	rameter Description	Units	Result	Guideline Limits*	Comment
Electrical Conductivity (EC)u Si/cm610pH7.86.5-8.5 (AC)AcceptableTotal Dissolved Solids (calculated)mg/L354500 (AC)AcceptableTrue ColourTGU<3	utine Water Potability Analysis (Potability pkg	g #2)			
pH7.86.5-8.5 (AC)AcceptableTotal Dissolved Solids (calculated)ng/L354500 (AO)AcceptableTrue ColourTCU<3	Electrical Conductivity (EC)	uS/cm	610		
Total Dissolved Solids (calculated)mg/L $354$ $500$ (AO)AcceptableTrue ColourTCU<3	рН		7.8	6.5-8.5 (AO)	Acceptable
True ColourTCU<315 (AO)AcceptableTurbidityNTU680 $0.1/0.3/1.0$ see notesSee notesDissolved Matals in Water by ICP-MSDissolved Manganesemg/L<0.0400	Total Dissolved Solids (calculated)	mg/L	354	500 (AO)	Acceptable
TurbidityNTU6800.1/0.3/1.0see notesDissolved Metals in Water by ICP-MSDissolved Manganesemg/L<0.0400	True Colour	TCU	<3	15 (AO)	Acceptable
Dissolved Metals in Water by ICP-MSDissolved Ironmg/L<0.0400	Turbidity	NTU	680	0.1/0.3/1.0 see notes	See notes
Dissolved Iron         mg/L         <0.0400         0.3000 (AO)         Acceptable           Dissolved Manganese         mg/L         <0.00400	Dissolved Metals in Water by ICP-MS				
Dissolved Manganese         mg/L         <0.00400         0.0500 (AO)         Acceptable           Akalinity parameters of water  <	Dissolved Iron	mg/L	<0.0400	0.3000 (AO)	Acceptable
Atkalinity parameters of water           Alkalinity (phenolphthalein, as CaCO3)         mg/L         <2.0	Dissolved Manganese	mg/L	<0.00400	0.0500 (AO)	Acceptable
Alkalinity (phenolphthalein, as CaCO3)       mg/L       <2.0	Alkalinity parameters of water				
Alkalinity (total, as CaCO3)       mg/L       311.5         Bicarbonate (as HCO3)       mg/L       379.8         Carbonate (as CO3)       mg/L       <1.5	Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Bicarbonate (as HCO3)         mg/L         379.8           Carbonate (as CO3)         mg/L         <1.5	Alkalinity (total, as CaCO3)	mg/L	311.5		
Carbonate (as CO3)         mg/L         <1.5           Hydroxide (as OH)         mg/L         <0.5	Bicarbonate (as HCO3)	mg/L	379.8		
Hydroxide (as OH)mg/L<0.5Cations in Watermg/L74.7Dissolved Calciummg/L33.4Dissolved Potassiummg/L4.3Dissolved Potassiummg/L8.8200.00 (AC)Dissolved Sodiummg/L324.1Hardness (calculated, as CaCO3)mg/L324.1Chloridemg/L7.83250.00 (AO)Fluoridemg/L0.131.50 (MAC)Passmg/L5.2210.00 (MAC)Nitrate-Nmg/L5.221.00 (MAC)Nitrite-N + Nitrate-Nmg/L5.22Phosphatemg/L5.22Sulphatemg/L31.90 (AO)Sulphatemg/L11.90Sulphatemg/L11.90	Carbonate (as CO3)	mg/L	<1.5		
Cations in WaterDissolved Calciummg/L74.7Dissolved Magnesiummg/L33.4Dissolved Potassiummg/L4.3Dissolved Sodiummg/L8.8200.00 (AO)Hardness (calculated, as CaCO3)mg/L324.1Anions in WaterChloridemg/L7.83Pluoridemg/L7.83250.00 (AO)AcceptableFluoridemg/L0.131.50 (MAC)Passmg/L5.2210.00 (MAC)Nitrite-Nmg/L5.22Nitrite-N + Nitrate-Nmg/L5.22Phosphatemg/L<0.10	Hydroxide (as OH)	mg/L	<0.5		
Dissolved Calcium         mg/L         74.7           Dissolved Magnesium         mg/L         33.4           Dissolved Potassium         mg/L         4.3           Dissolved Sodium         mg/L         8.8         200.00 (AO)         Acceptable           Hardness (calculated, as CaCO3)         mg/L         324.1	Cations in Water				
Dissolved Magnesium         mg/L         33.4           Dissolved Potassium         mg/L         4.3           Dissolved Sodium         mg/L         8.8         200.00 (AO)         Acceptable           Hardness (calculated, as CaCO3)         mg/L         324.1	Dissolved Calcium	mg/L	74.7		
Dissolved Potassiumng/L4.3Dissolved Sodiumng/L8.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)ng/L324.1	Dissolved Magnesium	mg/L	33.4		
Dissolved Sodiummg/L8.8200.00 (AO)AcceptableHardness (calculated, as CaCO3)mg/L324.1	Dissolved Potassium	mg/L	4.3		
Hardness (calculated, as CaCO3)       mg/L       324.1         Anions in Water       result       result<	Dissolved Sodium	mg/L	8.8	200.00 (AO)	Acceptable
Anions in Water         Main Mater           Chloride         mg/L         7.83         250.00 (AO)         Acceptable           Fluoride         mg/L         0.13         1.50 (MAC)         Pass           Nitrate-N         mg/L         5.22         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Hardness (calculated, as CaCO3)	mg/L	324.1		
Chloride         mg/L         7.83         250.00 (AO)         Acceptable           Fluoride         mg/L         0.13         1.50 (MAC)         Pass           Nitrate-N         mg/L         5.22         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Anions in Water				
Fluoride         mg/L         0.13         1.50 (MAC)         Pass           Nitrate-N         mg/L         5.22         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Chloride	mg/L	7.83	250.00 (AO)	Acceptable
Nitrate-N         mg/L         5.22         10.00 (MAC)         Pass           Nitrite-N         mg/L         <0.05	Fluoride	mg/L	0.13	1.50 (MAC)	Pass
Nitrite-N         mg/L         <0.05         1.00 (AO)         Acceptable           Nitrite-N + Nitrate-N         mg/L         5.22	Nitrate-N	mg/L	5.22	10.00 (MAC)	Pass
Nitrite-N + Nitrate-N         mg/L         5.22           Phosphate         mg/L         <0.10	Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Phosphate         mg/L         <0.10           Sulphate         mg/L         11.90         500.00 (AO)         Acceptable	Nitrite-N + Nitrate-N	mg/L	5.22		
Sulphate mg/L 11.90 500.00 (AO) Acceptable	Phosphate	mg/L	<0.10		
	Sulphate	mg/L	11.90	500.00 (AO)	Acceptable

# KaizenLAB

### KaizenLAB Sample # 167823\_002 Sample ID: MW 14-103 Date Sampled 20-Nov-2014 <td

Parameter Description	Units	Result	Guideline Limits*	Comment
Fotal Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	5.57	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.007858	0.0100 (MAC)	Pass
Total Barium	mg/L	0.700	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000290	0.0050 (MAC)	Pass
Total Chromium	mg/L	0.0076	0.050 (MAC)	Pass
Total Cobalt	mg/L	0.00445		
Total Copper	mg/L	0.0093	1.0000 (AO)	Acceptable
Total Iron	mg/L	12	0.30 (AO)	Unacceptable
Total Lead	mg/L	0.00464	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.928	0.0500 (AO)	Unacceptable
Total Molybdenum	mg/L	0.00184		
Total Nickel	mg/L	0.01196		
Total Selenium	mg/L	0.00112	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.423		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.236		
Total Uranium	mg/L	0.002014	0.020000 (MAC)	Pass
Total Vanadium	mg/L	0.01145		
Total Zinc	mg/L	0.033	5.000 (AO)	Acceptable

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L



#### Test Methodologies

Alkalinity in Water: Modified from APHA 2320B Anions in Water: Modified from APHA 4110B Cations in Water: Modified from APHA 3030B and APHA 3120B Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B Electrical Conductivity in Water: Modified from APHA 2510B pH in Water: Modified from APHA 4500-H+ B Total Dissolved Solids (calculated): Modified from APHA 1030E Total Mercury in Water: Modified from EPA 200.2 and EPA 1631 Total Metals in Water: Modified from EPA 200.2 and APHA 3125B True Colour in Water: Modified from APHA 2120C Turbidity in Water: Modified from APHA 2130B

Final Review by:

Joel Sababan Client Services Administrator

Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.



#### **ANALYTICAL REPORT**

Client:	SLR Consulting (Canada) Ltd. 6940 Roper Rd NW	KaizenLAB JOB #:	173114
	Edmonton, AB T6B 3H9	DATE RECEIVED: 04-Aug-2015	04-Aug-2015
		DATE REPORTED:	06-Aug-2015
Attention:	Robert Till	PROJECT ID:	203-50065-00003
		LOCATION:	Summit

#### KaizenLAB Sample # 173114\_001 Sample ID: MW14-103 Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	611		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	333	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	8.00	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00069	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	307.7		
Bicarbonate (as HCO3)	mg/L	375.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	73.3		
Dissolved Magnesium	mg/L	32.6		
Dissolved Potassium	mg/L	3.9		
Dissolved Sodium	mg/L	7.9	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	317.0		
Anions in Water				
Chloride	mg/L	8.81	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.801	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.801		
## KaizenLAB

### KaizenLAB Sample # 173114\_001 Sample ID: MW14-103 Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	10.56	500.00 (AO)	Acceptable
Fotal Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.109	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000336	0.0100 (MAC)	Pass
Total Barium	mg/L	0.332	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass
Total Chromium	mg/L	0.0016	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0013	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.22	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0144	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00086		
Total Nickel	mg/L	0.00051		
Total Selenium	mg/L	0.00087	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.377		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.118		
Total Uranium	mg/L	0.001563	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
otal Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

# KaizenLAB

KaizenLAB Sample # 173114\_002 Sample ID: WW1 Date Sampled 4-Aug-2015

ameter Description	Units	Result	Guideline Limits*	Comment
itine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	570		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	310	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.31	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	294.9		
Bicarbonate (as HCO3)	mg/L	359.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	68.2		
Dissolved Magnesium	mg/L	31.8		
Dissolved Potassium	mg/L	3.2		
Dissolved Sodium	mg/L	7.0	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	301.4		
Anions in Water				
Chloride	mg/L	4.49	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.658	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.658		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	7.51	500.00 (AO)	Acceptable

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## KaizenLAB

### KaizenLAB Sample # 173114\_002 Sample ID: WW1 Date Sampled 4-Aug-2015

Parameter Description	Units	Result	esult Guideline Limits*		
Total Metals including Mercury					
Total Mercury	mg/L	<0.00020			
Total Metals in Water by ICP-MS					
Total Aluminum	mg/L	0.0110	0.10 (OG) see notes	Acceptable	
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass	
Total Arsenic	mg/L	0.000132	0.0100 (MAC)	Pass	
Total Barium	mg/L	0.284	1.0000 (MAC)	Pass	
Total Beryllium	mg/L	<0.0010			
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass	
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass	
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass	
Total Cobalt	mg/L	<0.00020			
Total Copper	mg/L	0.0130	1.0000 (AO)	Acceptable	
Total Iron	mg/L	0.014	0.30 (AO)	Acceptable	
Total Lead	mg/L	0.00048	0.0100 (MAC)	Pass	
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable	
Total Molybdenum	mg/L	0.00147			
Total Nickel	mg/L	<0.00050			
Total Selenium	mg/L	<0.00060	0.0100 (MAC)	Pass	
Total Silver	mg/L	<0.000070			
Total Strontium	mg/L	0.450			
Total Thallium	mg/L	<0.00020			
Total Tin	mg/L	<0.0070			
Total Titanium	mg/L	0.105			
Total Uranium	mg/L	0.001241	0.020000 (MAC)	Pass	
Total Vanadium	mg/L	<0.00060			
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable	
Total Coliforms and E. coli					
E. Coli	MPN/100mL	<1	0 (MAC)	Pass	
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass	

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

# KaizenLAB

KaizenLAB Sample # 173114\_003 Sample ID: WW2 Date Sampled 4-Aug-2015

ameter Description	Units	Result	Guideline Limits*	Comment
utine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	585		
рН		8.1	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	317	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	1.23	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00275	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	307.6		
Bicarbonate (as HCO3)	mg/L	375.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	63.4		
Dissolved Magnesium	mg/L	35.0		
Dissolved Potassium	mg/L	2.6		
Dissolved Sodium	mg/L	9.3	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	302.4		
Anions in Water				
Chloride	mg/L	1.93	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.054	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.054		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	12.85	500.00 (AO)	Acceptable

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## KaizenLAB

### KaizenLAB Sample # 173114\_003 Sample ID: WW2 Date Sampled 4-Aug-2015

Parameter Description	Units	Result Guideline Limits*		Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000205	0.0100 (MAC)	Pass
Total Barium	mg/L	0.142	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000024	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0016	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.040	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0042	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00193		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00105	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.454		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.103		
Total Uranium	mg/L	0.001214	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Fotal Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

# KaizenLAB

KaizenLAB Sample # 173114\_004 Sample ID: WW3 Date Sampled 4-Aug-2015

ameter Description	Units	Result	Guideline Limits*	Comment
utine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	604		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	330	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.25	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	309.8		
Bicarbonate (as HCO3)	mg/L	377.7		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	69.7		
Dissolved Magnesium	mg/L	35.5		
Dissolved Potassium	mg/L	3.0		
Dissolved Sodium	mg/L	7.6	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	320.4		
Anions in Water				
Chloride	mg/L	5.88	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.889	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.889		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	11.09	500.00 (AO)	Acceptable

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## KaizenLAB

### KaizenLAB Sample # 173114\_004 Sample ID: WW3 Date Sampled 4-Aug-2015

Parameter Description	Units	Result Guideline Limits*		Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000121	0.0100 (MAC)	Pass
Total Barium	mg/L	0.225	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000024	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0057	1.0000 (AO)	Acceptable
Total Iron	mg/L	<0.010	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00104		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00085	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.418		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.111		
Total Uranium	mg/L	0.001688	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

# KaizenLAB

KaizenLAB Sam	ple #	173114_005	Sample ID:	WW4
Date Sampled	4-Aug	J-2015		

ameter Description	Units	Result	Guideline Limits*	Comment
tine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	608		
рН		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	328	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.23	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	299.6		
Bicarbonate (as HCO3)	mg/L	365.2		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	72.0		
Dissolved Magnesium	mg/L	31.5		
Dissolved Potassium	mg/L	2.9		
Dissolved Sodium	mg/L	6.5	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	309.4		
Anions in Water				
Chloride	mg/L	10.95	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.314	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	3.314		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	6.77	500.00 (AO)	Acceptable

333 50th Ave. S.E. Calgary, AB, T2G 2B3 Phone (403) 297-0868 Fax: (403) 297-0869

## KaizenLAB

### KaizenLAB Sample # 173114\_005 Sample ID: WW4 Date Sampled 4-Aug-2015

Parameter Description	Units Result Guideline Limits*		Comment	
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000194	0.0100 (MAC)	Pass
Total Barium	mg/L	0.391	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0018	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.044	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00066		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00096	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.421		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.114		
Total Uranium	mg/L	0.001672	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.031	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

# KaizenLAB

KaizenLAB Sample # 173114\_006 Sample ID: BHS1 Date Sampled 4-Aug-2015

ameter Description	Units	Result	Guideline Limits*	Comment
utine Water Potability Analysis (Potability pk	g #2)			
Electrical Conductivity (EC)	uS/cm	606		
рН		8.2	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	334	500 (AO)	Acceptable
True Colour	TCU	3	15 (AO)	Acceptable
Turbidity	NTU	1.07	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00069	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	304.3		
Bicarbonate (as HCO3)	mg/L	371.0		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	72.0		
Dissolved Magnesium	mg/L	33.3		
Dissolved Potassium	mg/L	3.3		
Dissolved Sodium	mg/L	7.5	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	317.0		
Anions in Water				
Chloride	mg/L	10.12	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.037	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	3.037		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	8.36	500.00 (AO)	Acceptable

\*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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## KaizenLAB

#### KaizenLAB Sample # 173114\_006 Sample ID: BHS1 Date Sampled 4-Aug-2015

Parameter Description	Units	Result Guideline Limits*		Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0144	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000146	0.0100 (MAC)	Pass
Total Barium	mg/L	0.313	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000008	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.019	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0012	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00089		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00130	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.450		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.117		
Total Uranium	mg/L	0.001875	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	1733	0 (MAC)	Fail
Total Coliforms	MPN/100mL	2420	0 (MAC)	Fail

#### Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L

\_\_\_\_\_

- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

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## KaizenLAB

#### **Test Methodologies**

Alkalinity in Water: Modified from APHA 2320B

Anions in Water: Modified from APHA 4110B

Cations in Water: Modified from APHA 3030B and APHA 3120B

Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B

E. coli in Water: Modified from Method 9223 B. Enzyme Substrate Test. Standard Methods for the Examination of Water and Wastewater, 22nd ed. 2012

Electrical Conductivity in Water: Modified from APHA 2510B

pH of Water: Modified from APHA 4500-H+ B

Total Coliforms in Water: Modified from Method 9223 B. Enzyme Substrate Test. Standard Methods for the Examination of Water and Wastewater, 22nd Total Dissolved Solids (calculated): Modified from APHA 1030E

Total Mercury in Water: Modified from EPA 200.2 and EPA 1631

Total Metals in Water: Modified from EPA 200.2 and APHA 3125B

True Colour in Water: Modified from APHA 2120C

Turbidity in Water: Modified from APHA 2130B

Engram Denden

Final Review by:



Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.



Your P.O. #: EDM4886 Your Project #: 212.06550.00003 Site Location: MOUNTAIN ASH Your C.O.C. #: M083946

### Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD 6940 ROPER ROAD EDMONTON, AB CANADA T6B 3H9

#### Report Date: 2019/07/25 Report #: R2757540 Version: 2 - Revision

## **CERTIFICATE OF ANALYSIS – REVISED REPORT**

#### BV LABS JOB #: B953759 Received: 2019/07/05, 07:00

Sample Matrix: Water # Samples Received: 5

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	4	N/A	2019/07/08	AB SOP-00005	SM 23 2320 B m
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	N/A	2019/07/10	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME - Dissolved	5	N/A	2019/07/24		Auto Calc
Cadmium - low level CCME (Total)	5	N/A	2019/07/11		Auto Calc
Chloride by Automated Colourimetry	5	N/A	2019/07/10	AB SOP-00020	SM 23-4500-Cl-E m
Total Coliforms and E.Coli	5	2019/07/05	2019/07/06	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	4	N/A	2019/07/08	AB SOP-00005	SM 23 2510 B m
Conductivity @25C	1	N/A	2019/07/10	AB SOP-00005	SM 23 2510 B m
Hardness	5	N/A	2019/07/10		Auto Calc
Mercury - Low Level (Total)	1	2019/07/11	2019/07/11	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury - Low Level (Total)	4	2019/07/11	2019/07/12	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	5	N/A	2019/07/09	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	5	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP- 00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	3	N/A	2019/07/23	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	2	N/A	2019/07/24	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	4	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP- 00043	EPA 6020b R2 m
Elements by ICPMS - Total	1	2019/07/10	2019/07/11	AB SOP-00014 / AB SOP- 00043	EPA 6020b R2 m
Ion Balance	5	N/A	2019/07/06		Auto Calc
Sum of cations, anions	5	N/A	2019/07/10		Auto Calc
Nitrate and Nitrite	5	N/A	2019/07/11		Auto Calc
Nitrate + Nitrite-N (calculated)	5	N/A	2019/07/11		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	5	N/A	2019/07/07	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	4	N/A	2019/07/08	AB SOP-00005	SM 23 4500-H+B m
pH @25°C (3)	1	N/A	2019/07/10	AB SOP-00005	SM 23 4500-H+B m
Sulphate by Automated Colourimetry	5	N/A	2019/07/10	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Calculated)	5	N/A	2019/07/10		Auto Calc
Turbidity	5	N/A	2019/07/06	CAL SOP-00081	SM 23 2130 B m

Remarks:



Your P.O. #: EDM4886 Your Project #: 212.06550.00003 Site Location: MOUNTAIN ASH Your C.O.C. #: M083946

#### Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD 6940 ROPER ROAD EDMONTON, AB CANADA T6B 3H9

> Report Date: 2019/07/25 Report #: R2757540 Version: 2 - Revision

### **CERTIFICATE OF ANALYSIS – REVISED REPORT**

#### BV LABS JOB #: B953759 Received: 2019/07/05.07:00

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

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

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

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

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

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

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

(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(2) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

**Encryption Key** 

Jenelle Feller finelle falle 25 Jul 2019 16:32:26

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jenelle Feller, Key Account Specialist Email: JFeller@bvlabs.com Phone# (403)735-2264

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



BV Labs ID		WA5520		WA5521		WA5522	[	WA5523		
formaling Data		2019/07/04		2019/07/04		2019/07/04		2019/07/04		
		09:55		10:55		11:55		13:55	<u> </u>	
COC Number		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	QC Batch	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	QC Batch
Calculated Parameters										
Anion Sum	meq/L	5.9	9493590	7.3	N/A	6.2	N/A	6.6	N/A	9493590
Cation Sum	meq/L	6.4	9493590	7.0	N/A	6.3	N/A	6.7	N/A	9493590
Hardness (CaCO3)	mg/L	300	9493521	320	0.50	280	0.50	310	0.50	9493521
Ion Balance (% Difference)	%	4.0	9493527	2.3	N/A	0.59	N/A	0.98	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	12	9493534	11	0.044	4.3	0.044	10	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	2.6	9493540	2.5	0.014	1.1	0.014	2.3	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	<0.033	9493534	0.16	0.033	0.32	0.033	<0.033	0.033	9493534
Calculated Total Dissolved Solids	mg/L	300	9493550	350	1.0	310	1.7	320	1.0	9493550
Misc. Inorganics										
Conductivity	uS/cm	560	9498908	610	2.0	570	2.0	590	2.0	9497188
рН	рН	8.05	9498906	7.91	N/A	7.91	N/A	7.87	N/A	9497187
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Alkalinity (Total as CaCO3)	mg/L	260	9498897	320	1.0	260	1.0	300	1.0	9497185
Bicarbonate (HCO3)	mg/L	320	9498897	390	1.0	310	1.0	360	1.0	9497185
Carbonate (CO3)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Hydroxide (OH)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Dissolved Sulphate (SO4)	mg/L	5.8	9501390	17	1.0	9.2	1.0	7.6	1.0	9501390
Dissolved Chloride (Cl)	mg/L	13	9501388	14	1.0	29	1.0	9.3	1.0	9501388
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	9495539	0.048	0.010	0.098	0.010	<0.010	0.010	9495539
Dissolved Nitrate (N)	mg/L	2.6	9495539	2.4	0.010	0.97	0.010	2.3	0.010	9495539
Lab Filtered Elements	•			<u>.</u>	•					•
Dissolved Aluminum (Al)	mg/L	<0.040	9497648	<0.040	0.040	<0.040	0.040	<0.040	0.040	9497648
Dissolved Barium (Ba)	mg/L	0.34	9497648	0.24	0.010	0.45	0.010	0.32	0.010	9497648
Dissolved Boron (B)	mg/L	<0.020	9497648	<0.020	0.020	0.031	0.020	<0.020	0.020	9497648
Dissolved Calcium (Ca)	mg/L	69	9497648	74	0.30	63	0.30	73	0.30	9497648
Dissolved Chromium (Cr)	mg/L	<0.010	9497648	<0.010	0.010	<0.010	0.010	<0.010	0.010	9497648
Dissolved Iron (Fe)	mg/L	0.16	9497648	0.16	0.060	0.18	0.060	0.16	0.060	9497648
Dissolved Lithium (Li)	mg/L	<0.020	9497648	<0.020	0.020	<0.020	0.020	<0.020	0.020	9497648
RDL = Reportable Detection Limit N/A = Not Applicable										



BV Labs ID		WA5520		WA5521		WA5522		WA5523		
Sampling Data		2019/07/04		2019/07/04		2019/07/04		2019/07/04		
		09:55		10:55		11:55		13:55		
COC Number		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	QC Batch	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	QC Batch
Dissolved Magnesium (Mg)	mg/L	32	9497648	32	0.20	30	0.20	31	0.20	9497648
Dissolved Manganese (Mn)	mg/L	<0.0040	9497648	0.064	0.0040	0.40	0.0040	0.018	0.0040	9497648
Dissolved Phosphorus (P)	mg/L	<0.10	9497648	<0.10	0.10	0.21	0.10	<0.10	0.10	9497648
Dissolved Potassium (K)	mg/L	2.9	9497648	3.4	0.30	4.1	0.30	3.3	0.30	9497648
Dissolved Silicon (Si)	mg/L	4.7	9497648	4.8	0.10	3.8	0.10	4.6	0.10	9497648
Dissolved Sodium (Na)	mg/L	5.7	9497648	12	0.50	13	0.50	9.0	0.50	9497648
Dissolved Strontium (Sr)	mg/L	0.44	9497648	0.46	0.020	0.41	0.020	0.44	0.020	9497648
Dissolved Sulphur (S)	mg/L	1.6	9497648	4.5	0.20	2.6	0.20	2.1	0.20	9497648
RDL = Reportable Detection Limit			·				,			



BV Labs ID		WA5524		
formaling Data		2019/07/04		
		14:55		
COC Number		M083946		
	UNITS	MW18-107	RDL	QC Batch
Calculated Parameters				
Anion Sum	meq/L	6.6	N/A	9493590
Cation Sum	meq/L	6.5	N/A	9493590
Hardness (CaCO3)	mg/L	310	0.50	9493521
Ion Balance (% Difference)	%	0.68	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	8.9	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	2.1	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	0.11	0.033	9493534
Calculated Total Dissolved Solids	mg/L	320	1.0	9493550
Misc. Inorganics				
Conductivity	uS/cm	580	2.0	9497188
рН	рН	7.80	N/A	9497187
Anions				·
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9497185
Alkalinity (Total as CaCO3)	mg/L	300	1.0	9497185
Bicarbonate (HCO3)	mg/L	370	1.0	9497185
Carbonate (CO3)	mg/L	<1.0	1.0	9497185
Hydroxide (OH)	mg/L	<1.0	1.0	9497185
Dissolved Sulphate (SO4)	mg/L	6.6	1.0	9501390
Dissolved Chloride (Cl)	mg/L	10	1.0	9501388
Nutrients				
Dissolved Nitrite (N)	mg/L	0.034	0.010	9495539
Dissolved Nitrate (N)	mg/L	2.0	0.010	9495539
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	<0.040	0.040	9497648
Dissolved Barium (Ba)	mg/L	0.34	0.010	9497648
Dissolved Boron (B)	mg/L	0.029	0.020	9497648
Dissolved Calcium (Ca)	mg/L	71	0.30	9497648
Dissolved Chromium (Cr)	mg/L	<0.010	0.010	9497648
Dissolved Iron (Fe)	mg/L	0.15	0.060	9497648
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9497648
RDL = Reportable Detection Limit				
N/A = Not Applicable				



BV Labs ID		WA5524		
Sampling Date		2019/07/04		
		14:55		
COC Number		M083946		
	UNITS	MW18-107	RDL	QC Batch
Dissolved Magnesium (Mg)	mg/L	32	0.20	9497648
Dissolved Manganese (Mn)	mg/L	0.039	0.0040	9497648
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9497648
Dissolved Potassium (K)	mg/L	3.0	0.30	9497648
Dissolved Silicon (Si)	mg/L	4.8	0.10	9497648
Dissolved Sodium (Na)	mg/L	6.6	0.50	9497648
Dissolved Strontium (Sr)	mg/L	0.46	0.020	9497648
Dissolved Sulphur (S)	mg/L	2.0	0.20	9497648
RDL = Reportable Detection Limit				



## REG. METALS (CCME/AT1) – DISS. LAB FILT.

BV Labs ID		WA5520	WA5521	WA5522	WA5523		WA5524		
Sampling Date		2019/07/04	2019/07/04	2019/07/04	2019/07/04		2019/07/04		
		09:55	10:55	11:55	13:55		14:55		
COC Number		M083946	M083946	M083946	M083946		M083946		
	UNITS	MW18-105	MW19-108	MW18-104	MW18-106	QC Batch	MW18-107	RDL	QC Batch
Low Level Elements									
Dissolved Cadmium (Cd)	ug/L	<0.020	<0.020	0.039	<0.020	9512961	<0.020	0.020	9513604
Lab Filtered Elements			•		•				
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0051	0.0051	0.0034	9519537	0.0033	0.0030	9519537
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.0013	<0.00060	9519537	<0.00060	0.00060	9519537
Dissolved Arsenic (As)	mg/L	<0.00020	0.00022	0.00080	<0.00020	9519537	0.00023	0.00020	9519537
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00039	0.0012	<0.00030	9519537	<0.00030	0.00030	9519537
Dissolved Copper (Cu)	mg/L	0.00030	<0.00020	0.0025	0.00072	9519537	<0.00020	0.00020	9519537
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	9519537	<0.00020	0.00020	9519537
Dissolved Molybdenum (Mo)	mg/L	0.00096	0.0029	0.012	0.0012	9519537	0.00095	0.00020	9519537
Dissolved Nickel (Ni)	mg/L	<0.00050	0.0023	0.0024	<0.00050	9519537	<0.00050	0.00050	9519537
Dissolved Selenium (Se)	mg/L	0.00043	0.00074	0.00024	0.00067	9519537	0.00081	0.00020	9519537
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	9519537	<0.00010	0.00010	9519537
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	9519537	<0.00020	0.00020	9519537
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	0.0012	0.0010	9519537
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Uranium (U)	mg/L	0.0018	0.0027	0.0015	0.0020	9519537	0.0017	0.00010	9519537
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	9519537	<0.0030	0.0030	9519537
RDL = Reportable Detection Li	mit		-		-				



BV Labs ID		WA5524		
Sampling Date		2019/07/04		
		14:55		
COC Number		M083946		
	UNITS	MW18-107 Lab-Dup	RDL	QC Batch
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	0.0036	0.0030	9519537
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9519537
Dissolved Arsenic (As)	mg/L	<0.00020	0.00020	9519537
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9519537
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9519537
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	9519537
Dissolved Copper (Cu)	mg/L	<0.00020	0.00020	9519537
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9519537
Dissolved Molybdenum (Mo)	mg/L	0.00090	0.00020	9519537
Dissolved Nickel (Ni)	mg/L	<0.00050	0.00050	9519537
Dissolved Selenium (Se)	mg/L	0.00079	0.00020	9519537
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9519537
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9519537
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9519537
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9519537
Dissolved Uranium (U)	mg/L	0.0018	0.00010	9519537
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9519537
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	9519537
RDL = Reportable Detection Li	mit			
Lab-Dup = Laboratory Initiated	l Duplica	ite		

## REG. METALS (CCME/AT1) – DISS. LAB FILT.



## **REGULATED METALS (CCME/AT1) - TOTAL**

BV Labs ID		WA5520		WA5521	WA5522	WA5523	WA5524		
Sampling Data		2019/07/04		2019/07/04	2019/07/04	2019/07/04	2019/07/04		
		09:55		10:55	11:55	13:55	14:55		
COC Number		M083946		M083946	M083946	M083946	M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	MW18-107	RDL	QC Batch
Low Level Elements									
Total Cadmium (Cd)	ug/L	5.5	0.020	0.95	0.36	0.95	0.33	0.020	9493589
Elements									
Total Aluminum (Al)	mg/L	5.4	0.0030	15	3.7	13	7.0	0.0030	9500624
Total Antimony (Sb)	mg/L	0.0060	0.00060	0.0022	0.0049	0.0048	0.00079	0.00060	9500624
Total Arsenic (As)	mg/L	0.0056	0.00020	0.0086	0.0044	0.017	0.0076	0.00020	9500624
Total Barium (Ba)	mg/L	2.8	0.010	1.1	0.61	1.1	0.79	0.010	9500611
Total Beryllium (Be)	mg/L	0.0014	0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0010	9500624
Total Boron (B)	mg/L	0.021	0.020	0.029	0.025	<0.020	<0.020	0.020	9500611
Total Calcium (Ca)	mg/L	720 (1)	1.5	170	90	350	170	0.30	9500611
Total Chromium (Cr)	mg/L	0.0046	0.0010	0.038	0.018	0.081	0.025	0.0010	9500624
Total Cobalt (Co)	mg/L	0.035	0.00030	0.011	0.0071	0.015	0.0051	0.00030	9500624
Total Copper (Cu)	mg/L	0.11	0.00020	0.038	0.064	0.11	0.018	0.00020	9500624
Total Iron (Fe)	mg/L	49	0.060	29	7.6	37	17	0.060	9500611
Total Lead (Pb)	mg/L	0.025	0.00020	0.024	0.0049	0.019	0.0075	0.00020	9500624
Total Lithium (Li)	mg/L	0.033	0.020	0.025	<0.020	0.021	<0.020	0.020	9500611
Total Magnesium (Mg)	mg/L	77	0.20	50	35	78	58	0.20	9500611
Total Manganese (Mn)	mg/L	2.9	0.0040	0.74	0.62	1.9	0.60	0.0040	9500611
Total Molybdenum (Mo)	mg/L	0.0014	0.00020	0.0065	0.015	0.0050	0.0021	0.00020	9500624
Total Nickel (Ni)	mg/L	0.015	0.00050	0.047	0.020	0.036	0.014	0.00050	9500624
Total Phosphorus (P)	mg/L	1.6	0.10	1.0	0.76	1.2	0.61	0.10	9500611
Total Potassium (K)	mg/L	6.6	0.30	5.6	4.6	5.0	3.6	0.30	9500611
Total Selenium (Se)	mg/L	0.00093	0.00020	0.0013	0.00049	0.0011	0.00094	0.00020	9500624
Total Silicon (Si)	mg/L	41	0.10	27	9.9	23	12	0.10	9500611
Total Silver (Ag)	mg/L	<0.00010	0.00010	0.00030	0.00044	0.0017	0.00010	0.00010	9500624
Total Sodium (Na)	mg/L	5.6	0.50	12	12	8.1	6.1	0.50	9500611
Total Strontium (Sr)	mg/L	1.4	0.020	0.57	0.41	0.58	0.51	0.020	9500611
Total Sulphur (S)	mg/L	2.3	0.20	5.7	3.2	2.5	2.2	0.20	9500611
Total Thallium (Tl)	mg/L	0.00023	0.00020	0.00028	<0.00020	0.00020	<0.00020	0.00020	9500624
Total Tin (Sn)	mg/L	<0.0010	0.0010	0.0037	0.0052	0.0014	<0.0010	0.0010	9500624
Total Titanium (Ti)	mg/L	0.0092	0.0010	0.098	0.030	0.092	0.13	0.0010	9500624
	1								

RDL = Reportable Detection Limit

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.



## REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WA5520		WA5521	WA5522	WA5523	WA5524		
Sampling Date		2019/07/04		2019/07/04	2019/07/04	2019/07/04	2019/07/04		
Sampling Date		09:55		10:55	11:55	13:55	14:55		
COC Number		M083946		M083946	M083946	M083946	M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	MW18-107	RDL	QC Batch
Total Uranium (U)	mg/L	0.012	0.00010	0.0047	0.0019	0.0030	0.0027	0.00010	9500624
Total Vanadium (V)	mg/L	0.0053	0.0010	0.036	0.011	0.033	0.018	0.0010	9500624
Total Zinc (Zn)	mg/L	0.19	0.0030	0.15	0.072	0.13	0.037	0.0030	9500624



### **RESULTS OF CHEMICAL ANALYSES OF WATER**

BV Labs ID		WA5520		WA5521	WA5522	WA5523		WA5524		
Sampling Data		2019/07/04		2019/07/04	2019/07/04	2019/07/04		2019/07/04		
		09:55		10:55	11:55	13:55		14:55		
COC Number		M083946		M083946	M083946	M083946		M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	RDL	MW18-107	RDL	QC Batch
Microbiological Param.										
E.Coli DST	MPN/100mL	<100 (1)	100	<10 (1)	10 (1)	<10 (1)	10	<1.0	1.0	9493707
Total Coliforms DST	MPN/100mL	<100 (1)	100	<10 (1)	>24000 (1)	1100 (1)	10	>2400	1.0	9493707
Physical Properties					·					
Turbidity	NTU	>4000 (2)	0.10	670	130	3100	0.10	53	0.10	9495349
RDL = Reportable Detection L	imit									
(1) Detection limit raised due	to matrix inter	rference.								

(2) Sample contained sediment



### **ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)**

BV Labs ID		WA5520		WA5521		WA5522		WA5523		WA5524		
Sampling Data		2019/07/04		2019/07/04		2019/07/04		2019/07/04		2019/07/04		
Sampling Date		09:55		10:55		11:55		13:55		14:55		
COC Number		M083946		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	RDL	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	MW18-107	RDL	QC Batch
Low Level Elements	UNITS	MW18-105	RDL	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	MW18-107	RDL	QC Batch
Low Level Elements Total Mercury (Hg)	UNITS ug/L	MW18-105	<b>RDL</b> 0.20	<b>MW19-108</b> 0.067 (1)	<b>RDL</b> 0.020	<b>MW18-104</b> 0.030 (1)	<b>RDL</b>	<b>MW18-106</b> 0.32 (1)	<b>RDL</b> 0.20	<b>MW18-107</b> 0.048 (1)	<b>RDL</b>	<b>QC Batch</b> 9502664

(1) Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.



### **GENERAL COMMENTS**

Each te	emperature is the	average of up to	three cooler temperatures taken at receipt
	Package 1	3.7°C	
	•		
Result	s relate only to th	e items tested.	



### **QUALITY ASSURANCE REPORT**

OA/OC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recoverv	UNITS	QC Limits
9493707	GK1	Method Blank	E.Coli DST	2019/07/06	<1.0		mpn/100m	nL
			Total Coliforms DST	2019/07/06	<1.0		mpn/100m	۱L
9493707	GK1	RPD	E.Coli DST	2019/07/06	170		%	N/A
			Total Coliforms DST	2019/07/06	33		%	N/A
9495349	EH2	Spiked Blank	Turbidity	2019/07/06		100	%	80 - 120
9495349	EH2	Method Blank	Turbidity	2019/07/06	<0.10		NTU	
9495349	EH2	RPD	Turbidity	2019/07/06	3.9		%	20
9495539	KD9	Matrix Spike	Dissolved Nitrite (N)	2019/07/07		100	%	80 - 120
		·	Dissolved Nitrate (N)	2019/07/07		99	%	80 - 120
9495539	KD9	Spiked Blank	Dissolved Nitrite (N)	2019/07/07		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495539	KD9	Method Blank	Dissolved Nitrite (N)	2019/07/07	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/07	<0.010		mg/L	
9495539	KD9	RPD	Dissolved Nitrite (N)	2019/07/07	NC		%	20
			Dissolved Nitrate (N)	2019/07/07	0.63		%	20
9497185	ІКО	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/08		105	%	80 - 120
9497185	ІКО	Method Blank	Alkalinity (PP as CaCO3)	2019/07/08	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/08	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/08	0.0.0,		mg/L	
					RDL=1.0			
			Carbonate (CO3)	2019/07/08	<1.0		mg/L	
			Hydroxide (OH)	2019/07/08	<1.0		mg/L	
9497185	IK0	RPD	Alkalinity (PP as CaCO3)	2019/07/08	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/08	1.7		%	20
			Bicarbonate (HCO3)	2019/07/08	1.7		%	20
			Carbonate (CO3)	2019/07/08	NC		%	20
			Hydroxide (OH)	2019/07/08	NC		%	20
9497187	IKO	Spiked Blank	рН	2019/07/08		100	%	97 - 103
9497187	IK0	RPD	рН	2019/07/08	0.052		%	N/A
9497188	IK0	Spiked Blank	Conductivity	2019/07/08		99	%	90 - 110
9497188	IK0	Method Blank	Conductivity	2019/07/08	<2.0		uS/cm	
9497188	IK0	RPD	Conductivity	2019/07/08	0.31		%	10
9497648	MAP	Matrix Spike	Dissolved Aluminum (Al)	2019/07/09		93	%	80 - 120
			Dissolved Barium (Ba)	2019/07/09		92	%	80 - 120
			Dissolved Boron (B)	2019/07/09		94	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/09		NC	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/09		92	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		94	%	80 - 120
			Dissolved Lithium (Li)	2019/07/09		94	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		87	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		94	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/09		96	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		91	%	80 - 120
			Dissolved Silicon (Si)	2019/07/09		92	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		80	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/09		86	%	80 - 120
0.4076.55			Dissolved Sulphur (S)	2019/07/09		102	%	80 - 120
9497648	MAP	Spiked Blank	Dissolved Aluminum (Al)	2019/07/09		96	%	80 - 120
			Dissolved Barium (Ba)	2019/07/09		97	%	80 - 120
			Dissolved Boron (B)	2019/07/09		9/	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/09		98	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/09		98	%	80 - 120



Disolved Iron (Fe)         2019/07/09         105         %         80         120           Dissolved Lithium (Li)         2019/07/09         96         %         80         120           Dissolved Marganester (Mn)         2019/07/09         96         %         80         120           Dissolved Marganester (Mn)         2019/07/09         95         %         80         120           Dissolved Potassium (K)         2019/07/09         93         %         80         120           Dissolved Stiticon (SI)         2019/07/09         98         %         80         120           Dissolved Strontium (Sr)         2019/07/09         98         %         80         120           Dissolved Strontium (Sr)         2019/07/09         98         %         80         120           Dissolved Aluminum (AI)         2019/07/09         <0.040         mg/L         0           Dissolved Isarium (Ba)         2019/07/09         <0.020         mg/L         0           Dissolved Isarium (Ba)         2019/07/09         <0.020         mg/L         0           Dissolved Isarium (Ba)         2019/07/09         <0.020         mg/L         0           Dissolved Maraganese (Mn)         2019/07/09
9497648         MAP         Method Blank         Dissolved Unithium (Li)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Phosphorus (P)         2019/07/09         95         %         80 - 120           9497648         MAP         Method Blank         Dissolved Phosphorus (P)         2019/07/09         98         %         80 - 120           9497648         MAP         Method Blank         Dissolved Solutor (Si)         2019/07/09         98         %         80 - 120           Dissolved Solutor (Si)         2019/07/09         98         %         80 - 120           Dissolved Solutor (Si)         2019/07/09         96         %         80 - 120           Dissolved Solutor (Si)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Mangenese (Mn)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Potassium (K)         2019/07/09         93         %         80 - 120           9497648         MAP         Method Blank         Dissolved Fotassium (K)         2019/07/09         98         %         80 - 120           9497648         MAP         Method Blank         Dissolved Strontium (sr)         2019/07/09         -0.040         mg/L           Dissolved Strontium (sr)         2019/07/09         -0.040         mg/L         -           Dissolved Aluminum (A)         2019/07/09         -0.040         mg/L         -           Dissolved Aluminum (A)         2019/07/09         -0.040         mg/L         -           Dissolved Aluminum (A)         2019/07/09         -0.040         mg/L         -           Dissolved Calcium (Ca)         2019/07/09         -0.040         mg/L         -           Dissolved Mangenese (Mn)         2019/07/09         -0.020         mg/L         -           Dissolved Mangenese (Mn)         2019/07/09         -0.030         mg/L         -           Dissolved Potassium (K)         2019/07/09
9497648         MAP         Method Blank         Dissolved Amaganese (Mm)         2019/07/09         90         %         80 - 120           9497648         MAP         Method Blank         Dissolved Fortassium (K)         2019/07/09         98         %         80 - 120           9497648         MAP         Method Blank         Dissolved Strontium (Sr)         2019/07/09         98         %         80 - 120           Dissolved Strontium (Sr)         2019/07/09         97         %         80 - 120           Dissolved Strontium (Sr)         2019/07/09         98         %         80 - 120           Dissolved Strontium (Sr)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Potassium (K)         2019/07/09         95         %         80 - 120           9497648         MAP         Method Blank         Dissolved Strontum (Sr)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Strontum (Sr)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Aluminum (A)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Solium (Na)         2019/07/09         93         %         80 - 120           9497648         MAP         Method Blank         Dissolved Solium (Na)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Solium (Na)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Silicon (Si)         2019/07/09         98         %         80 - 120           9497648         MAP         Method Blank         Dissolved Sulphur (Si)         2019/07/09         97         %         80 - 120           9497648         MAP         Method Blank         Dissolved Sulphur (Si)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Strontium (Sr)         2019/07/09         96         %         80 - 120           9497648         MAP         Method Blank         Dissolved Aluminum (Al)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Strontium (Sr) Dissolved Aluminum (AI)         2019/07/09 2019/07/09         98         %         80 - 120 80 - 120           9497648         MAP         Method Blank         Dissolved Aluminum (AI)         2019/07/09         <0.040
9497648         MAP         Method Blank         Dissolved Aluminum (Al)         2019/07/09         <0.040         mg/L           9497648         MAP         Method Blank         Dissolved Aluminum (Al)         2019/07/09         <0.010
9497648         MAP         Method Blank         Dissolved Aluminum (AI)         2019/07/09         <0.040         mg/L           Dissolved Barium (Ba)         2019/07/09         <0.010
9497648         MAP         RPD         Dissolved Barium (Ba)         2019/07/09         <0.010
9497648         MAP         RPD         Dissolved Boron (B)         2019/07/09         <0.020
9497648         MAP         RPD         Dissolved Calcium (Ca)         2019/07/09         <0.30
9497648         MAP         RPD         Dissolved Chromium (Cr)         2019/07/09         <0.010
P497648         MAP         RPD         Dissolved lron (Fe)         2019/07/09         <0.060         mg/L           9497648         MAP         RPD         Dissolved lithium (Li)         2019/07/09         <0.020
P497648         MAP         RPD         Dissolved Lithium (Li)         2019/07/09         <0.020         mg/L           9497648         MAP         RPD         Dissolved Maganese (Mn)         2019/07/09         <0.0040
P497648         MAP         RPD         Dissolved Magnesium (Mg)         2019/07/09         <0.20         mg/L           9497648         MAP         RPD         Dissolved Potassium (K)         2019/07/09         <0.10
Dissolved Manganese (Mn)         2019/07/09         <0.0040         mg/L           Dissolved Phosphorus (P)         2019/07/09         <0.10
P4997648         MAP         RPD         Dissolved Posphorus (P)         2019/07/09         <0.10         mg/L           9497648         MAP         RPD         Dissolved Solium (Na)         2019/07/09         <0.10
Jessolved Potassium (K)         2019/07/09         <0.30         mg/L           Dissolved Silicon (Si)         2019/07/09         <0.10
Dissolved Silicon (Si)         2019/07/09         <0.10         mg/L           Dissolved Sodium (Na)         2019/07/09         <0.50
Jissolved Sodium (Na)         2019/07/09         <0.50         mg/L           9497648         MAP         RPD         Dissolved Strontium (Sr)         2019/07/09         <0.20
9497648         MAP         RPD         Dissolved Strontium (Sr)         2019/07/09         <0.020         mg/L           9497648         MAP         RPD         Dissolved Sulphur (S)         2019/07/09         0.75         %         20           9497648         MAP         RPD         Dissolved Calcium (Ca)         2019/07/09         0.75         %         20           Dissolved Calcium (Ca)         2019/07/09         NC         %         20           Dissolved Iron (Fe)         2019/07/09         NC         %         20           Dissolved Magnesium (Mg)         2019/07/09         0.57         %         20           Dissolved Potassium (Mg)         2019/07/09         1.1         %         20           Dissolved Potassium (Na)         2019/07/09         1.1         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         92         %         80 - 120           9498897         IK0         Spiked Blank         Alkalinity (PP as CaCO3)         2019/07/09         <1.0
9497648         MAP         RPD         Dissolved Sulphur (S)         2019/07/09         <0.20         mg/L           9497648         MAP         RPD         Dissolved Calcium (Ca)         2019/07/09         0.75         %         20           Dissolved Iron (Fe)         2019/07/09         NC         %         20           Dissolved Magnesium (Mg)         2019/07/09         0.57         %         20           Dissolved Magnesium (Mg)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         NC         %         20           Dissolved Potassium (Na)         2019/07/09         0.69         %         20           9498897         IKO         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         91.0         mg/L           9498897         IKO         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         1.0         mg/L           9498897         IKO         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         1.0         mg/L           Garbonate (ICO3)         2019/07/09         1.0         mg/L         1.0         mg/L           Hydroxide (OH)         2019/07/09         1.0
9497648         MAP         RPD         Dissolved Calcium (Ca)         2019/07/09         0.75         %         20           Dissolved Iron (Fe)         2019/07/09         NC         %         20           Dissolved Magnesium (Mg)         2019/07/09         NC         %         20           Dissolved Magnese (Mn)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         NC         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         0.69         %         20           9498897         IK0         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         <1.0
Dissolved Iron (Fe)         2019/07/09         NC         %         20           Dissolved Magnesium (Mg)         2019/07/09         0.57         %         20           Dissolved Magnesium (Mg)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         1.1         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         0.69         %         20           9498897         IK0         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         <1.0
Dissolved Magnesium (Mg)         2019/07/09         0.57         %         20           Dissolved Manganese (Mn)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         1.1         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         0.69         %         20           9498897         IK0         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         <1.0
Dissolved Manganese (Mn)         2019/07/09         NC         %         20           Dissolved Potassium (K)         2019/07/09         1.1         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         0.69         %         20           9498897         IK0         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         <1.0
Dissolved Potassium (K)         2019/07/09         1.1         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         0.69         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         92         %         80 - 120           9498897         IK0         Method Blank         Alkalinity (PP as CaCO3)         2019/07/09         <1.0
Dissolved Sodium (Na)         2019/07/09         0.69         %         20           9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         92         %         80 - 120           9498897         IK0         Method Blank         Alkalinity (PP as CaCO3)         2019/07/09         <1.0
9498897         IK0         Spiked Blank         Alkalinity (Total as CaCO3)         2019/07/09         92         %         80 - 120           9498897         IK0         Method Blank         Alkalinity (Total as CaCO3)         2019/07/09         <1.0
9498897         IK0         Method Blank         Alkalinity (PP as CaCO3)         2019/07/09         <1.0         mg/L           Alkalinity (Total as CaCO3)         2019/07/09         <1.0
Alkalinity (Total as CaCO3)       2019/07/09       <1.0
Bicarbonate (HCO3)         2019/07/09         <1.0         mg/L           Carbonate (CO3)         2019/07/09         <1.0
Carbonate (CO3)         2019/07/09         <1.0         mg/L           Hydroxide (OH)         2019/07/09         <1.0
Hydroxide (OH)         2019/07/09         <1.0         mg/L           9498897         IK0         RPD         Alkalinity (PP as CaCO3)         2019/07/09         NC         %         20
9498897 IKO RPD Alkalinity (PP as CaCO3) 2019/07/09 NC % 20
Alkalinity (Total as CaCO3) 2019/07/09 2.2 % 20
Bicarbonate (HCO3) 2019/07/09 2.2 % 20
Carbonate (CO3) 2019/07/09 NC % 20
Hydroxide (OH) 2019/07/09 NC % 20
9498906 IKO Spiked Blank pH 2019/07/09 101 % 97 - 103
9498906 IKO RPD pH 2019/07/09 0.053 % N/A
9498908 IKO Spiked Blank Conductivity 2019/07/09 102 % 90 - 110
9498908 IKO Method Blank Conductivity 2019/07/09 <2.0 uS/cm
9498908 IKO RPD Conductivity 2019/07/09 1.1 % 10
9500611 ALX Matrix Spike Total Barium (Ba) 2019/07/10 96 % 80 - 120
Total Boron (B) 2019/07/10 97 % 80 - 120
Total Calcium (Ca) 2019/07/10 NC % 80 - 120
Total Iron (Fe) 2019/07/10 101 % 80 - 120
Total Lithium (Li) 2019/07/10 95 % 80 - 120



Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Magnesium (Mg)	2019/07/10		95	%	80 - 120
			Total Manganese (Mn)	2019/07/10		94	%	80 - 120
			Total Phosphorus (P)	2019/07/10		95	%	80 - 120
			Total Potassium (K)	2019/07/10		94	%	80 - 120
			Total Silicon (Si)	2019/07/10		99	%	80 - 120
			Total Sodium (Na)	2019/07/10		NC	%	80 - 120
			Total Strontium (Sr)	2019/07/10		94	%	80 - 120
			Total Sulphur (S)	2019/07/10		95	%	80 - 120
9500611	ALX	Spiked Blank	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		96	%	80 - 120
			Total Calcium (Ca)	2019/07/10		95	%	80 - 120
			Total Iron (Fe)	2019/07/10		103	%	80 - 120
			Total Lithium (Li)	2019/07/10		94	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		96	%	80 - 120
			Total Manganese (Mn)	2019/07/10		97	%	80 - 120
			Total Phosphorus (P)	2019/07/10		94	%	80 - 120
			Total Potassium (K)	2019/07/10		92	%	80 - 120
			Total Silicon (Si)	2019/07/10		98	%	80 - 120
			Total Sodium (Na)	2019/07/10		95	%	80 - 120
			Total Strontium (Sr)	2019/07/10		95	%	80 - 120
			Total Sulphur (S)	2019/07/10		96	%	80 - 120
9500611	ALX	Method Blank	Total Barium (Ba)	2019/07/10	<0.010		mg/L	
			Total Boron (B)	2019/07/10	<0.020		mg/L	
			Total Calcium (Ca)	2019/07/10	<0.30		mg/L	
			Total Iron (Fe)	2019/07/10	<0.060		mg/L	
			Total Lithium (Li)	2019/07/10	<0.020		mg/L	
			Total Magnesium (Mg)	2019/07/10	<0.20		mg/L	
			Total Manganese (Mn)	2019/07/10	<0.0040		mg/L	
			Total Phosphorus (P)	2019/07/10	<0.10		mg/L	
			Total Potassium (K)	2019/07/10	<0.30		mg/L	
			Total Silicon (Si)	2019/07/10	<0.10		mg/L	
			Total Sodium (Na)	2019/07/10	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/10	<0.020		mg/L	
			Total Sulphur (S)	2019/07/10	<0.20		mg/L	
9500611	ALX	RPD	Total Barium (Ba)	2019/07/10	0.68		%	20
			Total Boron (B)	2019/07/10	1.0		%	20
			Total Calcium (Ca)	2019/07/10	0.17		%	20
			Total Iron (Fe)	2019/07/10	3.0		%	20
			Total Lithium (Li)	2019/07/10	0		%	20
			Total Magnesium (Mg)	2019/07/10	0.46		%	20
			Total Manganese (Mn)	2019/07/10	NC		%	20
			Total Phosphorus (P)	2019/07/10	NC		%	20
			Total Potassium (K)	2019/07/10	0.63		%	20
			Total Silicon (Si)	2019/07/10	0.92		%	20
			Total Sodium (Na)	2019/07/10	0.55		%	20
			Total Strontium (Sr)	2019/07/10	0.38		%	20
			Total Sulphur (S)	2019/07/10	0.37		%	20
9500624	LQ1	Matrix Spike	Total Aluminum (Al)	2019/07/10		97	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		94	%	80 - 120
			Total Beryllium (Be)	2019/07/10		97	%	80 - 120
			Total Chromium (Cr)	2019/07/10		99	%	80 - 120



QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
	-		Total Cobalt (Co)	2019/07/10		97	%	80 - 120
			Total Copper (Cu)	2019/07/10		109	%	80 - 120
			Total Lead (Pb)	2019/07/10		102	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		104	%	80 - 120
			Total Nickel (Ni)	2019/07/10		96	%	80 - 120
			Total Selenium (Se)	2019/07/10		97	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (TI)	2019/07/10		99	%	80 - 120
			Total Tin (Sn)	2019/07/10		99	%	80 - 120
			Total Titanium (Ti)	2019/07/10		101	%	80 - 120
			Total Uranium (U)	2019/07/10		98	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		NC	%	80 - 120
9500624	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/10		99	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		95	%	80 - 120
			Total Beryllium (Be)	2019/07/10		94	%	80 - 120
			Total Chromium (Cr)	2019/07/10		100	%	80 - 120
			Total Cobalt (Co)	2019/07/10		98	%	80 - 120
			Total Copper (Cu)	2019/07/10		98	%	80 - 120
			Total Lead (Pb)	2019/07/10		97	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		100	%	80 - 120
			Total Nickel (Ni)	2019/07/10		97	%	80 - 120
			Total Selenium (Se)	2019/07/10		95	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (TI)	2019/07/10		100	%	80 - 120
			Total Tin (Sn)	2019/07/10		98	%	80 - 120
			Total Titanium (Ti)	2019/07/10		99	%	80 - 120
			Total Uranium (U)	2019/07/10		93	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		96	%	80 - 120
9500624	LQ1	Method Blank	Total Aluminum (Al)	2019/07/10	<0.0030		mg/L	
	-		Total Antimony (Sb)	2019/07/10	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/10	< 0.00020		mg/L	
			Total Bervllium (Be)	2019/07/10	< 0.0010		mg/L	
			Total Chromium (Cr)	2019/07/10	< 0.0010		mg/L	
			Total Cobalt (Co)	2019/07/10	< 0.00030		mg/L	
			Total Copper (Cu)	2019/07/10	<0.00020		mg/l	
			Total Lead (Pb)	2019/07/10	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/10	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/10	<0.00050		mg/l	
			Total Selenium (Se)	2019/07/10	<0.00020		mg/l	
			Total Silver (Ag)	2019/07/10	<0.00010		mg/l	
			Total Thallium (TI)	2019/07/10	<0.00020		mg/I	
			Total Tin (Sn)	2019/07/10	<0.00020		mg/l	
			Total Titanium (Ti)	2019/07/10	<0.0010		mø/l	
			Total Uranium (U)	2019/07/10	<0.00010		mg/l	
			Total Vanadium (V)	2019/07/10	<0.0010		mø/l	
			Total Zinc (Zn)	2019/07/10	<0.0030		mø/l	
9500624	101	RPD	Total Aluminum (Al)	2019/07/10	5 2		%	20
5555024	-41		Total Antimony (Sb)	2019/07/10	NC		%	20
			Total Arsenic (As)	2019/07/10	NC		%	20



Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Beryllium (Be)	2019/07/10	NC	•	%	20
			Total Chromium (Cr)	2019/07/10	7.9		%	20
			Total Cobalt (Co)	2019/07/10	NC		%	20
			Total Copper (Cu)	2019/07/10	7.8		%	20
			Total Lead (Pb)	2019/07/10	NC		%	20
			Total Molybdenum (Mo)	2019/07/10	1.8		%	20
			Total Nickel (Ni)	2019/07/10	12		%	20
			Total Selenium (Se)	2019/07/10	1.9		%	20
			Total Silver (Ag)	2019/07/10	NC		%	20
			Total Thallium (TI)	2019/07/10	NC		%	20
			Total Tin (Sn)	2019/07/10	NC		%	20
			Total Titanium (Ti)	2019/07/10	NC		%	20
			Total Uranium (U)	2019/07/10	4.8		%	20
			Total Vanadium (V)	2019/07/10	NC		%	20
			Total Zinc (Zn)	2019/07/10	NC		%	20
9501388	ZI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/10		NC	%	80 - 120
9501388	71	Spiked Blank	Dissolved Chloride (Cl)	2019/07/10		106	%	80 - 120
9501388	71	Method Blank	Dissolved Chloride (Cl)	2019/07/10	<1.0	100	mg/l	00 120
9501388	71	RPD	Dissolved Chloride (Cl)	2019/07/10	1.2		%	20
9501390	71	Matrix Snike	Dissolved Sulphate (SO4)	2019/07/10		NC	%	 80 - 120
9501390	71	Sniked Blank	Dissolved Sulphate (SO4)	2019/07/10		103	%	80 - 120
9501390	71	Method Blank	Dissolved Sulphate (SO4)	2019/07/10	<10	105	mg/l	00 120
9501390	71	RPD	Dissolved Sulphate (SO4)	2019/07/10	0.13		%	20
9502664	BK3	Matrix Snike	Total Mercury (Hg)	2019/07/10	0.15	95	%	80 - 120
0502664	DK3	Spiked Blank		2010/07/11		01	70 0/	80 - 120 80 - 120
9502664	BK3	Method Blank		2019/07/11	<0.0020	51	νσ/I	00 - 120
9502664	BK3			2019/07/11	<0.0020 NC		ug/L %	20
9519537	ANE	Matrix Spike	Dissolved Aluminum (Al)	2019/07/23		110	%	80 - 120
		[111002101]	Dissolved Antimony (Sb)	2019/07/23		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/23		98	%	80 - 120
			Dissolved Bervllium (Be)	2019/07/23		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/23		95	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/23		94	%	80 - 120
			Dissolved Copper (Cu)	2019/07/23		93	%	80 - 120
			Dissolved Lead (Pb)	2019/07/23		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/23		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/23		94	%	80 - 120
			Dissolved Selenium (Se)	2019/07/23		108	%	80 - 120
			Dissolved Silver (Ag)	2019/07/23		94	%	80 - 120
			Dissolved Thallium (TI)	2019/07/23		96	%	80 - 120
			Dissolved Tin (Sn)	2019/07/23		75 (1)	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/23		84	%	80 - 120
			Dissolved Uranium (1)	2019/07/23		104	%	80 - 120
			Dissolved Vanadium (V)	2019/07/23		98	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/23		94	%	80 - 120
9519537	ANF	Sniked Blank	Dissolved Aluminum (Al)	2019/07/23		106	%	80 - 120
5515557		epineo biolin	Dissolved Antimony (Sh)	2019/07/23		100	%	80 - 120
			Dissolved Arsenic (As)	2019/07/23		99	%	80 - 120
			Dissolved Rervilium (Re)	2019/07/23		100	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/23		98	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/23		97	%	80 - 120
1				, .,		5.		=0



QA/QC Batch	Init		Darameter	Date Analyzed	Value	Recovery		OC Limits
Datch	nnt	QC Type	Dissolved Conner (Cu)	2019/07/23	value	99	%	80 - 120
			Dissolved Lead (Pb)	2019/07/23		94	%	80 - 120
			Dissolved Molyhdenum (Mo)	2019/07/23		96	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/23		97	%	80 - 120
			Dissolved Selenium (Se)	2019/07/23		107	%	80 - 120
			Dissolved Silver (Ag)	2019/07/23		94	%	80 - 120
			Dissolved Thallium (TI)	2019/07/23		97	%	80 - 120
			Dissolved Tin (Sn)	2019/07/23		81	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/23		88	%	80 - 120
			Dissolved Uranium (U)	2019/07/23		100	%	80 - 120
			Dissolved Vanadium (V)	2019/07/23		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/23		94	%	80 - 120
9519537	ANE	Method Blank	Dissolved Aluminum (Al)	2019/07/23	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/07/23	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/07/23	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/07/23	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/07/23	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/23	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/23	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/23	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/23	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/23	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/23	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/23	<0.00010		mg/L	
			Dissolved Thallium (TI)	2019/07/23	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/23	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/23	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/23	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/23	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/23	<0.0030		mg/L	
9519537	ANE	RPD [WA5524-01]	Dissolved Aluminum (Al)	2019/07/23	9.8		%	20
			Dissolved Antimony (Sb)	2019/07/23	NC		%	20
			Dissolved Arsenic (As)	2019/07/23	12		%	20
			Dissolved Beryllium (Be)	2019/07/23	NC		%	20
			Dissolved Chromium (Cr)	2019/07/23	NC		%	20
			Dissolved Cobalt (Co)	2019/07/23	NC		%	20
			Dissolved Copper (Cu)	2019/07/23	NC		%	20
			Dissolved Lead (Pb)	2019/07/23	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/23	5.2		%	20
			Dissolved Nickel (Ni)	2019/07/23	NC		%	20
			Dissolved Selenium (Se)	2019/07/23	2.0		%	20
			Dissolved Silver (Ag)	2019/07/23	NC		%	20
			Dissolved Thallium (TI)	2019/07/23	NC		%	20
			Dissolved Tin (Sn)	2019/07/23	16		%	20
			Dissolved Titanium (Ti)	2019/07/23	NC		%	20
			Dissolved Uranium (U)	2019/07/23	4.6		%	20
			Dissolved Vanadium (V)	2019/07/23	NC		%	20



### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Zinc (Zn)	2019/07/23	NC		%	20

N/A = Not Applicable

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

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

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

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

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

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

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



### VALIDATION SIGNATURE PAGE

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

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

en

Harry (Peng) Liang, Senior Analyst

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



Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247 Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247 maxxam.ca



Invoice Information	Re	port Information	(if differs from i	nvoic	e)					Proje	ct In	forma	tion				Tu	rnaro	ound	d Time (TAT) Required
Company: SLR Consulting Ltd.	Company	Summit F	ggregates.			0	Quotati	on #:			ř	-					5 - 7 Days Regular (Most analyses)			
Contact Name: Robert Till	Contact N	lame:				F	P.O. #/	AFE#	Be	10	É	DM.	488	36		PLE	ASE PRO	DVIDE	ADV	ANCE NOTICE FOR RUSH PROJECTS
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2 MW19-108			10:55 Am	6	_	_	X	X	X		1	1	X	X						Asilty
3 mw18-104			11:SSAM	6			X	X	X				X	×					27	
4 MW18-106			1:55 pm	6			X	X	×				X	X						silly
5 MW18-107		1	2:55 Pm	6			X	X	X				×	X						
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8		120																		Too net in field a
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10																$\uparrow\uparrow$				Bottles wi Morter or
Please indicate Filtered, Preserved or E	oth (F, P, F/	'P)		-				T								$\uparrow \uparrow$				Pen. Labels on bags.
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aless otherwise agreed to in writing, work submitted on this Chain of Custody is subject	ct to Maxxam's star	idard Terms and Conditions	Signing of this Chain of Cu	stody do	cument	t is ackn	nowledgm	int and	acceptar	nce of ou	r terms	which are	available	e for viewir	ig at www.ma	» 117	М	, a	INTO	R 0220

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Your P.O. #: EDM4886 Your Project #: 212.06550.00003 Site Location: MOUNTAIN ASH PO # EDM3288 Your C.O.C. #: M083948

### Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD 6940 ROPER ROAD EDMONTON, AB CANADA T6B 3H9

> Report Date: 2019/07/12 Report #: R2751511 Version: 1 - Final

### **CERTIFICATE OF ANALYSIS**

#### BV LABS JOB #: B953951 Received: 2019/07/05, 12:20

Sample Matrix: Water # Samples Received: 2

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	N/A	2019/07/10	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME (Total)	2	N/A	2019/07/11		Auto Calc
Chloride by Automated Colourimetry	2	N/A	2019/07/10	AB SOP-00020	SM 23-4500-Cl-E m
Total Coliforms and E.Coli	2	2019/07/05	2019/07/06	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	2	N/A	2019/07/10	AB SOP-00005	SM 23 2510 B m
Hardness	2	N/A	2019/07/11		Auto Calc
Mercury (Total) by CV	1	2019/07/10	2019/07/10	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury (Total) by CV	1	2019/07/10	2019/07/11	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	2	N/A	2019/07/09	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	2	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP- 00042	EPA 6010d R4 m
Elements by ICPMS - Total	2	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP- 00043	EPA 6020b R2 m
Ion Balance	2	N/A	2019/07/06		Auto Calc
Sum of cations, anions	2	N/A	2019/07/11		Auto Calc
Nitrate and Nitrite	2	N/A	2019/07/10		Auto Calc
Nitrate + Nitrite-N (calculated)	2	N/A	2019/07/10		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2019/07/07	AB SOP-00023	SM 23 4110 B m
pH @25°C (2)	2	N/A	2019/07/10	AB SOP-00005	SM 23 4500-H+B m
Sulphate by Automated Colourimetry	2	N/A	2019/07/10	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Calculated)	2	N/A	2019/07/11		Auto Calc
Turbidity	2	N/A	2019/07/06	CAL SOP-00081	SM 23 2130 B m

#### Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

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



Your P.O. #: EDM4886 Your Project #: 212.06550.00003 Site Location: MOUNTAIN ASH PO # EDM3288 Your C.O.C. #: M083948

#### Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD 6940 ROPER ROAD EDMONTON, AB CANADA T6B 3H9

> Report Date: 2019/07/12 Report #: R2751511 Version: 1 - Final

### **CERTIFICATE OF ANALYSIS**

#### BV LABS JOB #: B953951 Received: 2019/07/05. 12:20

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

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

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

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

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

(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(2) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

**Encryption Key** 

Jenelle Feller Key Account Specialist 12 Jul 2019 17:52:06

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jenelle Feller, Key Account Specialist Email: JFeller@bvlabs.com Phone# (403)735-2264

\_\_\_\_\_

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


BV Labs ID		WA6549	WA6550		
Sampling Date		2019/07/05	2019/07/05		
COC Number		M083948	M083948		
	UNITS	MW19-109	WW4	RDL	QC Batch
Calculated Parameters					
Anion Sum	meq/L	6.9	6.3	N/A	9493590
Cation Sum	meq/L	7.9	7.3	N/A	9493590
Hardness (CaCO3)	mg/L	350	340	0.50	9494037
Ion Balance (% Difference)	%	6.2	7.6	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	7.4	14	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	1.7	3.2	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	0.22	<0.033	0.033	9493534
Calculated Total Dissolved Solids	mg/L	360	330	1.0	9493550
Misc. Inorganics	•	•			
Conductivity	uS/cm	660	600	2.0	9498940
рН	рН	8.19	8.13	N/A	9498939
Anions	+	•			
Alkalinity (PP as CaCO3)	mg/L	<1.0	<1.0	1.0	9498938
Alkalinity (Total as CaCO3)	mg/L	290	280	1.0	9498938
Bicarbonate (HCO3)	mg/L	350	340	1.0	9498938
Carbonate (CO3)	mg/L	<1.0	<1.0	1.0	9498938
Hydroxide (OH)	mg/L	<1.0	<1.0	1.0	9498938
Dissolved Sulphate (SO4)	mg/L	26	5.9	1.0	9501583
Dissolved Chloride (Cl)	mg/L	18	12	1.0	9501576
Nutrients		<u> </u>			
Dissolved Nitrite (N)	mg/L	0.065	<0.010	0.010	9495902
Dissolved Nitrate (N)	mg/L	1.7	3.2	0.010	9495902
Lab Filtered Elements				•	
Dissolved Calcium (Ca)	mg/L	77	80	0.30	9499250
Dissolved Iron (Fe)	mg/L	0.15	0.16	0.060	9499250
Dissolved Magnesium (Mg)	mg/L	37	35	0.20	9499250
Dissolved Manganese (Mn)	mg/L	0.42	<0.0040	0.0040	9499250
Dissolved Potassium (K)	mg/L	6.3	3.0	0.30	9499250
Dissolved Sodium (Na)	mg/L	18	7.7	0.50	9499250
RDL = Reportable Detection Limit N/A = Not Applicable					

## **ROUTINE WATER -LAB FILTERED (WATER)**

BV Labs ID		WA6549		WA6550		
Sampling Date		2019/07/05		2019/07/05		
COC Number		M083948		M083948		
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch
Low Level Elements						
Total Cadmium (Cd)	ug/L	10	0.020	<0.020	0.020	9494032
Elements					•	
Total Aluminum (Al)	mg/L	95	0.0030	0.0041	0.0030	9500624
Total Antimony (Sb)	mg/L	0.0034	0.00060	<0.00060	0.00060	9500624
Total Arsenic (As)	mg/L	0.071	0.00020	0.00032	0.00020	9500624
Total Barium (Ba)	mg/L	7.2 (1)	0.050	0.36	0.010	9500611
Total Beryllium (Be)	mg/L	0.0083	0.0010	<0.0010	0.0010	9500624
Total Boron (B)	mg/L	0.087	0.020	<0.020	0.020	9500611
Total Calcium (Ca)	mg/L	1500 (1)	1.5	68	0.30	9500611
Total Chromium (Cr)	mg/L	0.19	0.0010	0.0012	0.0010	9500624
Total Cobalt (Co)	mg/L	0.12	0.00030	<0.00030	0.00030	9500624
Total Copper (Cu)	mg/L	0.29	0.00020	0.034	0.00020	9500624
Total Iron (Fe)	mg/L	190	0.060	0.30	0.060	9500611
Total Lead (Pb)	mg/L	0.15	0.00020	0.011	0.00020	9500624
Total Lithium (Li)	mg/L	0.18	0.020	<0.020	0.020	9500611
Total Magnesium (Mg)	mg/L	210	0.20	30	0.20	9500611
Total Manganese (Mn)	mg/L	8.9	0.0040	<0.0040	0.0040	9500611
Total Molybdenum (Mo)	mg/L	0.023	0.00020	0.00065	0.00020	9500624
Total Nickel (Ni)	mg/L	0.41	0.00050	<0.00050	0.00050	9500624
Total Phosphorus (P)	mg/L	8.1	0.10	<0.10	0.10	9500611
Total Potassium (K)	mg/L	20	0.30	2.3	0.30	9500611
Total Selenium (Se)	mg/L	0.00059	0.00020	0.00093	0.00020	9500624
Total Silicon (Si)	mg/L	110 (1)	0.50	4.7	0.10	9500611
Total Silver (Ag)	mg/L	0.0025	0.00010	0.00012	0.00010	9500624
Total Sodium (Na)	mg/L	18	0.50	5.7	0.50	9500611
Total Strontium (Sr)	mg/L	2.4	0.020	0.39	0.020	9500611
Total Sulphur (S)	mg/L	11	0.20	1.7	0.20	9500611
Total Thallium (Tl)	mg/L	0.0026	0.00020	<0.00020	0.00020	9500624
Total Tin (Sn)	mg/L	0.0047	0.0010	<0.0010	0.0010	9500624
Total Titanium (Ti)	mg/L	0.23	0.0010	<0.0010	0.0010	9500624
RDL = Reportable Detection	Limit					

## **REGULATED METALS (CCME/AT1) - TOTAL**

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.



BV Labs ID		WA6549		WA6550							
Sampling Date		2019/07/05		2019/07/05							
COC Number		M083948		M083948							
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch					
Total Uranium (U)	mg/L	0.016	0.00010	0.0021	0.00010	9500624					
Total Vanadium (V)	mg/L	0.22	0.0010	<0.0010	0.0010	9500624					
Total Zinc (Zn)	mg/L	1.2	0.0030	0.99	0.0030	9500624					
RDL = Reportable Detection Limit											

# **REGULATED METALS (CCME/AT1) - TOTAL**



### **RESULTS OF CHEMICAL ANALYSES OF WATER**

BV Labs ID		WA6549		WA6550						
Sampling Date		2019/07/05		2019/07/05						
COC Number		M083948		M083948						
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch				
Microbiological Param.										
E.Coli DST	MPN/100mL	100	100	<1.0	1.0	9494183				
Total Coliforms DST	MPN/100mL	120000	100	11	1.0	9494183				
Physical Properties										
Turbidity	NTU	>4000 (1)	0.10	0.66	0.10	9495457				
RDL = Reportable Detection	on Limit	,	•	,						
(1) Sample contained sedi	ment									



## MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WA6549		WA6550						
Sampling Date		2019/07/05		2019/07/05						
COC Number		M083948		M083948						
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch				
Elements										
Total Mercury (Hg)	ug/L	2.08 (1)	0.20	<0.0020	0.0020	9500789				
RDL = Reportable Detection Limit										
(1) Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.										



### **GENERAL COMMENTS**

Each te	mperature is the	average of up to	rree cooler temperatures taken at receipt						
	Package 1	7.0°C	]						
			-						
Results	Results relate only to the items tested.								



### **QUALITY ASSURANCE REPORT**

04/00								
Batch	Init	OC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	OC Limits
9494183	GK1	Method Blank	E.Coli DST	2019/07/06	<1.0	necovery	mpn/100m	
			Total Coliforms DST	2019/07/06	<1.0		mpn/100m	า
9494183	GK1	RPD	E.Coli DST	2019/07/06	NC		%	N/A
5 15 1200	0.112		Total Coliforms DST	2019/07/06	NC		%	N/A
9495457	FH2	Spiked Blank	Turbidity	2019/07/06		100	%	80 - 120
9495457	EH2	Method Blank	Turbidity	2019/07/06	<0.10	200	NTU	00 120
9495457	FH2	RPD [WA6550-02]	Turbidity	2019/07/06	5.9		%	20
9495902	кD9	Matrix Spike	Dissolved Nitrite (N)	2019/07/07	0.0	99	%	80 - 120
5.55502	112 5	indi in opine	Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495902	KD9	Spiked Blank	Dissolved Nitrite (N)	2019/07/07		99	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495902	KD9	Method Blank	Dissolved Nitrite (N)	2019/07/07	<0.010	100	mg/l	00 120
5.55502	112 5		Dissolved Nitrate (N)	2019/07/07	<0.010		mg/l	
9495902	KD9	RPD	Dissolved Nitrite (N)	2019/07/07	NC		%	20
			Dissolved Nitrate (N)	2019/07/07	NC		%	20
9498938	ІКО	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/10		92	%	80 - 120
9498938	IKO	Method Blank	Alkalinity (PP as CaCO3)	2019/07/10	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/10	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/10	<1.0		mg/L	
			Carbonate (CO3)	2019/07/10	<1.0		mg/L	
			Hydroxide (OH)	2019/07/10	<1.0		mg/L	
9498938	ІКО	RPD	Alkalinity (PP as CaCO3)	2019/07/10	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/10	1.7		%	20
			Bicarbonate (HCO3)	2019/07/10	1.7		%	20
			Carbonate (CO3)	2019/07/10	NC		%	20
			Hydroxide (OH)	2019/07/10	NC		%	20
9498939	ІКО	Spiked Blank	Н	2019/07/10		101	%	97 - 103
9498939	ІКО	RPD	pH	2019/07/10	0.36		%	N/A
9498940	IKO	Spiked Blank	Conductivity	2019/07/10		102	%	90 - 110
9498940	IK0	Method Blank	Conductivity	2019/07/10	<2.0		uS/cm	
9498940	IKO	RPD	Conductivity	2019/07/10	0.61		%	10
9499250	ALX	Matrix Spike	Dissolved Calcium (Ca)	2019/07/09		97	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		101	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		98	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		101	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		NC	%	80 - 120
9499250	ALX	Spiked Blank	Dissolved Calcium (Ca)	2019/07/09		100	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		105	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		104	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		102	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		103	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		105	%	80 - 120
9499250	ALX	Method Blank	Dissolved Calcium (Ca)	2019/07/09	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/07/09	<0.060		mg/L	
			Dissolved Magnesium (Mg)	2019/07/09	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/09	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/09	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/09	0.77, RDL=0.50 (1)		mg/L	
9499250	ALX	RPD	Dissolved Calcium (Ca)	2019/07/09	2.2		%	20
			Dissolved Iron (Fe)	2019/07/09	0.079		%	20



Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
		. //	Dissolved Magnesium (Mg)	2019/07/09	2.2		%	20
			Dissolved Manganese (Mn)	2019/07/09	NC		%	20
			Dissolved Potassium (K)	2019/07/09	0.075		%	20
			Dissolved Sodium (Na)	2019/07/09	1.6		%	20
9500611	ALX	Matrix Spike	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		97	%	80 - 120
			Total Calcium (Ca)	2019/07/10		NC	%	80 - 120
			Total Iron (Fe)	2019/07/10		101	%	80 - 120
			Total Lithium (Li)	2019/07/10		95	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		95	%	80 - 120
			Total Manganese (Mn)	2019/07/10		94	%	80 - 120
			Total Phosphorus (P)	2019/07/10		95	%	80 - 120
			Total Potassium (K)	2019/07/10		94	%	80 - 120
			Total Silicon (Si)	2019/07/10		99	%	80 - 120
			Total Sodium (Na)	2019/07/10		NC	%	80 - 120
			Total Strontium (Sr)	2019/07/10		94	%	80 - 120
			Total Sulphur (S)	2019/07/10		95	%	80 - 120
9500611	ALX	Spiked Blank	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		96	%	80 - 120
			Total Calcium (Ca)	2019/07/10		95	%	80 - 120
			Total Iron (Fe)	2019/07/10		103	%	80 - 120
			Total Lithium (Li)	2019/07/10		94	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		96	%	80 - 120
			Total Manganese (Mn)	2019/07/10		97	%	80 - 120
			Total Phosphorus (P)	2019/07/10		94	%	80 - 120
			Total Potassium (K)	2019/07/10		92	%	80 - 120
			Total Silicon (Si)	2019/07/10		98	%	80 - 120
			Total Sodium (Na)	2019/07/10		95	%	80 - 120
			Total Strontium (Sr)	2019/07/10		95	%	80 - 120
			Total Sulphur (S)	2019/07/10		96	%	80 - 120
9500611	ALX	Method Blank	Total Barium (Ba)	2019/07/10	<0.010		mg/L	
			Total Boron (B)	2019/07/10	<0.020		mg/L	
			Total Calcium (Ca)	2019/07/10	<0.30		mg/L	
			Total Iron (Fe)	2019/07/10	<0.060		mg/L	
			Total Lithium (Li)	2019/07/10	<0.020		mg/L	
			Total Magnesium (Mg)	2019/07/10	<0.20		mg/L	
			Total Manganese (Mn)	2019/07/10	< 0.0040		mg/L	
			Total Phosphorus (P)	2019/07/10	<0.10		mg/L	
			Total Potassium (K)	2019/07/10	<0.30		mg/L	
			Total Silicon (Si)	2019/07/10	<0.10		mg/L	
			Total Sodium (Na)	2019/07/10	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/10	< 0.020		mg/L	
			Total Sulphur (S)	2019/07/10	<0.20		mg/L	
9500611	ALX	RPD	Total Barium (Ba)	2019/07/10	0.68		%	20
			Total Boron (B)	2019/07/10	1.0		%	20
			Total Calcium (Ca)	2019/07/10	0.17		%	20
			Total Iron (Ee)	2019/07/10	3.0		%	20
			Total Lithium (Li)	2019/07/10	0		%	20
			Total Magnesium (Mg)	2019/07/10	0.46		%	20
			Total Manganese (Mn)	2019/07/10	NC		%	20
			Total Phosphorus (P)	2019/07/10	NC		%	20
			Total Potassium (K)	2019/07/10	0.63		%	20



QA/QC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silicon (Si)	2019/07/10	0.92		%	20
			Total Sodium (Na)	2019/07/10	0.55		%	20
			Total Strontium (Sr)	2019/07/10	0.38		%	20
			Total Sulphur (S)	2019/07/10	0.37		%	20
9500624	LQ1	Matrix Spike [WA6550-04]	Total Aluminum (Al)	2019/07/10		97	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		94	%	80 - 120
			Total Beryllium (Be)	2019/07/10		97	%	80 - 120
			Total Chromium (Cr)	2019/07/10		99	%	80 - 120
			Total Cobalt (Co)	2019/07/10		97	%	80 - 120
			Total Copper (Cu)	2019/07/10		109	%	80 - 120
			Total Lead (Pb)	2019/07/10		102	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		104	%	80 - 120
			Total Nickel (Ni)	2019/07/10		96	%	80 - 120
			Total Selenium (Se)	2019/07/10		97	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (TI)	2019/07/10		99	%	80 - 120
			Total Tin (Sn)	2019/07/10		99	%	80 - 120
			Total Titanium (Ti)	2019/07/10		101	%	80 - 120
			Total Uranium (U)	2019/07/10		98	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		NC	%	80 - 120
9500624	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/10		99	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		95	%	80 - 120
			Total Beryllium (Be)	2019/07/10		94	%	80 - 120
			Total Chromium (Cr)	2019/07/10		100	%	80 - 120
			Total Cobalt (Co)	2019/07/10		98	%	80 - 120
			Total Copper (Cu)	2019/07/10		98	%	80 - 120
			Total Lead (Pb)	2019/07/10		97	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		100	%	80 - 120
			Total Nickel (Ni)	2019/07/10		97	%	80 - 120
			Total Selenium (Se)	2019/07/10		95	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (Tl)	2019/07/10		100	%	80 - 120
			Total Tin (Sn)	2019/07/10		98	%	80 - 120
			Total Titanium (Ti)	2019/07/10		99	%	80 - 120
			Total Uranium (U)	2019/07/10		93	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		96	%	80 - 120
9500624	LQ1	Method Blank	Total Aluminum (Al)	2019/07/10	<0.0030		mg/L	
			Total Antimony (Sb)	2019/07/10	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/10	<0.00020		mg/L	
			Total Beryllium (Be)	2019/07/10	<0.0010		mg/L	
			Total Chromium (Cr)	2019/07/10	<0.0010		mg/L	
			Total Cobalt (Co)	2019/07/10	<0.00030		mg/L	
			Total Copper (Cu)	2019/07/10	<0.00020		mg/L	
			Total Lead (Pb)	2019/07/10	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/10	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/10	<0.00050		mg/L	
			Total Selenium (Se)	2019/07/10	<0.00020		mg/L	



### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2019/07/10	<0.00010		mg/L	
			Total Thallium (Tl)	2019/07/10	<0.00020		mg/L	
			Total Tin (Sn)	2019/07/10	<0.0010		mg/L	
			Total Titanium (Ti)	2019/07/10	<0.0010		mg/L	
			Total Uranium (U)	2019/07/10	<0.00010		mg/L	
			Total Vanadium (V)	2019/07/10	<0.0010		mg/L	
			Total Zinc (Zn)	2019/07/10	<0.0030		mg/L	
9500624	LQ1	RPD	Total Aluminum (Al)	2019/07/10	5.2		%	20
			Total Antimony (Sb)	2019/07/10	NC		%	20
			Total Arsenic (As)	2019/07/10	NC		%	20
			Total Beryllium (Be)	2019/07/10	NC		%	20
			Total Chromium (Cr)	2019/07/10	7.9		%	20
			Total Cobalt (Co)	2019/07/10	NC		%	20
			Total Copper (Cu)	2019/07/10	7.8		%	20
			Total Lead (Pb)	2019/07/10	NC		%	20
			Total Molybdenum (Mo)	2019/07/10	1.8		%	20
			Total Nickel (Ni)	2019/07/10	12		%	20
			Total Selenium (Se)	2019/07/10	1.9		%	20
			Total Silver (Ag)	2019/07/10	NC		%	20
			Total Thallium (Tl)	2019/07/10	NC		%	20
			Total Tin (Sn)	2019/07/10	NC		%	20
			Total Titanium (Ti)	2019/07/10	NC		%	20
			Total Uranium (U)	2019/07/10	4.8		%	20
			Total Vanadium (V)	2019/07/10	NC		%	20
			Total Zinc (Zn)	2019/07/10	NC		%	20
9500789	RK3	Matrix Spike	Total Mercury (Hg)	2019/07/10		101	%	80 - 120
9500789	RK3	Spiked Blank	Total Mercury (Hg)	2019/07/10		113	%	80 - 120
9500789	RK3	Method Blank	Total Mercury (Hg)	2019/07/10	<0.0020		ug/L	
9500789	RK3	RPD	Total Mercury (Hg)	2019/07/10	NC		%	20
9501576	STI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/10		NC	%	80 - 120
9501576	STI	Spiked Blank	Dissolved Chloride (Cl)	2019/07/10		106	%	80 - 120
9501576	STI	Method Blank	Dissolved Chloride (Cl)	2019/07/10	<1.0		mg/L	
9501576	STI	RPD	Dissolved Chloride (Cl)	2019/07/10	0.52		%	20
9501583	STI	Matrix Spike	Dissolved Sulphate (SO4)	2019/07/10		NC	%	80 - 120
9501583	STI	Spiked Blank	Dissolved Sulphate (SO4)	2019/07/10		102	%	80 - 120
9501583	STI	Method Blank	Dissolved Sulphate (SO4)	2019/07/10	<1.0		mg/L	
9501583	STI	RPD	Dissolved Sulphate (SO4)	2019/07/10	1.4		%	20

N/A = Not Applicable

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

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

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

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

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

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

(1) Method blank above criteria. Data inspected. All data < RDL or greater than 10x Method Blank.



### VALIDATION SIGNATURE PAGE

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

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

em

Harry (Peng) Liang, Senior Analyst

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



Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247 Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247 maxxam.ca

179 CHAIN OF CUSTODY RECORD



Invoice Information	Report Information (if differs from invoice)			le.	Project Information	1	Turnaround Time (TAT) Required		
ompany: SLR consulting Ltd.	Company: Summ	it Aggregate	Í.	Quotation #:	r F s		5 - 7 Days Reg	ular (Most analyses)	
ontact Name: Robert Till	Contact Name:			P.O. #/ AFE#:	EDM 4886		PLEASE PROVIDE ADVA	NCE NOTICE FOR RUSH PROJECTS	
ddress: <u>6940 Roper Read</u> , Edmonton, TGB 3H9	Address:	a		Project #: 2	12-06550-00	2003	Rush TAT (Sur	charges will be applied)	
none:	Phone:			Site Location:	Mantain 1	1sh	1 Day	3-4 Days	
mail: Hillastreasulting.com	Email: rfilla	streamenting.c	cm	Site #:			Date Required:		
opies: nyaria streamaching.com	Copies: nyaric	o streensulting	· com	Sampled By:	NY		Rush Confirmation #		
Laboratory Us	e Only				Analysis Reque	sted		Regulatory Criteria	
YES     NO     Cooler ID       Seal Present     Temp     6     9     6       Seal Intact     Temp     6     9     6       YES     NO     Cooler ID     5       Seal Present     Seal Intact     Temp     6       Seal Intact     Temp     6     9     6	Depot Rec	eption		Tot Diss	sitt, Clay) III	A H BURE	NALYZE	AT1 CCME Drinking Water D50 (Drilling Waste)	
YES         NO         Cooler ID           Seal Present	Depth (Unit) Date Sample	d Time Sampled Matrix	of containers EX F1 UOC EX F1-F2	EX F1-F4 Jutine Water gulated Metals ercury Total	linity 4 ive (75 micron) xture (% Sand, 9 sic Class II Landf	feat march	DD - DO NOT AL	Saskatchewan Other:	
Mulla lia	(YYYY/MM/D	(HH:MM)	18 18 18	BT S BT	Sie Sie Te Ba Ba	1 12	¥	Special Instructions	
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3 WW 4 4 WW 2			0	× X X	X	X		1	
5 <u>BHS1</u> 5	V	Stream under	6	XXX	×			Metals preserved not filtered.	
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Please indicate Filtered, Preserved or B	oth (F, P, F/P)							in each bag indi	
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AB FCD-00331/7

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Your P.O. #: EDM4886 PO # EDM3288 Your C.O.C. #: M083881

#### Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD 6940 ROPER ROAD EDMONTON, AB CANADA T6B 3H9

> Report Date: 2019/07/18 Report #: R2753966 Version: 1 - Final

### **CERTIFICATE OF ANALYSIS**

# BV LABS JOB #: B955649

Received: 2019/07/10, 20:35

Sample Matrix: Water # Samples Received: 3

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	N/A	2019/07/16	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME - Dissolved	3	N/A	2019/07/12		Auto Calc
Cadmium - low level CCME (Total)	3	N/A	2019/07/15		Auto Calc
Chloride/Sulphate by Auto Colourimetry	3	N/A	2019/07/16	AB SOP-00020 / AB SOP- 00018	SM23-4500-Cl/SO4-E m
Total Coliforms and E.Coli	3	2019/07/11	2019/07/12	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	3	N/A	2019/07/16	AB SOP-00005	SM 23 2510 B m
Hardness	3	N/A	2019/07/12		Auto Calc
Mercury (Total) by CV	2	2019/07/16	2019/07/16	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury (Total) by CV	1	2019/07/16	2019/07/17	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	3	N/A	2019/07/12	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	3	2019/07/13	2019/07/16	AB SOP-00014 / AB SOP- 00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	3	N/A	2019/07/12	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	3	2019/07/13	2019/07/14	AB SOP-00014 / AB SOP- 00043	EPA 6020b R2 m
Ion Balance	3	N/A	2019/07/12		Auto Calc
Sum of cations, anions	3	N/A	2019/07/12		Auto Calc
Nitrate and Nitrite	3	N/A	2019/07/12		Auto Calc
Nitrate + Nitrite-N (calculated)	3	N/A	2019/07/12		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2019/07/11	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	1	N/A	2019/07/12	AB SOP-00023	SM 23 4110 B m
рН @25°С (3)	3	N/A	2019/07/16	AB SOP-00005	SM 23 4500-H+B m
Total Dissolved Solids (Calculated)	3	N/A	2019/07/17		Auto Calc
Turbidity	3	N/A	2019/07/13	CAL SOP-00081	SM 23 2130 B m

#### Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless



Your P.O. #: EDM4886 PO # EDM3288 Your C.O.C. #: M083881

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> Report Date: 2019/07/18 Report #: R2753966 Version: 1 - Final

### **CERTIFICATE OF ANALYSIS**

## BV LABS JOB #: B955649

#### Received: 2019/07/10, 20:35

indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

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

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

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

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

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

(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(2) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

**Encryption Key** 

Jenelle Feller Key Account Speciali 18 Jul 2019 17:04:14 Jenelle Feller

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jenelle Feller, Key Account Specialist Email: JFeller@bvlabs.com Phone# (403)735-2264

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

### **ROUTINE + DISS. REG. METALS – LAB FILT (WATER)**

BV Labs ID		WB5701		WB5702	WB5703		
Semuling Date		2019/07/10		2019/07/10	2019/07/10		
		13:45		14:52	16:48		
COC Number		M083881		M083881	M083881		
	UNITS	BHS1	QC Batch	WW2	MW19-110	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	4.3	9502278	6.2	6.0	N/A	9502278
Cation Sum	meq/L	4.4	9502278	6.1	5.9	N/A	9502278
Hardness (CaCO3)	mg/L	200	9502270	260	280	0.50	9502270
Ion Balance (% Difference)	%	0.87	9502276	1.3	0.91	N/A	9502276
Dissolved Nitrate (NO3)	mg/L	6.3	9502284	1.6	8.6	0.044	9502284
Nitrate plus Nitrite (N)	mg/L	1.4	9502287	0.37	1.9	0.014	9502287
Dissolved Nitrite (NO2)	mg/L	<0.033	9502284	<0.033	<0.033	0.033	9502284
Calculated Total Dissolved Solids	mg/L	210	9502288	300	290	1.0	9502288
Misc. Inorganics							
Conductivity	uS/cm	420	9508468	580	560	2.0	9508468
рН	рΗ	8.07	9508466	7.95	7.82	N/A	9508466
Low Level Elements							
Dissolved Cadmium (Cd)	ug/L	0.025	9502398	0.036	0.032	0.020	9502398
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Alkalinity (Total as CaCO3)	mg/L	190	9508465	290	270	1.0	9508465
Bicarbonate (HCO3)	mg/L	240	9508465	350	330	1.0	9508465
Carbonate (CO3)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Hydroxide (OH)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Dissolved Chloride (Cl)	mg/L	8.2	9509749	2.0	8.4	1.0	9509749
Dissolved Sulphate (SO4)	mg/L	4.7	9509749	20	8.1	1.0	9509749
Nutrients							
Dissolved Nitrite (N)	mg/L	<0.010	9503263	<0.010	<0.010	0.010	9503263
Dissolved Nitrate (N)	mg/L	1.4	9503263	0.37	1.9	0.010	9503263
Lab Filtered Elements							
Dissolved Aluminum (Al)	mg/L	0.12	9504202	<0.0030	0.0078	0.0030	9504202
Dissolved Antimony (Sb)	mg/L	<0.00060	9504202	<0.00060	<0.00060	0.00060	9504202
Dissolved Arsenic (As)	mg/L	0.00044	9504202	<0.00020	0.00023	0.00020	9504202
Dissolved Barium (Ba)	mg/L	0.19	9503452	0.097	0.25	0.010	9503452
Dissolved Beryllium (Be) mg/		<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Boron (B)	mg/L	<0.020	9503452	0.023	<0.020	0.020	9503452
Dissolved Calcium (Ca)	mg/L	48	9503452	55	62	0.30	9503452
RDL = Reportable Detection Limit							
N/A = Not Applicable							



### **ROUTINE + DISS. REG. METALS – LAB FILT (WATER)**

BV Labs ID		WB5701		WB5702	WB5703		
		2019/07/10		2019/07/10	2019/07/10		
Sampling Date		13:45		14:52	16:48		
COC Number		M083881		M083881	M083881		
	UNITS	BHS1	QC Batch	WW2	MW19-110	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Cobalt (Co)	mg/L	<0.00030	9504202	<0.00030	<0.00030	0.00030	9504202
Dissolved Copper (Cu)	mg/L	0.00095	9504202	0.0026	0.00032	0.00020	9504202
Dissolved Iron (Fe)	mg/L	0.10	9503452	<0.060	<0.060	0.060	9503452
Dissolved Lead (Pb)	mg/L	<0.00020	9504202	<0.00020	<0.00020	0.00020	9504202
Dissolved Lithium (Li)	mg/L	<0.020	9503452	<0.020	<0.020	0.020	9503452
Dissolved Magnesium (Mg)	mg/L	20	9503452	30	30	0.20	9503452
Dissolved Manganese (Mn)	mg/L	<0.0040	9503452	0.0096	0.042	0.0040	9503452
Dissolved Molybdenum (Mo)	mg/L	0.00098	9507484	0.0020	0.0021	0.00020	9504202
Dissolved Nickel (Ni)	mg/L	0.00085	9504202	0.00054	0.0015	0.00050	9504202
Dissolved Phosphorus (P)	mg/L	<0.10	9503452	<0.10	<0.10	0.10	9503452
Dissolved Potassium (K)	mg/L	4.8	9503452	2.0	2.7	0.30	9503452
Dissolved Selenium (Se)	mg/L	0.00058	9504202	0.00045	0.00067	0.00020	9504202
Dissolved Silicon (Si)	mg/L	6.4	9503452	4.0	4.4	0.10	9503452
Dissolved Silver (Ag)	mg/L	<0.00010	9504202	<0.00010	<0.00010	0.00010	9504202
Dissolved Sodium (Na)	mg/L	5.0	9503452	17	6.0	0.50	9503452
Dissolved Strontium (Sr)	mg/L	0.27	9503452	0.56	0.41	0.020	9503452
Dissolved Sulphur (S)	mg/L	1.8	9503452	5.3	2.2	0.20	9503452
Dissolved Thallium (Tl)	mg/L	<0.00020	9504202	<0.00020	<0.00020	0.00020	9504202
Dissolved Tin (Sn)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Titanium (Ti)	mg/L	0.0038	9504202	<0.0010	0.0012	0.0010	9504202
Dissolved Uranium (U)	mg/L	0.0011	9504202	0.00081	0.0024	0.00010	9504202
Dissolved Vanadium (V)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Zinc (Zn)	mg/L	<0.0030	9504202	0.043	0.0032	0.0030	9504202
RDL = Reportable Detection Limit							

## **REGULATED METALS (CCME/AT1) - TOTAL**

BV Labs ID		WB5701	WB5702		WB5703		
Comulius Data		2019/07/10	2019/07/10		2019/07/10		
Sampling Date		13:45	14:52		16:48		
COC Number		M083881	M083881		M083881		
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch
Low Level Elements							
Total Cadmium (Cd)	ug/L	0.034	0.029	0.020	4.2	0.020	9502399
Elements						•	
Total Aluminum (Al)	mg/L	0.30	0.0060	0.0030	10	0.0030	9505482
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	<0.00060	0.00060	9505482
Total Arsenic (As)	mg/L	0.00061	<0.00020	0.00020	0.0084	0.00020	9505482
Total Barium (Ba)	mg/L	0.21	0.11	0.010	2.2	0.010	9505479
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	0.0019	0.0010	9505482
Total Boron (B)	mg/L	<0.020	0.023	0.020	<0.020	0.020	9505479
Total Calcium (Ca)	mg/L	50	59	0.30	600 (1)	1.5	9505479
Total Chromium (Cr)	mg/L	0.0010	<0.0010	0.0010	0.019	0.0010	9505482
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	0.00030	0.030	0.00030	9505482
Total Copper (Cu)	mg/L	0.0013	0.0045	0.00020	0.032	0.00020	9505482
Total Iron (Fe)	mg/L	0.25	<0.060	0.060	10	0.060	9505479
Total Lead (Pb)	mg/L	<0.00020	0.00054	0.00020	0.019	0.00020	9505482
Total Lithium (Li)	mg/L	<0.020	0.023	0.020	<0.020	0.020	9505479
Total Magnesium (Mg)	mg/L	21	33	0.20	130	0.20	9505479
Total Manganese (Mn)	mg/L	<0.0040	0.012	0.0040	7.3	0.0040	9505479
Total Molybdenum (Mo)	mg/L	0.00038	0.0014	0.00020	0.0015	0.00020	9505482
Total Nickel (Ni)	mg/L	0.00088	0.00060	0.00050	0.065	0.00050	9505482
Total Phosphorus (P)	mg/L	<0.10	<0.10	0.10	2.5	0.10	9505479
Total Potassium (K)	mg/L	5.4	2.3	0.30	4.7	0.30	9505479
Total Selenium (Se)	mg/L	0.00068	0.00052	0.00020	0.00096	0.00020	9505482
Total Silicon (Si)	mg/L	7.5	4.6	0.10	15	0.10	9505479
Total Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	9505482
Total Sodium (Na)	mg/L	5.3	20	0.50	6.9	0.50	9505479
Total Strontium (Sr)	mg/L	0.27	0.58	0.020	1.1	0.020	9505479
Total Sulphur (S)	mg/L	1.8	6.1	0.20	2.5	0.20	9505479
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	0.00024	0.00020	9505482
Total Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	9505482
Total Titanium (Ti)	mg/L	0.0068	<0.0010	0.0010	0.17	0.0010	9505482
Total Uranium (U)	mg/L	0.0013	0.00091	0.00010	0.0060	0.00010	9505482
Total Vanadium (V)	mg/L	0.0015	<0.0010	0.0010	0.025	0.0010	9505482
RDL = Reportable Detection L	imit						

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.



# **REGULATED METALS (CCME/AT1) - TOTAL**

BV Labs ID		WB5701	WB5702		WB5703					
Sampling Date		2019/07/10	2019/07/10		2019/07/10					
Sampling Date		13:45	14:52		16:48					
COC Number		M083881	M083881		M083881					
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch			
Total Zinc (Zn)	mg/L	<0.0030	0.046	0.0030	0.14	0.0030	9505482			
RDL = Reportable Detection Limit										



### **RESULTS OF CHEMICAL ANALYSES OF WATER**

BV Labs ID		WB5701	WB5702		WB5703							
formaling Data		2019/07/10	2019/07/10		2019/07/10							
Sampling Date		13:45	14:52		16:48							
COC Number		M083881	M083881		M083881							
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch					
Microbiological Param.												
E.Coli DST	MPN/100mL	1600	<1.0	1.0	63 (1)	10	9502759					
Total Coliforms DST	MPN/100mL	>2400	1.0	1.0	180 (1)	10	9502759					
Physical Properties												
Turbidity	NTU	5.1	0.31	0.10	<0.10	0.10	9505873					
RDL = Reportable Detection L	RDL = Reportable Detection Limit											
(1) Detection limit raised due	to matrix inter	ference.										



### MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WB5701	WB5702		WB5703		
Sompling Data		2019/07/10	2019/07/10		2019/07/10		
Sampling Date		13:45	14:52		16:48		
COC Number		M083881	M083881		M083881		
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch
Elements		I					
Elements Total Mercury (Hg)	ug/L	0.0025	<0.0020	0.0020	0.257 (1)	0.020	9509199
Elements Total Mercury (Hg) RDL = Reportable Detection Li	ug/L imit	0.0025	<0.0020	0.0020	0.257 (1)	0.020	9509199



### **GENERAL COMMENTS**

Package 1 5.0°C

#### **RESULTS OF CHEMICAL ANALYSES OF WATER Comments**

Method Blank Total Coliforms and E.Coli: Method Blank exceeds normal acceptance limits due to possible lab contamination. Sample WB5701, Elements by ICPMS-Dissolved-Lab Filtered: Test repeated.

Results relate only to the items tested.



### QUALITY ASSURANCE REPORT

Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9502759	AP1	Method Blank	E.Coli DST	2019/07/12	1.0,	•	mpn/100m	L
					RDL=1.0			
			Total Coliforms DST	2019/07/12	1.0,		mpn/100m	L
					RDL=1.0			
9502759	AP1	RPD [WB5702-03]	E.Coli DST	2019/07/12	NC		%	N/A
			Total Coliforms DST	2019/07/12	0		%	N/A
9503263	PR6	Matrix Spike	Dissolved Nitrite (N)	2019/07/11		104	%	80 - 120
		[WB5701-01]						
			Dissolved Nitrate (N)	2019/07/11		103	%	80 - 120
9503263	PR6	Spiked Blank	Dissolved Nitrite (N)	2019/07/11		102	%	80 - 120
			Dissolved Nitrate (N)	2019/07/11		103	%	80 - 120
9503263	PR6	Method Blank	Dissolved Nitrite (N)	2019/07/11	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/11	<0.010		mg/L	
9503263	PR6	RPD [WB5701-01]	Dissolved Nitrite (N)	2019/07/11	NC		%	20
			Dissolved Nitrate (N)	2019/07/11	0.16		%	20
9503452	MAP	Matrix Spike	Dissolved Barium (Ba)	2019/07/12		95	%	80 - 120
			Dissolved Boron (B)	2019/07/12		102	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/12		104	%	80 - 120
			Dissolved Iron (Fe)	2019/07/12		99	%	80 - 120
			Dissolved Lithium (Li)	2019/07/12		93	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/12		103	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/12		107	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/12		104	%	80 - 120
			Dissolved Potassium (K)	2019/07/12		98	%	80 - 120
			Dissolved Silicon (SI)	2019/07/12		99	%	80 - 120
			Dissolved Sodium (Na)	2019/07/12		99	%	80 - 120
			Dissolved Sulphur (S)	2019/07/12		100	70 0/	80 - 120 80 - 120
0502452	MAD	Snikod Blank	Dissolved Barium (Ba)	2019/07/12		80	70 0/	80 - 120
5505452	IVIAF	Spikeu bialik	Dissolved Barran (B)	2019/07/12		05	70 0/	80 - 120
			Dissolved Calcium (Ca)	2019/07/12		93	70 %	80 - 120
			Dissolved Iron (Ee)	2019/07/12		94	%	80 - 120
			Dissolved Lithium (Li)	2019/07/12		86	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/12		97	%	80 - 120
			Dissolved Magnesian (Mg)	2019/07/12		99	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/12		93	%	80 - 120
			Dissolved Potassium (K)	2019/07/12		90	%	80 - 120
			Dissolved Silicon (Si)	2019/07/12		91	%	80 - 120
			Dissolved Sodium (Na)	2019/07/12		92	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/12		94	%	80 - 120
			Dissolved Sulphur (S)	2019/07/12		94	%	80 - 120
9503452	MAP	Method Blank	Dissolved Barium (Ba)	2019/07/12	<0.010		mg/L	
			Dissolved Boron (B)	2019/07/12	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/12	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/07/12	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/12	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/12	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/12	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/07/12	<0.10		mg/L	
			Dissolved Potassium (K)	2019/07/12	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/07/12	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/07/12	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/12	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/12	<0.20		mg/L	
9503452	MAP	RPD	Dissolved Barium (Ba)	2019/07/12	0.76		%	20



QA/QC	1	06 Turne	Davamatar	Date Archive	Value	Deer		001
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Boron (B)	2019/07/12	2.7		%	20
			Dissolved Lean (Ca)	2019/07/12	0.72		70 0/	20
			Dissolved lithium (Li)	2019/07/12	20		70 0/	20
			Dissolved Litiliani (Li)	2019/07/12	0.45		70 0/	20
			Dissolved Magnesium (Mg)	2019/07/12	0.45		/0 0/	20
			Dissolved Manganese (Min)	2019/07/12	NC		/0 0/	20
			Dissolved Phosphorus (P)	2019/07/12	E O		/0 0/	20
			Dissolved Foldssluff (K)	2019/07/12	5.0		/0	20
			Dissolved Solium (No)	2019/07/12	0.94		/0 0/	20
			Dissolved Strontium (Sr)	2019/07/12	0.29		/0 0/	20
			Dissolved Stibilitum (S)	2019/07/12	0.40		/0 0/	20
0504202		Matrix Spika	Dissolved Suprint (S)	2019/07/12	0.089	00	70 0/	20
9504202	HC/	Matrix Spike	Dissolved Antimony (Sh)	2019/07/12		90	/0	80 - 120
			Dissolved Antimoliy (SD)	2019/07/12		97	70 0/	80 - 120
			Dissolved Arsellic (As)	2019/07/12		94	70 0/	80 - 120
			Dissolved Berymum (Be)	2019/07/12		90	%	80 - 120
			Dissolved Coholt (Co)	2019/07/12		97	%	80 - 120
			Dissolved Cobait (Co)	2019/07/12		95	%	80 - 120
			Dissolved Lood (Dh)	2019/07/12		96	%	80 - 120
			Dissolved Lead (PD)	2019/07/12		90	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/12		98	%	80 - 120
			Dissolved Nicker (Ni)	2019/07/12		93	70 0/	80 - 120
			Dissolved Selenium (Se)	2019/07/12		99	%	80 - 120
			Dissolved Sliver (Ag)	2019/07/12		89	%	80 - 120
			Dissolved Thailium (TI)	2019/07/12		90	%	80 - 120
			Dissolved Titopium (Ti)	2019/07/12		94	70 0/	80 - 120
			Dissolved Intanium (II)	2019/07/12		98	70 0/	80 - 120
			Dissolved Urandium (U)	2019/07/12		97	%	80 - 120
			Dissolved Variadium (V)	2019/07/12		97	70 0/	80 - 120 80 - 120
0504202		Spiked Plank	Dissolved Aluminum (Al)	2019/07/12		104	/0 0/	00 - 120 00 - 120
9504202	nc/	эрікей віанк	Dissolved Antimony (Sh)	2019/07/12		99 105	70 0/	80 - 120
			Dissolved Antimoliy (SD)	2019/07/12		105	70 0/	80 - 120
			Dissolved Arsellic (As)	2019/07/12		100	70 0/	80 - 120
			Dissolved Berymum (Be)	2019/07/12		95	70 0/	80 - 120
			Dissolved Cabalt (Ca)	2019/07/12		99 101	70 0/	80 - 120
			Dissolved Copart (Co)	2019/07/12		101	70 0/	80 - 120
			Dissolved Load (Ph)	2019/07/12		102	%	80 - 120
			Dissolved Ledu (PD)	2019/07/12		97	70 0/	80 - 120
			Dissolved Nickel (Ni)	2019/07/12		101	70 0/	80 - 120
			Dissolved Nickel (NI)	2019/07/12		101	%	80 - 120
			Dissolved Selenium (Se)	2019/07/12		99	%	80 - 120
			Dissolved Sliver (Ag)	2019/07/12		98	%	80 - 120
			Dissolved Thailium (T)	2019/07/12		99	%	80 - 120
			Dissolved Tin (Sn)	2019/07/12		96	%	80 - 120
			Dissolved Intanium (11)	2019/07/12		102	%	80 - 120
			Dissolved Uranium (U)	2019/07/12		101	%	80 - 120
				2019/07/12		103	% 0/	00 - 120 00 - 120
0504202	107	Mothod Diami	Dissolved Aluminum (Al)	2019/07/12	<0.0020	104	% m=//	80 - 120
9504202	HC/	wethod Blank	Dissolved Autimany (AI)	2019/07/12	<0.0030		mg/L	
			Dissolved Antimony (SD)	2019/07/12	<0.00060		mg/L	
			Dissolved Arsenic (AS)	2019/07/12	<0.00020		ing/L	
			Dissolved Beryllium (Be)	2019/07/12	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/07/12	<0.0010		mg/L	
			Dissolved Copart (Co)	2019/07/12	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/12	<0.00020		mg/L	



QA/QC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lead (Pb)	2019/07/12	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/12	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/12	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/12	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/12	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/07/12	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/12	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/12	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/12	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/12	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/12	<0.0030		mg/L	
9504202	HC7	RPD	Dissolved Aluminum (Al)	2019/07/12	NC		%	20
			Dissolved Antimony (Sb)	2019/07/12	NC		%	20
			Dissolved Arsenic (As)	2019/07/12	NC		%	20
			Dissolved Beryllium (Be)	2019/07/12	NC		%	20
			Dissolved Chromium (Cr)	2019/07/12	NC		%	20
			Dissolved Cobalt (Co)	2019/07/12	4.5		%	20
			Dissolved Copper (Cu)	2019/07/12	4.7		%	20
			Dissolved Lead (Pb)	2019/07/12	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/12	8.3		%	20
			Dissolved Nickel (Ni)	2019/07/12	0.86		%	20
			Dissolved Selenium (Se)	2019/07/12	11		%	20
			Dissolved Silver (Ag)	2019/07/12	NC		%	20
			Dissolved Thallium (TI)	2019/07/12	NC		%	20
			Dissolved Tin (Sn)	2019/07/12	NC		%	20
			Dissolved Titanium (Ti)	2019/07/12	NC		%	20
			Dissolved Uranium (U)	2019/07/12	4.8		%	20
			Dissolved Vanadium (V)	2019/07/12	NC		%	20
			Dissolved Zinc (Zn)	2019/07/12	6.3		%	20
9505479	FM0	Matrix Spike	Total Barium (Ba)	2019/07/16		99	%	80 - 120
			Total Boron (B)	2019/07/16		99	%	80 - 120
			Total Calcium (Ca)	2019/07/16		96	%	80 - 120
			Total Iron (Fe)	2019/07/16		105	%	80 - 120
			Total Lithium (Li)	2019/07/16		99	%	80 - 120
			Total Magnesium (Mg)	2019/07/16		99	%	80 - 120
			Total Manganese (Mn)	2019/07/16		99	%	80 - 120
			Total Phosphorus (P)	2019/07/16		97	%	80 - 120
			Total Potassium (K)	2019/07/16		96	%	80 - 120
			Total Silicon (Si)	2019/07/16		100	%	80 - 120
			Total Sodium (Na)	2019/07/16		100	%	80 - 120
			Total Strontium (Sr)	2019/07/16		98	%	80 - 120
			Total Sulphur (S)	2019/07/16		98	%	80 - 120
9505479	<b>ЕМО</b>	Sniked Blank	Total Barium (Ba)	2019/07/16		98	%	80 - 120 80 - 120
5505475	11110	Spiked Blank	Total Boron (B)	2019/07/16		98	%	80 - 120
			Total Calcium (Ca)	2019/07/16		95	%	80 - 120
			Total Iron (Fe)	2013/07/16		103	%	80 - 120
			Total Lithium (Li)	2019/07/16		103	70 %	80 - 120
			Total Magnesium (Mg)	2013/07/16		08 08	%	80 - 120
			Total Manganese (Mn)	2013/07/16		50	/0 0/	80 - 120 80 - 120
			Total Phosphorus (D)	2013/07/10		30 0E	/0 0/	00 - 120 90 - 120
				2019/07/16		55	70 0/	00 - 120 80 120
			Total Silicon (Si)	2013/07/10		54 00	/0 0/	00 - 120 00 - 120
			Total Sodium (Na)	2019/07/10		20	70 0/	00 - 120
				2019/07/16		98	% 0/	ou - 120
			Total Strontium (Sr)	2019/07/16		96	%	80 - 120
			i otal Sulphur (S)	2019/07/16		99	%	80 - 120



QA/QC Batch	lni+		Parameter	Date Analyzed	Value	Recovery		OC Limita
	ENIO	Mothod Plank	Total Barium (Pa)	2010/07/16		Recovery	UNITS mg/l	QC LIMITS
9505479	FIVIU	Methou Bialik	Total Baron (P)	2019/07/10	<0.010		mg/L	
			Total Colcium (Co)	2019/07/10	<0.020		mg/L	
				2019/07/10			mg/L	
			Total Lithium (Li)	2019/07/10	<0.000		mg/L	
			Total Magnosium (Mg)	2019/07/16	<0.020		mg/L	
				2019/07/16	<0.20		iiig/L	
			Total Manganese (Min)	2019/07/16	<0.0040		mg/L	
			Total Phosphorus (P)	2019/07/16	<0.10		mg/L	
			Total Potassium (K)	2019/07/16	<0.30		mg/L	
			Total Silicon (Si)	2019/07/16	<0.10		mg/L	
			Total Sodium (Na)	2019/07/16	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/16	<0.020		mg/L	
			Total Sulphur (S)	2019/07/16	<0.20		mg/L	
9505479	FM0	RPD	Total Iron (Fe)	2019/07/16	NC		%	20
9505482	LQ1	Matrix Spike	Total Aluminum (Al)	2019/07/14		NC	%	80 - 120
			Total Antimony (Sb)	2019/07/14		108	%	80 - 120
			Total Arsenic (As)	2019/07/14		97	%	80 - 120
			Total Beryllium (Be)	2019/07/14		101	%	80 - 120
			Total Chromium (Cr)	2019/07/14		94	%	80 - 120
			Total Cobalt (Co)	2019/07/14		93	%	80 - 120
			Total Copper (Cu)	2019/07/14		90	%	80 - 120
			Total Lead (Pb)	2019/07/14		95	%	80 - 120
			Total Molybdenum (Mo)	2019/07/14		104	%	80 - 120
			Total Nickel (Ni)	2019/07/14		93	%	80 - 120
			Total Selenium (Se)	2019/07/14		101	%	80 - 120
			Total Silver (Ag)	2019/07/14		106	%	80 - 120
			Total Thallium (TI)	2019/07/14		105	%	80 - 120
			Total Tin (Sn)	2019/07/14		119	%	80 - 120
			Total Titanium (Ti)	2019/07/14		94	%	80 - 120
			Total Uranium (U)	2019/07/14		115	%	80 - 120
			Total Vanadium (V)	2019/07/14		97	%	80 - 120
			Total Zinc (Zn)	2019/07/14		NC	%	80 - 120
9505482	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/14		92	%	80 - 120
		-	Total Antimony (Sb)	2019/07/14		109	%	80 - 120
			Total Arsenic (As)	2019/07/14		97	%	80 - 120
			Total Bervllium (Be)	2019/07/14		99	%	80 - 120
			Total Chromium (Cr)	2019/07/14		94	%	80 - 120
			Total Cobalt (Co)	2019/07/14		93	%	80 - 120
			Total Copper (Cu)	2019/07/14		93	%	80 - 120
			Total Lead (Pb)	2019/07/14		99	%	80 - 120
			Total Molybdenum (Mo)	2019/07/14		101	%	80 - 120
				2019/07/14		0/	70 0/	80 - 120
				2019/07/14		100	70 0/	80 - 120
			Total Sciencer (Ag)	2019/07/14		100	70 0/	80 - 120 80 - 120
			Total Thallium (TI)	2019/07/14		105	70 0/	80 - 120 80 - 120
				2019/07/14		107	70 0/	80 - 120
			Total Titonium (Ti)	2019/07/14		110	% 0/	80 - 120
			Total Irranium (11)	2019/07/14		92	% 0/	60 - 120 80 - 120
			Total Uranium (U)	2019/07/14		97	%	80 - 120
			i otal vanadium (V)	2019/0//14		96	%	80 - 120
0505.005			i otal zinc (Zn)	2019/07/14		92	%	80 - 120
9505482	LQ1	wiethod Blank	Total Aluminum (Al)	2019/0//14	<0.0030		mg/L	
			Total Antimony (Sb)	2019/07/14	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/14	<0.00020		mg/L	
			Total Beryllium (Be)	2019/07/14	<0.0010		mg/L	
			Total Chromium (Cr)	2019/07/14	< 0.0010		mg/L	



QA/QC								
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Cobalt (Co)	2019/07/14	<0.00030		mg/L	
			Total Copper (Cu)	2019/07/14	<0.00020		mg/L	
			Total Lead (Pb)	2019/07/14	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/14	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/14	<0.00050		mg/L	
			Total Selenium (Se)	2019/07/14	<0.00020		mg/L	
			Total Silver (Ag)	2019/07/14	<0.00010		mg/L	
			Total Thallium (Tl)	2019/07/14	<0.00020		mg/L	
			Total Tin (Sn)	2019/07/14	<0.0010		mg/L	
			Total Titanium (Ti)	2019/07/14	<0.0010		mg/L	
			Total Uranium (U)	2019/07/14	<0.00010		mg/L	
			Total Vanadium (V)	2019/07/14	<0.0010		mg/L	
			Total Zinc (Zn)	2019/07/14	<0.0030		mg/L	
9505482	LQ1	RPD	Total Aluminum (Al)	2019/07/14	NC		%	20
			Total Lead (Pb)	2019/07/14	NC		%	20
9505873	FH2	Sniked Blank	Turbidity	2019/07/13		96	%	80 - 120
9505873	EH2	Method Blank	Turbidity	2019/07/13	<0.10	50	NTU	00 120
9505873	EH2		Turbidity	2019/07/13	2 1		%	20
0507484	101	Matrix Sniko	Dissolved Molybdenum (Mo)	2019/07/15	2.1	96	70 0/	20 20 - 120
0507404		Spiked Blank	Dissolved Molybdenum (Mo)	2019/07/15		90	/0 0/	00 - 120 00 - 120
9507464	LQI	Spikeu Didlik	Dissolved Molybdenum (Mo)	2019/07/15	-0.00020	54	/0	00 - 120
9507484	LQI		Dissolved Molybdenum (Mo)	2019/07/15	<0.00020		IIIg/L	20
9507484	LQI	RPD Greibert Blande	Dissolved Molybdenum (Mo)	2019/07/15	NC	02	%	20
9508465	IKU	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/16		92	%	80 - 120
9508465	IKU	Method Blank	Alkalinity (PP as CaCO3)	2019/07/16	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/16	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/16	<1.0		mg/L	
			Carbonate (CO3)	2019/07/16	<1.0		mg/L	
			Hydroxide (OH)	2019/07/16	<1.0		mg/L	
9508465	IK0	RPD [WB5703-01]	Alkalinity (PP as CaCO3)	2019/07/16	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/16	1.5		%	20
			Bicarbonate (HCO3)	2019/07/16	1.5		%	20
			Carbonate (CO3)	2019/07/16	NC		%	20
			Hydroxide (OH)	2019/07/16	NC		%	20
9508466	IK0	Spiked Blank	рН	2019/07/16		100	%	97 - 103
9508466	IK0	RPD [WB5703-01]	рН	2019/07/16	0.39		%	N/A
9508468	IK0	Spiked Blank	Conductivity	2019/07/16		100	%	90 - 110
9508468	IK0	Method Blank	Conductivity	2019/07/16	<2.0		uS/cm	
9508468	IK0	RPD [WB5703-01]	Conductivity	2019/07/16	2.7		%	10
9509199	RK3	Matrix Spike	Total Mercury (Hg)	2019/07/16		81	%	80 - 120
9509199	RK3	Spiked Blank	Total Mercury (Hg)	2019/07/16		90	%	80 - 120
9509199	RK3	Method Blank	Total Mercury (Hg)	2019/07/16	<0.0020		ug/L	
9509199	RK3	RPD	Total Mercury (Hg)	2019/07/16	NC		%	20
9509749	STI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/16		NC	%	80 - 120
		· · · · · · · · · · · · · · · · · · ·	Dissolved Sulphate (SO4)	2019/07/16		NC	%	80 - 120
9509749	STI	Sniked Blank	Dissolved Chloride (Cl)	2019/07/16		108	%	80 - 120
5555745	511	epineo biolin	Dissolved Sulphate (SOA)	2010/07/16		108	%	80 - 120
9509710	стı	Method Blank	Dissolved Chloride (Cl)	2010/07/16	<10	100	ma/l	00 - 120
5505745	511		Dissolved Sulphate (SOA)	2019/07/16	~1.0		mg/L	
0500740	רדי		Dissolved Chlorida (Cl)	2019/07/10	<1.U 1.F		111g/L	20
9509749	511	крр	Dissolved Chloride (CI)	2019/07/16	1.5		%	20



QA/QC												
Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits				
			Dissolved Sulphate (SO4)	2019/07/16	0.63		%	20				
N/A = No	ot Applic	able										
Duplicat	Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.											
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.												
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.												
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.												
NC (Mat was too	NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)											
NC (Dup differend	NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).											



### VALIDATION SIGNATURE PAGE

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

agentit

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

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

Invoice Information Company : <u>SLR</u> (GISWIFING (Garada) Ltd. Comp Contact Name: <u>Robert Till</u> Conta Address: <u>69460 Roper Road</u> . Edgechtan, <u>AB</u> hone: <u>780 - 490 - 7893</u> mail: <u>rhildsir consulting.com</u> Copies: <u>Ayaridsir consulting.com</u> Copies: <u>Ayaridsir consulting.com</u> Cooling Media <u>Ves NO Cooler ID</u> <u>Seal Present</u> <u>Seal Intact</u> <u>Cooling Media</u> <u>Ves NO Cooler ID</u> <u>Seal Present</u> <u>Seal Intact</u> <u>Cooling Media</u> <u>Media</u> <u>BHS1</u> <u>WW2</u>	Report Information any: <u>Summit</u> SLR Ct Name: <u>SLR</u> SLR SLR SLR SLR SLR SLR SLR SLR SLR SLR	Ir can	s from i egate liting	3. C	om om	Qu P.0 Pro Sit Sit	oject i e Loca e #: mplec	on #: AFE#: #: ation: 	Pr ED	m 4	Inform	<i>o</i>			PL	EASE P Ru S 1	Turna 5 - 7 Da PROVID ush TA Same D L Day	roun ays Re E ADV AT (Su Day	d Time (TAT) Required gular (Most analyses) /ANCE NOTICE FOR RUSH PROJECTS Jrcharges will be applied) 2 Days
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Laboratory Use Only          Laboratory Use Only         Seal Present         Seal Present       Temp         Seal Intact       Temp         Cooling Media       Temp         Seal Present       Temp         Seal Intact       Temp         Cooling Media       Temp         Seal Intact       Temp         Seal Intact       Temp         BHS1       WW2	Depot Recep	tion		Ĺ						_					Rus	h Con	nfirma	tion	#:
VES     NO     Cooler ID       Seal Present     Temp     5     5       Cooling Media     Temp     5     5       VES     NO     Cooler ID       Seal Present     Temp     Cooler ID       Seal Intact     Temp     Cooler ID       Seal Intact     Temp     Cooler ID       Seal Present     Temp     Cooler ID       Seal Intact     Temp     Cooler ID       BHS1     WW2     WW2	Depot Recep	ition								Ana	lysis R	eques	sted		_				Regulatory Criteria
Seal Intact     Temp     S     S       Cooling Media     VES     NO     Cooler ID       Seal Intact     Temp     Cooling Media     Cooler ID       Seal Intact     Temp     Cooler ID       Seal Intact     Temp     Cooler ID       Seal Intact     Temp     Cooler ID       Seal Present     Seal Present     Cooler ID       Seal Intact     Temp     Cooler ID       BHS1     WW2     WW2						Т	Т	M		П		1		Т				Т	52
Cooling Media     YES     ND     Cooler ID       Seal Present								SS	2				+						AT1
Seal Intact     Temp       Gooling Media     Temp       Seal Present     Temp       Seal Intact     Temp       Gooling Media     Temp       Seal Intact     Temp       Sample Identification     Depth (Uni       BHS1     WW2								No			5		SW						CCME
Cooling Media     YES     NO     Cooler ID       Seal Present								Tot			, Clay		A					LYZE	Drinking Water
Seal Present     Temp       Seal Intact     Temp       Cooling Media     Temp       Sample Identification     Depth (United to the second to the seco					U			s		-	d, Silt	3	10 T					ANA	D50 (Drilling Waste)
Cooling Media     Depth (Uni       Sample Identification     Depth (Uni       BHS1     WW2				ners	2		ater	Meta		licror	Sano	13	-9					NOT	Saskatchewan
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BHSI WWZ	it) Date Sampled (YYYY/MM/DD)	Sampled (HH:MM)	Matrix	# of c	BTEX	BTEX	Routin	Regul	Salinit	Sieve	Textu	Ter	10					НОГВ	Special Instructions
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		2:52	blu	6			×	X)	<			X	×						filtered.
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AB FCD-00331/7

# APPENDIX H Baseline Water Resources – Water Well Testing Results Letter Report

Hydrogeological Assessment Report Mountain Ash Limited Partnership Aggregate Operation NW and SW Section 31, Twp 26, Rge 3 W5M Rocky View County, Alberta SLR Project No. 212.06650.00003



June 7, 2013

Mr. K. Carroll 103 Dalcastle Mews NW Calgary, Alberta T3A 2N8

41

## RE: <u>Water Well Testing Results: SE 06-027-03 W5M</u> <u>PENGROWTH ENERGY CORPORATION: 03-06-027-03 W5M</u> <u>BASELINE WATER RESOURCE INC.: Project # 13-4007</u>

# INTRODUCTION

Baseline Water Resource Inc. (BWRI) was retained by Pengrowth Energy Corporation (Pengrowth) to conduct a baseline water well assessment (1 well) for Mr. Kevin Carroll in SE 06-027-03 W5M on May 7, 2013. Pengrowth plans to develop from a surface location within 03-06-027-03 W5M.

The table below displays the water well location, UTM co-ordinates and where available the corresponding Alberta Environment and Sustainable Resource Development (ESRD) Drilling Report GIC ID number (ESRD, 2013).

Water Well Name	Legal Land Location	NAD 83, UTM Zone 11	ESRD Well GIC ID		
House Well	SE 06-027-03 W5M	5683479 m, 0680742 m	0360164		

## RESULTS

## HOUSE WELL

### Procedure

Testing was completed by discharging water from a hose bib off east side of the residence. Water was flowed through <sup>3</sup>/<sub>4</sub>" lines and discharged approximately 5 m east of the residence. Photographs of the well casing, discharge connection/sample area, and the Flow Through Cell at discharge follow this report.

### Water Quantity

The water level at the start of the test was 35.100 m from the top of the well casing (TOC). The well was pumped at a constant flow rate of 24.0 L/min (5.28 IGPM) for 60 minutes. The water level at the end of the test was 35.270 m



from the TOC (0.170 m total drawdown). The water level in the well recovered to 35.115 m in 60 minutes (90% Recovery). Yield test data is presented in Table 1.

## Water Quality

Water quality samples were collected and submitted to ALS Laboratory Group Ltd (ALS) in Calgary, Alberta for routine potability, total metals, benzene, toluene, ethyl benzene and xylenes (BTEX) and petroleum hydrocarbon fractions (F1-F2) and bacteriological analysis (total coliforms and E. coli). A copy of the laboratory analytical report is attached.

Field parameters including electrical conductivity (EC), pH and temperature were measured prior to water sample collection. Field parameter results are included in the table below.

Water Well Name	Time	EC (µS/cm)	рН	Temp (°C)
House Well	1520 h	534	7.28	5.7

Water quality analytical results were compared to the "Guideline for Canadian Drinking Water Quality" (GCDWQ) standard (Health Canada, 2012). Guidelines are either health-based (Maximum Acceptable Concentration (MAC)) or Aesthetic Objectives (AO). Aesthetic Objectives are based on considerations such as taste, odour and colour, and do not constitute a health hazard. Water quality exceedances are summarized in the table below.

Parameter	Concentration	MAC	AO
Iron (Fe)-Total	0.927 mg/L	-	0.3 mg/L
Turbidity	6.70 NTU	1 NTU	

The turbidity value (6.70 NTU) exceeded the MAC guidelines. It should be noted that this is an operational guideline intended for water treatment facilities and therefore is not directly related to private water wells.

In cases where a MAC has been exceeded, the landowner is encouraged to contact the local health unit.

## **BTEX and Petroleum Hydrocarbon Analysis**

None of the analyzed parameters were detected above the laboratory's minimum reportable detection limits.



## **Free Gas Analysis**

Water was directed through a Flow Through Cell (FTC) at a constant rate of 3.0 L/min for 60 minutes (180 L total). No free gas was observed during the sampling event

# INTERPRETATION OF ANALYTICAL RESULTS

For assistance with the interpretation of your water sample analytical results, please find the attached interpretation guides provided by Alberta Health Services.

Any parameter exceedance relating to groundwater quality can be discussed with your local Health Office. For further information call the Health Link line at 1-866-408-LINK (5465) or go to the following website link:

http://www.healthlinkalberta.ca/default.htm

# FOLLOW UP CONTACT FOR WATER WELL CONCERNS

Any concerns regarding baseline water well quality or performance should be directed to Alberta Environment and Sustainable Resources (ESRD). To reach a water well specialist at ESRD, the contact number is 1-800-222-6514.

## CLOSURE

Baseline Water Resource Inc. is pleased to submit this report as fulfillment of Pengrowths' requirements for baseline water well testing.

Sincerely,



S. Brent Bowerman, P.Geol. President Baseline Water Resource Inc.



# DISCLAIMER

Baseline Water Resource Inc. has used proficient skill and diligence conducting the water well assessment and preparation of this report. This report is a representation of the conditions and information present and available at the time of the assessment. Information received from all other sources is considered to be accurate but cannot be guaranteed. Baseline Water Resource Inc. is not responsible for any individual interpretation of this material nor any decisions based upon findings in this report.

# REFERENCES

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Alberta Health Services, Environmental Health, 2009. Guide to Interpreting Your Drinking Water Chemical Test Results, June, 2009.

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Health Canada, 2012. "Guidelines for Canadian Drinking Water Quality Summary Table (Prepared by the Federal-Provincial-Territorial Committee on Drinking Water)".





Photograph 1. View of the well casing, located approximately 12 m west of the residence.



Photograph 2. View of the discharge connection and sample area located on the east side of the residence.





Photograph 3. View of the FTC at discharge, located approximately 5 m east of the residence.
### TABLE 1. YIELD TEST DATA (House Well)

### Total Drawdown: 0.170 m

### 90% Recovery: 35.117 m

Draw	down	Rec	overy			
Time (minutes)	Depth to Water (m b.t.c. <sup>1</sup> )	Time (minutes)	Depth to Water (m b.t.c.)			
0	35.100	0	35.270			
1	35.100	1	35.125			
2	35.100	2	35.120			
3	35.100	3	35.120			
4	35.100	4	35.120			
5	35.100	5	35.120			
6	35.100	6	35.120			
7	35.105	7	35.120			
8	35.105	8	35.120			
9	35.105	9	35.115			
10	35.105	10	35.115 <sup>2</sup>			
15	-					
20	35.230					
25	35.115					
30	35.140					
35	35.260					
40	35.135					
50	35.120					
60	35.270					

### NOTES:

- 1. b.t.c. denotes "below top of well casing".
- 2. Denotes 90% Recovery achieved.
- 3. The constant pumping rate was 24.0 L/min ( 5.28 lgpm).
- 4. The distance between ground level and the top of the well casing 0.33 m.
- 5. All water level measurements were taken from the top of the well casing.
- 6. A water level tape was used to collect water level measurements.



BASELINE WATER RESOURCE INC. ATTN: CLINT GANES #7, 3800-19 STREET NE CALGARY AB T2E 6V2 Date Received: 08-MAY-13 Report Date: 14-MAY-13 17:07 (MT) Version: FINAL

Client Phone: 403-282-3999

# **Certificate of Analysis**

Lab Work Order #:

Project P.O. #: Job Reference: C of C Numbers: Legal Site Desc: L1298547 2013LC0027 13-4007

03-06-027-03 W5M

Other INV COMMENTS: 13-4007 Information:

Bal Wetlesd

Brent Whitehead Senior Scientist

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### ANALYTICAL GUIDELINE REPORT

L1298547 CONTD .... Page 2 of 5

14-MAY-13 17:07 (MT)

Grouping Analyte	Result	Qualifier	D.L.	Units	Analyzed		Guideline Limits
L1298547-1 K. CARROLL							
Sampled By: GF on 07-MAY-13 @ 15:20							
Matrix: WATER					(	#1	#2
Physical Tests							
Turbidity	6.70		0.10	NTU	10-MAY-13		
Anions and Nutrients	<u> </u>						
Alkalinity, Total (as CaCO3)	334		5.0	ma/L	08-MAY-13		
Bicarbonate (HCO3)	407		5.0	mg/L	08-MAY-13		
Carbonate (CO3)	<5.0		5.0	mg/L	08-MAY-13		
Chloride (CI)	1.79		0,10	mg/L	08-MAY-13	250	
Conductivity (EC)	626		3,0	uS/cm	08-MAY-13		
Fluoride (F)	0,13		0.10	mg/L	08-MAY-13		1.5
Hardness (as CaCO3)	337		0	mg/L	11-MAY-13		
Hydroxide (OH)	<5.0		5.0	mg/L	08-MAY-13		
Ion Balance	101			%	11-MAY-13		
Nitrate and Nitrite (as N)	0.704		0.071	mg/L	10-MAY-13		10
Nitrate (as N)	0.633		0.050	mg/L	08-MAY-13		10
Nitrite (as N)	0.072		0.050	mg/L	08-MAY-13		1
pН	7.65		0.10	pН	08-MAY-13	6.5-8.5	
TDS (Calculated)	345			mg/L	11-MAY-13	500	
Sulfate (SO4)	18.7		0.50	mg/L	08-MAY-13	500	
Bacteriological Tests							
MPN - E. coli	<1		1	MPN/100m	08-MAY-13		**0
MPN - Total Coliforms	<1		1	L MPN/100m	08-MAY-13		**0
Total Metals		8. a					
Aluminum (AI)-Total	<0.0050		0.0050	ma/L	10-MAY-13	0.1	2
Antimony (Sb)-Total	<0.00010		0.00010	mo/L	10-MAY-13	0.1	0.006
Arsenic (As)-Total	0.00011		0.00010	mo/l	10-MAY-13		0.01
Barium (Ba)-Total	0.108		0.000050	mo/l	10-MAY-13		1
Bervilium (Be)-Total	<0.00050		0.00050	mo/l	10 MAY-13		
Boron (B)-Total	0.016		0.010	mg/L	10-MAY-13		5
Cadmium (Cd)-Total	<0.000050		0.00050	mo/l	10-MAY-13		0.005
Calcium (Ca)-Total	66.3		0.10	mo/l	10-MAY-13		0.005
Chromium (Cr)-Total	<0.00050		0.00050	ma/L	10-MAY-13		0.05
Cobalt (Co)-Total	<0.00010		0.00010	ma/l	10-MAY-13		0.05
Copper (Cu)-Total	0.00183	1 1	0.00010	ma/L	10-MAY-13	1	
Iron (Fe)-Total	0.927		0.030	ma/L	10-MAY-13	103	
Lead (Pb)-Total	0.00022		0.00010	mo/L	10-MAY-13	0.0	0.01
Lithium (Li)-Total	0.0100		0.0050	ma/l	10-MAY-13		0.01
Magnesium (Mg)-Total	38.8		0.10	ma/L	10-MAY-13		
Manganese (Mn)-Total	0.0092		0.0050	mg/L	10-MAY-13	0.05	
Mercury (Hg)-Total	<0.000050		0.000050	ma/L	10-MAY-13		0.001
Molybdenum (Mo)-Total	0.00101		0.000050	mo/l	10-MAY-13		0.001
Nickel (Ni)-Total	0.00055		0.00050	ma/L	10-MAY-13		
Potassium (K)-Total	2.27		0.50	mg/L	10-MAY-13		
Selenium (Se)-Total	0.0016		0.0010	mg/L	10-MAY-13		0.01
Silver (Ag)-Total	<0.000010		0.000010	mg/L	10-MAY-13		

Detection Limit for result exceeds Guldeline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied

Federal Guidelines for Canadian Drinking Water Quality (AUG, 2012) = [Suite] - CA\_CDWQ MAC and AO (includes "interim" MACs)

#1: GCDWQ - Aesthetic Objective

#2: GCDWQ - Maximum Acceptable Concentrations (MACs)



13-4007

### ANALYTICAL GUIDELINE REPORT

L1298547 CONTD ....

Page 3 of 5 14-MAY-13 17:07 (MT)

Sample Details Grouping Analyte	Result	Qualifier	D.L.	Units	Analyzed		Guidell	ne Limits	
L1298547-1 K. CARROLL									5 C 12055
Sampled By: GF on 07-MAY-13 @ 15:20					5				
Matrix: WATER					1 3	#1	#2		
Total Metals			1	2					1
Sodium (Na)-Total	11.0		1.0	ma/L	10-MAY-13	200			
Thallium (TI)-Total	<0.00010		0.00010	ma/L	10-MAY-13	200		2	
Tin (Sn)-Total	<0.00010		0.00010	mg/L	10-MAY-13				
Titanium (Ti)-Total	<0.0010		0.0010	mg/L	10-MAY-13				
Uranium (U)-Total	0.00168	1 2	0.000010	mg/L	10-MAY-13		0.02	1	
Vanadium (V)-Total	<0.0010	1 L	0.0010	mg/L	10-MAY-13				
Zinc (Zn)-Total	<0.0050		0.0050	mg/L	10-MAY-13	5			
Volatile Organic Compounds								1	
Benzene	<0.00050		0.00050	mg/L	10-MAY-13		0.005		
Ethylbenzene	<0.00050		0.00050	mg/L	10-MAY-13	0.0024	10000540310		
Toluene	<0.00050		0.00050	mg/L	10-MAY-13	0.024			
o-xylene	<0.00050		0.00050	mg/L	10-MAY-13				
m+p-Xylene	<0.00050		0.00050	mg/L	10-MAY-13				
Xylenes	<0.00050		0.00050	mg/L	10-MAY-13	0.3			
F1(C6-C10)	<0.10		0.10	mg/L	10-MAY-13				
F1-BTEX	<0.10		0,10	mg/L	10-MAY-13	8			
Hydrocarbons									
F2 (C10-C16)	<0.25		0.25	mg/L	10-MAY-13				

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal Guidelines for Canadian Drinking Water Quality (AUG, 2012) = [Suite] - CA\_CDWQ MAC and AO (includes "Interim" MACs)

#1: GCDWQ - Aesthetic Objective

#2: GCDWQ - Maximum Acceptable Concentrations (MACs)

L1298547 CONTD.... Page 4 of 5 14-MAY-13 17:07 (MT)

# **Reference Information**

#### Methods Listed (if applicable):

BTX, FI-CL         Water         BTEX and F1 (C6-C10)         EPA 630380158 2820-PAT GC-MS/FID           CL-CL         Water         Choride (C)         APA 4110 B-ion Chromalography           FarceCL         Water         Fluoride         CVAFS           This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the DMA andrean View in transport (FA). The procedure involves a cold-crotation of the sample with transport (FA). The procedures adapted form Test Methods for the Examination of Water and Wastewater" published by the DMA andrean Published and the CONSELOCL.           MET-10F-ICP-CL         Water         Total Metrod 00 (50).         EPA SW-846 3005/K0108           MET-10F-ICP-CL         Water         Total Metrod 00 (50).         EPA SW-846 3005/K0108           MET-10F-ICP-CL         Water         Total Metrod 00 (50).         EPA SW-846 3005/K0108           MET-10F-ICP-CL         Water         Total Metais in Water by CPM Method 3005/K0108           MET-10F-ICP-CL	ALS Test Code	Matrix	Test Description	Method Reference***	
CL-CL     Water     Chloride (CI)     APHA 4110 B-lon Chromatography       Inorganic Anions by ion chromatography     Flucide     APHA 4110 B-lon Chromatography       F2-CL     Water     Flucide     APHA 4110 B-lon Chromatography       F2-CL     Water     F2     EPA 35108000-GC-FID       F2-CL     Water     Total Mercury in Water by     EPA 1631E       F2-CL     Water     Total Mercury in Water by     EPA 1631E       CMASS     CMASS     CMASS     APHA 4110 B-lon Chromatography       This analysis is carried out using procedures adapted from "Standard Methods for Evaluating Solid Waster SW-486 published by the Unit       American Public Health Association, and with procedures involves a code-outcation of Water and Wastewater" published by the Unit       This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit       States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005/V6010B       This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit       States Environmental Protection Agency (EPA). The procedures involves preliminary sample with standards is by the Unit       States Environmental Protection Agency (EPA). The procedures involves     Frauster adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Base State Envit (Method 3005/V6010B       This a	BTX,F1-CL	Water	BTEX and F1 (C6-C10)	EPA 5030/8015& 8260-P&T GC	-MS/FID
Inergenic Anlons by Ion chromatography (IC) in water and aqueous extracts of soils. F-RC-CL Water Flouride APHA 4110 B-Ion Chromatography F2-CL Water F2 RHS-TOT-CVARS-CL Water F2 F3-CC Water F1 Total Marcury in Water by F2A 1631E F3-CC Water F2 CVARS-F Metro T-CVARS-CL Water Total Marcury in Water by F2A 1631E CVARS-F Metro T-CVARS-CL Water Total Marcury in Water by F2A 1631E CVARS-F Metro T-CVARS-CL Water Total Marcury in Water by F2A 1631E CVARS-F Metro T-CVARS-CL Water Total Marcury in Water by F2A 1631E CVARS-F Metro T-CVARS-CL Water In construction of the actified sample using bromp during the procedure involves a cold-contained on the assemble water SV-846 published by the Link States Environmental Protection Approx (F2A). The procedure involves a cold-contained in Gree Swater SV-846 published by the American Public Health Association, and with proceedures adapted from T-Est Methods for the Examination of Water and Wastewater Published by the American Public Health Association, and with procedures adapted from T-Est Methods for Evaluating Solid Waster SW-846 published by the Link States Environmental Protection Agency (F2A). The procedure involves fillmation (EPA Method 3005A) and analysis by inductively coupled plasm apical emission spectrophotometry (F2A Method 50108). MET-TOT-ICP-CL Water Total Matalis in Water by EPA SW-846 3005A/60108 MET-TOT-ICP-CL Water Total Matalis in Water by ICPA SW-846 3005A/60108 MET-TOT-ICP-CL Water Nitrate-Nitrike CLACULATION V23-CALC-CL Water Nitrate-Nitrike CLACULATION V23-CL Water Nitrate-Nitrike CLACULATION V24-CL Water Nitrate-Nitrike CLACULATION V24-CL Water Nitrate-Nit	CL-CL	Water	Chloride (CI)	APHA 4110 B-lon Chromatograp	bhy
FJ-C-CL       Weiter       Fluoride       APPH 4 110 8-Ion Chromatography         F2-CL       Weiter       F2       EPA 3510/8000-GC-FID         F3-CL       Weiter       F2       EPA 3510/8000-GC-FID         F4-C-TOT-CVAFS-CL       Waiter       F2       EPA 3510/8000-GC-FID         This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Publich Health Association, and with proceedures adapted from "Test Methods for Evaluating Solid Waster" SW-846 published by the CMR Method 246 CMR8LANCE-CL       Water       To Balance Calculation       APHA 1302E         MET-DSI-CPC-L       Water       Dissolvade Methods bis by COPOSE       EPA SW-846 3005/K0010B         This analysis is carried out using procedures adapted from "Standard Mathods for the Examination of Water and Wastewater" published by the Unit         States Environmental Protection Agency (EPA)       The procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit         Optical mission and with procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit         Optical mission, and with procedures adapted from "Test Methods for the Examination of Water and Wastewater" published by the Unit         Vietal mathods       Total Metals in Water by       EPA SW-846 3005/K00108         Weitar Total Metals in Water by       EPA SW-846 3005/K00108	Inorganic Anions by ion c	hromatograp	hv (IC) in water and aqueaous ex	tracts of soils.	
F2-CL     Water     F2     EPA 3510/8000-GC-FID       HG-TOT-CVAFS-CL     Water     Total Moreury in Water by CVAS     EVA 1631E       F1 is analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waster SW-846 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waster SW-846 published by the Unit annous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 244 (OMBALANCE CL)       Water     Dissolved Metals by ICPOES     EPA 5W-846 3005/V60108       This analysis is carried out using procedures adapted from "Test Methods for the Examination of Water SW-846 published by the Unit american Public Health Association, and with procedures adapted from Test Methods for the Examination of Water SW-846 published by the Unit States Environmental Protection Agency (EPA). The procedures adapted from Test Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedures adapted from Test Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedures adapted from Test Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedures adapted from Test Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedures adapted from Test Methods for the Examination of Water and Wastewater" published by the Unit States Envinnernalal Protection Agency (EPA). The procedures adapted from Te	F-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatograg	bhy
HG-TOT-CVAFS-CL Water Total Marcury in Water by CPA 1631E CVAFS This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit States Environmenial Protection Agency (EPA). The procedure involves a cod-oxidation of the acidled sample using bromine monochonde pric deviction of the sample with stantonus chindle. Instrumential analysis is by cold vapour atorine fluorescence spectrophotometry (EPA Method 2016 ONBALANCE-CL Water Ion Balance Catulation APHA 1030E This analysis is carried out using procedures adapted from "Standard Methods for Evaluating Solid Waster SW-846 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waster SW-846 published by the American Public Health Association, and with procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Distates Environmental Protection Agency (EPA). The procedure from Test Methods for Evaluating Solid Waster's SW-846 published by the Unit States Environmental Protection Agency (EPA). The procedures may involve profession spectrophotometry (EPA Method 3005/N6010B This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wasterwater" published by the Unit States Environmental Protection Agency (EPA). The procedures may involve profession spectrophotometry (EPA Method 3005/N6010B WET-TOT-LOW-MS-CL Water Nitrate-N APHA 4110 B-Ion Chromatography AW3-SCALC-CL Water Nitrate-N APHA 4110 B-Ion Chromatography Astanting massurement is based on the sample's capacity to canve APHA 4110 B-Ion C	F2-CL	Water	F2	EPA 3510/8000-GC-FID	
CVAPS         CVAPS           This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedure involves a cold-coldadino of the actified sample using bornine monochloide pric reduction of the sampte with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 24: ONBALANCE-CL.           Water         Dissolved Metals by ICPOES         EPA SW-846 3005/k00108           This analysis is carried out using procedures adapted from "Test Methods for the Examination of Water and Wastewater" published by the Unit States Environmental Protection Agency (EPA). The procedure involves flintation (EPA Method 3005A) and analysis by inductively coupled plasm optical mission spectrophotomenty (EPA) Mathod 50106).           MET-TOT-ICP-CL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICP-CL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICP-CL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICP-CL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICP-CL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICW-KL.         Water         Total Metals in Water by EPA SW-846 3005/k0108           MET-TOT-ICW-KL.         Water         Total Metals in Water by EPA SW-846 3005/k020A           MET-TOT-ICW	HG-TOT-CVAFS-CL	Water	Total Mercury in Water by	EPA 1631E	
MET-DIS-ICP-CL     Water     Dissolved Metals by ICPOES     EPA SW-846 3005A/6010B       This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Standard Methods 3005A/6010B       States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A/6010B     Water     Total Metals in Water by     EPA SW-846 3005A/6010B       MET-TOT-ICP-CL     Water     Total Metals in Water by     EPA SW-846 3005A/6010B     Water and Wastewater" published by the American Publish.       States Environmental Protection Agency (EPA). The procedures adapted from "Set Methods for the Examination of Water and Wastewater" published by the Online Health Association, and with procedures adapted from "Set Methods 5005A/6020A       States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digustion using a hotblock (EF Method 5006A).       MET-TOT-LOW-MS-CL     Water     Total Metals in Water by (CPM)     EPA SW-846 3005A/6020A       N2N3-CALC-CL     Water     Nitrite-N     APHA 4110 B-Ion Chromatography       N2N3-CALCACL     Water     Nitrite-N     APHA 4110 B-Ion Chromatogr	This analysis is carried or American Public Health A States Environmental Pro reduction of the sample w IONBALANCE-CL	ut using proc Association, a Ditection Ager with stannous Water	CVAFS edures adapted from "Standard N and with procedures adapted from icy (EPA). The procedure involve chloride. Instrumental analysis is lon Balance Calculation	Tethods for the Examination of Water "Test Methods for Evaluating Solid V is a cold-oxidation of the acidified sar s by cold vapour atomic fluorescence APHA 1030E	and Wastewater" published by the Naste" SW-846 published by the United nple using bromine monochloride prior to spectrophotometry (EPA Method 245.7)
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Inis analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the Unit. States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion using a hobbock (EF Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 60108). MET-TOT-LOW-MS-CL Water Total Metals in Water by ICPMS EPA SW-846 3005A/6020A MET-TOT-LOW-MS-CL Water Nitrate+Nitrite CALCULATION NO2-CL Water PH, Conductivity and Total APHA 4110 B-Ion Chromatography NO3-IC-CL Water PH, Conductivity and Total APHA 4500H, 2510, 2320 Alkalinity All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommends for pH where highly accurate results are needed) PH measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to neutralize acid APHA 4110 B-Ion Chromatography Method 5024-CL Water Suffate (SO4) APHA 4110 B-Ion Chromatography TC=CE-MPN-CL Water Total Coliforms and E. Coli by APHA 4110 B-Ion Chromatography MPN Total Coliforms and E. Coli by APHA 4110 B-Ion Chromatography MPN Total Coliforms and E. Coli by APHA 4110 B-Ion Chromatography MPN Total Coliforms and E. Coli by APHA 4110 B-Ion Chromatography MPN Total Coliform sample's capacity to neutralize acid AMETHOD 9223 MPN MPN Total analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample's capacity to containize and the sample's capacity to autralize of the somple urbibility table. TURBIDITY-CL Water Turbidity APHA 2130 B-Nephelometer A strong light beam is			ICPOES		
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NRN3-CALC-CL Water Nitrite+Nitrite CALCULATION NO2-CL Water Nitrite-N APHA 4110 B-ton Chromatography NO3-IC-CL Water Nitrite-N APHA 4110 B-ton Chromatography PH/EC/ALK-CL Water pH, Conductivity and Total APHA 4500H,2510,2320 Alkalinity All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen lons using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current SO4-CL Water Sulfate (SO4) APHA 4110 B-ton Chromatography TC-EC-MPN-CL Water Total Coliforms and E. Coli by MPN This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneousiy. The sample is mixed with a mixture hydrolyzable substrates and then seated in a multi-well packet. The packet is incubated for 18 or 24 hours and ther number of wells exhibiling a positive response are counted. The final result is obtained by comparing the positive responses to a probability table. TURBIDITY-CL Water Turbidity APHA 2130 B-Nephelometer A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended partic detected by the photocell. The electrical response is proportional to the sample turbidity. * ALS test methods may incorporate modifications from specified reference methods to improve performance. Chain of Custody numbers: The last two letters of the above lest code(s) indicate the laboratory that performed analytical analysis for that lest. Refer to the list below: Laboratory Definition Code Laboratory Location Laboratory Definition Code Laboratory Location CL ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA		vvater	I otal Metals in Water by ICPN	IS EPA SW-846 3005A/6020A	
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NO3-IC-CL       Water       Nitrale-N       APHA 4110 B-Ion Chromatography         PH/EC/ALK-CL       Water       PH, Conductivity and Total       APHA 4500H,2510,2320         All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)         pH measurement is based on the sample's capacity to neutralize acid       Conductivity measurement is based on the sample's capacity to convey an electric current         S04-CL       Water       Sufface (SO4)       APHA 4110 B-Ion Chromatography         TC-EC-MPN-CL       Water       Sufface (SO4)       APHA 4110 B-Ion Chromatography         This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample's capacity to convey an electric current sufface and then sample's capacity to response are counted. The final result is obtained by comparing the positive responses to a probability table.         'URBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         'ALS lest methods may incorporate modifications from specified reference methods to improve performance.       Chain of Custody numbers:         The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:         Laboratory Definition Code       Laboratory Location       Laboratory Definition Code <t< td=""><td>NO2-CL</td><td>Water</td><td>Nitrite-N</td><td>APHA 4110 B-Ion Chromatograp</td><td>hy</td></t<>	NO2-CL	Water	Nitrite-N	APHA 4110 B-Ion Chromatograp	hy
PH/EC/ALK-CL       Water       pH, Conductivity and Total Alkalinity       APHA 4500H, 2510, 2320 Alkalinity         All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is based on the sample's capacity to onever an electric current         Alkalinity measurement is based on the sample's capacity to convey an electric current       Conductivity measurement is based on the sample's capacity to convey an electric current         COAductivity measurement is based on the sample's capacity to convey an electric current       Conductivity measurement is based on the sample's capacity to convey an electric current         COAductivity measurement is based on the sample's capacity to convey an electric current       Conductivity measurement is based on the sample's capacity to convey an electric current         COAductivity measurement is based on the sample's capacity to convey an electric current       Conductivity measurement is procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The         Sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and ther number of wells exhibiling a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.         TURBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         A strong light beam is sent through a transparent tube containing the sample turbidity.	NO3-IC-CL	Water	Nitrate-N	APHA 4110 B-Ion Chromatograp	hy
SO4-CL       Water       Sulfate (SO4)       APHA 4110 B-Ion Chromatography         TC-EC-MPN-CL       Water       Total Coliforms and E. Coli by       APHA METHOD 9223         This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then seated in a multi-well packet. The packet is incubated for 18 or 24 hours and then number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.         FURBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particid detected by the photocell. The electrical response is proportional to the sample turbidity.         * ALS test methods may incorporate modifications from specified reference methods to improve performance.         Chain of Custody numbers:         The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test, Refer to the list below;         Laboratory Definition Code       Laboratory Location       Laboratory Definition Code       Laboratory Location         CL       ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA       ALBERTA, CANADA       Laboratory Definition Code       Laboratory Location <td>All samples analyzed by t recommended for pH whe pH measurement is deter Alkalinity measurement is Conductivity measurement</td> <td>his method f are highly acc mined from t based on th t is based on</td> <td>Alkalinity or pH will have exceeded the 15 n :urate results are needed) he activity of the hydrogen ions us e sample's capacity to neutralize 1 the sample's capacity to convey</td> <td>ninute recommended hold time from sing a hydrogen electrode and a refer acid an electric current</td> <td>time of sampling (field analysis is rence electrode.</td>	All samples analyzed by t recommended for pH whe pH measurement is deter Alkalinity measurement is Conductivity measurement	his method f are highly acc mined from t based on th t is based on	Alkalinity or pH will have exceeded the 15 n :urate results are needed) he activity of the hydrogen ions us e sample's capacity to neutralize 1 the sample's capacity to convey	ninute recommended hold time from sing a hydrogen electrode and a refer acid an electric current	time of sampling (field analysis is rence electrode.
TC-EC-MPN-CL       Water       Total Coliforms and E. Coli by MPN       APHA METHOD 9223         This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then seated in a multi-well packet. The packet is incubated for 18 or 24 hours and their number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.         TURBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particid detected by the photocell. The electrical response is proportional to the sample turbidity.         * ALS test methods may incorporate modifications from specified reference methods to improve performance.         Chain of Custody numbers:       The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:         Laboratory Definition Code       Laboratory Location       Laboratory Definition Code       Laboratory Location         CL       ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA       Laboratory Definition Code       Laboratory Location	SO4-CL	Water	Sulfate (SO4)	APHA 4110 B-Ion Chromatograp	hv
MPN         This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.         FURBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particle detected by the photocell. The electrical response is proportional to the sample turbidity.         * ALS test methods may incorporate modifications from specified reference methods to improve performance.         Chain of Custody numbers:       The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:         Laboratory Definition Code       Laboratory Location       Laboratory Definition Code       Laboratory Location         CL       ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA       ALBERTA, CANADA       Laboratory Definition Code       Laboratory Location	TC-EC-MPN-CL	Water	Total Coliforms and E. Coli by	APHA METHOD 9223	,
TURBIDITY-CL       Water       Turbidity       APHA 2130 B-Nephelometer         A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particle detected by the photocell. The electrical response is proportional to the sample turbidity.         ** ALS test methods may incorporate modifications from specified reference methods to improve performance.       Chain of Custody numbers:         The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below;         Laboratory Definition Code       Laboratory Location         CL       ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA	This analysis is carried ou determined simultaneousl sample is mixed with a mi number of wells exhibiling	it using proce y. The xture hydroly a positive re	MPN adures adapted from APHA Metho zable substrates and then sealed sponse are counted. The final res	od 9223 "Enzyme Substrate Coliform in a multi-well packet. The packet is sult is obtained by comparing the pos	Test". E. coli and Total Coliform are incubated for 18 or 24 hours and then the itive responses to a probability table.
A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particle detected by the photocell. The electrical response is proportional to the sample turbidity.  * ALS test methods may incorporate modifications from specified reference methods to improve performance. Chain of Custody numbers: The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below: Laboratory Definition Code Laboratory Location Laboratory Definition Code Laboratory Location CL ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA	TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer	
<ul> <li>ALS test methods may incorporate modifications from specified reference methods to improve performance.</li> <li>Chain of Custody numbers:</li> <li>The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test, Refer to the list below:</li> <li>Laboratory Definition Code</li> <li>Laboratory Location</li> <li>Laboratory Definition Code</li> <li>Laboratory Location</li> <li>CL</li> <li>ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA</li> </ul>	A strong light beam is sen detected by the photocell.	t through a t The electric	ransparent tube containing the sa al response is proportional to the	mple. Light that is reflected at 90 de sample turbidity.	grees to the axis by suspended particles
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### **Reference Information**

#### **GLOSSARY OF REPORT TERMS**

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

- mg/kg milligrams per kilogram based on dry weight of sample
- mg/kg wwt milligrams per kilogram based on wet weight of sample
- mg/kg lwt milligrams per kilogram based on lipid-adjusted weight
- mg/L unit of concentration based on volume, parts per million.
- < Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information.

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### **GUIDE TO INTERPRETING YOUR DRINKING WATER CHEMICAL TEST RESULTS**

The laboratory report on the chemical quality of your drinking water sample is attached.

The *Guidelines for Canadian Drinking Water Quality* provide maximum limits for substances in drinking water that can be harmful to your health, such as sodium, fluoride, nitrate and nitrite. For your protection, the maximum limits are set below the levels at which any harmful health effects have actually been observed.

The other chemical quality limits provided below (e.g. total hardness, sulphate and iron) are not significant to health, but describe water quality conditions that are best for various household uses and for aesthetic reasons such as the water's taste, smell, and appearance.

The amount of a substance in your water sample is described as milligrams per Litre (mg/L), which is equivalent to parts per million (ppm).

The test results for Conductivity, Cation/Anion Sum, Ion Balance, % Difference are for laboratory work purposes only.

PARAMETER (limit)	DESCRIPTION									
<b>рН</b> (6.5 – 8.5)	A pH above 8.5 may lead to problems with scale formation (mineral deposits) on cookware, plumbing and appliance parts. Corrosion (rusting or eating away) of plumbing and appliance parts may be a problem below pH 6.5.									
Sodium (200 mg/L)	Sodium in drinking water should not exceed 20 mg/L for people on sodium-reduced diet (if your doctor told you to cut down on salt). If in doubt consult your doctor. Over 200 mg/L will give water a salty taste, but poses no significant risk to people in good health.									
Potassium (No guideline)	Potassium at levels of 50 to 100 mg/L may add to corrosion and scaling problems.									
<b>Calcium</b> (No guideline)	Calcium adds to water hardness and is essential for human health.									
<b>Magnesium</b> (No guideline)	Magnesium adds to water hardness and is essential for human health. High levels of magnesium can cause a laxative effect (loose stools) in new users.									
Total Hardness (80 to 100 mg/L)	Water hardness results from the calcium, magnesium, and other minerals that water collects as it moves through the ground. Water hardness is described as follows: soft = 0 to <60 mg/L; medium hard = 60 to <120 mg/L; hard = 120 to <180 mg/L; and very hard = 180 mg/L or more. Soft water can increase corrosion while hard water increases scaling on pipes, water heaters and appliances. Hard water also requires more soap during washing. Water softeners will lower hardness to acceptable levels, but will increase sodium levels (see sodium).									
lron (0.3 mg/L)	At levels above 0.3 mg/L, iron can leave a reddish-brown stain on laundry and plumbing fixtures and produce unpleasant tastes in beverages. High iron levels also cause growth of iron bacteria on parts of the well, water system, and plumbing. Shock chlorination is used to control iron bacteria (shocking your well may have to be repeated every year). In really bad cases, an iron filter may be needed.									
Total Dissolved Solids (TDS) (500 mg/L)	TDS is a measure of minerals in the water. High TDS can cause scaling and affect water's taste and smell. Low TDS can give water a flat taste.									

GUIDE TO INTERPRETING YOUR CHEMICAL DRINKING WATER TEST RESULTS

PARAMETER (limit)	DESCRIPTION							
Carbonate, Bicarbonate & Hydroxide (No guideline)	Carbonates, bicarbonates and hydroxides are related to water's alkalinity, salinity, and the amount of total dissolved solids. Higher levels of bicarbonates can cause more scale formation.							
Total Alkalinity (No guideline)	Alkalinity is formed by bicarbonate, carbonate and hydroxide. Lower levels of alkalinity can cause corrosion problems while higher levels can cause more scale formation.							
Fluoride (1.5 mg/L)	Fluoride levels over 1.5 mg/L may increase the risk of dental fluorosis (e.g. white spots on tooth enamel) in children with developing teeth (newborns to age thirteen). Contact your family dentist for information on the correct use of fluoride supplements for children in low-fluoride areas (less than 0.7 mg/L).							
	Fluoride can be removed from drinking water by point-of-use devices such as reverse osmosis or distillation.							
Nitrate (10 mg/L) Nitrite	Nitrate and nitrite levels above the limits can cause methemoglobinemia (often referred to as blue baby syndrome) in sensitive people, including pregnant women and infants less than 6 months of age. Nitrates and nitrites decrease the ability of the blood to carry oxygen, which can be life-threatening. Infants and sensitive people should not drink water or eat foods prepared with water that contains levels of nitrates or nitrites above the limit.							
(1.0 mg/L)	Agricultural wastes (nitrates are a part of fertilizers) and malfunctioning or poorly designed onsite septic systems are common sources of nitrate and nitrite contamination of water wells. Nitrates and nitrites can be removed by point-of-use devices such as distillation and reverse osmosis.							
Sulphate (500 mg/L)	Sulphates can occur naturally in water, or result from the decomposition of plants, animals and organic wastes. Ground water that naturally contains sulphates may also contain sulphate-reducing bacteria which change sulphates to hydrogen sulphide (a gas with a "rotten egg" odour). Sulphate-reducing bacteria can also cause corrosion problems. Aeration or chlorination followed by filtration will reduce hydrogen sulphide in well water.							
	High levels of sulphate may have a laxative effect (loose stools) on new users. Regular users tend to become accustomed to high sulphate levels.							
Chloride (250 mg/L)	Chloride over 250 mg/L may affect the taste of water and beverages. High levels of chloride may also cause either corrosion or scale formation, depending upon what else is in the water. A sudden increase in chloride levels may indicate pollution of your water supply (e.g. from road salt, irrigation drainage).							

#### For more information contact

- <u>www.albertahealthservices.ca/eph.asp</u>
- HEALTH Link Alberta at 403-943-LINK or 1-866-408-LINK
- or your local health centre at one of the locations listed below.

Airdrie Airdrie Public Health Centre 604 Main Street South Airdrie, AB T4B 3K7 Phone: 403-912-8400 Fax: 403-912-8410	Banff Banff Health Centre 303 Lynx Street PO Box 1266 Banff, AB T1L 1B3 Phone: 403-762-2990 Fax: 403-762-5570	Calgary/Mountain View/Rocky View Calgary and Area 10101 Southport Rd SW Calgary, AB T2G 2E6 Phone: 403-943-2288 Fax: 403-943-8056	Canmore Canmore Public Health #104, 800 Railway Avenue Canmore, AB T1W 1P1 Phone: 403-678-5656 Fax: 403-678-5068
Claresholm Claresholm Public Health 5221 2 <sup>nd</sup> Street W PO Box 1391 Claresholm, AB TOL 0T0 Phone: 403-625-4061 Fax: 403-625-4062	Didsbury Didsbury Health Unit PO Bag 130 1210 -20th Avenue Didsbury, AB TOM 0W0 Phone: 403-335-7292 Fax: 403-335-7610	Okotoks Okotoks Public Health Centre 11 Cimarron Commons Okotoks, AB T1S 2E9 Phone: 403-995-2600 Fax: 403-995-2639	Strathmore Public Health Building 650 Westchester Road Strathmore, AB T1P 1H8 Phone: 403-361-7200 Fax: 403-934-7244

2

June 2006



#### Interpretation of Bacteriological Results

The Provincial Laboratory of Public Health performs laboratory tests on well water samples. Initially the laboratory looks for whether bacteria are present or absent in a sample. The presence of certain types of bacteria such as *E-coli* or Total Coliforms indicates that your water may be unsafe to drink. Private laboratories often test for fecal coliforms instead of *E-coli*.

If your well water sample result shows the presence of *E-coli* or Total Coliforms, you will be contacted by a Health Inspector to discuss these results and what further actions should be taken.

The following definitions will help you interpret your report:

#### DEFINITIONS

**Alberta Health** 

Services

Absent: Indicates bacteria were not identified in the well water sample tested.

Present: Indicates bacteria were identified in the well water sample tested.

#### E-coli:

The presence of *E-coli* in a private water supply indicates that the water supply has recently been impacted by fecal contamination and **should not be considered safe to drink**. This situation should be discussed with the Health Inspector who can make recommendations about boiling your water or other treatment methods.

#### **Total Coliforms:**

The presence of Total Coliforms in a private water supply indicates the possible surface contamination of the water supply. Total Coliforms may also indicate inadequate water treatment (if treatment used). This situation should be discussed with the Health Inspector who can make recommendations on what further action you should take.

For more information contact:

- www.albertahealthservices.ca/eph.asp
- Health Link Alberta at 403-943-LINK or 1-866-408-LINK
- or your local health centre



## global environmental solutions

Calgary, AB 1185-10201 Southport Rd SW Calgary, AB T2W 4X9 Canada Tel: (403) 266-2030 Fax: (403) 263-7906

Kamloops, BC 8 West St. Paul Street Kamloops, BC V2C 1G1 Canada Tel: (250) 374-8749 Fax: (250) 374-8656

Ottawa, ON 400 – 2301 St. Laurent Blvd. Ottawa, ON K1G 4J7 Canada Tel: (613) 725-1777 Fax: (905) 415-1019

Toronto, ON 36 King Street East, 4<sup>th</sup> Floor Toronto, ON M5C 3B2 Canada Tel: (905) 415-7248 Fax: (905) 415-1019

Whitehorse, YT 6131 6<sup>th</sup> Avenue Whitehorse, YT Y1A 1N2 Canada Tel: (867) 689-2021 Edmonton, AB 6940 Roper Road Edmonton, AB T6B 3H9 Canada Tel: (780) 490-7893 Fax: (780) 490-7819

Kelowna, BC #107-1726 Dolphin Avenue Kelowna, BC V1Y 9R9 Canada Tel: (250) 762-7202 Fax: (250) 763-7303

Prince George, BC 1586 Ogilvie Street Prince George, BC V2N 1W9 Canada Tel: (250) 562-4452 Fax: (250) 562-4458

Vancouver, BC (Head Office) 200-1620 West 8<sup>th</sup> Avenue Vancouver, BC V6J 1V4 Canada Tel: (604) 738-2500 Fax: (604) 738-2508

Yellowknife, NT 1B Coronation Drive Yellowknife, NT X1A 0G5 Canada Tel: (867) 688-2847 **Grande Prairie, AB** 9905-97 Avenue Grande Prairie, AB T8V 0N2 Canada Tel: (780) 513-6819 Fax: (780) 513-6821

Markham, ON 200 - 300 Town Centre Blvd Markham, ON L3R 5Z6 Canada Tel: (905) 415-7248 Fax: (905) 415-1019

Regina, SK 1048 Winnipeg Street Regina, SK S4R 8P8 Canada Tel: (306) 525-4690 Fax (306) 525-4691

Victoria, BC Unit 303 – 3960 Quadra Street Victoria, BC V8X 4A3 Canada Tel: (250) 475-9595 Fax: (250) 475-9596 Guelph, ON 105-150 Research Lane Guelph, ON N1G 4T2 Canada Tel: (226) 706-8080 Fax: (226) 706-8081

Nanaimo, BC 9-6421 Applecross Road Nanaimo, BC V9V 1N1 Canada Tel: (250) 390-5050 Fax: (250) 390-5042

Saskatoon, SK 620-3530 Millar Avenue Saskatoon, SK S7P 0B6 Canada Tel: (306) 374-6800 Fax: (306) 374-6077

Winnipeg, MB 1353 Kenaston Boulevard Winnipeg, MB R3P 2P2 Canada Tel: (204) 477-1848 Fax: (204) 475-1649

