Groundwater Science Corp.

Unit 2, 465 Kingscourt Drive,
Waterloo, ON N2K 3R5
Phone: (519) 746-6916
groundwaterscience.ca

# Technical Memo

| | | | |
|---|---|---|---|
| To : | Mal Wensierski | Date : | October 24, 2018 |
| | Lafarge Canada Inc. | Re. : | 2017 Monitoring Summary |
| | 6509 Airport Road, | Project: | Oro Pit |
| | Mississauga, ON L4V 1S7 | From : | Andrew Pentney |

As requested we are providing a summary of the 2017 groundwater monitoring program results for the Oro Pit for your records. Previous memos outlined the complete monitoring program requirements in detail and summarized available monitoring results, including private well surveys in the area of the pit.

Extraction activities began at the Oro Pit in January 2015. The adjacent Greek Pit is well established and extraction has occurred at that site for a number of years.

The current monitoring program requirements for the Oro Pit include quarterly water level measurements and annual water quality sampling.

We note that bi-monthly water level measurements to establish baseline seasonal water table fluctuations at the site were only required during the first operational year (2015). However, the bi-monthly frequency was maintained by Lafarge from 2013 to 2016 in order to ensure a robust baseline data set.

**Monitoring Program**

The monitoring completed in 2017 constitutes the third year of measurements during Oro Pit extraction operations.

The site location and monitoring network is shown in **Figure 1** (attached). Existing Oro Pit monitors include locations M6, DC-1, DC-2, DC-4 and DC-5. In addition monitor OW1, at the Greek Pit is included in the program.

Based on the water table configuration, groundwater flows from the area of DC-1, and moves radially north, northeast and east across the site (north to DC-2; northeast to Greek Pit OW1; and, east to the Roehner Pit). The current extraction area is immediately north of M6, therefore locations M6 and DC-4 are upgradient of the current extraction area. Location OW1 is downgradient of the current extraction area.

Monitoring completed in 2017 at the Oro Pit included 4 seasonal (quarterly) water level measurements at monitoring wells M6, DC-1, DC-2, DC-4, DC-5 and OW1. Due to scheduling issues the December 2017 site visit, which was to include sampling, was delayed until January 8, 2018. Unfortunately due to extreme cold conditions, which froze the sampling equipment and bottles, water quality samples could not be obtained at that time. Samples were obtained on May 17, 2018, which generally represent conditions at the end of the 2017 operating season. The water quality results are attached.

We intend to obtain the 2018 operational season water quality samples in fall 2018, in order to avoid freezing conditions and access limitations due to snow cover.

**Monitoring Results Summary**

The 2017 water level monitoring results at on-site wells are summarized in the attached table and hydrograph. As shown, water level elevations and overall water table fluctuations are consistent from 2013 to 2017, and are comparable to historical (1991) results. No water quantity concerns are noted and no impacts due to the Oro Pit operations are noted.

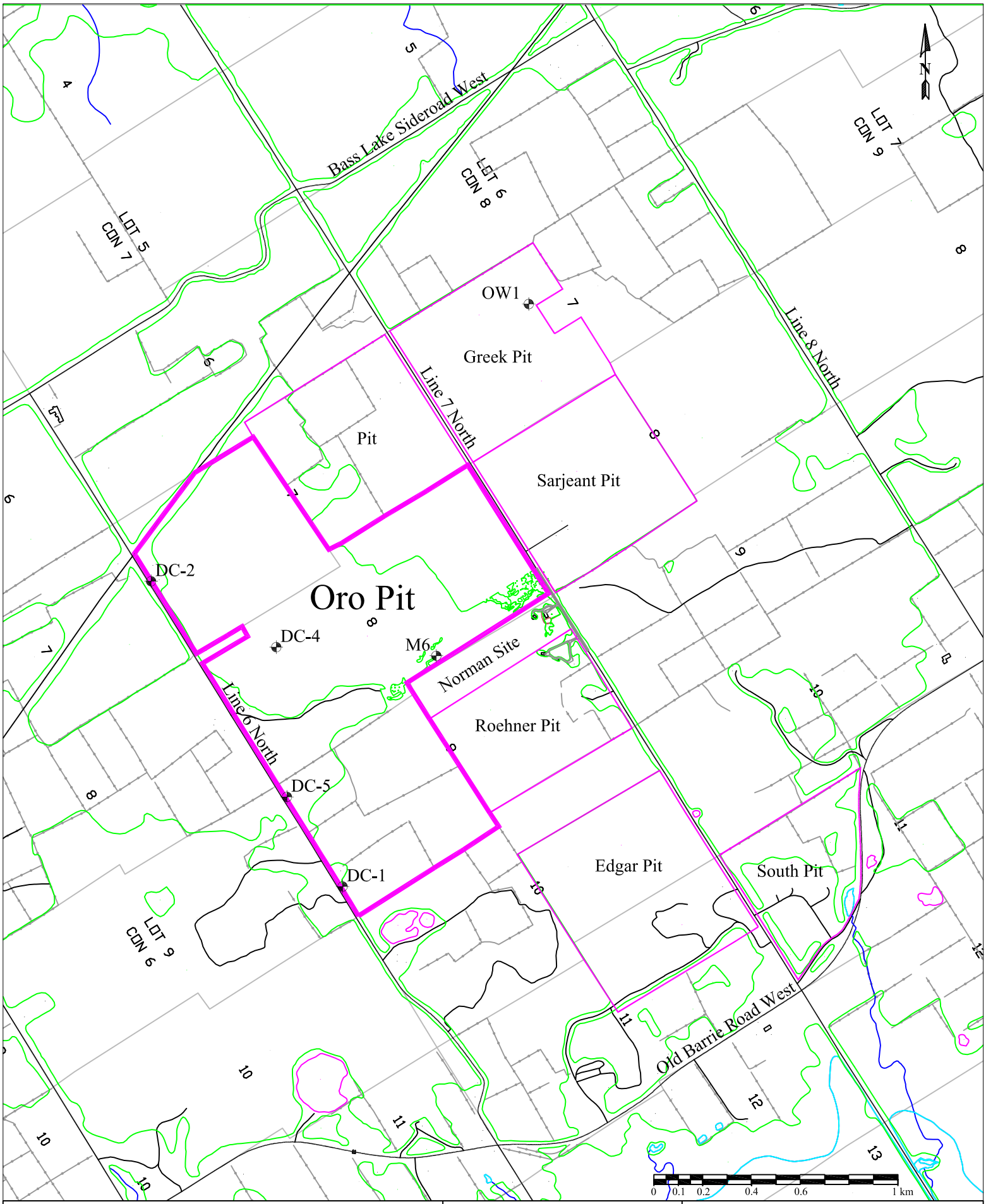
Based on the water quality sampling results to date, no significant water quality concerns are noted, and no impacts due to Oro Pit or Greek Pit operations are apparent. The results indicate that the groundwater quality within the water table system on-site is slightly hard, however overall meets the MOE drinking water health related guidelines.

Although chloride concentrations are historically slightly higher at OW1 as compared to M6 and DC-4, the results can be considered to be within natural (background) ranges for groundwater in southern Ontario and remain well below suggested drinking water criterial related to aesthetics and health. Based on the sampling results to date both at the site and in the surrounding area, there is no evidence that extraction activities at the Oro Pit have affected chloride concentrations in the local groundwater system.

Continued quarterly water level monitoring and annual water quality sampling is recommended, and will occur as part of the stipulated monitoring program.

Attached:

Figure 1: Site Location
Water Level Summary Table
Water Level Hydrograph
Water Quality Sampling Analysis Laboratory Report




Pit licence boundary (approx)
river, stream, pond
treeline
monitoring well location

modified from: OBM mapping, Site Plan
UNDER LICENSE, WITHOUT PREJUDICE OR ENDORSEMENT, FROM THE QUEEN'S PRINTER OF ONTARIO, 2005

March 2014
Scale: as shown

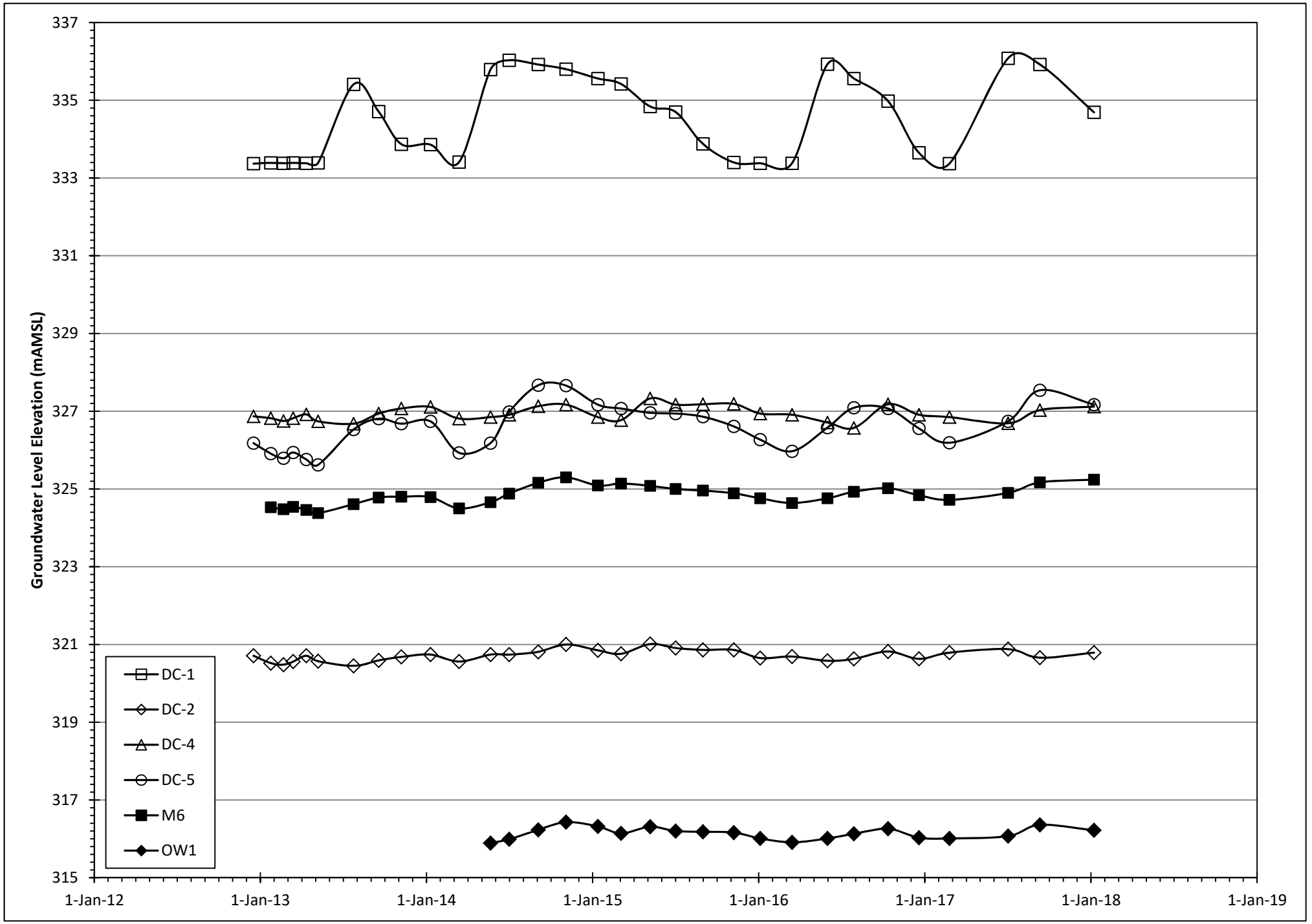
*Groundwater Science Corp.*

# Figure 1: Site Location

Lafarge Canada Inc.
Oro Pit Monitoring Program

| Reported Installation Elevations and Details | | | | | | |
|---|---|---|---|---|---|---|
| Monitor: | **DC-1** | **DC-2** | **DC-4** | **DC-5** | **M6** | **OW1** |
| GS (mASL): | 366.7 | 354.07 | 354.62 | 352.05 | 352.305 | 343.22 |
| TOC (mASL): | 367.45 | 354.57 | 355.66 | 352.64 | 352.95 | 343.63 |
| TD (mBTOC): | 34.12 | 36.64 | 30.48 | 30.15 | 31.8 | 33.88 |
| SU (m): | 0.75 | 0.5 | 1.04 | 0.59 | 0.645 | 0.41 |
| GS = ground surface | | TOC = Top of Casing | | TD = total depth | | SU = stick-up |

| Water Level Elevation - mASL | | | | | | |
|---|---|---|---|---|---|---|
| **Date** | **DC-1** | **DC-2** | **DC-4** | **DC-5** | **M6** | **OW1** |
| 3-May-91 | 334.56 | 320.22 | 326.22 | 325.94 | 323.81 | #N/A |
| 13-May-91 | 335.58 | 320.3 | 326.3 | 326.19 | 323.89 | #N/A |
| 22-Jul-91 | 335.72 | 320.26 | 326.46 | 327.22 | 324.22 | #N/A |
| 1-Oct-91 | 335.39 | 320.52 | 326.91 | 327.17 | 324.45 | #N/A |
| 14-Nov-91 | #N/A | #N/A | #N/A | #N/A | #N/A | 315.20 |
| 11-Dec-91 | #N/A | #N/A | #N/A | #N/A | #N/A | 315.00 |
| | | | | | | |
| 17-Dec-12 | 333.37 * | 320.71 | 326.87 | 326.18 | #N/A | #N/A |
| 24-Jan-13 | 333.39 * | 320.52 | 326.82 | 325.91 | 324.53 | #N/A |
| 21-Feb-13 | 333.38 * | 320.48 | 326.75 | 325.79 | 324.48 | #N/A |
| 14-Mar-13 | 333.39 * | 320.56 | 326.82 | 325.94 | 324.54 | #N/A |
| 12-Apr-13 | 333.38 * | 320.71 | 326.92 | 325.76 | 324.46 | #N/A |
| 8-May-13 | 333.39 * | 320.57 | 326.74 | 325.62 | 324.38 | #N/A |
| 25-Jul-13 | 335.41 | 320.45 | 326.68 | 326.53 | 324.61 | #N/A |
| 18-Sep-13 | 334.71 | 320.59 | 326.94 | 326.81 | 324.78 | #N/A |
| 7-Nov-13 | 333.87 | 320.68 | 327.07 | 326.68 | 324.80 | #N/A |
| 10-Jan-14 | 333.86 | 320.74 | 327.11 | 326.74 | 324.79 | #N/A |
| 14-Mar-14 | 333.41 * | 320.56 | 326.81 | 325.93 | 324.50 | #N/A |
| 22-May-14 | 335.79 | 320.74 | 326.85 | 326.18 | 324.66 | 315.89 |
| 2-Jul-14 | 336.03 | 320.74 | 326.91 | 326.98 | 324.88 | 315.99 |
| 4-Sep-14 | 335.92 | 320.81 | 327.13 | 327.67 | 325.16 | 316.23 |
| 4-Nov-14 | 335.80 | 321.00 | 327.17 | 327.66 | 325.30 | 316.43 |
| 13-Jan-15 | 335.56 | 320.85 | 326.85 | 327.17 | 325.09 | 316.32 |
| 5-Mar-15 | 335.42 | 320.76 | 326.77 | 327.07 | 325.14 | 316.14 |
| 8-May-15 | 334.84 | 321.01 | 327.33 | 326.96 | 325.08 | 316.31 |
| 3-Jul-15 | 334.70 | 320.91 | 327.17 | 326.94 | 325.00 | 316.20 |
| 1-Sep-15 | 333.88 | 320.86 | 327.18 | 326.86 | 324.96 | 316.18 |
| 8-Nov-15 | 333.40 * | 320.86 | 327.19 | 326.61 | 324.89 | 316.16 |
| 5-Jan-16 | 333.38 * | 320.65 | 326.94 | 326.27 | 324.76 | 316.01 |
| 15-Mar-16 | 333.38 * | 320.69 | 326.91 | 325.97 | 324.64 | 315.91 |
| 1-Jun-16 | 335.93 | 320.58 | 326.71 | 326.58 | 324.76 | 316.01 |
| 29-Jul-16 | 335.56 | 320.63 | 326.57 | 327.09 | 324.93 | 316.13 |
| 12-Oct-16 | 334.98 | 320.82 | 327.18 | 327.07 | 325.02 | 316.26 |
| 19-Dec-16 | 333.65 | 320.63 | 326.91 | 326.56 | 324.84 | 316.03 |
| 24-Feb-17 | 333.37 * | 320.79 | 326.85 | 326.19 | 324.72 | 316.01 |
| 3-Jul-17 | 336.08 | 320.88 | 326.69 | 326.74 | 324.90 | 316.07 |
| 11-Sep-17 | 335.92 | 320.66 | 327.03 | 327.54 | 325.17 | 316.36 |
| 8-Jan-18 | 334.69 | 320.79 | 327.12 | 327.17 | 325.24 | 316.22 |
| mASL = metres above sea level | | | | #N/A = not available | | |
| * = likely dry (<10 cm of water column) | | | | | | |




Lafarge Canada Inc.
Oro Pit and Greek Pit

**Water level Hydrograph**

Groundwater Science Corp.
Monitoring Program

GROUNDWATER SCIENCE (Waterloo)
ATTN: ANDREW PENTNEY
328 Daleview Place
WATERLOO ON N2L 5M5

Date Received: 17-MAY-18
Report Date: 22-MAY-18 09:20 (MT)
Version: FINAL

Client Phone: 519-746-6916

# Certificate of Analysis

## Lab Work Order #: L2096659

Project P.O. #: NOT SUBMITTED
Job Reference: ORO PIT
C of C Numbers: 17619205
Legal Site Desc:

Nellie Gudzak
Account Manager

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2096659-1 M6<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:00<br>Matrix: GW | | | | | | | |
| **Physical Tests** | | | | | | | |
| Colour, Apparent | 119 | | 2.0 | CU | | 18-MAY-18 | R4047863 |
| Conductivity | 357 | | 3.0 | umhos/cm | | 18-MAY-18 | R4047490 |
| pH | 8.06 | | 0.10 | pH units | | 18-MAY-18 | R4047480 |
| Total Dissolved Solids | 206 | DLDS | 20 | mg/L | | 18-MAY-18 | R4049497 |
| Turbidity | 1110 | | 0.10 | NTU | | 18-MAY-18 | R4047708 |
| **Anions and Nutrients** | | | | | | | |
| Alkalinity, Bicarbonate (as CaCO3) | 179 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Carbonate (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Hydroxide (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Total (as CaCO3) | 179 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Ammonia, Total (as N) | 0.027 | | 0.020 | mg/L | | 18-MAY-18 | R4047709 |
| Bromide (Br) | <0.10 | | 0.10 | mg/L | | 17-MAY-18 | R4047769 |
| Chloride (Cl) | 0.56 | | 0.50 | mg/L | | 17-MAY-18 | R4047769 |
| Fluoride (F) | 0.033 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrate (as N) | 1.17 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 17-MAY-18 | R4047769 |
| Orthophosphate-Dissolved (as P) | <0.0030 | | 0.0030 | mg/L | | 18-MAY-18 | R4047695 |
| Sulfate (SO4) | 9.19 | | 0.30 | mg/L | | 17-MAY-18 | R4047769 |
| **Dissolved Metals** | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 17-MAY-18 | R4047160 |
| Aluminum (Al)-Dissolved | 0.0107 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Antimony (Sb)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Arsenic (As)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Barium (Ba)-Dissolved | 0.0551 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Beryllium (Be)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Bismuth (Bi)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Boron (B)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cadmium (Cd)-Dissolved | <0.0000050 | | 0.0000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Calcium (Ca)-Dissolved | 47.9 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cesium (Cs)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Chromium (Cr)-Dissolved | 0.00126 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cobalt (Co)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Iron (Fe)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lead (Pb)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lithium (Li)-Dissolved | 0.0015 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Magnesium (Mg)-Dissolved | 14.4 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Manganese (Mn)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Molybdenum (Mo)-Dissolved | 0.000138 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Nickel (Ni)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Phosphorus (P)-Dissolved | <0.050 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2096659-1 M6<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:00<br>Matrix: GW | | | | | | | |
| **Dissolved Metals** | | | | | | | |
| Potassium (K)-Dissolved | 1.07 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Rubidium (Rb)-Dissolved | 0.00093 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Selenium (Se)-Dissolved | 0.000098 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silicon (Si)-Dissolved | 5.52 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silver (Ag)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sodium (Na)-Dissolved | 2.02 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Strontium (Sr)-Dissolved | 0.126 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sulfur (S)-Dissolved | 2.82 | | 0.50 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tellurium (Te)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thallium (Tl)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thorium (Th)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tin (Sn)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Titanium (Ti)-Dissolved | 0.00055 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tungsten (W)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Uranium (U)-Dissolved | 0.000332 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Vanadium (V)-Dissolved | 0.00107 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zinc (Zn)-Dissolved | <0.0010 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zirconium (Zr)-Dissolved | <0.00030 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| **Aggregate Organics** | | | | | | | |
| Phenols (4AAP) | <0.0010 | | 0.0010 | mg/L | | 18-MAY-18 | R4047831 |
| L2096659-2 GREEK OW1<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:40<br>Matrix: GW | | | | | | | |
| **Physical Tests** | | | | | | | |
| Colour, Apparent | 240 | | 2.0 | CU | | 18-MAY-18 | R4047863 |
| Conductivity | 424 | | 3.0 | umhos/cm | | 18-MAY-18 | R4047490 |
| pH | 7.93 | | 0.10 | pH units | | 18-MAY-18 | R4047480 |
| Total Dissolved Solids | 261 | DLDS | 20 | mg/L | | 18-MAY-18 | R4049497 |
| Turbidity | 1100 | | 0.10 | NTU | | 18-MAY-18 | R4047708 |
| **Anions and Nutrients** | | | | | | | |
| Alkalinity, Bicarbonate (as CaCO3) | 207 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Carbonate (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Hydroxide (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Total (as CaCO3) | 207 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Ammonia, Total (as N) | 0.077 | | 0.020 | mg/L | | 18-MAY-18 | R4047709 |
| Bromide (Br) | <0.10 | | 0.10 | mg/L | | 17-MAY-18 | R4047769 |
| Chloride (Cl) | 0.66 | | 0.50 | mg/L | | 17-MAY-18 | R4047769 |
| Fluoride (F) | 0.030 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrate (as N) | 0.551 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 17-MAY-18 | R4047769 |
| Orthophosphate-Dissolved (as P) | <0.0030 | | 0.0030 | mg/L | | 18-MAY-18 | R4047695 |
| Sulfate (SO4) | 12.8 | | 0.30 | mg/L | | 17-MAY-18 | R4047769 |

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2096659-2 GREEK OW1<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:40<br>Matrix: GW | | | | | | | |
| **Anions and Nutrients** | | | | | | | |
| **Dissolved Metals** | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 17-MAY-18 | R4047160 |
| Aluminum (Al)-Dissolved | 0.0054 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Antimony (Sb)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Arsenic (As)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Barium (Ba)-Dissolved | 0.0427 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Beryllium (Be)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Bismuth (Bi)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Boron (B)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cadmium (Cd)-Dissolved | <0.0000050 | | 0.0000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Calcium (Ca)-Dissolved | 65.8 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cesium (Cs)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Chromium (Cr)-Dissolved | 0.00087 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cobalt (Co)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Iron (Fe)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lead (Pb)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lithium (Li)-Dissolved | <0.0010 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Magnesium (Mg)-Dissolved | 13.8 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Manganese (Mn)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Molybdenum (Mo)-Dissolved | 0.000085 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Nickel (Ni)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Phosphorus (P)-Dissolved | <0.050 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Potassium (K)-Dissolved | 0.875 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Rubidium (Rb)-Dissolved | 0.00108 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Selenium (Se)-Dissolved | 0.000226 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silicon (Si)-Dissolved | 5.25 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silver (Ag)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sodium (Na)-Dissolved | 2.46 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Strontium (Sr)-Dissolved | 0.130 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sulfur (S)-Dissolved | 2.27 | | 0.50 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tellurium (Te)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thallium (Tl)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thorium (Th)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tin (Sn)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Titanium (Ti)-Dissolved | <0.00030 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tungsten (W)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Uranium (U)-Dissolved | 0.000268 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Vanadium (V)-Dissolved | 0.00081 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zinc (Zn)-Dissolved | <0.0010 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zirconium (Zr)-Dissolved | <0.00030 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2096659-2 GREEK OW1<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:40<br>Matrix: GW | | | | | | | |
| **Aggregate Organics** | | | | | | | |
| Phenols (4AAP) | <0.0010 | | 0.0010 | mg/L | | 18-MAY-18 | R4047831 |
| L2096659-3 DC-4<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:35<br>Matrix: GW | | | | | | | |
| **Physical Tests** | | | | | | | |
| Colour, Apparent | 50.0 | | 2.0 | CU | | 18-MAY-18 | R4047863 |
| Conductivity | 363 | | 3.0 | umhos/cm | | 18-MAY-18 | R4047490 |
| pH | 8.05 | | 0.10 | pH units | | 18-MAY-18 | R4047480 |
| Total Dissolved Solids | 201 | DLDS | 20 | mg/L | | 18-MAY-18 | R4049497 |
| Turbidity | 70.0 | | 0.10 | NTU | | 18-MAY-18 | R4047708 |
| **Anions and Nutrients** | | | | | | | |
| Alkalinity, Bicarbonate (as CaCO3) | 178 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Carbonate (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Hydroxide (as CaCO3) | <10 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Alkalinity, Total (as CaCO3) | 178 | | 10 | mg/L | | 18-MAY-18 | R4047718 |
| Ammonia, Total (as N) | <0.020 | | 0.020 | mg/L | | 18-MAY-18 | R4047709 |
| Bromide (Br) | <0.10 | | 0.10 | mg/L | | 17-MAY-18 | R4047769 |
| Chloride (Cl) | 3.56 | | 0.50 | mg/L | | 17-MAY-18 | R4047769 |
| Fluoride (F) | 0.024 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrate (as N) | 2.59 | | 0.020 | mg/L | | 17-MAY-18 | R4047769 |
| Nitrite (as N) | <0.010 | | 0.010 | mg/L | | 17-MAY-18 | R4047769 |
| Orthophosphate-Dissolved (as P) | <0.0030 | | 0.0030 | mg/L | | 18-MAY-18 | R4047695 |
| Sulfate (SO4) | 7.24 | | 0.30 | mg/L | | 17-MAY-18 | R4047769 |
| **Dissolved Metals** | | | | | | | |
| Dissolved Metals Filtration Location | LAB | | | | | 17-MAY-18 | R4047160 |
| Aluminum (Al)-Dissolved | <0.0050 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Antimony (Sb)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Arsenic (As)-Dissolved | 0.00019 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Barium (Ba)-Dissolved | 0.0404 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Beryllium (Be)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Bismuth (Bi)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Boron (B)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cadmium (Cd)-Dissolved | 0.0000121 | | 0.0000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Calcium (Ca)-Dissolved | 47.6 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cesium (Cs)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Chromium (Cr)-Dissolved | 0.00086 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Cobalt (Co)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Copper (Cu)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Iron (Fe)-Dissolved | <0.010 | | 0.010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lead (Pb)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Lithium (Li)-Dissolved | 0.0015 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Magnesium (Mg)-Dissolved | 17.0 | | 0.0050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L2096659-3 DC-4<br>Sampled By: D NAHRGANG on 17-MAY-18 @ 12:35<br>Matrix: GW | | | | | | | |
| **Dissolved Metals** | | | | | | | |
| Manganese (Mn)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Molybdenum (Mo)-Dissolved | 0.000289 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Nickel (Ni)-Dissolved | <0.00050 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Phosphorus (P)-Dissolved | <0.050 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Potassium (K)-Dissolved | 1.09 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Rubidium (Rb)-Dissolved | 0.00041 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Selenium (Se)-Dissolved | 0.000082 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silicon (Si)-Dissolved | 5.45 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Silver (Ag)-Dissolved | <0.000050 | | 0.000050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sodium (Na)-Dissolved | 2.41 | | 0.050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Strontium (Sr)-Dissolved | 0.114 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Sulfur (S)-Dissolved | 4.20 | | 0.50 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tellurium (Te)-Dissolved | <0.00020 | | 0.00020 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thallium (Tl)-Dissolved | <0.000010 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Thorium (Th)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tin (Sn)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Titanium (Ti)-Dissolved | <0.00030 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Tungsten (W)-Dissolved | <0.00010 | | 0.00010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Uranium (U)-Dissolved | 0.000382 | | 0.000010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Vanadium (V)-Dissolved | 0.00083 | | 0.00050 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zinc (Zn)-Dissolved | <0.0010 | | 0.0010 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| Zirconium (Zr)-Dissolved | <0.00030 | | 0.00030 | mg/L | 17-MAY-18 | 17-MAY-18 | R4047195 |
| **Aggregate Organics** | | | | | | | |
| Phenols (4AAP) | <0.0010 | | 0.0010 | mg/L | | 18-MAY-18 | R4047831 |

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

# Reference Information

## QC Samples with Qualifiers & Comments:

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|---|---|
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Sulfur (S)-Dissolved | MS-B | L2096659-1, -2, -3 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L2096659-1, -2, -3 |

## Sample Parameter Qualifier key listed:

| Qualifier | Description |
|---|---|
| DLDS | Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

## Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| ALK-AUTO-WT | Water | Automated Speciated Alkalinity | EPA 310.2 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

| | | | |
|---|---|---|---|
| ALK-SPECIATED-WT | Water | pH Measurement for Spec. Alk | APHA 4500 H-Electrode |

Water samples are analyzed directly by a calibrated pH meter.

| | | | |
|---|---|---|---|
| BR-IC-N-WT | Water | Bromide in Water by IC | EPA 300.1 (mod) |

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

| | | | |
|---|---|---|---|
| CL-IC-N-WT | Water | Chloride by IC | EPA 300.1 (mod) |

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

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| | | | |
|---|---|---|---|
| COLOUR-APPARENT-WT | Water | Colour | APHA 2120 |

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

| | | | |
|---|---|---|---|
| EC-WT | Water | Conductivity | APHA 2510 B |

Water samples can be measured directly by immersing the conductivity cell into the sample.

| | | | |
|---|---|---|---|
| F-IC-N-WT | Water | Fluoride in Water by IC | EPA 300.1 (mod) |

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

| | | | |
|---|---|---|---|
| MET-D-CCMS-WT | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030B/6020A (mod) |

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| | | | |
|---|---|---|---|
| NH3-WT | Water | Ammonia, Total as N | EPA 350.1 |

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

| | | | |
|---|---|---|---|
| NO2-IC-WT | Water | Nitrite in Water by IC | EPA 300.1 (mod) |

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

| | | | |
|---|---|---|---|
| NO3-IC-WT | Water | Nitrate in Water by IC | EPA 300.1 (mod) |

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

| | | | |
|---|---|---|---|
| PHENOLS-4AAP-WT | Water | Phenol (4AAP) | EPA 9066 |

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

| | | | |
|---|---|---|---|
| PO4-DO-COL-WT | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P PHOSPHORUS |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

# Reference Information

| | | | |
|---|---|---|---|
| SO4-IC-N-WT | Water | Sulfate in Water by IC | EPA 300.1 (mod) |

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

| | | | |
|---|---|---|---|
| SOLIDS-TDS-WT | Water | Total Dissolved Solids | APHA 2540C |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| TURBIDITY-WT | Water | Turbidity | APHA 2130 B |

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

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

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

| Laboratory Definition Code | Laboratory Location |
|---|---|
| WT | ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA |

**Chain of Custody Numbers:**

17619205

**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 weight of sample*
*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.*