June 24, 2019 Project No. 1536522

Ministry of the Environment, Conservation and Parks
Attention: Permit to Take Water Director
Environmental Approvals Access
and Service Integration Branch
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5

APPLICATION FOR A CATEGORY 3 PERMIT TO TAKE WATER AMENDMENT
LAFARGE WELLINGTON COUNTY SITE – 7051 WELLINGTON ROAD 124, GUELPH, ONTARIO

Dear Sir or Madame:

A Category 3 application for a Permit to Take Water (PTTW) amendment has been prepared by Golder Associates Ltd. (Golder) on behalf of Lafarge Canada Inc. (Lafarge). The permit is required for the quarry dewatering and manufacturing purposes. The application was submitted on May 31, 2019 and the following file number assigned by MECP to the amendment to PTTW No. 2718-7S3RM7. During the MECP screening of the application for completeness it was noted that the payment was not complete. At that time Lafarge requested that the MECP receive an updated Technical Study Report in Attachment 6 in addition to the payment. Attached is the Updated Study Report and the site figure also to be replaced in Attachment 2 as well.

CLOSURE

We trust that this letter and attachments provides the information that you require at this time. If you have any questions or require additional information about this application, please contact the undersigned at your convenience.

For the purposes of Environmental Registry posting, we request the following Proposal Summary and Details:

Proposal Summary:

Lafarge Canada Inc. has applied to amend its current Permit to Take Water Number 2718-7S3RM7 for industrial purposes and quarry dewatering at the ARA licensed Wellington County pit and quarry located on the south side of Highway 124, in the Townships of Guelph-Eramosa and Puslinch.

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, N1T 1A8, Canada T: +1 519 620 1222 F: +1 519 620 9878

Proposal Details:

The Wellington County pit and quarry is licensed under the Aggregate Resources Act (ARA; Ontario 1990, Licence #5514) to extract sand, gravel and bedrock. Extraction of bedrock will be limited to a depth of 285 m above sea level which is determined to be above the aquitard referred to as the Vinemount Member of the Eramosa Formation. The PTTW application includes all water handling on site. The current Environmental Compliance Approval (Certificate of Approval Industrial Sewage Works Number 0290-6PHGPS) will be amended to address changes in water handling in order to advance the quarry.

Golder Associates Ltd.

Phyllis McCrindle

Phyllis McCrindle, M.Sc., P.Geo.
Associate, Senior Hydrogeologist

GRP/SM/ll/mp

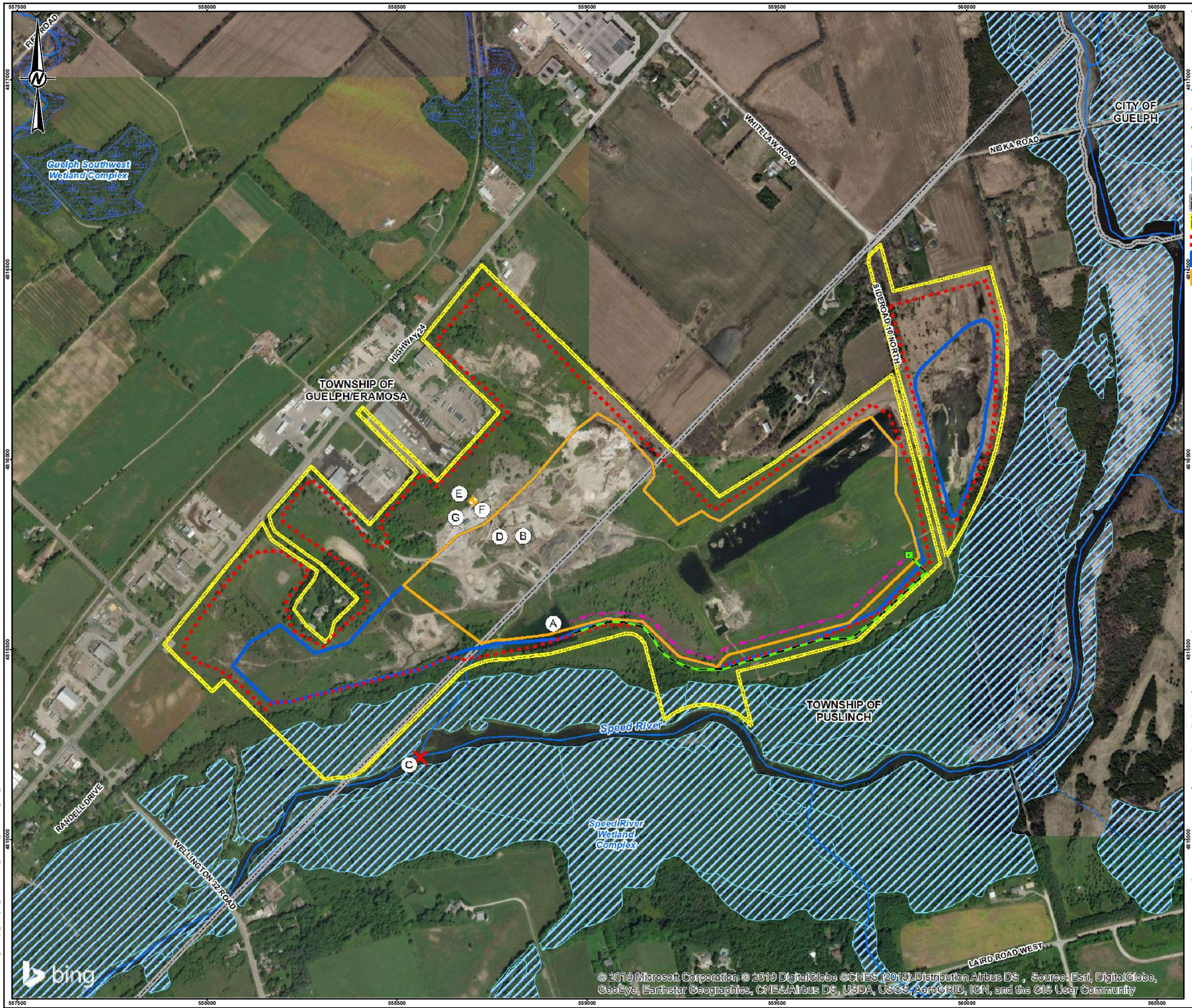
CC: Robert Cumming, Lafarge Canada Inc.
Faith Stewart, Lafarge Canada Inc.

Attachments: Attachment 2 – Location of Water Taking
Attachment 6 – Technical Study Report

https://golderassociates.sharepoint.com/sites/18194g/reports/final reports/pttw application/version 2/1536522-l-rev1-2019jun24-pttw application cover letter.docx

ATTACHMENT 2

Location of Water Taking



LEGEND

- Supply Well
- Sump
- Discharge to Speed River
- Watercourse
- Intermittent Watercourse
- Infiltration Ditch or Weir or Diffusers
- Piped Discharge
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction
- (A) Source Pond / Quarry Water Management Pond
- (B) Holding Pond
- (C) River Intake
- (D) Asphalt Plant Wet Scrubber
- (E) On-Site Supply Well
- (F) Concrete Batching Plant
- (G) Concrete Plant Washout

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
CONTAINS INFORMATION MADE AVAILABLE UNDER GRAND RIVER CONSERVATION AUTHORITY'S OPEN DATA LICENCE V1.0 - HTTPS://DATA.GRANDRIVER.CA/DOCS/GRCA%20OPEN%20DATA%20LICENCE%20V1.PDF
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
WATER TAKING LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0004	B	1

PATH: S:\Clients\Lafarge\Guelph_Quarry\99_PROJ\1536522_PTTW\40_PROD\0011_Final_PTTW\1536522-0011-CH-0018.mxd PRINTED ON: 2019-06-21 AT 3:46:38 PM

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

ATTACHMENT 6

Technical Study Report

REPORT

Lafarge Wellington County Site

Quarry Dewatering and Water Use Investigation

Submitted to:

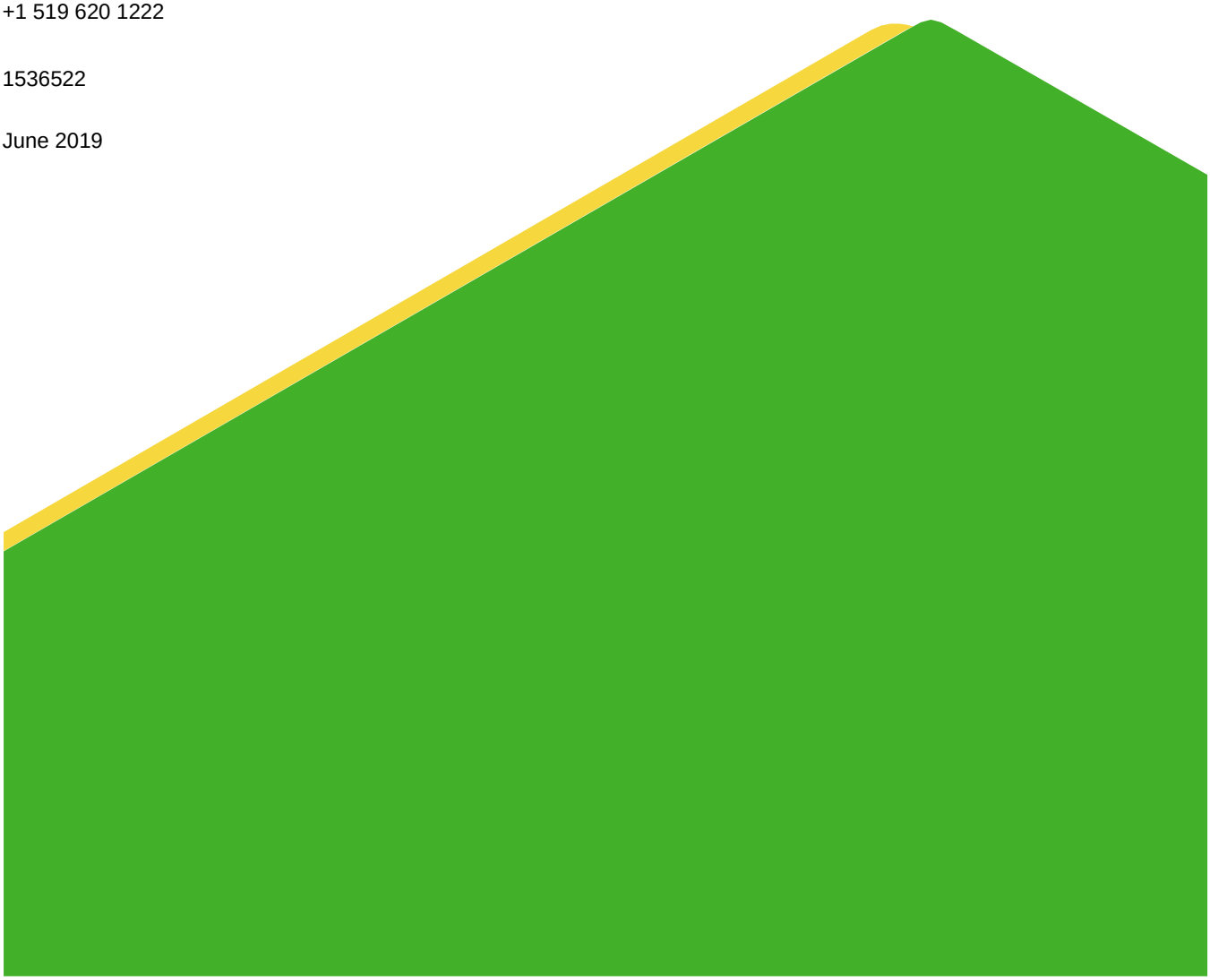
Lafarge Canada Inc.
6509 Airport Road
Mississauga, Ontario
L4V 1S7

Submitted by:

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, N1T 1A8, Canada
+1 519 620 1222

1536522

June 2019



Distribution List

1 Copy - Lafarge Canada Inc.

1 Copy - Ministry of the Environment, Conservation and Parks

1 e-copy - Golder Associates Ltd.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Lafarge Canada Inc. (Lafarge) currently owns and operates the Wellington County Site (the Site) located on the south side of Highway 124, in the Townships of Guelph-Eramosa and Puslinch, West of the City of Guelph (Figure 1). Golder Associates Ltd. (Golder) was retained by Lafarge to complete technical studies to support the application for a Permit to Take Water (PTTW) and Environmental Compliance Approval (ECA) amendment. The PTTW and ECA includes all water takings and discharge of water on the Site.

The investigation included hydrogeologic, hydrologic and natural environment studies, which are summarized into this Technical Document to support the application to amend its existing PTTW and ECA.

1.1 Background and Proposed Site Operations

Lafarge has a licence under the Aggregate Resources Act (ARA; Ontario 1990 Licence #5514) to extract sand/gravel and bedrock at their Lafarge Wellington County Site which includes extraction below the water table (see the operational sites plans in Appendix K). The extraction of bedrock will be to a depth of 285 m above sea level which is determined to be above the Vinemount Member of the Eramosa Formation. The Vinemount Member of the Eramosa Formation typically acts as an aquitard between the upper Guelph Formation aquifer above it and the lower Goat Island and Gasport Formation aquifers below it. The bedrock for extraction is below the water table and as such the operations will require quarry dewatering. The proposed quarry sump will be located in the southeast corner of the property near PW16-1 (Figure 2). It is proposed that the quarry water will be discharged to the wetland to the south and the Speed River, and can be used to maintain flow and water levels within the wetland if effects on wetland water levels result from dewatering of the quarry.

Lafarge is currently permitted to pump water at the Site (from the Speed River, a Source Pond and a Holding Pond) for operational purposes (aggregate washing and manufacturing) under an existing PTTW (Number 2718-7S3RM7) and Environmental Compliance Approval (Certificate of Approval Number 0290-6PHGPS).

Key points of water use at the Lafarge operation include the following (as shown on Figure 15):

A – Source Pond (and proposed Quarry Water Management Pond)

B – Holding Pond

C – River Intake

D - Asphalt plant wet scrubber

E – On-Site Supply Well

F - Concrete Batching Plant

G – Concrete Plant Washout

The proposed operation on the site will be as follows. A large source pond / quarry water management pond (A), located at the southern end of the property, will receive the quarry discharge water and be topped up, if required, from the river intake (C). There is also an overflow connection from the source pond / quarry water management pond (A) to the Speed River (governed by an existing discharge permit). The river intake (C) is only used if the source pond / quarry water management pond (A) requires make-up water, and only under the conditions specified in the current permit. A small holding pond (B) constructed with a liner, receives water from the source

pond / quarry water management pond (A) for use in the asphalt plant's wet scrubber (D) and is returned back into the holding pond (B).

The On-Site supply well (E) will be used to supply water for the concrete batching plant (F) and the concrete plant washout (G), as required. Any additional water required by the concrete batching plant (F) would be taken from the source pond / quarry water management pond (A). Water used to wash out concrete mixer drums is circulated in a closed loop washout (G) with any excess being returned to the plant for use in batching concrete.

As operations progress, should additional water be available from the dewatering (stored in the source pond / quarry water management pond (A)), Lafarge is willing to make the non-potable water available to the City potentially for firefighting or irrigation purposes.

The On-Site Supply Well is constructed with an open bedrock interval in the Guelph Formation aquifer and the Goat Island/Gasport Formations aquifer. The well is constructed as a 152 mm diameter well to a depth of 54.9 m with casing set to 7.6 m. A copy of the water well record is included in Appendix A.

Given the proximity of the licenced extraction area to the Speed River, associated wetlands and private wells, and the fact that the supply well is constructed in the same aquifer used for municipal supply, an assessment of potential adverse effects of the proposed quarry dewatering and water taking on environmental features and functions is required. This investigation provides a comprehensive study of hydrogeological (groundwater), hydrological (surface water) and ecological (natural environment) features and their resulting interactions along with potential adverse effects that may result from quarry dewatering and water taking.

1.2 Scope of Work

The specific tasks undertaken as part of the investigation included the following:

Hydrogeology

- Deepen two of the existing core holes to just below the interface of the Vinemount Member and Goat Island/Gasport Formation to determine the thickness of the Eramosa Formation (inclusive of the Vinemount Member) and core five additional holes (one to the top of the Vinemount Member and four into the Goat Island/Gasport Formation);
- Conduct packer testing of two existing core holes and five new core holes to determine hydraulic properties of the bedrock;
- Conduct geophysical logging of the five existing core holes and five new core holes to support the characterization of local bedrock stratigraphy;
- Design and install multi-level monitoring wells in the six core holes that extend into the Goat Island/Gasport Formation;
- Install two piezometers in the provincially significant wetland;
- Drill two test wells and two additional monitoring wells adjacent to the test wells within the licenced extraction depth of the quarry to allow for pumping tests;
- Complete a 24-hour groundwater pumping test at each newly constructed pumping well (PW 16-1 and PW16-2) and the existing test well (TW1) to assess the transmissivity of the bedrock within the licenced extraction depth;

- Complete a pumping test at the On-Site Supply Well to determine if the well can be used as a water supply for the ready-mix concrete plant and assess any effects of the water taking;
- Collect groundwater samples to determine the on-Site water quality;
- Conduct on-going groundwater elevation monitoring; and,
- Assess dewatering requirements and potential impacts.

Hydrology

- Conduct a desktop background review of available hydrologic information;
- Install two surface water stations on-Site and two stations in the Speed River;
- Conduct on-going water level and flow monitoring in selected surface water features;
- Collect surface water samples to determine water quality;
- Conduct a water budget assessment; and,
- Conduct an assessment of the receiving system.

Natural Environment

- Conduct a natural environment desktop assessment of existing conditions and species at risk (SAR) screening;
- Conduct confirmatory field surveys including breeding bird surveys, plant community surveys, wildlife visual encounter surveys and aquatic habitat assessment; and,
- Conduct potential impact assessment

2.0 PHYSICAL SETTING

The Site is located south of Highway 124 in part of lots 4 through 8 of Division B South of Waterloo Road in the Township of Guelph-Eramosa and in part of lots 7 through 11 of Concession 5 in the Townships of Guelph/Eramosa and Puslinch (Figure 1). The Site is located in a rural setting west of the City of Guelph. The Site is bounded by the Speed River to the south (although the Lafarge property does not extend all the way to the Speed River along most of the southern boundary) and Highway 124 to the north. Some industrial and commercial land use exists along Highway 124 with most of the surrounding area consisting of rural residential land use. There are several man-made ponds on the south and east part of the Site.

As per the Site Plans, the licenced area is 142.34 ha, and the area to be extracted is 120.81 ha. Bedrock extraction is proposed to take place in the area identified in Figures 2 and 15 (orange line) which will be referred to as the “Initial Extraction Area”. This initial phase of extraction is approximately 51.25 ha and does not continue westward beyond where the Vinemount Member of the Eramosa Formation is not present. While the licence boundary (Figure 2) does contain portions of wetland features, there is no extraction in these areas of the Site.

2.1 Topography and Drainage

Detailed topographic mapping was available for the Site while regional topographic mapping was reviewed for the surrounding area. The topographic mapping for the area (Figure 3) shows that the ground surface generally slopes toward the Speed River with a high elevation of 340 m above sea level (masl) north of the Site to a low of 295 masl along the river. On-Site ground elevation ranges from approximately 324 masl to 296 masl, for an overall topographic relief on the Site of approximately 28 m.

The Site lies within the Grand River watershed, with the Speed River located immediately adjacent to the property at its closest location. The Speed River generally flows in a south-southwest direction through Guelph where it is joined by the Eramosa River before flowing past the Site and eventually discharging into the Grand River, approximately 15.5 km downstream, in north-west Cambridge. The flow in the adjacent Speed River is regulated via the Guelph Lake dam, which provides flow attenuation, limiting flooding downstream during spring and augmenting low flows during the summer season. According to the recent Water Quality in the Grand River Watershed board report (GRCA, 2017a), the Speed/Eramosa River sub-basin displays water quality levels classified as marginal to good.

The Speed River Wetland Complex is located on the south side of the Site along the Speed River. The Speed River Wetland Complex is considered a Provincially Significant Wetland. Some smaller wetland features, referred to as the Guelph Southwest Wetland Complex also exist northwest of the Site. Wetland features also extend into portions of the Site boundary.

2.2 Physiographic Region

The Site is located within the physiographic region identified as the Guelph Drumlin Field (Chapman and Putnam, 1984) with the Horseshoe Moraines located southeast of the Site. The Guelph Drumlin Field is situated in front of the Paris Moraine. Chapman and Putnam (1984) describe the general landform pattern as consisting of drumlins or groups of drumlins fringed by gravel terraces and separated by swampy valleys in which flow sluggish tributaries of the Grand River.

2.3 Regional Overburden Geology

Surficial geology mapping by the Ontario Geological Society (2003) is shown on Figure 4. The surficial geology across the Site consists mainly of outwash gravel deposits which also occur in a broader area following the Speed River. The surficial deposits along the Speed River consist of recent stream deposits including gravel, sand, silt and clay. Moving away from the Speed River the deposits consist of silt to sandy silt till (Port Stanley Till). Interspersed within these deposits are ice-contact stratified deposits (gravel in kames or eskers), massive well laminated silt and clay pond deposits and peat and muck swamp and bog deposits (organic deposits). Some areas of the overburden are thin with bedrock exposed at surface.

2.4 Regional Bedrock Geology

The bedrock formations in the study area consist of Palaeozoic sedimentary rocks, composed of limestone, dolostone and shale sequences. The bedrock formations exhibit a gentle regional dip to the southwest. A brief description of each of the bedrock formations is provided below (from oldest to youngest).

- **Cabot Head Formation:** The Cabot Head Formation, readily distinguished by its grey-green colour, is a non-calcareous shale with thin interbeds of sandstone and limestone.

- **Merritton Formation:** The Merritton Formation consists of a pinkish-brown, finely crystalline dolostone unit with dark shaley partings. This unit, where present in the area, is generally less than 1 m thick.
- **Rockway Formation:** The Rockway Formation is a greenish-grey fine crystalline argillaceous dolostone with shaley partings (Brunton, 2008). The thickness of the Formation is consistent and estimated to range 1 to 2 m.
- **Irondequoit Formation:** This Formation is a thickly to medium-bedded crinoidal grainstone (Brunton, 2008). The unit has a fairly consistent thickness of approximately 3 m throughout the area.
- **Gasport Formation:** The Gasport Formation is a cross-bedded crinoidal grainstone-packstone with sequences of reef mound and coquina (shell bed) lithofacies. This unit has commonly been referred to as the Amabel Formation in previous studies in the area. In and around the City of Guelph, the Formation generally varies in thickness from about 25 to over 70 m, and the upper sections of the reef mounds, the crinoidal grainstones and the coquina shell beds make this formation highly transmissive, where they are present (Golder, 2011).
- **Goat Island Formation:** The Goat Island Formation consists of two members; the lower Niagara Falls Member and the upper Ancaster Member.
  - *Goat Island Formation – Niagara Falls Member:* The Niagara Falls Member is a finely crystalline and cross laminated crinoidal grainstone with small reef mounds. This unit is typically less than 10 m thick in the Guelph area.
  - *Goat Island Formation – Ancaster Member:* The Ancaster Member is a chert rich, finely crystalline dolostone that is medium to ash grey in colour.
- **Eramosa Formation:** The Eramosa Formation consists of three members including, from oldest to youngest, the Vinemount Member, the Reformatory Quarry Member and the Stone Road Member.
  - *Eramosa Formation – Vinemount Member:* The Vinemount Member is comprised of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken (Brunton, 2008). This dark grey to black dolostone unit was commonly identified in water well records as ‘black shale’ and mapped in previous studies in the City of Guelph as the Eramosa Member. The shaley beds of this Formation significantly reduce the vertical permeability across this unit relative to the other Formations.
  - *Eramosa Formation – Reformatory Quarry Member:* The Eramosa Formation above the Vinemount Member is described by Brunton (2008) as light brown to cream coloured, pseudonodular, thickly bedded and coarsely crystalline dolostone. This unit is susceptible to karstification due to its uniform fine dolomite crystallinity (Brunton, 2008). This unit also often contains mud-rich and microbial mat-bearing lithofacies that may act as aquitard materials, reducing the vertical permeability across this unit.
  - *Eramosa Formation – Stone Road Member:* This cream coloured coarsely crystalline Upper Eramosa unit is not present in most of the area and can be difficult to distinguish from the Guelph Formation.
- **Guelph Formation:** The Guelph Formation consists of two members; the lower Hanlon Member and the upper Wellington Member.

- *Guelph Formation – Hanlon and Wellington Members:* The Guelph Formation consists of medium to thickly bedded crinoidal grainstones and wackestones and reefal complexes (Brunton, 2008). The Guelph Formation is cream coloured and fossiliferous.

- **Salina Formation:** The Salina Formation consists of interbedded brown dolostone and grey to green shale with lenses of gypsum and anhydrite. Typically, groundwater extracted from the Salina Formation is of poor quality due to high concentrations of calcium and sulphate resulting from the dissolution of gypsum and anhydrite minerals.

At the Site, the Guelph Formation is the uppermost bedrock while the Salina Formation is encountered further to the west. The Eramosa Formation is the uppermost formation east of the Site. Of interest for the dewatering study are the formations above the Vinemount Member of the Eramosa Formation. For the water supply study, the well is constructed within the Guelph Formation aquifer and the Goat Island/Gasport Formations aquifer and as such all the formations above the Cabot Head Formation are of interest.

3.0 BOREHOLE DRILLING AND TESTING PROGRAM

As part of a preliminary investigation, prior to this study, Lafarge completed five cored holes (12-CH-1069, 12-CH-1070, 12-CH-1071, 12-CH-1072 and 12-CH-1073) into the bedrock within the south-east portion of the property to determine the suitability of the bedrock as an aggregate source. Previously, Lafarge also installed a test well (TW1) and two monitoring wells (OW1 and OW2) in the western part of the Site and conducted a limited pumping test at TW1 in 2005 to get a general understanding of the transmissivity of the Guelph Formation bedrock. The locations of the wells are shown on Figure 2. The drilling and testing program completed as part of this study is described below and borehole logs are included in Appendix A.

3.1 Borehole Drilling and Monitoring Well Installation

3.1.1 Deepen Existing Core Holes and Drill New Core Holes

All of the drilling at the Site occurred with a track mounted drill rig and consisted of HQ coring through the bedrock. The drilling was completed by Aardvark Drilling and drilling supervision was provided by Golder field staff including examination and photographing the core. Steel surface casings were installed through the overburden and into the top of competent rock.

As indicated, Lafarge previously completed five core holes (HQ size) into the top of the Vinemount Member of the Eramosa Formation in the central to southeast area of the property. One of the core holes 12-CH-1071 was extended through the Vinemount Member and a second core hole (12-CH-1073) was decommissioned and replaced with a new core hole (15-CH-1073) completed through the Vinemount Member. The objective of the deeper holes was to confirm the integrity and thickness of the Eramosa Formation (Vinemount Member) at the Site. One additional core hole (15-CH-1074) was drilled on the eastern part of the property and four additional core holes (15-CH-1075, 15-CH-1076, 15-CH-1077 and 15-CH-1078) were also drilled on the central to western part of the property (Figure 2). The core holes on the western part of the property were drilled down into the top of the Goat Island or Gasport Formations while the core hole on the eastern part of the property was completed into the top of the Vinemount Member. The total depth of all the core holes ranged from 21.49 m (12-CH-1069) to 40.94 m (15-CH-1075).

3.1.2 Installation of Monitoring Wells in Core Holes

Monitoring wells were completed by Aardvark drilling under the supervision of Golder. Six of the deep core holes (12-CH-1071, 15-CH-1073, 15-CH-1075, 15-CH-1076, 15-CH-1077 and 15-CH-1078) were converted to multi-level monitoring wells consisting of two 1 inch diameter PVC monitoring wells with one screen in the lower bedrock and one in the upper bedrock. The wells were completed with 10 foot screens surrounded by a sand pack around the screen and bentonite grout in the annular space between the screens and up to surface. The shallow core holes remained as open bedrock holes above the Vinemount Member. Well designs were based on the results of the geophysical logging and core hole logging.

3.1.3 Installation of Test Wells and Additional Monitoring Wells

In order to conduct pumping tests at the Site, two test wells and two monitoring wells were installed; two on the eastern part of the Initial Extraction Area and two immediately south of the middle part of the Initial Extraction Area (Figure 2). The pair of wells were located within approximately 10 m of each other. The drilling was completed by Gerrits Well Drilling using rotary drilling methods with supervision provided by Golder. The wells were constructed as 6 inch diameter wells to the bottom of the Reformatory Quarry Member of the Eramosa Formation (i.e. within the licenced extraction depth) and cased through the overburden. The wells were drilled to just over 20 m in depth. Following drilling, the wells were developed to ensure that the drill cuttings were removed from the well. At each location (i.e., eastern part and middle part), the well that appeared to produce more water was designated as the test well (PW16-1 and PW16-2) while the other wells were designated as the monitoring wells (MW16-1 and MW16-2). These wells were constructed in addition to the previously installed TW1 test well.

3.2 Packer Testing

Packer testing was completed in seven of the core holes by Aardvark Drilling prior to the installation of the monitoring wells under the supervision of Golder. The tests were conducted in November/December 2015 and supervised by Golder field staff. At each of the deep holes, packer tests were conducted from the top of the Goat Island Formation up into the Guelph Formation through a number of tests. Testing was also conducted above the Vinemount Member in one of the shallow holes. The packer testing included:

- 8 tests at 12-CH-1071;
- 10 tests at 12-CH-1073;
- 5 tests at 15-CH-1074;
- 7 tests at 15-CH-1075;
- 6 tests at 15-CH-1076;
- 5 tests at 15-CH-1077; and,
- 8 tests at 15-CH-1078.

The packer tests were conducted using a straddle packer over test zones ranging from 3.0 m to 6.3 m to isolate bedrock sections. Hydraulic conductivity tests were conducted in each test zone using the falling head method with each zone tested for a maximum of two hours. For the falling head tests, water was injected into the borehole and monitored until the water level returned to static conditions. If water returned to static conditions very quickly then a constant head test was performed. The constant head test involved pumping water into the borehole and keeping the head of water at a constant level. Golder measured water levels and recorded the data (through both

manual measurements and pressure transducer data loggers) during the testing. The data was analyzed to estimate the hydraulic conductivity of each zone as summarized below. Transmissivity was estimated from the hydraulic conductivity values.

3.2.1 Analysis of Packer Test Results

A summary of the interval details for each packer test and the hydraulic conductivity results from the individual tests are included in Table B1 in Appendix B. The transmissivity is also plotted on the borehole logs in Appendix A. The packer test results provide an indication of the horizontal permeability of the formations immediately local to the borehole. The hydraulic conductivity within the different formations varied as follows:

- Guelph Formation – $1.9x10^{-5}$ to $3.1x10^{-3}$ cm/s;
- Reformatory Quarry Member – $1.8x10^{-5}$ to $1.0x10^{-2}$ cm/s;
- Vinemount Member – $2.1x10^{-6}$ to $4.1x10^{-2}$ cm/s; and,
- Goat Island Formation – $4.7x10^{-6}$ to $1.5x10^{-3}$ cm/s.

The variation in the hydraulic conductivity is representative of the changes in the bedrock characteristics (i.e., composition, fractures, bedding planes, vugs, etc.). Eleven of the zones tested had a hydraulic conductivity greater than $1x10^{-3}$ cm/s. Six of the higher permeability zones are situated within the Guelph Formation, the Reformatory Quarry Member of the Eramosa Formation and the Goat Island Formation which are considered bedrock aquifers. Based on the hydraulic conductivity estimates from the packer testing, there are also zones within the Vinemount Member in the area of the Site that are characterized by horizontal hydraulic conductivity values that are similar to the higher values observed in the bedrock aquifer formations. The Vinemount Member of the Eramosa Formation is typically considered an aquitard with low permeability (i.e., vertical hydraulic conductivity). Specifically, these higher permeability zones in the Vinemount Member occur at 12-CH-1071 and 15-CH-1073. A review of the core collected from these boreholes indicates that there are fractures within these zones that could account for the higher permeability. The zones at 12-CH-1071 are also located just above a transition zone where a fracture with clay infilling was present. At 15-CH-1073 there is a fracture with staining at 28 m and fracture with clay infilling at 35 m. Fractures with clay infilling can be due to weathering and water circulation.

3.3 Geophysical Logging

Geophysical logging, including caliper (structural property), gamma and conductivity (stratigraphic properties) was conducted by Golder. The geophysical logging was performed to collect information on the geological structure of the bedrock underlying the overburden in order to confirm the stratigraphic logging. Geophysical probes were run on a wireline through the open portion of the borehole to measure different properties of the bedrock. A description of the borehole logging methods is described below.

Natural Gamma

The natural gamma log records the average natural gamma activity of the formation and can be related to variations in lithology. For example, rock with higher clay content, such as shales, have higher natural gamma activity than limestones. Natural gamma logs were generally recorded twice in each borehole for QA/QC purposes.

Apparent Conductivity

This borehole probe records the apparent conductivity of the rock mass surrounding the borehole using the inductive electromagnetic technique. The probe provides a radial bulk measurement of the material 0.1 m to 1.0 m from the borehole wall over a distance of 1.0 m. The measurement is unaffected by conductive borehole fluid or the presence of plastic casing. This log is generally used in conjunction with the natural gamma log to identify variations in lithology/stratigraphy. Apparent conductivity logs were generally recorded twice in each borehole for QA/QC purposes.

Mechanical Caliper

The caliper log represents the average borehole diameter determined by the extension of three spring-loaded arms that interact with variable pot resistors in the probe. The output is a voltage that is calibrated against rings of known diameter. The primary applications are fracture location and characterization and to indicate intervals where there are rough borehole walls or washouts due to the circulation of drilling fluids. Caliper logs record average borehole diameter and increases in diameter could represent fractures, bedding planes, drill-bit scour or solution openings.

4.0 LOCAL GEOLOGIC SETTING

Three cross-sections have been prepared (Figures 5 through 7) through the Site with the locations shown on Figure 2. A summary of the thickness of the various stratigraphic units is as follows based on the borehole drilling:

- Overburden on-site in areas already extracted above the water table – 0.9 m (15-CH-1077) to 10.7 m (15-CH-1075);
- Guelph Formation – 10.3 m (15-CH-1076) to 28.7 m (15-CH-1077);
- Reformatory Quarry Member – 0 m (15-CH-1077) to 6.6 m (15-CH-1075); and,
- Vinemount Member – 0 m (15-CH-1077 and 15-CH-1078) to 14.9 m (15-CH1073).

The bedrock stratigraphy is similar across the central and eastern parts of the property with relatively uniform thicknesses of the Guelph Formation and the Reformatory Quarry Member of the Eramosa Formation. In this area, these formations are underlain by the Vinemount Member of the Eramosa Formation. The geologic stratigraphy in the western part of the property, near 15-CH-1077 and 15-CH-1078, is different than the rest of the property and contains a thicker sequence of the Guelph Formation and no underlying Vinemount Member of the Eramosa Formation. The Vinemount Member thickens to the east with the thickest part of the sequence observed at 15-CH-1073. This is consistent with the findings of Brunton and Dodge (2008), who identified some boreholes in central and northwest Guelph as having well developed Amabel reefal facies overlain by Guelph reefal facies with the Eramosa missing.

None of the boreholes were drilled through the entire Goat Island or Gasport Formations. Based on the City of Guelph Tier 3 Water Budget and Local Area Risk Assessment (Golder, 2011), the Goat Island Formation is estimated to range in thickness from approximately 1 to 10 m and the Gasport Formation is estimated to range in thickness from approximately 45 to 50 m.

5.0 GROUNDWATER MONITORING

A monitoring well network was established at the Site including six multi-level monitoring wells, eight monitoring wells, three test wells and two multi-level mini-piezometers. The multi-level monitoring wells are completed in both the upper bedrock (above the Vinemount Member) and the lower bedrock (below the Vinemount Member) while the remaining monitoring wells are completed in the upper bedrock. Pressure transducer data loggers were installed in the monitoring wells to provide a near continuous record of water levels. In addition, manual water levels were measured in the monitoring wells on a quarterly basis at which time the pressure transducer dataloggers were downloaded.

Groundwater samples were collected from the three test wells and the On-Site Supply Well during the pumping tests and submitted to an accredited laboratory for water quality analysis (general chemistry, metals and inorganics).

5.1 Groundwater Levels and Flow

Hydrographs for monitoring wells on the eastern part of the property and western part of the property and mini-piezometers in the wetland are included on Figures C1 to C3 in Appendix C, respectively. Continuous groundwater levels have been measured in the monitoring wells since December 2015 and in the mini-piezometers since July 2016 (as a requirement of the pumping tests). Water level fluctuations over that time ranged from 0.8 m at 12-CH-1069 to 5.1 m at 12-CH-1071A. Overall there was less fluctuation in the water levels on the western part of the Site compared to the eastern part of the Site. The water levels appear to fluctuate seasonally with higher water levels observed in the spring and lower water levels observed in the late summer and fall. The exception to this is some of the water levels on the eastern part of the property had a sharp decline in water levels at the beginning of July 2016 followed by relatively stable water levels. The sharp decline in water levels was greater in the deeper bedrock (i.e., below the Vinemount Member of the Eramosa Formation) compared to the shallow bedrock which may be due to regional effects from off site pumping in the bedrock aquifer by others. The magnitude of this change in water level varies across the site likely due to interconnectivity of the bedrock aquifer.

The daily influence of pumping from the On-Site Supply Well is observed at 15-CH-1076A and B with a greater response observed in the deeper well.

Vertical gradients were also reviewed based on the water levels in the multi-level wells. Wells situated on the northern part of the property (15-CH-1075, 15-CH-1076 and 15-CH-1077) all showed downward gradients with the largest difference in hydraulic head occurring at the well furthest north (15-CH-1075). The wells along the southern part of the property showed minimal gradient at 15-CH-1078, upward gradient at 12-CH-1071 and a gradient that reverses between up and down at 15-CH-1073. The vertical gradients appear to decrease from downward or reverse to upward (at least during certain times of the year) moving south toward the Speed River where groundwater may discharge.

Water levels were also monitored at two multi-level mini-piezometers situated in the wetland area on the southern part of the Site north of the Speed River. Water levels in MP16-1, located in the southwest corner of the property, fluctuated approximately 1.03 m in the deeper monitor and 0.97 m in the shallow monitor. There was a consistent upward gradient during the monitoring. The water levels in MP16-2, located in the south-central part of the property fluctuated more than MP16-1 with approximately 1.43 m of fluctuation in the deep monitor and 1.26 m in the shallow monitor. There was also an upward gradient at this location.

Groundwater elevations and flow direction are shown on Figures 8 and 9 for the shallow and deep bedrock aquifers based on groundwater measurements taken on June 14, 2016. Groundwater in the shallow bedrock aquifer (Guelph Formation and Reformatory Quarry Member of the Eramosa Formation) ranged from more than 307 masl at the northern part of the Site to less than 298 masl along the southern part of the Site. Groundwater flow is in a south and southeast direction toward the Speed River. The horizontal gradient increases toward the Speed River.

Groundwater in the deep bedrock aquifer (Goat Island and Gasport Formations) ranged from approximately 304 masl in the northern part of the Site to less than 300 masl in the southern part of the Site. Groundwater flow in the deep bedrock aquifer is also to the south and southeast with larger horizontal gradients on the western part of the property.

5.2 Groundwater Quality

Groundwater samples were collected from PW16-1, PW16-2 and TW1 at the end of a 24-hour pumping test at each well at the end of August/beginning of September 2016. Groundwater samples were also collected from the On-Site Supply Well at the end of the aquifer testing program in January 2018. The samples were sent to Maxxam Laboratories for general water quality analysis including metals and inorganics. A summary of the water quality results is presented in Table D1 of Appendix D along with the laboratory certificates of analysis. The water quality was similar between the four samples with some slightly higher metals detected in PW16-1 and the On-Site Supply Well. The results were compared to the Provincial Water Quality Objectives (PWQO). Of the parameters tested, zinc exceeded the objective of 30 ug/L at all three wells, and uranium exceeded the objective of 5 ug/L at PW16-1. It should be noted that the analysis was for dissolved metals and not total metals, which is reasonable for groundwater samples. Based upon our knowledge of this area and a review of publicly available water quality information in this region, these zinc and uranium concentrations are typical of naturally occurring groundwater (GRCA 2017b and OGS, 2016).

6.0 AQUIFER TESTING PROGRAM

Pumping tests (24-hour duration) were completed at each of the test wells (PW16-1, PW16-2 and TW1) and On-Site Supply Well under temporary MECP PTTWs. As part of the pumping test, with the exception of the On-Site Supply Well, a variable rate step test was initially conducted at the wells to determine the pumping rate for the tests.

During the tests, flow rates were measured at each well using a flow meter. Prior to any testing, the frequency of the readings of the pressure transducer/data loggers in the monitoring wells and test wells was increased. Water levels were measured manually and at 1-minute intervals with pressure transducer dataloggers prior to, during and following the test. Manual measurements at the pumping wells were taken with more frequent measurements at the start of the test and immediately following shutdown of the wells. During each test, water levels were also monitored in the on-site wells within 500 m of the pumping well.

No off-Site wells were monitored during the test but residents within 500 m of the pumping wells were notified of the test at least 24 hours prior to pumping.

Hydrographs of the pumping wells and monitoring wells during the test are included in Appendix H.

6.1 PW16-1 Test

The 24-hour pumping test at PW16-1 was conducted at a rate of 15.5 L/min from August 31, 2016 at 8 am to September 1, 2016 at 8 am. The test was conducted under PTTW Number 7425-AANL73. The pumped water was discharged through layflat hose approximately 200 m north into a drainage swale that emptied into the on-Site offline pond north of PW16-1.

6.1.1 Analysis of PW16-1 Test

A hydrograph of wells monitored during the PW16-1 pumping test is included on Figure H1 in Appendix H. The water levels in the pumping well drew down quickly at the start of the test and then declined at a slower rate after 60 minutes of pumping. Water levels in the pumping well stabilized after 4 hours of pumping and remained relatively constant for the remainder of the test. After 24 hours of pumping, the water level in PW16-1 had drawn down approximately 13 m. A response to pumping was observed at monitoring wells MW16-1 (2.8 m of drawdown 9 m away) and at 15-CH-1073B (0.4 m of drawdown 96 m away). A clear response to pumping was not evident at the other monitoring wells (i.e. instantaneous response at pump start and pump shutdown) including 15-CH-1073A located in the deep bedrock aquifer.

The upper aquifer transmissivity was calculated at the PW16-1 Site using the Cooper-Jacob Straight Line Analysis. The analysis is shown on Figure H2 and the resulting transmissivity is 3 m^2/d at the pumping well and ranged from 8 m^2/d to 14 m^2/day at the monitoring wells. Based on the minimal drawdown observed at further distances from the pumping well, the zone of influence is estimated to be approximately 100 m.

6.2 PW16-2 Test

The 24-hour pumping test at PW16-2 was conducted at a rate of 33.2 L/min from September 1, 2016 at 12 pm to September 2, 2016 at 12 pm. The test was conducted under PTTW Number 3362-AANMYV. The pumped water was discharged through layflat hose to an old silt pond approximately 200 m west of the well (the pond was originally used for the settling of fine grain sediments).

6.2.1 Analysis of PW16-2 Test

A hydrograph of wells monitored during the PW16-2 pumping test is included on Figure H3 in Appendix H. The water levels in the pumping well drew down quickly at the start of the test and then declined at a slower rate after 60 minutes of pumping until the end of the test. After 24 hours of pumping, the water level in PW16-2 had drawn down approximately 11.6 m. A response to pumping was observed at monitoring wells MW16-2 (0.6 m of drawdown 9 m away) and at 15-CH-1071B (0.2 m of drawdown 102 m away). The water level in the deeper aquifer at 15-CH-1071A declined approximately 0.1 m during the test. It is not clear whether this response was due to pumping at PW16-1 or natural fluctuations within the aquifer. A clear response to pumping was not evident at the other monitoring wells (i.e. instantaneous response at pump start and pump shutdown). There was also no response to pumping in the wetland at the shallow piezometer MP16-2 (Figure H4 in Appendix H). The vertical gradient at MP16-2 remained upward during the test.

The upper aquifer transmissivity was calculated at the PW16-2 Site using the Cooper-Jacob Straight Line Analysis. The analysis is shown on Figure H5 and the resulting transmissivity is 44 m^2/d at the pumping well and approximately 87 m^2/d at the monitoring wells. Based on the minimal drawdown observed at further distances from the pumping well, the zone of influence is estimated to be approximately 200 m.

6.3 TW1 Test

The 24-hour pumping test at TW1 was conducted at a rate of 40.9 L/min from September 6, 2016 at 10:30 am to September 7, 2016 at 10:30 am. The test was conducted under PTTW Number 5371-AANS92. The pumped water was discharged through layflat hose to a low lying area approximately 120 m northwest of TW1.

6.3.1 Analysis of TW1 Test

A hydrograph of wells monitored during the TW1 pumping test is included on Figure H6 in Appendix H. The water levels in the pumping well drew down quickly at the start of the test and then declined at a slower rate after 50 minutes of pumping. Water levels in the pumping well stabilized after approximately 2 hours of pumping and remained relatively constant for the remainder of the test with the exception of some flow adjustments. After 24 hours of pumping, the water level in TW1 had drawn down approximately 9.3 m. A response to pumping was observed at monitoring wells OW1S (3 m of drawdown 8 m away), OW1D (1.7 m of drawdown 8 m away), OW2 (2.9 m of drawdown 13 m away) and at 15-CH-1078B (0.1 m of drawdown 100 m away). The water level in the deeper aquifer at 15-CH-1078A declined less than 0.1 m during the test. It is not clear whether this response was due to pumping at TW1 or natural fluctuations within the aquifer. A clear response to pumping was not evident at the other monitoring wells (i.e. instantaneous response at pump start and pump shutdown). There was also no response to pumping in the wetland at the shallow piezometer MP16-1 (Figure H7 in Appendix H). The vertical gradient at MP16-1 remained upward during the test.

The upper aquifer transmissivity was calculated at the TW1 Site using the Cooper-Jacob Straight Line Analysis. The analysis is shown on Figure H8 and the resulting transmissivity is 24 m^2/d at the pumping well and ranged from 22 m^2/d to 27 m^2/day at the monitoring wells. Based on the minimal drawdown observed at further distances from the pumping well, the zone of influence is estimated to be approximately 100 m.

6.4 On-Site Supply Well Test

The 24-hour pumping test at the On-Site Supply Well was conducted at a rate of 303 L/min from January 18, 2018 at 4 pm to January 19, 2018 at 4 pm. In addition, the well also operated for two 12-hour periods at a rate of 303 L/min to simulate a 2-day cycle of maximum pumping. The well was pumped on January 22 from 4:50 am to 4:50 pm and on January 23 from 3:50 am to 3:50 pm. The tests were conducted under PTTW Number 8280-AU7R5L. The pumped water was discharged through layflat hose approximately 220 m southwest into a low lying area.

6.4.1 Analysis of On-Site Supply Well Test

Hydrographs of wells monitored in the upper bedrock aquifer and lower bedrock aquifer during the On-Site Supply Well pumping test are included on Figures H9 and H10 in Appendix H, respectively. The water levels in the pumping well drew down quickly at the start of the test and then declined at a slower rate after 120 minutes of pumping. Water levels in the pumping well began to stabilize after 8 hours of pumping and remained relatively constant for the remainder of the test. After 24 hours of pumping, the water level in the On-Site Supply Well had drawn down approximately 16.6 m. Since the well straddles both the upper and lower bedrock aquifer, a response to pumping was observed in the monitoring wells in both aquifers. The response to pumping in the upper aquifer was observed at monitoring wells 12-CH-1069 (0.21 m), 12-CH-1070 (0.56 m), 15-CH-1075B (0.28 m), and 15-CH-1076B (0.83 m) and in the lower aquifer at monitoring wells 15-CH-1075A (1.46 m) and 15-CH-1076A (2.47 m). A clear response to pumping was not evident at the other monitoring wells (i.e. instantaneous response at pump start and pump shutdown).

During the two 12-hour pumping tests, a response to pumping was observed during in the same monitoring wells as during the 24-hour test (Figures H11 and H12 in Appendix H). During the 11 hours between the tests the static water levels returned to within 4 cm of the static water level prior to the 12-hour test. Prior to the 12-hour tests there was a melt event along with precipitation, which caused a rise in water levels in the area. The rise in water levels appears to be at the peak during the two 12-hour tests. Although there was an influence on water levels from the melt event and precipitation, the testing indicates that measurable drawdown from the testing is limited to within 500 m of the On-Site Supply Well.

The aquifer transmissivity was calculated at the On-Site Well Site using the Cooper-Jacob Straight Line Analysis for wells in both the upper and lower bedrock aquifers with the analysis shown on Figure H13. The resulting transmissivity is 36 m^2/d at the pumping well and ranged from 33 m^2/d to 39 m^2/day at the monitoring wells in the lower bedrock aquifer and ranged from 114 m^2/d to 222 m^2/day at the monitoring wells in the upper bedrock aquifer.

7.0 SURFACE WATER MONITORING

7.1 Surface Water Study Methodology

The following sections detail the methodologies used to complete the surface water studies at the Site.

7.1.1 Water Balance

The Meteorological Service Data Analysis and Archive division of Environment Canada (EC) provides monthly water budget summaries for meteorological stations with greater than 20 years of meteorological data. These water budgets include monthly values for all parts of the water budget (rainfall, snowmelt, potential evaporation, etc.) for each of the years in the historic record, as well as average monthly values over the entire record.

The water balance assessment was based on meteorological data from the EC Thornthwaite water budgets (Environment Canada averaged stations within the Site area between Guelph and Waterloo, Ontario between 1984 and 2013), watershed boundaries, land use data, and the existing soil types.

This method describes water flux in a unit area of soil on a monthly basis based on a balance of precipitation (rainfall and snowmelt), evapotranspiration (ET), soil storage, and surplus. The water budget can be summarized as follows:

$$P = S + ET + R + I$$

Where: P = precipitation;

S = change in soil water storage;

ET = evapotranspiration;

R = surface runoff; and,

I = infiltration (groundwater recharge).

The various water budget components associated with catchment areas are typically presented in millimetres (mm) over their respective sub-catchments and represent the amount of water per unit of watershed area. This amount is related to specific soil properties, including field capacity and wilting point.

The water budget model combines accumulated rainfall and snowmelt to estimate total precipitation. Rainfall represents precipitation when monthly mean temperatures are greater than 0°C. Snowmelt is initiated when snow is on the ground and monthly mean temperatures are greater than 0°C. Hence, snowmelt is based on the depletion of snow storage (accumulated precipitation during periods of sub-zero temperatures). Precipitation data collected at Guelph and Waterloo meteorological stations indicated a mean annual precipitation (P) of 865 mm/year.

The potential or maximum ET is estimated, in this case, by the empirical Thornthwaite equation (using average monthly temperature and hours of daylight) and represents the amount of water that would be evaporated or transpired under saturated soil-water scenarios. The actual ET is the total evapotranspiration for the period of study based on evapotranspiration demand, available soil-water storage, and the rate at which soil water is drawn from the ground (as defined by an established drying curve specific to the soil type). The mean annual potential ET for the study Site is approximately 600 mm/year based on data provided by EC.

Annual water surplus is the difference between P and the actual ET. The water surplus represents the total amount of water available for either surface runoff (R) or groundwater infiltration (I) on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snow-melt, and maximum soil or snow pack storage is exceeded. Maximum soil storage is quantified using a water holding capacity (WHC) specific to the soil type and land use.

7.1.1.1 Catchment Delineation

Site catchments were delineated using topographic mapping, site visits in 2016 and site boundary information as illustrated on Figures 10 to 12 and summarized in Table 1.

7.1.1.2 Water Balance Scenarios

Under existing conditions, the catchment is composed of wooded areas, pasture lands, open water ponds, open sand / gravel pit areas and impervious rooftop and parking areas (Figure 10).

Under operational conditions, the portion of the Site outside of the below water extraction (Initial Extraction Area) will remain similar to existing conditions (Figure 11). The quarry area within the below water extraction limit (Initial Extraction Area) is represented as bare bedrock under operational conditions.

Rehabilitated conditions were also considered in this study to identify the water surplus after excavation operations have ceased and the quarry is decommissioned. The rehabilitated condition considers the quarry area (Initial Extraction Area) fully ponded and the areas of above water extraction vegetated (Figure 12). The general drainage off-Site is not expected to change and all pumping will be ceased.

7.1.1.3 Water Balance Parameters

Soil information was taken from the 2012 Ontario Quaternary Soils Mapping. Soils at the Site are primarily Sandy Loam for the agricultural areas and Silt Loam for the wooded areas. Gravelly sand was assumed in the above water extraction areas, while bedrock was assumed in the below water extraction areas (under operational conditions).

The maximum soil storage is quantified using a Water Holding Capacity (WHC) that is based on guidelines provided in Table 3.1 of the Ministry of the Environment (MOE, now the Ministry of the Environment, Conservation and Parks (MECP)) Stormwater Management Planning and Design Manual (MECP, 2003), (MECP manual).

The WHC represents the total amount of water that can be stored in the soil capillaries and is defined as the water content between the field capacity and wilting point (the practical maximum and minimum soil water content, respectively).

WHCs are specific to the soil type and land use, whereby values typically range from approximately 10 mm for bedrock to 400 mm for mature forest over silt loam. For temperate region watersheds, soil storage is typically relatively stable year round, remaining at or near field capacity with the exception of the typical mid- to late-summer dry period. As such, the change in soil storage is a minor component in the water budget, particularly at an annual scale. Surplus water remains in the system after actual ET has been removed (ET demand is met) and the maximum WHC is exceeded (soil-water storage demand is met).

There are three main factors that determine the percent infiltration of the total surplus: topography, soil type and ground cover. The sum of the fractions representing the three characteristics establishes the approximate annual percentage of surplus which can be infiltrated in an area with a sufficient downward groundwater gradient.

Existing and proposed catchment areas are summarized by land use, WHC, soil type, and infiltration factor in Table 1.

Table 1: Summary of WHCs, Soil Types, and Infiltration Factors

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)
Open Water	N/A[1]	Water	Any	0 [2]
Wetland	N/A[1]	Water	Any	0
Impervious	3 mm	Roof, paved lots	Any	0.1
Gravel / Bare	75 mm	Gravel lot, open pit	Gravel	0.7
Vegetated/Agricultural	150 mm	Agricultural, pasture, shrubs	Gravel	0.85
Forest	300 mm	Forest	Gravel	0.9
Quarry	10 mm	Quarry	Bedrock	0

Notes: [1.]Surplus for ponded water was estimated as precipitation – PET
[2.] On Site ponds discharge. Therefore, the infiltration is estimated to be 0 %.

Existing surficial geology throughout the Site was assumed as sandy loam (i.e., Hydrological Soil Type B), given the gravel/sand encountered on surficial layers and overlaying bedrock. Based on the identified land uses (under existing, operational and rehabilitated conditions) and the recommendations included in Table 3.1 from the MECP manual (MECP, 2003), the selected Water Holding Capacities (WHCs) associated with soil type, land use activities and infiltration factors are as follows:

- *Moderately rooted crops* (i.e., Agricultural) and *pasture and shrubs* (i.e., Meadow) land covers were grouped as *Vegetated/Agricultural* type and assumed 150 mm WHC and infiltration factor of 0.85;

- *Mature forest* land cover assumed 300 mm WHC and infiltration factor of 0.9;
- *Bare areas* (i.e., pit) and gravel parcels (urban lawn) assumed 75 mm WHC and infiltration factor of 0.7;
- *Wetland and Open Water* assumed surplus equals Precipitation minus Potential Evapotranspiration (No WHC was applied);
- *Quarry* assumed as 10 mm WHC; and,
- *Impervious areas* assumed 3 mm WHC and infiltration factor as 0.1.

Annual infiltration was assumed to be zero for areas classified as wetlands, open water and quarry.

7.1.2 Baseflow Analysis

To provide an independent estimate of base flow rates, an automated base flow separation and recession analysis technique was employed. BFlow is a software package that is used to estimate the base flow from a stream flow record. BFlow uses a digital filter that is passed over stream flow data three times (forward, backward, forward) to provide estimates of base flow. Depending on the characteristics of the watercourse and its watershed, the user can select which pass represents the conditions most appropriately. Base flow is reduced approximately 17 percent by the second pass and a further 10 percent by the third (Arnold et al. 1995).

BFlow is an interpretative model that can process any numerical data input to the model. Therefore, the results produced by the model are an approximation and do not necessarily represent the actual component of base flow in stream flow data. Average daily flow rates are used as an input into BFlow and therefore seasonal variations can be estimated.

Two Water Survey of Canada (WSC) stations located on the Speed River near the Site were selected to perform a base flow analysis. The selected stations are located on the Speed River upstream and downstream of the Site. The base flow estimates for the two WSC Speed River gauge stations were then prorated to the two water level monitoring stations on the Speed River immediately adjacent to the Site (i.e., SW1 and SW3). The Speed River in the area of the Site is largely regulated, which causes low flows conditions (i.e. baseflow conditions) to be artificially high (supplemented with storage from Guelph Lake and waste water plant discharges). However, this baseflow analysis is still important to gain an understanding of the effects the quarry water taking will have under all conditions, including the regulated low flow conditions.

7.1.3 Surface Water Level Monitoring

Four surface water monitoring stations were established at the Site including two stations at the Speed River (upstream and downstream of the Site's discharge points), one monitoring station on-Site at the outlet of the Retention Pond, and one monitoring station on the stream which conveys flow from the southwest portion of the Site. The surface water stations, shown on Figure 2, correspond to:

- SW1: Speed River, downstream of the Lafarge Wellington County Site discharge;
- SW2: On-Site, at the outlet of the retention pond;
- SW3: Speed River, upstream of the Lafarge Wellington County Site discharge; and,
- SW4: On-Site, located on the small stream which drains the west portion of the Site.

Non-vented pressure transducers with dataloggers were installed at each monitoring station to provide a near continuous record of water levels. A datalogger was installed on-Site to measure barometric pressure and provide correction for atmospheric pressure. In addition, manual water levels were measured at the monitoring stations during monitoring visits at which time the pressure transducer dataloggers were downloaded.

7.1.4 Flow Monitoring

Flow monitoring was conducted at the two on-Site surface water stations (i.e., SW2 and SW4). Flow estimates were collected during quarterly Site visits. The discrete flow measurements were completed at each station using standard hydrometric methods for flow measurements in natural channels. The hydrometric methods, in general, follow the Hydrometric Field Manual – Measurement of Streamflow prepared by R.A. Terzi (1981). Flow measurements were taken using a Valeport Electromagnetic Meter Model 801 (or equivalent). The stream cross-sections were separated into multiple panels where the velocity and depth were measured. The depth was used to estimate the cross-sectional flow area in each panel across the stream. This area was multiplied by the average velocity in the section measured at 60% depth (or the 20% and 80% depth during high water level measurements) to estimate the flow in that panel. The sum of the flows in all of the panels yields the total flow at the station at the time of each measurement.

7.1.5 Surface Water Quality

Surface water samples were collected from each surface water monitoring station. Water quality samples were analyzed for in-situ parameters (temperature, conductivity, pH and dissolved oxygen) and submitted to an accredited laboratory for total suspended solids (TSS) and turbidity analysis.

7.2 Surface Water Study Results

The following sections detail the results of the surface water study at the Site.

7.2.1 Water Balance

The following sections detail the water balance analysis results for the existing, operational and rehabilitated scenarios at the Site.

7.2.1.1 Existing Conditions

Existing conditions were assessed based on existing information (topographic and digital imagery), which was combined with field observations to assess current drainage patterns. Under existing conditions, a total of six (6) sub-catchment areas were identified on Site (Figure 10). Detailed tables of the monthly water balance are included in Appendix E.

- **Catchment 1:** Partially extracted area, drainage occurs in a southern direction towards the Retention Pond, from where it discharged off-Site via a culvert (SW2).
- **Catchment 2:** Partially rehabilitated area which drains predominantly southeast towards the Speed River Wetland Complex via a ditch where SW4 is installed. There is a small portion of stripped area (active pit) in the south portion of the catchment. This area contributes to the drainage of Catchment 5.
- **Catchment 3:** This catchment area drains to an on-Site pond in a closed depression, where it infiltrates (no off-Site drainage).
- **Catchment 4:** This catchment area drains to an on-Site pond in a closed depression, where it infiltrates (no off-Site drainage).

- **Catchment 5:** This catchment drains the southwest corner of the Site, which is largely dominated by forest or wetland. This catchment receives runoff from catchment 2 and drains by gravity south to the Speed River.
- **Catchment 6:** This catchment drains by gravity south to the Speed River.

The results from the pre-development conditions water balance at each catchment are provided in Table 2 below.

Table 2: Water Balance Results under Existing Conditions

Catchment	Area	Runoff	Infiltration	Surplus
	(ha)	(m^3/yr)	(m^3/yr)	(m^3/yr)
Catchment 1 – Draining to Retention Pond (SW2)	27.8	29,000	60,000	89,000
Catchment 2 – Draining to local stream (SW4)	28.5	13,000	71,000	84,000
Catchment 3 – Draining to Infiltration Pond	70.1	53,000	159,000	212,000
Catchment 4 – Draining to Infiltration Pond	20.0	13,000	48,000	60,000
Catchment 5 – Draining to Speed River Wetland Complex	6.7	13,000	5,000	18,000
Catchment 6 – Draining to Speed River Wetland Complex	2.5	4,000	3,000	7,000
TOTAL	155.6	125,000	346,000	470,000

Note:[1.] Surplus is available runoff and infiltration based on the catchment area and Thornthwaite water budgets.
[2.] Infiltration estimate based on surplus.
[3.] Runoff estimate based on surplus.
[4.] Groundwater Seepage was excluded from the calculations.
[5.] Reported values are rounded to the nearest 1,000 m^3/year.

7.2.1.2 Operational Conditions

Operational conditions were assessed based on the approximate above (and below) water limit of extraction. Golder assumed that the area outside of the Initial Extraction Area would preserve the same land uses as under existing conditions. The area within the Initial Extraction Area was assumed as quarry (i.e., exposed bedrock). The quarry will drain the area of catchment 1 (see below). The drainage areas were, however, modified as result of the proposed extraction and changes in grading. The areas were reduced to five (5) catchments. Figure 11 shows the catchments and land uses considered in the water balance.

- **Catchment 1:** This catchment will drain the majority of the Site with all the runoff collected in the Initial Extraction Area within the catchment.
- **Catchment 2:** This catchment will drain predominantly southeast towards the Speed River Wetland Complex via a small stream where SW4 is installed. There is a small portion of stripped area (active pit) in the south portion of the catchment. This area contributes to the drainage of Catchment 4.
- **Catchment 3:** This catchment will drain the Site area east of the Sideroad 10 North access lane. The drainage within this catchment will collect at an on-Site pond in a closed depression, where it will infiltrate (no off-Site drainage).

- **Catchment 4:** This catchment will drain the southwest corner of the Site largely dominated by forest or wetland. This catchment will drain, by gravity, south to the Speed River.
- **Catchment 5:** This catchment area will drain by gravity south to the Speed River.

Table 3 presents the results of the water balance under operational conditions. Detailed tables of the monthly water balance are included in Appendix E.

Table 3: Water Balance Results under Operational Conditions

Catchment	Area	Runoff	Infiltration	Surplus
	(ha)	(m^3/yr)	(m^3/yr)	(m^3/yr)
Catchment 1 – Quarry (dewatered)	99.4	254,000	100,000	355,000
Catchment 2 – Draining to local stream (SW4)	27.0	13,000	67,000	80,000
Catchment 3 – Draining to Infiltration Pond	15.8	10,000	37,000	48,000
Catchment 4 – Draining to Speed River Wetland Complex	6.7	13,000	5,000	18,000
Catchment 5 – Draining to Speed River Wetland Complex	2.5	4,000	3,000	7,000
TOTAL	151.4	294,000	212,000	508,000

Note: 1. Surplus is available runoff and infiltration based on the catchment area and Thornthwaite water budgets.
2. Infiltration estimate based on surplus.
3. Runoff estimate based on surplus.
4. Groundwater Seepage was excluded from the calculations.
5. Reported values are rounded to the nearest 1,000 m^3/year.

Under operational conditions, the total annual surplus for the entire property would be increased by approximately 40,000 m^3/year compared to existing conditions, representing an increment of 8%, as a result of land use changes (due to the lower water holding capacity, there is less opportunity for evapotranspiration of water) resulting from quarrying activities. Total Site infiltration is expected to be reduced by 134,000 m^3/year (39%). The total Site runoff is expected to increase by 169,000 m^3/year, which is equivalent to an increment of 135% in comparison to existing conditions.

7.2.1.3 Rehabilitated Conditions

Rehabilitated conditions were assessed assuming that the area corresponding to extraction below the water level would be ponded water. Areas classified as bare gravel during operational conditions are assumed to be vegetated. The drainage pattern is assumed to be the same as under operational conditions. Figure 12 shows the catchments and land uses considered in the water balance under rehabilitated conditions.

- **Catchment 1:** This catchment will drain the majority of the Site with all the runoff collected in the rehabilitated quarry area (pond) within the catchment.
- **Catchment 2:** This catchment will drain predominantly southeast towards the Speed River Wetland Complex via a small stream where SW4 is installed. This area contributes to the drainage of Catchment 4.

- **Catchment 3:** This catchment will drain the Site area east of the Sideroad 10 North access lane. The drainage within this catchment will collect at an on-Site pond in a closed depression, where it will infiltrate (no off-Site drainage).
- **Catchment 4:** This catchment will drain the southwest corner of the Site largely dominated by forest or wetland. This catchment will drain by gravity south to the Speed River.
- **Catchment 5:** This catchment area will drain by gravity south to the Speed River.

Table 4 presents the results of the water balance under rehabilitated conditions. Detailed tables of the monthly water balance are included in Appendix E.

Table 4: Water Balance Results under Rehabilitated Conditions

Catchment	Area	Runoff	Infiltration	Surplus
	(ha)	(m^3/yr)	(m^3/yr)	(m^3/yr)
Catchment 1 – Rehabilitated Quarry (pond)	99.4	177,000	106,000	283,000
Catchment 2 – Draining to local stream (SW4)	27.0	12,000	67,000	79,000
Catchment 3 – Draining to Infiltration Pond	15.8	8,000	33,000	41,000
Catchment 4 – Draining to Speed River Wetland Complex	6.7	13,000	5,000	18,000
Catchment 5 – Draining to Speed River Wetland Complex	2.5	4,000	3,000	7,000
TOTAL	151.4	214,000	214,000	428,000

Note:[1.] Surplus is available runoff and infiltration based on the catchment area and Thornthwaite water budgets.
[2.] Infiltration estimate based on surplus.
[3.] Runoff estimate based on surplus.
[4.] Groundwater Seepage was excluded from the calculations.
[5.] Reported values are rounded to the nearest 1,000 m^3/year.

Under rehabilitated conditions the total annual surplus for the entire property would be decreased compared to existing conditions by approximately 40,000 m^3/year representing an increment of 9% (compared to existing conditions) due to the higher loss of water as a result of increased evaporation occurring from the larger ponded water surface. The infiltration would be reduced by approximately 132,000 m^3/year (38%). The total runoff would be increased by approximately 89,000 m^3/year, which is equivalent to an increment of approximately 71% in comparison with existing conditions.

7.2.2 Base Flow Analysis

The characteristics and results of the base flow analysis are summarized in Table 5. The base flow at the SW1 and SW3 stations was estimated based on the measured flow data at station 02GA047 (Speed River at Cambridge) prorated to account for the drainage area reporting to stations SW1 and SW3, respectively. The catchment areas at stations SW1 and SW3 were estimated using the Ontario Flow Assessment Tool III (OFAT III), confirmed with topographic data and field observations. Table 5 presents the average measured and estimated base flows at the selected WSC stations (02GA015 and 02GA047) and stations SW1 and SW3.

Table 5: Base Flow Estimates

Station	Area (km^2)	Average Flow (m^3/s)	Base Flow [6] (m^3/s)
02GA015 - Speed River Below Guelph	567.86 [1]	6.13 [3]	3.35
SW3 – Upstream of discharge point	625.35 [2]	7.33 [4]	4.26
SW1 – Downstream of discharge point	631.43 [2]	7.40 [4,5]	4.30
02GA047 - Speed River at Cambridge	761.59 [1]	8.92 [5]	5.18

Notes:
1. Area according Water Survey of Canada (WSC) website
2. Area estimated using the OFAT III tool and confirmed with topographic data and field observations.
3. Average base flow for the period of record (January 2012 to December 2015).
4. Estimated prorated flow based on WSC station 02GA047.
5. Average flow for the period of record (January 2012 to December 2015).
6. Base flow estimated using BFlow tool third pass.

The Speed River base flow estimates (Table 5) are slightly higher than would normally be expected in a river of this size and average flow. The base flow estimates are thought to be higher than normal because of the municipal discharges and reservoir controls upstream of the gauging stations and the Site. These controls limit the river flow peaks which are stored and released under drier conditions. These activities generate higher than normal base flows in the Speed River adjacent to the Site. This baseflow analysis is still important to estimate the potential effects that the Site may have on the low flow in the Speed River.

7.2.3 Surface Water Level Results

Water level hydrographs for surface water stations are shown on Figures F1 to F4 in Appendix F. Surface water levels have been continuously monitored (at one-hour intervals) from November 11, 2015 to November 24, 2016 (with the exception of SW4 which was monitored until May 2019).

The Speed River hydrographs (stations SW1 and SW3) show water levels which range approximately 1.6 m (between peaks and low water levels). The Speed River hydrographs are marked by high water level peaks associated with melt events that extend through the spring. These stations also mark precipitation runoff events throughout the summer and fall of the record. These precipitation responses typically have peaks 0.2 to 0.3 m high and pass quickly (within a day or two).

The water level hydrograph at SW2 is marked by what appears to be sporadic water level increases and event responses fluctuating in range of approximately 0.3 m. Some of these event responses are driven by precipitation events while a number of the water level increases that do not follow the typical peak and regression are in response to debris buildup at the outlet of the retention pond (i.e., vegetation debris and beaver activity). For these reasons, the water level hydrograph does not represent fluctuations in outlet flows but merely changes in pond levels caused by both precipitation and outlet blockage.

The SW4 water level hydrograph is marked by large peak events during snow melt, which may have also been influenced by ice in the channel (approximately 0.25 m of water level increase). The remainder of the hydrograph is marked by precipitation event responses that include water level increases typically 0.05 – 0.1 m in magnitude

and then recede rapidly. Overall the water level hydrograph at SW4 is stable and experience little seasonal variability and likely receives flow from a stable source (potentially groundwater influenced).

7.2.4 Flow Monitoring

Instantaneous flow measurements were collected at SW2 and SW4. The measurements were collected over a one year period from November 2015 to November 2016 and are summarized in Table 6.

Table 6: Instantaneous Flow Measurements

Date	Flow (L/s)	
	SW2	SW4
November 11, 2015	6.5	6.5
January 25, 2016	1.9	--[1]
February 22, 2016	4.3	1.6
April 27, 2016	3.0	2.5
May 25, 2016	0.6	10.2
June 30, 2016	6.4	6.0
August 22, 2016	0.6	7.7
September 27, 2016	0.9	3.7
November 24, 2016	--[2]	2.0

Notes: [1.] Channel ice conditions
[2.] Meter malfunction

The maximum instantaneous flow measurement for SW2 was observed in November of 2015, while the maximum measurement at SW4 was observed in May 2016. The minimum instantaneous flows at SW2 were observed in in the summer of 2016 while the minimum measurements at SW4 were observed in the winter of 2016.

7.2.5 Surface Water Quality

Water quality sampling was completed at each of the four surface water monitoring stations (i.e., SW1 – SW4). In situ measurements were completed for pH, temperature and conductivity since January 2016. Sample sets were collected in August 2016 and sent to Maxxam Laboratories for analysis of TSS and turbidity. A summary of water quality results can be found in Table G1 in Appendix G and laboratory reports are included in Appendix G.

All pH measurements were within the 6.5 – 8.5 PWQO. While the temperature measurements ranged from 0.4 °C to 26 °C, and conductivity ranged from 689 µS to 1410 µS. Turbidity and TSS readings were generally low and did not exceed 2.1 NTU and were <10 mg/L, respectively.

8.0 NATURAL ENVIRONMENT

Prior to the proposed quarry extraction and dewatering, the land within the extraction limit will be cleared. As such, the description of the baseline conditions focusses on the Study Area (defined below) and the assessment of the proposed dewatering and water taking are limited to potential adverse effects to off-Site functions and features. The assessment of the aggregate extraction is outside the scope of this evaluation and is not discussed further in this report.

For the purpose of the natural environment investigation, the Site is defined as the total land area within the property owned by Lafarge that is licenced under the ARA. The licenced area is 142.43 hectares (ha). The Study Area is defined as the area 500 m around the Site, which is the anticipated extent of groundwater drawdown due to dewatering of the Wellington County Site. Further detail on the dewatering and predicted zone of influence is presented in Section 9 and potential adverse effects on the natural environment from dewatering are presented in Section 11.

8.1 Methods

8.1.1 Background Review

The investigation of existing conditions in the Study Area included a background information search and literature review to gather data about the local area and provide context for the evaluation of the natural features. Sources included:

- Natural Heritage Information Centre (NHIC) database, maintained by the MNRF (NHIC 2016);
- Land Information Ontario (LIO) geospatial data (MNRF 2018a);
- Species at Risk Public Registry (ECCC 2018);
- Species at Risk in Ontario (SARO) List (MNRF 2018b);
- Breeding Bird Atlas of Ontario (OBBA) (Cadman et al. 2007);
- Atlas of the Mammals of Ontario (Dobbyn 1994);
- Ontario Reptile and Amphibian Atlas (Ontario Nature 2016);
- Bat Conservation International (BCI) range maps (BCI 2016);
- Ontario Butterfly Atlas (Jones et al. 2016);
- eBird species maps (eBird 2012);
- Aquatic Resources Area Layer (MNRF 2018c);
- Fish ON-Line (MNRF 2018d);
- County of Wellington Official Plan (2016);
- State of the Watershed Report – Background Report on the Health of the Grand River Watershed 1996-97 (GRCA 1998);
- Draft Grand River Characterization Report (LESPRTT 2008);

- A Watershed Forest Plan for the Grand River (GRCA 2004);
- Grand River Conservation Authority (GRCA) Watershed Information: Grand River Information Network (GRCA 2016a); and,
- Aerial imagery.

8.1.2 SAR Screening

SAR considered for this report include those species listed under the Ontario *Endangered Species Act* (ESA: Ontario 2007) and the federal *Species at Risk Act* (SARA: 2002). An assessment was conducted to determine which SAR had potential habitat in the Study Area. A screening of all SAR which have the potential to be found in the vicinity of the Study Area was conducted first as a desktop exercise using the sources listed in Section 8.1.1. Species with ranges overlapping the Study Area, or recent occurrence records in the vicinity, were screened by comparing their habitat requirements to habitat conditions in the Study Area.

The potential for the species to occur was determined through a probability of occurrence. A ranking of low indicates no suitable habitat availability for that species in the Study Area and no specimens identified. Moderate probability indicates more potential for the species to occur, as suitable habitat appeared to be present in the Study Area, but no occurrence of the species has been recorded. Alternatively, a moderate probability could indicate an observation of a species, but there is no suitable habitat on the Site or in the Study Area.
High potential indicates a known species record in the Study Area (including during the field surveys or background data review) and good quality habitat is present.

Searches were conducted during the field surveys (described below) for suitable habitats and signs of all SAR identified through the desktop screening. The potential for the species to occur in the Study Area was refined based on the results of the field surveys. Any habitat identified during the field surveys with potential to provide suitable conditions for additional SAR not already identified through the desktop screening was also assessed and recorded.

8.1.3 Field Surveys

The terrestrial and aquatic features in the Study Area were characterized through field surveys, where access was possible. The following sections outline the methods used for each of the field surveys. During all surveys, area searches were conducted, and additional incidental wildlife, plant, and habitat observations were recorded. Searches were also conducted to document the presence or absence of suitable habitat, based on habitat preferences, for those species identified in the desktop SAR screening described above. Although a qualitative habitat assessment was completed, existing published data as listed in Section 8.1.1 were used to describe the Speed River and the fish community.

The dates when all surveys were conducted are included in Table 7.

Table 7: Dates of Field Surveys Conducted in the Study Area

Survey Type	Date
Breeding bird survey, wildlife visual encounter survey (VES)	May 25, 2016
Breeding bird survey, wildlife VES, plant community survey	July 4, 2016
Plant community survey, wildlife VES, aquatic habitat assessment	September 23, 2016

8.2 Existing Conditions

8.2.1 Plant Communities

It was noted that there are wetland communities at the southern edge of the Site, including some that are contiguous with the Speed River provincially significant wetland (PSW) off-Site, within the Study Area, to the south. There are also several residential properties off-Site in the eastern portion of the Study Area that have small areas of associated meadow and forest.

During field surveys conducted in the Study Area, off-Site, nine plant communities were identified. These communities are shown on Figure 13 and are briefly described in Table 8.

All of the plant species identified through the field surveys are secure and common in Ontario and globally (S4 or S5; G4 or G5). None of the plant species identified in the SAR screening as having ranges which overlap the Study Area were observed during field surveys (Appendix I).

Table 8: Plant Communities in the Study Area

Plant Community	Description	SRRANK[1]
ANTHROPOGENIC		
AGRC Agricultural Row Crop	There are fields planted in row crop in the Study Area, east, west and north of the Site.	n/a
AGRH Agricultural Crop (Hay)	Based on a desktop assessment of available imagery (MNRF 2018a), there is one hay field off-Site, north of Highway 124.	n/a
CUM Open meadow	Areas of open meadow occur in several locations off-Site in the Study Area and are primarily associated with residential properties.	n/a

Plant Community	Description	SRRANK[1]
CONIFEROUS FOREST		
FOC4-1 Fresh to Moist White Cedar Coniferous Forest	This semi-mature forest community is located at the southwestern corner of the Site. It is contiguous with a larger forested swamp off-Site. The canopy is primarily closed and dominated by eastern white cedar. The understory and ground cover are sparse and composed of species such as glossy buckthorn (*Rhamnus frangula*) and garlic mustard (*Alliaria petiolate*). Although the soils appear to be moist at times, they are not wet enough for a long enough period to be considered swamp. Downed woody debris and snags are occasional.	S5
MIXED FOREST		
FOM Mixed Forest	Two areas of mixed forest occur off-Site in the eastern portion of the Study Area. One area of open, mixed forest surrounds a residential property. The other area of mixed forest has a denser canopy cover and is located between the Speed River PSW and residential areas and an agricultural field.	n/a
WETLAND		
MAS Mineral Shallow Marsh	Areas of marsh, primarily dominated by cattails (*Typha* sp.), mixed herbs, grasses, and sedges, with shrubs such as willow, dogwood (*Cornus* spp.), raspberry (*Rubus idaeus*) and some white cedar in the Speed River Wetland Complex south of the Site (Coulson et al. 1986).	n/a
SWC1-1 White Cedar Mineral Coniferous Swamp	This semi-mature forested swamp is located at the southern edge of the Site. It is contiguous off-Site with the larger PSW along the Speed River. The partially closed canopy is dominated by an almost pure stand of eastern white cedar. The understory and groundcover is moderately dense and includes species such as bulblet fern (*Cystopteris bulbifera*) and fowl manna grass (*Glyceria striata*). Although no areas of open water were observed during the field surveys, vernal pools may occur in spring. Snags are occasional and downed woody debris is abundant.	S5
SWC2-1 White Cedar Organic Coniferous Swamp	This community is another small piece of the larger PSW that is contiguous off-Site. It is a mix of treed swamp, interspersed with open marshy areas. Trees include species such as eastern white cedar and white elm (*Ulmus americana*). The understory and marshy areas include species such as slender willow (*Salix petiolaris*), common cattail (*Typha latifolia*), and soft rush (*Juncus effusus*). No areas of open water were observed during the field surveys, however, flooding likely occurs during periods of high water. Snags and downed woody debris are occasional.	S5

Plant Community	Description	SRRANK[1]
SWC / SWD Coniferous Swamp / Deciduous Swamp	A mosaic of coniferous and deciduous swamp communities, dominated by white cedar, willows, poplar (*Populus* sp.), maple (*Acer* sp.), white birch (*Betula papyrifera*), black ash (*Fraxinus nigra*), speckled alder (*Alnus incana*), and dogwoods, that compose the Speed River Wetland Complex south of the Site (Coulson et al. 1986).	n/a

[1] An SRANK is a provincial – level rank indicating the conservation status of a species or plant community and is assigned by the NHIC in Ontario (NHIC 2018). SRANKs are not legal designations but are used to prioritize protection efforts in the Province. SRANKs for plant communities in Ontario are defined in the Significant Wildlife Habitat Technical Guide (MNR 2000). Ranks 1-3 are considered extremely rare to uncommon in Ontario; Ranks 4 and 5 are considered to be common and widespread.
n/a = indicates a community that has not been ranked, which often applies to anthropogenic, culturally-influenced or high-level ELC communities (e.g., FOC).

8.2.2 Wildlife

Seven SAR were observed in the Study Area during the field surveys. Two of the SAR were bird species designated as threatened under the ESA, including eastern meadowlark (*Sturnella magna*), and barn swallow (*Hirundo rustica*). The remaining five species are designated as special concern under the ESA and include eastern wood-pewee (*Contopus virens*), wood thrush (*Hylocichla mustelina*), grasshopper sparrow (*Ammodramus savannarum*), snapping turtle (*Chelydra serpentina*), and monarch (*Danaus plexippus*).

The remainder of the wildlife species observed in the Study Area during the field surveys are provincially ranked S4 (apparently secure – uncommon, but not rare), S5 (secure – common, widespread and abundant in the province), or SNA (not applicable – species is not a target for conservation).

Lafarge has complied with all of the provisions of the ESA for any SAR habitat on the site.

8.2.3 Fish and Fish Habitat in Speed River

The majority of the Site is spatially separated from the Speed River by the Speed River PSW complex (Figure 13). The separation distance varies between 50 and 500 m along the southern Site boundary, but generally increases towards the east. In two locations, the Site boundary extends south to meet the top-of-bank of the Speed River (Figure 13).

The Speed River is a large river approximately 35 m wide and 0.6 m deep and has both riffle and run morphological features. The Speed River is known to have a cool / warmwater thermal regime (GRCA 1998). Although no fish were observed in the river during field surveys, species including smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), bullhead (*Ameiurus* spp.), carp and panfish are known to occur in the lower reaches of the Speed River below the Guelph Dam (GRCA 2016b).

Flow in the lower reaches of the Speed River, within the Study Area, is regulated by the Guelph Dam (LESPRTT 2008). Overall water quality in the lower reaches are impaired and generally of a lower quality than the upper reaches, upstream of the Guelph Dam. Chloride levels are high in the lower Speed River as a result of road salt and water softener discharge. Phosphorus levels are also high in the lower reaches and often exceed water quality guidelines (LESPRTT 2008).

8.3 Assessment of Significant Natural Heritage Features

The following sources were used during the assessment of natural heritage features and functions in the Study Area:

- Natural Heritage Reference Manual (NHRM; MNR 2010);
- Significant Wildlife Habitat Technical Guide (SWHTG; MNR 2000);
- Significant Wildlife Habitat Mitigation Support Tool (SWHMiST; MNRF 2014); and,
- Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (MNRF 2015).

8.3.1 Significant Wetlands

A portion of the provincially significant Speed River Wetland Complex overlaps the majority of the southern Study Area (Figure 13). The Speed River PSW is approximately 546 ha in size and extends for several km east and west along the Speed River. Based on the PSW evaluation report (Coulson et al. 1986), the Speed River PSW is primarily composed of swamp with a small shallow marsh component and has a catchment basin of 726 km^2. Soils are an equal mix of clays/loams/silts, organics and undesignated (i.e., open water areas).

No provincially significant plant or animal species were identified in the PSW during the evaluation process completed in 1986. However, several regionally significant species, including black duck (*Anas rubripes*), osprey (*Pandion haliaetus*), interrupted fern (*Osmunda claytoniana*), walking fern (*Asplenium rhizophyllum*), and closed gentian (*Gentian andrewsii*) were identified in the PSW. The PSW was also evaluated to provide several different types of wildlife habitat. The PSW has regionally significant habitat for waterfowl staging and deer winter cover, and locally significant habitat for waterfowl production (Coulson et al. 1986).

Based on field surveys, and data from the Speed River PSW evaluation report, the wetland is comprised of fairly tolerant wetland types (i.e., swamp and marsh) with dominant vegetation species that are tolerant of minor fluctuations in the water regime (e.g., white cedar). There are no wetland types that are particularly sensitive to disturbances in the Speed River PSW (i.e., fen or bog).

A non-significant wetland, the Guelph Southwest Wetland Complex, is located approximately 800 m north of the Site. This wetland is outside of the predicted zone of influence (as described in Section 9) and is not expected to be impacted by the proposed dewatering (Figure 14).

It is important to note that while the licence boundary (Figure 14) includes sections of wetland features, these are not part of the extraction area and no development is planned in these areas. Potential adverse effects to the Speed River PSW from the proposed dewatering and discharge, are discussed in Section 11.5.

8.3.2 Habitat of Endangered or Threatened Species

Barn swallow, bobolink and eastern meadowlark or their associated habitats will not be adversely impacted by the proposed dewatering or discharge, so are not discussed further.

Chimney swift, designated threatened under the ESA, was assessed to have a low to moderate potential to occur in the Study Area. Large diameter trees in the Speed River PSW south of the Site may provide suitable nesting habitat. In addition, there is recent documentation of chimney swift along the Speed River within the Study Area (eBird 2012). Because the Speed River PSW has potential to be impacted by the proposed dewatering and discharge, chimney swift habitat is carried forward to the impact assessment (Section 11.6).

Although there are no recent occurrence records for Blanding's turtle, designated threatened under the ESA in the Study Area, there is suitable habitat in the Speed River PSW. Because the Speed River PSW within the Study Area has potential to be impacted by the proposed dewatering and discharge, Blanding's turtle habitat is carried forward to the impact assessment (Section 11.6).

Tri-colored bat, northern myotis and little brown myotis are all designated endangered under the ESA and were assessed to have a moderate potential to occur in the Study Area. The forested areas in the Speed River PSW south of the Site may provide suitable roosting habitat for these three bat species and the open water of the Speed River may provide foraging habitat (Figure 13). Several snag trees with cavities and other large trees were observed in the swamp of the Speed River PSW during field surveys. Because the Speed River PSW within the Study Area has potential to be impacted by the proposed dewatering and discharge, habitat for tri-colored bat, northern myotis and little brown myotis is carried forward to the impact assessment (Section 11.6).

No other species designated threatened or endangered under the ESA were assessed to have a moderate or high potential to occur in the Study Area based on the results of the SAR screening (Appendix I).

8.3.3 Fish Habitat

Because the Speed River within the Study Area has potential to be impacted by the proposed dewatering and discharge, fish habitat is carried forward to the impact assessment (Section 11.7).

8.3.4 Significant Woodlands

Areas of forest off-Site, within the Study Area, extend several km west and east along the Speed River (Figure 13). This combined area of forest is larger than 4 ha and meets the County's and the province's criteria to be considered a significant woodland.

Although no trees will be removed off-Site, because the Speed River PSW within the Study Area has potential to be impacted by the proposed dewatering and discharge, significant woodlands are carried forward to the impact assessment (Section 11.8).

8.3.5 Significant Valleylands

The valleyland associated with the Speed River in the Study Area is located within the predicted zone of influence of groundwater drawdown (see Figure 13 and Section 9). Because the valleyland, has potential to be impacted by the proposed dewatering and discharge, significant valleylands are carried forward to the impact assessment (Section 11.9).

8.3.6 Significant Areas of Natural or Scientific Interest (ANSIs)

There are no ANSIs in the Study Area and no further analysis is warranted.

8.3.7 Significant Wildlife Habitat

There are four general types of significant wildlife habitat: seasonal concentration areas, migration corridors, rare or specialized habitats, and species of conservation concern. The specific habitats considered in this report are evaluated based on the criteria outlined in the Ecoregion 6E Criterion Schedule (MNRF 2015). All types of SWH are discussed below in relation to the Study Area.

8.3.7.1 Seasonal Concentration Areas

The swamp communities (SWD/SWC) in the Speed River PSW in the Study Area may provide suitable bat maternity colony habitat. Open water in the Speed River to the south of the swamp may also provide foraging

habitat and increases the habitat suitability of the swamp (Figure 13). Several snag trees with cavities were observed in the Speed River PSW during field surveys, and it is likely the Speed River PSW contains greater than 10 snags/ha to qualify as a candidate bat maternity colony.

The Speed River PSW is designated as a Deer Wintering Area (Stratum 2).

Because the Speed River PSW within the Study Area has potential to be impacted by the proposed dewatering and discharge, bat maternity colony and deer wintering area SWH is carried forward to the impact assessment (Section 11.10).

8.3.7.2 Migration Corridors

The Speed River PSW in the Study Area likely functions as a movement corridor for both large mammals (e.g., deer) and smaller fauna (e.g., amphibians and reptiles) in the region. The Speed River PSW extends for several km south into Cambridge and is connected to several smaller stream and valley corridors.

Although no trees will be removed in the Study Area, the Speed River PSW has potential to be impacted by the proposed dewatering and discharge, so migration corridor SWH is carried forward to the impact assessment (Section 11.10).

8.3.7.3 Specialized Habitats

The Speed River PSW in the Study Area may provide woodland amphibian breeding habitat. Because the Speed River PSW has potential to be impacted by the proposed dewatering and discharge, woodland amphibian breeding habitat SWH is carried forward to the impact assessment (Section 11.10).

8.3.7.4 Rare Habitat

There is no rare habitat in the Study Area, and no further analysis is warranted.

8.3.7.5 Habitat for Species of Conservation Concern

Habitat for species of conservation concern (SOCC) includes habitat for three groups of species:

- Species that are rare, those whose populations are significantly declining, or have a high percentage of their global population in Ontario;
- Species listed as special concern under the ESA; and
- Species listed as threatened or endangered under SARA.

Ten SOCC (snapping turtle, western chorus frog, eastern ribbonsnake, common nighthawk, ram's-head lady's-slipper, harbinger-of-spring, monarch, eastern wood-pewee, grasshopper sparrow, and wood thrush) were assessed to have moderate to high potential to occur in the Study Area based on the SAR screening (Appendix I).

The Speed River and Speed River PSW south of the Site provides suitable habitat for snapping turtle, designated special concern under the ESA. Because the Speed River and Speed River PSW within the Study Area have potential to be impacted by the groundwater regime as a result of the proposed dewatering, snapping turtle is carried forward to the impact assessment (Section 11.10).

There is potential habitat for the following species in the Speed River PSW to the south of the Site: wood thrush (designated special concern under the ESA and observed in the Study Area), eastern wood-pewee (designated special concern under the ESA), western chorus frog (designated threatened under SARA), eastern ribbonsnake

(designated special concern under the ESA and SARA), ram's-head lady's-slipper and harbinger-of-spring (both with a provincial rarity rank of S3 [vulnerable]). Although no direct removal of potential habitat will occur off-Site in the Study Area, the Speed River PSW within the Study Area has potential to be impacted by the proposed dewatering and discharge, so these species are carried forward to the impact assessment (Section 11.10).

Common nighthawk (*Chordeiles minor*) is designated special concern under the ESA and threatened the SARA. Areas of fallow meadow habitat associated with residential properties east and west of the Site may provide suitable habitat. However, there are no recent occurrence records in the Study Area. Suitable open or shrub meadow and edge habitat in the Study Area may provide suitable host or foraging plants for monarch (designated special concern under both the ESA and the SARA), and individuals were observed during field surveys. Agricultural fields in the Study Area may provide suitable habitat for grasshopper sparrow (designated special concern under both the ESA and the SARA), and individuals were observed during field surveys. Meadow and edge habitats and agricultural fields in the Study Area are not expected to be impacted by the proposed dewatering and discharge, and no further analysis is warranted.

9.0 QUARRY DEWATERING ESTIMATE

In order to support the bedrock excavation, the groundwater levels in the vicinity of the quarry will need to be depressed to the bottom of the quarry floor (estimated to be 285 masl) or slightly below. Based on a high water table of 305 masl along the upgradient side of the quarry and 300 masl along the downgradient side of the quarry, up to 20 m and 15 m of groundwater drawdown may be required at Site, respectively. The following groundwater control measures are expected in support of the quarry operation:

- The excavation within the licenced area (Initial Extraction Area) will occur to a depth of 285 masl and will remain above the Vinemount Member of the Eramosa Formation;
- Pumping from a sump within the quarry will be used to control groundwater inflow. The sump will be located in the southeast corner of the Initial Extraction Area near PW16-1 at an elevation slightly below 285 masl but above the Vinemount Member of the Eramosa Formation;
- Surface water runoff should be directed away from any open excavation where possible;
- Water pumped from the quarry during excavation will be diverted to the Speed River and the adjacent Provincially Significant Wetlands if required for mitigation purposes. Environmental Compliance Approval will be required for the discharge as described in Section 15.3;
- If a significant fracture is encountered connecting the quarry to the Speed River, the fracture will need to be grouted to reduce the inflow of water into the quarry; and,
- Quarry dewatering will begin at lower pumping rates during the initial quarrying and increase as the size of the quarry increases.

9.1 Predicted Zone of Influence of Quarry Dewatering

The concept of hydraulic efficiency is expected to be encountered at the quarry-rock wall interface during quarry dewatering operations. On the quarried side of the rock wall, the water table will be pumped down to maintain a quarry floor of approximately 285 masl. The water level in the bedrock outside of the quarried area may approach the pumping elevation, however, considering the relatively low transmissivity of the bedrock, it will likely remain

higher than the dewatering elevation. This is typically observed in other quarries as groundwater seepage occurs along sections of the bedrock walls. Assuming a conservative estimate of 85% hydraulic efficiency, the theoretical water level outside of the quarry walls is expected to be 288 masl on the upgradient side of the quarry and 287 masl on the downgradient side of the quarry. This would result in approximately 17 m and 13 m of drawdown on the upgradient and downgradient sides of the quarry, respectively. Assuming a transmissivity of 20 m^2/d to 40 m^2/d (average range from pumping tests) and applying the Theis equation over a 90-day period (assuming the aquifer is recharged within this period), the predicted zone of quarry dewatering is expected to extend laterally to a maximum distance of approximately 350 m to 500 m, with significant drawdown (greater than approximately 1 m) limited to within 150 m to 250 m from the quarry wall. The extent of drawdown on the southern part of the quarry will be intercepted by the Speed River and thus have a smaller zone of influence.

9.2 Estimated Pumping Rate Required for Quarry Dewatering

This section provides an estimate of the pumping rate required to maintain drained conditions within the quarry during excavation. The pumping rate required to adequately dewater the upper bedrock to approximately 285 masl was estimated using two separate equations, Darcy's Law and Jacob's modified non-equilibrium equation.

9.2.1 Darcy's Law

Groundwater flow into the proposed quarry will include the following components:

1) horizontal flow through the bedrock walls (upgradient and downgradient); and,

2) groundwater upwelling from deeper hydrogeologic formations.

According to Darcy's Law, the volumetric discharge rate horizontally (Qh) and vertically (Qv) into the quarry area can be calculated by the following equations:

Q_h (upgradient) = T I_h L, where:

T = transmissivity of the Guelph Formation/Reformatory Quarry Member (40 m^2/day)

I_h = horizontal hydraulic gradient across the Site (0.04 m/m)

L = perimeter length of bedrock wall (approximately 1,700 m)

Q_h (downgradient) = T I_h L, where:

T = transmissivity of the Guelph Formation/Reformatory Quarry Member (40 m^2/day)

I_h = horizontal hydraulic gradient across the Site (0.02 m/m)

L = perimeter length of bedrock wall (approximately 2,000 m)

Q_v = K I_v A, where:

K_v = vertical hydraulic conductivity of the Vinemount Formation ($9x10^{-4}$ m/day) – conservative compared to $9x10^{-5}$ m/day from the Guelph Tier 3 Study.

I_v = vertical hydraulic gradient across the Vinemount Member when water levels are lowered to 285 masl in the upper bedrock (assume 3.0 m/m – range from multi-level wells where Vinemount Member is present is approximately 1.3 m/m to 3.0 m/m).

A = cross-sectional area of quarry floor (512,500 m^2).

Applying Darcy's Law, the horizontal (Q_h) and vertical (Q_v) flow rates into the proposed quarry is predicted to be approximately 4,320 m^3/day and 1,384 m^3/day, respectively. The total flow rate into the quarry area is therefore estimated to be approximately 5,704 m^3/day by Darcy's Law. This conservative estimate has assumed the vertical hydraulic conductivity of the Vinemount Formation, therefore, flow rates into the quarry area may vary from the estimated rate if the vertical hydraulic conductivity is found to be significantly different.

9.2.2 Jacob's Modified Non-Equilibrium Equation

The Vinemount Member is generally considered to be a regional aquitard across the region limiting vertical groundwater flow. An alternative method of conservatively predicting the volumetric groundwater flow rate into the quarry is to assume dewatering is extended throughout the entire thickness of the Guelph Formation and Reformatory Quarry Member of the Eramosa Formation. Jacob's modified non-equilibrium equation is generally considered to be industry standard in most construction dewatering operations. This analytical solution was developed to calculate the volume of water that a dewatering system will have to pump (Q) from an unconfined aquifer to produce a certain drawdown.

$Q = (K (H_2 – h_2)) / (0.733 \log (R/r))$, where

K_h = horizontal hydraulic conductivity of the aquifer (2.2 m/day from pumping tests)

H = saturated thickness of the aquifer before pumping (18 m based on the average across the Site)

h = water level drawdown resulting from the dewatering program (0.5 m below the base of the quarry)

R = radius of influence of the cone of depression (790 m (r plus 250 m or the approximate radius where 1 m of drawdown is expected)

r = radius of the area of dewatering (540 m equivalent to the entire system acting as a single large well)

The total flow rate into the quarry area is therefore estimated to be approximately 5,940 m^3/day by Jacob's modified non-equilibrium equation, which is similar to the Darcy's Law calculations presented above.

Based on these methods of predicting flow rates from dewatering areas, a conservative estimate for the volumetric discharge rate into the quarry area is approximately 5,940 m^3/day. This would be the anticipated pumping rate under full operation.

9.2.3 Other Water Removal

For short periods of time, higher rates of dewatering are required (relative to the above steady-state dewatering rate) to remove direct precipitation.

Assuming a storm event with 60 mm of precipitation in 24 hours would result in the accumulation of approximately 31,000 m^3 of stormwater within the quarry. A flow rate of 15,500 m^3/day would be required assuming removal of the precipitation from the quarry in two days. This rate would only be required under storm event conditions.

10.0 ON-SITE WATER TAKING ESTIMATE (NON-DEWATERING)

The on-Site ready-mix concrete plant can operate at a production rate that equates to a water production rate of 417 L/min. To be able to accommodate large projects and support Guelph's developing infrastructure, commercial and residential requirements, it is estimated that the maximum production would occur over a 12 hour period,

which results in a daily volume of 300,000 L. The On-Site Supply Well that is proposed to be used to supply water to the ready-mix concrete plant and washroom facilities was tested at 303 L/min or approximately 73% of the maximum water production rate. Lafarge has indicated that a supply of 303 L/min over a 12 hour period each day will be sufficient for normal operation needs and would like to proceed on that basis. Therefore, it is not anticipated that any additional water will be required for normal operational needs.

The existing PTTW (Number 2718-7S3RM7), which is proposed to be amended, also includes water taking from the source pond / quarry water management pond (A), the holding pond (B) and from the river intake (C), as shown on Figure 15. These water takings will remain the same as the current permit. Lafarge is willing to allow the City to use any additional water stored in the source pond / quarry water management pond (A) for non-potable uses such as firefighting or irrigation.

11.0 ASSESSMENT OF POTENTIAL ADVERSE EFFECTS OF QUARRY DEWATERING

The groundwater level within the quarry limit will be lowered to approximately 285 masl. Upgradient of the Site, the water will rise to static conditions within approximately 500 m of the quarry. Downgradient of the Site, the water will rise to levels in the Speed River located to the south of the Site. Figure 14 shows the zone of influence where potential adverse effects may occur. Lowering of groundwater has the potential to impact other groundwater users, surface water features and the natural environment. An assessment of these potential adverse effects is presented in the following sections.

The operation of the On-site Supply Well will be less than 12 hours a day allowing for recovery to occur over a minimum of the same amount of time. As such, it is anticipated that the pumping of the On-Site Supply Well will create a daily lowering in nearby water levels followed by a recovery of water levels overnight. This daily fluctuation in water levels is not anticipated to have long-term potential adverse effects on the surrounding environment. The daily drawdown cone is estimated to extend less than 500 m from the On-Site Supply Well.

11.1 Private Groundwater Users

It should be noted that this area around the site is not municipally serviced. According to the MECP water well database, there are 91 water wells located within 500 m of the licenced below water table extraction area (see Figure 14 and Table J2 in Appendix J). It should be noted that some water well records may be plotted in incorrect locations, however, an analysis of the water well records provides an estimate of the type of water use and depth of wells in the area.

Of the 91 wells, 60 are completed in the bedrock, two in the overburden and 29 do not have completion details. The wells range in depth from approximately 3.4 m to 90 m. The well use is summarized as follows: 42 domestic water supplies, 18 observation/test wells, 18 commercial/industrial, 2 livestock, 1 public, 7 abandoned and 3 unknown.

The water well records were reviewed for domestic wells, commercial wells, industrial wells and livestock wells to determine the available water in the well (based on static water level and depth of well) and the estimated drawdown. The results are summarized in Table 1 in Appendix J for the wells within 500 m of the Initial Extraction Area. Based on the water well record information the available water in these wells ranges from 8.3 m to 49.3 m

with estimated drawdowns due to quarry dewatering ranging from 0.1 m to 0.7 m. The percent of drawdown is less than 4% of the available water column. Interference with private wells in the area is expected to be minimal.

PTTWs are required for water takings greater than 50,000 L/day. A search of the MECP Map of Permits to Take Water indicates that there is one PTTW located within 1 km of the property (west of the property). The permit was issued to Flochem Ltd. for other industrial use at a rate of 208,800 L/d (PTTW 7042-AT6QF5 November, 2017). There is another PTTW located approximately 1.7 km southeast of the property that was issued to Cox Construction Ltd. for aggregate washing in the amount of 2,998,037 L/d (PTTW 5755-A72SBP January, 2013).

11.2 Source Water Protection (Municipal Water Users)

The Clean Water Act was established in 2006 to ensure clean, safe and sustainable drinking water for Ontarians, by protecting sources of municipal drinking water including lakes, rivers and well water. Under this legislation, the drinking water source protection program was established which resulted in the development of science-based assessment reports and local source protection plans. The Site is governed by the Grand River Source Protection Plan which falls within the Lake Erie Source Protection Region.

As part of the assessment, wellhead protection areas (WHPA) were delineated for the area within 100 m of a well (WHPA-A) and the 2 year time of travel (WHPA-B), 5 year time of travel (WHPA-C) and 25 year time of travel (WHPA-D). The eastern portion of the Site overlaps with a WHPA-C that is sensitive to waste disposal, sewage systems and dense nonaqueous phase liquids (DNAPLs). The Site operates an existing septic bed for the facilities bathroom and kitchen sanitary sewage, which is located in the central portion of the Site outside of the WHPA-C boundary. The remainder of the Site overlaps the WHPA-D, which is sensitive to DNAPLs. The Site's regular operations do not use DNAPLs (LERSPC 2017) (see Figure 16). The Site is approximately 1.8 km west of the Downey Road Well and 1.8 km south of the Queensdale Well, which are both City of Guelph municipal wells. Both of these wells are open across both the Guelph and Gasport aquifers.

The Site is underlain by the Vinemount aquitard, with the exception of the western part of the Site, which will limit the amount of seepage into or dewatering from the underlying Gasport Formation. We note that extraction is not planned for the Western Area at this time. The Site will be mined to the top of the Vinemount. There will be no potential for off-Site migration of any contamination sources from the quarry to the municipal wells due to the inward flow to the quarry resulting from quarry dewatering. Following cessation of dewatering the quarry will flood. Following flooding the presence of vin aquitard will continue to protect the aquifer below the Vinemount from potential contaminants typically present in flooded quarries.

The vulnerability of WHPAs is an estimate of how quickly water moves from surface to the aquifer. It is measured on a scale of 2 to 10 with 10 being the most vulnerable. The vulnerability across the Site ranges from 4 to 8 with the higher vulnerable areas located along the eastern part of the property within WHPA-C (LERSPC 2015a).

The goal of source protection is to manage or eliminate existing activities that are, or could be, significant threats to a water supply. The Clean Water Act lists the following as potential threats:

- Quality:
  - Waste disposal sites;
  - Sewage systems, including septic systems;
  - Storage, management and application of agricultural source material (e.g. manure);

- Handling, storage and application of non-agricultural source material (e.g. biosolids, food waste);
- Handling, storage and application of commercial fertilizers;
- Handling, storage and application of pesticides;
- Handling, storage and application of road salt;
- Storage of snow;
- Handling and storage of fuel (e.g. gasoline, home heating oil);
- Handling and storage of dense non-aqueous phase liquids (DNAPL, e.g. paint strippers, metal and plastic cleaning solvents, dry cleaning solvents);
- Handling and storage of organic solvents (e.g. dry-cleaning solvents, paint thinners, glue solvents);
- Chemicals used in the de-icing of aircraft; and,
- Livestock grazing, pasturing, outdoor confinement areas and farm-animal yards.

- Quantity:
  - An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body; and,
  - An activity that reduces the recharge of an aquifer.

There are different factors that determine whether or not an activity is a significant threat. The Source Protection Plan (LERSPC 2015b) indicates that activities related to waste disposal, sewage systems, and DNAPLs could potentially be significant threats (as mapped using the Lake Erie Source Protection Region Policy Mapping Tool). The septic bed and sanitary sewage are located in the central portion of the site and outside of the WHPA-C boundary. The remainder of the Site overlaps the WHPA-D, which is sensitive to DNAPLs. The Site's regular operations do not use DNAPLs. In addition, the Clean Water Act permits asphalt plants and fuel storage within WHPA D and Lafarge will restrict any fueling to outside of WHPA-C (5 year capture zone) so that there are not significant threats to the municipal drinking water wells. The transportation, storage, and handling of all fuels during construction and operations will be in compliance with the Technical Standards and Safety Act, 2000 (Government of Ontario 2000), with a plan to: transport fuel and hazardous materials in approved containers in licensed vehicles; isolate fuel storage tanks with a secondary containment tub to prevent fuels from escaping; avoid re-fuelling of vehicles and equipment, to the extent practicable, within 100 m of a water body; inspect equipment for leaks on a routine basis; and provide adequate supply of spill prevention and emergency response equipment on site at all times. An Environmental Emergency Response Plan that describes response procedures to potential environmental incidents or emergencies (e.g., spills, fire, erosion or sedimentation) will be prepared, for the proposed quarry operation. The identified mitigation measures are expected to minimize opportunities for accidental spills and leaks that could be washed off into nearby water bodies during a runoff event or infiltrate into the shallow groundwater system. In the event of an accidental spill or leak, the implementation of the response plan is expected to result in minimal changes (if any) to the chemical constituents in receiving water systems.

Quantity threats are assessed within the water quantity wellhead protection zone (WHPA-Q) (see Figure 17). WHPA-Q is delineated as the area where drawdown occurs from the municipal supply wells plus other permitted

water takings. The model predicted heads in the Gasport Formation. Simulated drawdown was greatest and extended furthest in this production aquifer and thus it was used to delineate the extent of the WHPA-Q area.

Since the WHPA-Q includes the influence of drawdown from permitted takings in addition to the municipal wells, the area is typically larger than the quality WHPA which is based on saturated travel time to the well. This WHPA-Q is defined for the aquifer in the most permeable geologic unit which for this area is the geologic unit below the Vinemount. Given the quarry extraction is taking place above the Vinemount these well head protection areas do not interact with the predicted shallow groundwater drawdown expected from above the Vinemount extraction. The Lafarge Site lies within the WHPA-Q and a Risk Management Measures Evaluation Process will need to be undertaken by the Source Water Protection Committee (Matrix 2018a) since the City of Guelph WHPA-Q was assigned a significant risk. This process should take into consideration that the quarry will remain above the Vinemount.

Due to the intermittent operation and relatively small permitted taking of the On-Site Supply Well (i.e., maximum 12 hours a day), it is not anticipated to affect the operation of the municipal wells. Further investigation of the dewatering is presented in the following sections.

11.3 Speed River Baseflow

As the quarry face is adjacent to the wetland to the south and the nearby Speed River, the groundwater level in the wetland area will be lowered during dewatering and some water will be drawn from the Speed River. The seepage into the quarry along the face parallel to the Speed River can be estimated using Darcy's Law as follows:

$Q_h = T\ I_h\ L$, where:

T = transmissivity of the Guelph Formation/Reformatory Quarry Member (40 m^2/day)

I_h = horizontal hydraulic gradient under full dewatering between the quarry and the river (0.02 m/m)

L = perimeter length of bedrock wall parallel to the river (approximately 1,750 m)

Applying Darcy's Law, the potential seepage from the Speed River into the proposed quarry is predicted to be approximately 1,400 m^3/day. As previously described, the baseflow in the Speed River south of the Site is approximately 4.3 m^3/s. The dewatering has the potential to reduce baseflow by approximately 0.4%. If the total dewatering rate of approximately 6,000 m^3/d is considered to impact baseflow, then it would be reduced by 1.6%. The impact to baseflow is interpreted to be minor, however, mitigation measures will be put in place as described below. These mitigation measures include collecting Speed River seepage and groundwater seepage in the quarry sump and discharging it to the river via the site discharge(s).

11.4 Surface Water Runoff

Under operational and rehabilitated conditions, the Site runoff (as drained by gravity) to the Speed River and adjacent wetlands will be reduced by 29,000 m^3/year and 30,000 m^3/year, respectively. These decreases in Site runoff will be augmented by pumping the settled quarry water to the Speed River and adjacent wetlands. Accounting for the quarry dewatering (excluding groundwater inputs), the Site runoff will increase under both operational and rehabilitated conditions. Therefore, it is not anticipated that the Speed River or adjacent wetlands will experience drier conditions (compared to existing) as an effect of the quarry.

11.5 Speed River PSW

Potential adverse effects on the Speed River PSW include the effects to surface water and groundwater regimes associated with dewatering on the ecology of the wetland. Based on the hydrogeological assessment, groundwater drawdown as a result of the proposed dewatering is expected to extend a maximum distance of 350 m to 500 m from the limit of extraction, which encompasses portions of the PSW. Significant levels of water level drawdown (i.e., greater than 1 m) will be limited to within 150 to 250 m of the quarry face. The drawdown extends under portions of the PSW adjacent to the Site. The extent of drawdown on the southern part of the quarry will be intercepted by the Speed River and thus have a smaller zone of influence (Figure 14). The PSW in this area does appear to have connection to the Speed River (at least at certain periods of the year), and therefore under full extraction it is expected that the PSW will still receive water from the Speed River however the hydroperiod (the portion of the year with standing water in the wetland) may be reduced.

Based on observations during the field surveys and information from the Speed River PSW evaluation report, dominant plant species in the Speed River PSW are primarily facultative wetland species (i.e., usually occurs in wetlands, but occasionally found in non-wetlands) or obligate wetland species (i.e., almost always occurs in wetlands) (Oldham et al. 1995). Although the overall plant community prefers wetland conditions and requires sufficient water inputs to maintain soil moisture levels, the dominant species are tolerant of minor fluctuations in the water regime. For example, white cedar, the dominant coniferous species, can occur in wetland communities (i.e., SWC) or fresh to moist upland forest communities (i.e., FOC). The root structure of white cedar can adapt in response to soil moisture, resulting in laterally focused, shallow roots in high-moisture environments or a long taproot structure in drier environments (Musselman et al. 1975).

It is expected that during the proposed dewatering, the groundwater and surface water flows to the Speed River PSW will be maintained. Groundwater and surface water at the Site currently flow towards the PSW and Speed River. Based on analysis conducted as part of the hydrological assessment, intercepted flows Groundwater and surface water) from the Site will continue to be discharged to strategic locations along the Speed River PSW (i.e. through the use of an infiltration ditch, etc.). The Site discharge to the PSW will be conducted in a manner to mimic the natural hydroperiod to minimise potential effects. As such, the net change in the wetland water balance is expected to be negligible.

Further details of the mitigation measures are described in Section 12.2.

11.6 Endangered and Threatened Species

Mitigation will be implemented (Section 12.2) to off-set any losses of water in the Speed River PSW. With this mitigation measure, wetland habitat for SAR in the Study Area is not anticipated to be adversely affected by the proposed dewatering. As such, populations of, or habitat for turtles, including Blanding's turtle will not be adversely impacted by the proposed dewatering.

In addition, it is anticipated that the form and function of the Speed River PSW can be maintained through a combination of mitigation measures to maintain surface water and groundwater flows to the Speed River PSW (Section 12.2), and natural processes of plant adaptation. As such, wildlife that rely on the overall structure of the forest communities that compose the PSW, including chimney swift, tri-colored bat, northern myotis and little brown myotis, will not be adversely impacted by the proposed dewatering.

11.7 Fish Habitat

The calculated decrease in Site runoff is compounded by the potential groundwater seepage from the Speed River and adjacent wetlands to the operating quarry. These changes to the surface water features on Site may reduce base flow in the Speed River. With the implementation of mitigation (Section 12.3), it is anticipated that adverse effects to the baseflow of the Speed River will be negligible.

The taking and off-Site discharge of quarry sump water (i.e., surface water and groundwater inflow) from the Site will be conducted in compliance with conditions of the PTTW, and an ECA from the MECP. As such, the quality of the discharge water entering the Speed River will meet required standards and is not expected to adversely impact the existing fish community of the Speed River. Overall, the discharge of groundwater to the Speed River will be less than 2% of the baseflow in the river and therefore is not anticipated to significantly affect current river water temperature, quality or quantity conditions.

In addition, intercepted flows from the Site can be discharged to strategic locations along the Speed River PSW in such a manner that it is expected that there will be no erosion, undercutting or sedimentation anticipated in the Speed River as a result of the discharge.

Further details of the mitigation measures are described in Section 12.3.

11.8 Significant Woodlands

Based on measurements recorded in the shallow mini-piezometers installed in the wetland features at the south end of the Site, the water table in the wetlands varies between 0 m and 1.3 m below the ground surface. At one monitoring location in the southwest corner of the Site, the water level in the shallow piezometer varied from 0.1 m to 1.1 m below the ground surface. The hydraulic head in the deeper piezometers sometimes recorded to be above the ground surface. Under the proposed dewatering conditions, the water table would be lowered by a maximum of 13 m along the southern quarry face. However, the drawdown in the PSW will be mitigated keeping water levels closer to surface.

Rooting depths of plants are often limited by factors such as stratified layers of clay and shale, permafrost, and the water table (Canadell et al. 1996). A comparison of rooting biomass in terrestrial biomes demonstrated that root systems tended to be shallow where waterlogging was prevalent, and deeper in wooded biomes, such as temperate coniferous forests (Jackson et al. 1996). Based on the measured water table level in the Speed River PSW, it is expected that the rooting depth in the significant woodland is relatively shallow and limited by the water table.

However, research conducted on average rooting depths of trees in temperate forests concluded an average rooting depth of 3.9 m (highest value of 7.5 m) in coniferous forests, and 2.9 m (highest value 4.4 m) in deciduous forests (Canadell et al. 1996). Trees are thought to be relatively insensitive to soil drying until moisture levels are significantly depleted, which is due in part to a tree's ability to root deeper and access water at depth (Roberts 1983). Maximum rooting depths of 2.9 m have been recorded for trembling aspen and 3.7 m for silver maple (Canadell et al. 1996), both of which are known to occur in the Speed River PSW (Coulson et al. 1986). In addition, white cedar, a dominant species in the PSW, is known to change rooting habits in response to changes in the soil moisture levels.

Based on this data, it is anticipated that tree species in the significant woodland have the ability to alter or extend their root systems to access the depressed water table. In addition, it is expected that groundwater and surface

water flows to the Speed River PSW will be maintained through mitigation and the net change in the wetland water balance is expected to be negligible.

With the implementation of mitigation (Section 12.2), it is anticipated that the form and function of the significant woodland associated with the Speed River PSW, in the Study Area, will not be altered by the proposed dewatering and no further analysis is warranted.

11.9 Significant Valleylands

The proposed dewatering is not expected to alter the landform of the valleyland. Similar to the discussion on significant woodlands, it is anticipated that the form and function of the overall woodland community can be maintained through a combination of mitigation measures to maintain surface water and groundwater flows to the Speed River PSW, and natural adaptations in plant physiology to access the lower water table. In addition, a portion of the quarry discharge will be pumped to the Speed River, which will maintain hydrological connections between the Site and the valleyland.

As such, ecological features of the significant valleyland, including surface water and groundwater functions, the extent of riparian vegetation, linkage functions, and ability to provide important habitats (e.g., deer wintering area, waterfowl staging), is not expected to be altered as a result of the proposed dewatering.

With the implementation of mitigation (Section 12.2), it is anticipated that the form and function of the significant valleylands in the Study Area will not be altered by the proposed dewatering and no further analysis is warranted.

11.10 Significant Wildlife Habitat

With the implementation of mitigation (Section 12.2), it is anticipated that the form and function of the overall wetland and woodland that compose the Speed River PSW will be maintained for the duration of the dewatering. Types of SWH that rely on the wetland function, including amphibian breeding habitat, or the overall form and structure of the woodland and valleyland, including bat maternity colonies, deer wintering areas, and wildlife movement corridors, will not be adversely impacted by the proposed dewatering. SOCC that may use the PSW for habitat, including western chorus frog, eastern ribbonsnake, snapping turtle, eastern wood-pewee, wood thrush, ram's-head lady's-slipper and harbinger-of-spring will not be adversely impacted by the proposed dewatering and discharge.

11.11 Cumulative Effects

Cumulative effects are changes to the environment due to a combination of the potential effects examined in Section 11 of this report that are investigated over a regional scale, over longer periods of time (past, present and future) considering multiple external actions.

A search for other water users adjacent to the site was conducted. PTTWs are required for water takings greater than 50,000 L/day. A search of the MECP Map of Permits to Take Water indicates that there is one PTTW located within 1 km of the property (west of the property). This permit was issued to Flochem Ltd. for other industrial use at a rate of 208,800 L/d (PTTW 7042-AT6QF5). There is another PTTW located approximately 1.7 km southeast of the property that was issued to Cox Construction Ltd. for aggregate washing in the amount of 2,998,037 L/d (PTTW 5755-A72SBP). There are also two municipal wells located about 1.8 km toward the east and north of the site and are Downey Road Well 5,237,000 L/day (PTTW 1118-7STRS8) and Queensdale Well 5,237,000 L/day (PTTW 5126-9J7RQ2). As described in the previous section, the Site lies within the WHPA-Q for the City of Guelph, which represents the combined area of the cone of influence of the well and the whole of the cones of

influence of all other wells that intersect that area. The water budget and local area risk assessment to define the WHPA-Q was developed using the Tier 3 Groundwater Model (Matrix 2017) and included investigating different scenarios of climate change and drought (Matrix 2017, 2018b). The Tier 3 Assessment scenarios predicted that the City of Guelph's municipal wells can meet the current water supply demand, however, it was predicted that the Queensdale Well would be unable to meet future needs under normal climate conditions and during prolonged drought (Matrix 2017). The results of the simulations of a range of climate change scenarios suggest there will be an increase in recharge during the winter months and relatively small changes during the rest of the year. As such, there may be more recharge during the early parts of each year.

Based on this study the drawdown from dewatering is not anticipated to extend to the municipal wells and should not limit the available pumping from the wells. In addition, the water removed from the upper bedrock aquifer will be discharged back into the wetland and Speed River where majority of the water can infiltrate back into the shallow aquifer system. Overall the consumptive groundwater use is minimal as the operations consist mainly of water handling therefore a cumulative effect on nearby surface water features are not anticipated.

The Speed River is regulated by a series of flow control structures upstream of the Site including, Wellington Street Dam, Guelph Dam and Rockwood Dam. These control structures considerably alter the flow fluctuations within the system. These allow the peak flow periods to be dampened and the low flow periods to be augmented with storage water. With the addition of these structures to the river system, the risk of extreme high or low water levels and flows is greatly reduced. As such, the potential effects on the river baseflow and flooding risks from the Site discharge(s) is expected to be negligible.

Because sufficient water will be returned to the Speed River PSW and the Speed River to maintain current hydroperiod conditions, it is anticipated that there will be no residual effects to habitats and other natural heritage features in these systems. As such, no cumulative effects are predicted.

12.0 MITIGATION

12.1 Surface Water Features

In order to mitigate potential effects caused by the reduction in Site runoff and groundwater seepage, a mitigation plan will be required. A mitigation plan would include dewatering the quarry under operational conditions and constructing spillways. These discharges can be directed to adjacent wetlands and the Speed River through a ditch, and potentially weirs or diffusers, if required. The sump would be located in the southeast corner of the quarry and discharge water along two routes as follows (see Figure 15):

- the majority of the water would be piped to the pond located in the southcentral part of the property, where any sediment can settle before gravity draining through the ditch to the Speed River; and
- water would be piped into a ditch starting in the southeast corner of the property, where it would flow in the ditch discharging into the pond in the southcentral area of the property. A portion of the water in the ditch will infiltrate into the wetland. The ditch could be augmented as required to include weirs or diffusers to direct water to the adjacent wetlands to prevent dry conditions and maintain the hydroperiod observed under existing conditions. These mitigations would be situated along the majority of the southern licence boundary to mitigate wetland features adjacent to the Site.

The quarry discharge will ultimately be directed to the Speed River to mitigate any dewatering effects that may be observed on base flow in the river with a portion of the water going to the wetland to prevent dry conditions.

Overall the Site will produce higher runoff under operational and rehabilitated conditions (compared to existing) and effects of dry conditions are not anticipated. No significant impacts to baseflow are expected under rehabilitated conditions, and discharges to the wetlands or the Speed River will not need to be maintained post-rehabilitation.

In addition, a Water Management Plan is included in the ECA, which outlines many of the items to be included in the mitigation plan such as how discharge water will be managed and monitored to establish limits for mitigation actions.

12.2 Speed River PSW

As discussed in Section 12.1, a portion of the quarry discharge will be directed to a ditch as shown on Figure 15. The final design will depend on site operations and wetland monitoring. If the ditch does not provide a good transmission of water to the required wetland areas, then weirs or diffusers can be installed in strategic locations in the Speed River PSW to mitigate any dewatering effects that may be observed on the wetland's hydroperiod and soil moisture levels. Operations of the system would be managed under and subject to an amended ECA.

During the proposed dewatering, the groundwater and surface water flows to the Speed River Wetland will be maintained. Quarry discharge will be directed to a ditch and the pond in the southcentral area that eventually outlets at the Speed River. Quarry discharge can be directed to a ditch, and weirs or diffusers, if required, installed in areas of the adjacent wetlands to prevent dry conditions and extend the hydroperiod to normal / existing conditions. As such, the net change in the wetland water balance is expected to be negligible.

12.3 Fish Habitat

A portion of the quarry discharge will be directed to the Speed River through the existing ditch channel to mitigate any dewatering effects that may be observed on the river's base flow. The discharge will be directed to the Speed River in a diffuse manner to avoid bank erosion or undercutting. For any new, or modification to existing, discharge into the Speed River, submission of a Request for Review to Fisheries and Oceans Canada (DFO) will be required. Monitoring, as described in Section 15, will be implemented to detect any changes to water temperature, quality or quantity at an early stage. Examples of additional mitigation that may be required, if changes are detected, are included in Section 13. Based on implementation of recommended mitigation including any DFO required mitigation, no adverse effects on fish habitat are anticipated as a result of dewatering activities.

13.0 RECEIVING SYSTEM ASSESSMENT

The Speed River has a cool / warmwater thermal regime (GRCA 1998). The discharge of groundwater to the Speed River will be less than 2% of the baseflow in the river and therefore is not anticipated to significantly affect current river water temperature, quality or quantity conditions. As outlined in Section 15 below, groundwater, surface water and natural environment monitoring plans will be implemented prior to and during bedrock extraction. The extraction of the bedrock will progress slowly; therefore, the monitoring will act as an early warning if unexpected effects on the river or aquatic ecosystem were to occur. If such unexpected effects did occur, then additional contingency mitigation measures would be implemented. Examples of suitable contingency mitigation

measures include management and discharge methods. In addition, further assessment of the receiving system was completed, to support the ECA application.

14.0 CONCLUSIONS

The following conclusions are provided based on the findings of the study:

1) Quarry excavation will occur within the Guelph Formation and the Reformatory Quarry Member of the Eramosa Formation and remain above the Vinemount Member of the Eramosa Formation;

2) Groundwater flow in both the Guelph aquifer and the Goat Island/Gasport aquifer is generally in a southerly or southeasterly direction toward the Speed River;

3) Downward vertical gradients are observed in the northern part of the Site and become less or upward moving toward the Speed River;

4) Pumping tests indicate that the transmissivity of the bedrock aquifers ranges from 3 to 87 m^2/d;

5) In order to dewater the quarry for excavation, the estimated pumping rates will be approximately 6,000 m^3/d under normal operation plus additional dewatering during significant storm events;

6) During full dewatering of the Site, the zone of influence will extend approximately 350 to 500 m from the excavation face with drawdown up to 1 m occurring within 150 to 250 m of the quarry;

7) Drawdown from dewatering is not expected to extend to the City of Guelph municipal wells;

8) Potential adverse effects to private wells from quarry dewatering will be minor with less than 5% reduction in available drawdown;

9) Potential adverse effects from pumping the On-Site Supply Well will be minimal due to the proposed cyclical operation of the well;

10) Fuel handling and storage, and the Asphalt Plant are located outside of WHPA-C. Based on the type of activities to occur on-Site, there are no anticipated adverse effects to the water quality, with respect to criteria in the source water protection threats, specifically to the water captured by the City of Guelph municipal wells;

11) Overall the consumptive groundwater use is minimal as the operations consist mainly of water handling; therefore a cumulative effect on nearby surface water features are not anticipated;

12) Quarry dewatering will lower the water levels below the wetland to the south of the Site, however, these adverse effects can be mitigated by pumping the discharge water back into the wetland;

13) Quarry dewatering accounts for less than 2% of the base flow in the Speed River. These adverse effects can be mitigated by pumping the discharge water into the Speed River; and,

14) Quarry operation may lower the water levels or reduce hydroperiods in the wetlands adjacent to the Site, however these effects can be mitigated by pumping the treated (settled) quarry discharge water back into the wetlands.

Based on these analyses, it is expected that there will be no residual negative effects to the significant natural features and functions in the Study Area. These conclusions will be verified based on the results of the groundwater, surface water and ecological monitoring programs to be implemented at the start of the dewatering program (i.e., dewatering will proceed on a precautionary principle, with monitoring occurring in parallel, to identify any issues). Should any adverse effects to significant natural features and functions be identified, additional mitigation measures may be implemented.

Similar dewatering with discharge to surface water features is occurring or proposed at other quarries in southern Ontario. These permits incorporate conditions to track changes in groundwater and surface water levels, monitor the discharge water quality and observe the natural environment. This monitoring is done, in part, to establish trigger levels which in turn initiate a mitigation action. It is proposed that the Wellington County Site permits would be established in a similar manner.

15.0 RECOMMENDATIONS

The following recommendations are provided with respect to a monitoring program, permit to take water application and environmental compliance approval application. In summary, the fundamental objective of Lafarge is to extract the resource on the property to the extent possible without causing an adverse effect on the wetland and local groundwater users by implementing mitigation measures and applying trigger levels. This can be accomplished through the implementation of a comprehensive multi-disciplinary monitoring program that defines baseline conditions (which facilitates the development of appropriate trigger mechanism) and characterizes conditions as quarry dewatering proceeds.

15.1 Monitoring

The taking and off-Site discharge of quarry sump water (i.e., surface water and groundwater inflow) from the Site along with the water taking from the On-Site Supply Well will be conducted in compliance with conditions of the PTTW and ECA. The maximum allowable water taking rate and discharge rate will be specified on the PTTW and ECA, respectively.

Groundwater, surface water and ecological monitoring programs will be developed to measure and evaluate the actual effects on water resources associated with long term quarry development on the Site, and to allow a comparison between the actual effects measured during the monitoring program with those predicted as part of the impact assessment.

A monitoring program should be established at the Site to monitor current conditions and continue once quarry operations proceed. The monitoring program should include the following:

Private Well Survey

It is recognised that the MECP water well database, which was used for this assessment, may not capture all private wells. Therefore, a door to door well survey will be conducted on private wells within a 500 m radius of the full extraction boundary. This 500 m radius will be limited to the south by the Speed River as it is a hydraulic boundary. This survey will be conducted prior to bedrock extraction. During this survey the well owner will be asked to provide consent for the monitoring of water quality and quantity in their well. The scope of work will include a delivery of notification to individual well owners that the survey will be conducted, single well quantity

testing and the collection and analysis of water samples by a laboratory. Water quality sampling will be conducted from a tap located prior to any water quality treatment systems in the residence/building, if possible.

This survey will include collecting detailed information (where available and subject to landowner permission) such as:

- Owner name, address and telephone number;
- Well depth, age, construction details;
- Pump information (type, age, intake depth);
- Water consumption;
- Existing water quality and quantity; and,
- Current static water level (if accessible).

Groundwater Monitoring

- Quarterly manual groundwater level monitoring with hourly water level logging using a pressure transducer datalogger in wells 12-CH-1070, 12-CH-1071, 12-CH-1072, 15-CH-1073, 15-CH-1074, 15-CH-1075, 15-CH-1076, 15-CH-1077 and 15-CH-1078;
- Quarterly manual groundwater level monitoring with hourly water level logging using a pressure transducer datalogger in mini-piezometers MP16-1 and MP16-2; and,
- Annual groundwater quality monitoring at 12-CH-1070, 12-CH-1071B, 12-CH-1072, 15-CH-1073B, 15-CH-1075B, 15-CH-1076B and 15-CH-1078B.

Surface Water Monitoring

- Quarterly manual surface water level monitoring with hourly water level logging using a pressure transducer datalogger at SW1 and SW3; and
- A quarry effluent monitoring program (including wetland water level monitoring) would be developed as part of an application for an ECA (Section 53 of the *Ontario Water Resources Act*), which is required to allow discharge of water from the quarry sump.

Natural Environment Monitoring

- The natural environment monitoring program should employ transect and plot based methods that have been successfully implemented in previous wetland monitoring initiatives. This plan should include an inventory of plant species within the Speed River Wetland adjacent to the Site as well as fixed-point photo monitoring at various stations within the wetland. This monitoring will provide both a qualitative and quantitative means of tracking changes in the vegetation over time. It is anticipated that the response of the vegetation to environmental change will not be immediate or dramatic. For that reason, although regular and recurrent, the periods between vegetation monitoring events becomes increasingly longer, unless significant change occurs between sampling events. During the first ten years of Site operations, the following monitoring frequency is proposed (one sampling event in each specified year): year zero (baseline); year one; year two; year four; year six; and, year ten. If significant change is observed between sampling events, the vegetation sampling would return to an annual frequency.

15.2 Well Complaint Action Plan

Although impacts to off site private wells are not anticipated, Lafarge has developed a Well Complaint Action Plan to respond to well complaints received within 500m from the Initial Extraction Area . This 500 m radius will be limited to the south by the Speed River as it is a hydraulic boundary (Figure 14). The overall objective of the response plan will be to minimize inconvenience to the neighbours and provide them with a direct point of contact to restore any water supply that is potentially affected by the future development of the site.

This plan would consist of the following components:

- When a complaint is received by Lafarge, a representative of Lafarge or their agent will visit the site to make an assessment. This includes an examination of the well (where accessible) to determine the water level and pump depth setting.
- If the water supply has been interrupted due to excavation activities, then a temporary supply is immediately arranged.
- In the event that the water interruption can be corrected by lowering the pump this will be done immediately.
- If there is the potential to deepen and /or widen the existing well that option could be followed.
- Where sufficient water is not encountered in the current well then relocating the well on the property would be considered.

At a distance greater than 500 m from the Initial Extraction Area no measurable water level declines attributable to quarry dewatering are anticipated. However, should a complaint be received a Lafarge representative, who is familiar with the operations, will contact the resident to discuss the issue and decide if further investigation is warranted. If it is determined that the quarry operation may have had an effect on the well outside the zone of influence, then the actions outlined above will be employed for the affected well.

15.3 Permit To Take Water

Based on the above assessment, a PTTW (Category 3) for groundwater control will be required to support quarry dewatering and water supply for the concrete plant, in addition to the current water supply sources. The rates determined for the Quarry Sump and the On-Site Supply Well are described in this report while the rates for the Source Pond, Holding Pond and Speed River are from the existing PTTW. The following rates also include a factor of safety. The total dewatering rate and water supply rates are therefore summarized as follows:

Table 9: Dewatering Assessment Summary

Source Name	Purpose	Maximum Taken Per Minute (L)	Maximum Number of Hours Taken Per Day	Maximum Taken Per Day (L)	Maximum Number of Days Taken Per Year
Quarry Sump	Dewatering	14,930	24	21,500,000[1]	365
On-Site Supply Well	Manufacturing	303	12	218,000	365
Source Pond / Quarry Water Management Pond	Manufacturing	7,455	10	4,473,000	295
Holding Pond	Manufacturing	455	10	273,000	295
Speed River	Manufacturing	909	24	1,309,000	295

[1] Typical pumping rates for the Quarry Sump will be 6,000,000 L/d during full operation. The additional 15,500,000 L/d is for emergency purposes such as dewatering following a storm event.

15.4 Environmental Compliance Approval

An Environmental Compliance Approval (ECA) application will be submitted to the MECP soon after the submission of the PTTW application.

16.0 CONSIDERATIONS FOR STATEMENT OF ENVIRONMENTAL VALUES

The Ontario government and Lafarge are both guided by principles meant to protect the environment in a sustainable and accountable fashion.

Each provincial ministry subject to the Ontario Environmental Bill of Rights has a framework called a “Statement of Environmental Values” (SEV) to be used when the environment may be affected by a ministry decision. The SEV are a means for each ministry to record their commitment to the environment and to be accountable for ensuring the environment is considered in decision making. The MECP applies the principles in their SEV when developing acts, regulations and policies to protect the environment and human health.

Although not a requirement, this application package has been assembled in a manner that goes beyond demonstrating compliance by proposing how the MECP can consider the SEV principles during the review process.

Table 10 is intended to summarize how each SEV can be considered in the review process, with specific references to technical components of the application package.

Table 10: Considerations for Each of the Statement of Environmental Values

Factors to Consider
The Ministry adopts an ecosystem approach to environmental protection and resource management. This approach views the ecosystem as composed of air, land, water and living organisms, including humans, and interactions among them.
In order to adapt an ecosystem approach, the technical report involved studies in hydrology, hydrogeology and the natural environment to determine how changes in one discipline may affect another discipline. On the larger scale, the study has not only reviewed potential impacts on a local scale but includes a review of source water protection. Significant consideration has been given to the potential for detrimental impacts to municipal drinking water supplies (quantity and quality) and measures have been put in place to prevent potential issues. Monitoring will be conducted to confirm the mitigative measures are working as operations gradually proceed. In addition, an ISW ECA is being applied for showing that the project has considered where the water will go and how it will be used.
The Ministry considers the cumulative effects on the environment; the interdependence of air, land, water and living organisms; and the relationship among the environment, the economy and society.
The site has gone through the approvals process and a licence was granted to extract sand and gravel, and rock from the site. As operations proceed and a PTTW and ECA need to be amended, this technical study has been completed to ensure the Site's development is done with due regard to the interdependences within the environment such that the Site will promote sustainable development and thereby achieve or maintain a healthy environment and a healthy economy. Cumulative effects were reviewed within the context of source water protection (i.e., Matrix 2017, 2018a, 2018b; LERSPC 2015a, 2015b). Dewatering will be above the regional aquitard to avoid potential impacts to the lower aquifer. In addition, the majority of the operation is water handling and minimal water consumption.
The Ministry considers the effects of its decisions on current and future generations, consistent with sustainable development principles.
A sustainability approach was used to determine if the project is environmentally sound, socially responsible and economically viable. The quarry provides a valuable source for future development in the City of Guelph and surrounding area while managing risks to the environment.
The Ministry uses a precautionary, science-based approach in its decision-making to protect human health and the environment.
To ensure that projects are considered in a careful and precautionary manner, the technical study assessment process is based on a precautionary and science-based approach. The precautionary approach is guided by judgement, based on values, and is intended to address uncertainties in the assessment. The science-based approach characterizes and assesses the current conditions and the potential effects of the Project in a thorough, traceable manner, and proposes impact management measures to mitigate potential negative environmental effects. The study also predicts whether there will be likely significant net environmental effects after impact management measures are implemented.

Factors to Consider
The Ministry's environmental protection strategy will place priority on preventing pollution and minimizing the creation of pollutants that can adversely affect the environment.
Lafarge has a spill prevention plan to minimize the risk of spills to the groundwater system. In addition, Lafarge will restrict any fueling to outside of WHPA-C (5 year capture zone) so that there are not significant threats to the municipal drinking water wells.
The Ministry endeavours to have the perpetrator of pollution pay for the cost of clean-up and rehabilitation consistent with the polluter pays principle.
It is Lafarge's intent to clean-up and rehabilitate the site should it be shown that Lafarge has polluted the site. As per the Site Plan, rehabilitation of the property includes the creation of a lake and recreational land.
In the event that significant environmental harm is caused, the Ministry will work to ensure that the environment is rehabilitated to the extent feasible.
This is a reactive principle not applicable to the application process. It is the intent of Lafarge to avoid significant environmental harm and rehabilitate to the extent feasible when the environment is harmed. The long-term goal may be to create a conservation area at the site once operations are finished.
Planning and management for environmental protection should strive for continuous improvement and effectiveness through adaptive management.
The technical study proposes impact management measures to mitigate potential negative environmental effects and predicts whether there will be significant net environmental effects after management measures are implemented. Groundwater, surface water and natural environment monitoring programs were developed to track changes in the natural environment once operations begin and to confirm that mitigation measures are effective. It is estimated that a detailed mitigation plan will be developed as a condition of the PTTW.
The Ministry supports and promotes a range of tools that encourage environmental protection and sustainability (e.g., stewardship, outreach, education).
Lafarge holds open house events at their facilities to provide outreach and education to the public on how the business operates. In addition, Lafarge is a member of the Ontario Stone, Sand and Gravel Association which also provides outreach and education.
The Ministry will encourage increased transparency, timely reporting and enhanced ongoing engagement with the public and Aboriginal communities as part of environmental decision making.
As part of the application process, the application will be posted on the EBR to allow public comment. Lafarge will address any concerns identified by the MECP.

17.0 LIMITATIONS

This report has been prepared by Golder Associates Ltd. (Golder) for Lafarge Canada Inc. (Client) and for the express purpose described to Golder by the Client. This report is provided for the exclusive use by Client and is confidential. The report may be used by the Ministry of the Environment, Conservation and Parks (MECP) as part of the review for the Permit To Take Water Application.

The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and are not to be modified, amended, excerpted or revised. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express prior written permission of Golder.

Golder has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

The findings and conclusions documented in this report have been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of or variation in the site conditions, purpose or development plans, or if the project is not initiated within a reasonable time frame after the date of this report (but no later than 24 months of the date of the report), may alter the validity of the report. Accordingly, Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The scope and the period of Golder's services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the report. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

Any assessments, designs and advice made in this report are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this report. Where data supplied by the client or other external sources (including without limitation, other consultants, laboratories, public databases), including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the hydrogeologic aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost.

Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report.

Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.

Recommendations are provided for the specific purpose indicated herein and may need to be modified depending on new operating conditions and actual field conditions that may be discovered during subsequent investigations and construction. Golder expressly denies any responsibility for constructed works that are subject to new operating conditions that affect the integrity of the design. Sufficient monitoring, testing and consultation should be provided by Golder during construction to confirm that the conditions encountered are consistent with those anticipated, to provide recommendations for design changes should the conditions revealed differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with Golder's recommendations.

The passage of time affects the information and assessment provided in this report. Golder's opinions are based upon information that existed at the time of the production of the report. The Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by

Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be to the foregoing and to the entirety of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

The information, recommendations and opinions expressed in this report are for the sole benefit of Lafarge Canada Inc. and were prepared for the specific purpose set out herein. No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

18.0 CLOSURE

We trust this report provides sufficient information to approve a Category 3 PTTW for the proposed dewatering and on site water taking. Should you have any questions, or require further information, please do not hesitate to contact the undersigned.

19.0 REFERENCES

Arnold, J.G., Allen, P.M., Muttiah, R., Bernhardt, G. 1995. Automated Base Flow Separation and Recession Analysis Techniques. Groundwater, 33 (6); 1009-1018. November-December 1995.

Bat Conservation International (BCI). 2016. Range Maps. URL: http://batcon.org/index.php/all-about-bats/species-profiles.html. Accessed April 2016.

Brunton, F.R., 2008. Preliminary Revisions to the Early Silurian Stratigraphy of Niagara Escarpment: Integration of Sequence Stratigraphy, Sedimentology and Hydrogeology to Delineate Hydrogeologic Units. In Summary of Field Work and Other Activities 2008, Ontario Geological Survey, Open File Report 6226, p. 31-1 to 31-18.

Brunton, F.R. and Dodge, J.E.P. 2008. Karst of Southern Ontario and Manitoulin Island; Ontario Geological Survey, Groundwater Resources Study 5.

Cadman, M.D., D. A. Sutherland, G. G. Beck , D. Lepage , and A. R. Couturier , editors. 2007. Atlas of the Breeding Birds of Ontario. Co-published by Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp. ISBN 978-1-896059-15-0.

Canada, Government of (Canada). 2002. *Species at Risk Act*. S.C. 2002, c. 29.

Canadell, J., R.B. Jackson, J.R. Ehleringer, H.A. Mooney, O.E. Sala, and E.D. Schulze. 1996. Maximum rooting depth of vegetation types at the global scale. *Oecologia* 108:583-595.

Chapman, L.J., and Putnam, D.F., 1984. The Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2, 270p. Accompanied by Map P.2715 (coloured), scale 1:600,000.

Coulson, D.P., E. O'Neill, B. Neeb-Brechun, M. Ross, M. Belanger, and B. Ahrens. 1986. Speed River Wetland Provincially Significant Wetland Data Record. Ontario Ministry of Natural Resources – Cambridge District. June 23-25, 1986.

Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Federation of Ontario Naturalists, Toronto. 120 pp.

eBird. 2012. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. URL: http://www.ebird.org. (Accessed: September 2016).

Environment and Climate Change Canada (ECCC). 2018. Species at Risk Public Registry. URL: http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm. Accessed April 2016.

Golder Associates Ltd., 2011. City of Guelph Tier Three Water Budget and Local Area Risk Assessment Appendix A: Characterization Final Report.

Grand River Conservation Authority (GRCA). 1998. State of the Watershed Report – Background Report on the Health of the Grand River Watershed 1996-97. The Grand Strategy Coordinating Committee. August 1998.

Grand River Conservation Authority (GRCA). 2004. A Watershed Forest Plan for the Grand River. June 2004. Grand River Conservation Authority. 146 pp.

Grand River Conservation Authority (GRCA). 2017a. Water Quality Conditions Report. Cooke, S. E, Boyd, D., February 2017.

Grand River Conservation Authority (GRCA). 2016a. Grand River Information Network. URL: http://grims.grandriver.ca/imf/imf.jsp?site=grca_viewer&ddsid=236004. Accessed October 2016.

Grand River Conservation Authority (GRCA). 2016b. Fishing Rivers and Streams. URL: https://www.grandriver.ca/en/outdoor-recreation/Fishing-rivers-and-streams.aspx. Accessed November 2016.

Grand River Conservation Authority (GRCA). 2017b. Grand River Information Network. Version 2070901 URL: https://maps.grandriver.ca/web-gis/public/?theme=General&bbox=538431,4807431,577463,4831782

Jackson, R.B., J. Canadell, J.R. Ehleringer, H.A. Mooney, O.E. Sala, and E.D. Schulze. 1996. *Oecologia* 108:389-411.

Jones, C., Layberry, R., and Macnaughton, A. 2016. Ontario Butterfly Atlas Online. Toronto Entomologists' Association. URL: http://www.ontarioinsects.org/atlas_online.htm. Accessed April 2016.

Lake Erie Region Source Protection Committee (LERSPC). 2015a. Grand River Source Protection Area Approved Assessment Report.

Lake Erie Region Source Protection Committee (LERSPC). 2015b. Grand River Source Protection Area Approved Source Protection Plan.

Lake Erie Source Protection Region Technical Team (LESPRTT). 2008. Draft Grand River Characterization Report. January 2008. Grand River Conservation Authority. 318 pp.

Matrix Solutions Inc. 2017. City of Guelph and Township of Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc. 2018a. Guelph-Guelph/Eramosa Water Quantity Policy Development Study: Threats Management Strategy. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc. 2018b. Assessment of Climate Change and Assessment of Water Quantity Threats in IPZ-Q in Support of the Guelph-Guelph/Eramosa Water Quantity Policy Study. Prepared for the Lake Erie Source Protection Region.

Ministry of Environment, Conservation and Parks (MECP). 2003. Stormwater Management Planning and Design Manual. March 2003.

Musselman, R.C., D.T. Lester and M.S. Adams. 1975. Localized ecotypes of *Thuja occidentalis* L. in Wisconsin. *Ecology* 56: 647-655.

Natural Heritage Information Centre (NHIC). 2018. Natural Areas, Species Lists and Element Occurrence Databases. Ontario Ministry of Natural Resources. Peterborough, ON. URL: https://www.ontario.ca/environment-and-energy/natural-heritage-information-centre.

Oldham, M.J., W.D. Bakowsky and D.A. Sutherland. 1995. Floristic Quality Assessment System for Southern Ontario. Natural Heritage Information Centre, Ontario Ministry of Natural Resources. Peterborough, Ontario. 48 pp.

Ontario Geological Survey, 2003. 1:250,000 scale, Surficial Geology of Southern Ontario [electronic resource] Miscellaneous Release – Data 128.

Ontario Geological Survey, 2016. Open File Report:6323Project Unit 11-032. Regional-Scale Groundwater Mapping in the early Silurian Carbonates of the Niagara Escarpment: Final Update. Pp.20-1 to 29-10.

Ontario, Government of (Ontario). 1990. *Aggregate Resources Act*. R.S.O. 1990, c. A.8.

Ontario, Government of (Ontario). 2007. *Endangered Species Act*. S.O. 2007.

Ontario Ministry of Natural Resources (MNR). 2000. Significant Wildlife Habitat Technical Guide (SWHTG). 151 pp.

Ontario Ministry of Natural Resources (MNR). 2010. Natural Heritage Reference Manual for Natural Heritage Polices of the Provincial Policy Statement, 2005 Second Edition.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2014. Significant Wildlife Habitat Mitigation Support Tool. Version 2014.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015. Significant Wildlife Habitat 6E Criterion Schedule. 39 pp.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2018a. Land Information Ontario. URL: http://www.ontario.ca/environment-and-energy/land-information-ontario.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2018b. Species At Risk in Ontario List. Queens Printer for Ontario. URL: http://www.ontario.ca/environment-and-energy/species-risk-ontario-list. Accessed April 2016.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2018c. Land Information Ontario, Aquatic Resources Area Layer. Fisheries Section, Species Conservation Policy Branch.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2018d. Fish ON-Line. Powered by Land Information Ontario. Queen's Printer for Ontario. URL: https://www.gisapplication.lrc.gov.on.ca/FishONLine/Index.html?site=FishONLine&viewer=FishONLine&locale=en-US.

Ontario Nature. 2018. Ontario Reptile and Amphibian Atlas URL: http://www.ontarionature.org/protect/species/herpetofaunal_atlas.php.

Roberts, J.M. 1983. Forest transpiration: a conservative hydrological process? *Journal of Hydrology* 66: 133-141. Cited in Nisbet, T. 2005. Water Use by Trees. Forestry Commission, Edinburgh.

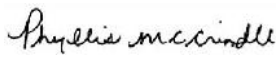
Terzi, R.A., 1981. Hydrometric field manual – measurement of stream flow. Environment Canada, Inland Waters Directorate, Water Resources Branch, Ottawa, ON.

Wellington, County of. 2016. County of Wellington Official Plan. Office Consolidation Last Updated September 1, 2016.

Signature Page

Golder Associates Ltd.

Hydrogeology

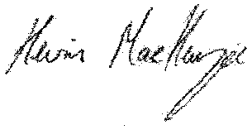


Phyllis McCrindle, M.Sc., P.Geo.
Associate, Senior Hydrogeologist

Sean McFarland, Ph.D., P.Geo.
Principal

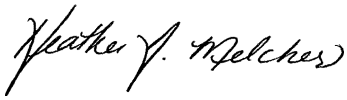
Hydrology

Craig DeVito, P.Eng.
Water Resources Engineer



Kevin MacKenzie, M.Sc., P.Eng.
Associate, Senior Water Resources Engineer

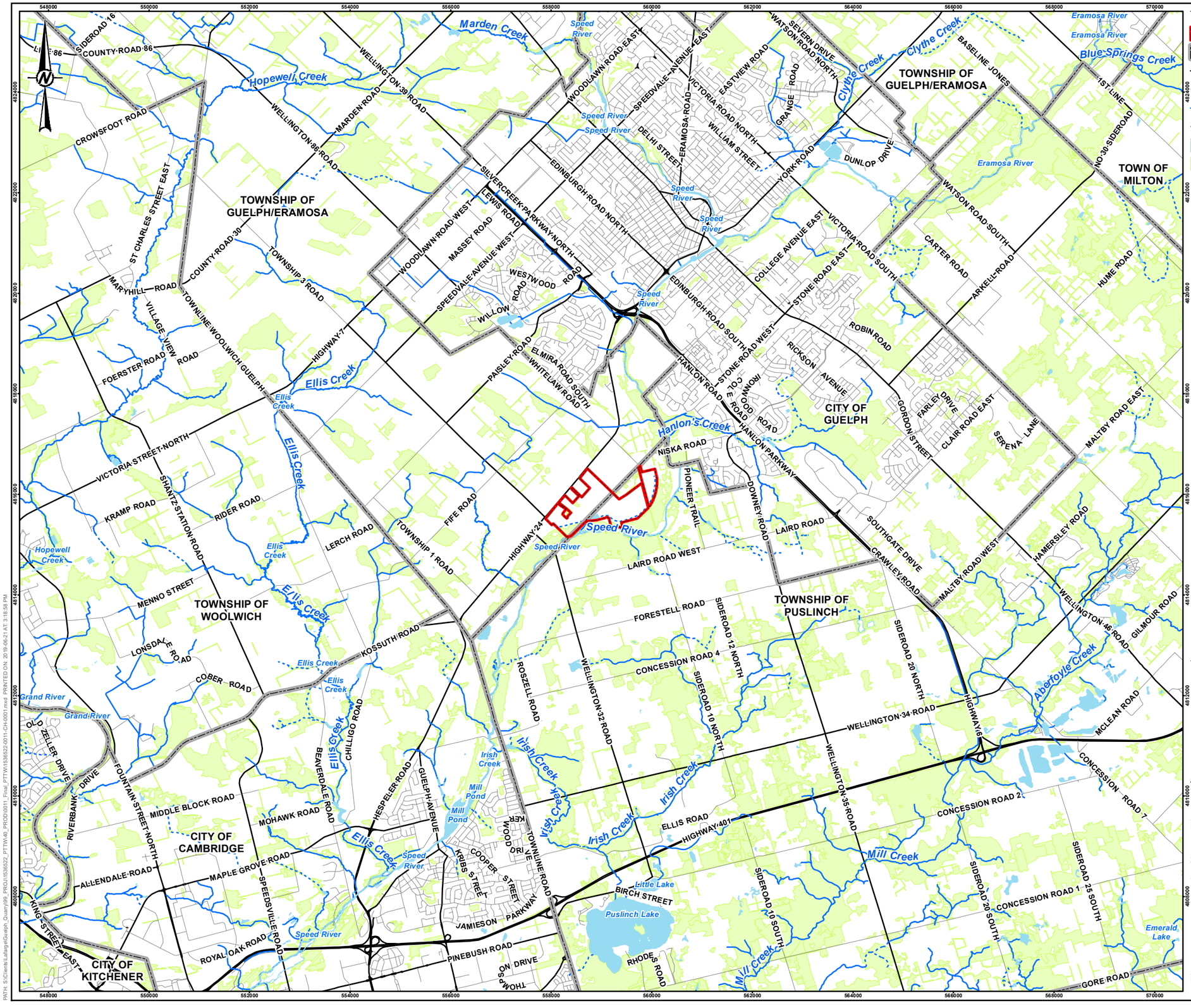
Natural Environment



Heather Melcher, M.Sc.
Associate, Senior Ecologist

GP/CD/HM/SM/PM/ll/mp

FIGURES



LEGEND

- License Boundary
- Municipal Boundary
- Major Road / Highway
- Local Road
- Watercourse
- Intermittent Watercourse
- Waterbody
- Wooded Area

0 1 2 3

1:75,000 Kilometers

REFERENCE(S)

1. BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
2. SERVICE LAYER CREDITS:
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
SITE LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PM
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0001	0.0	1

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

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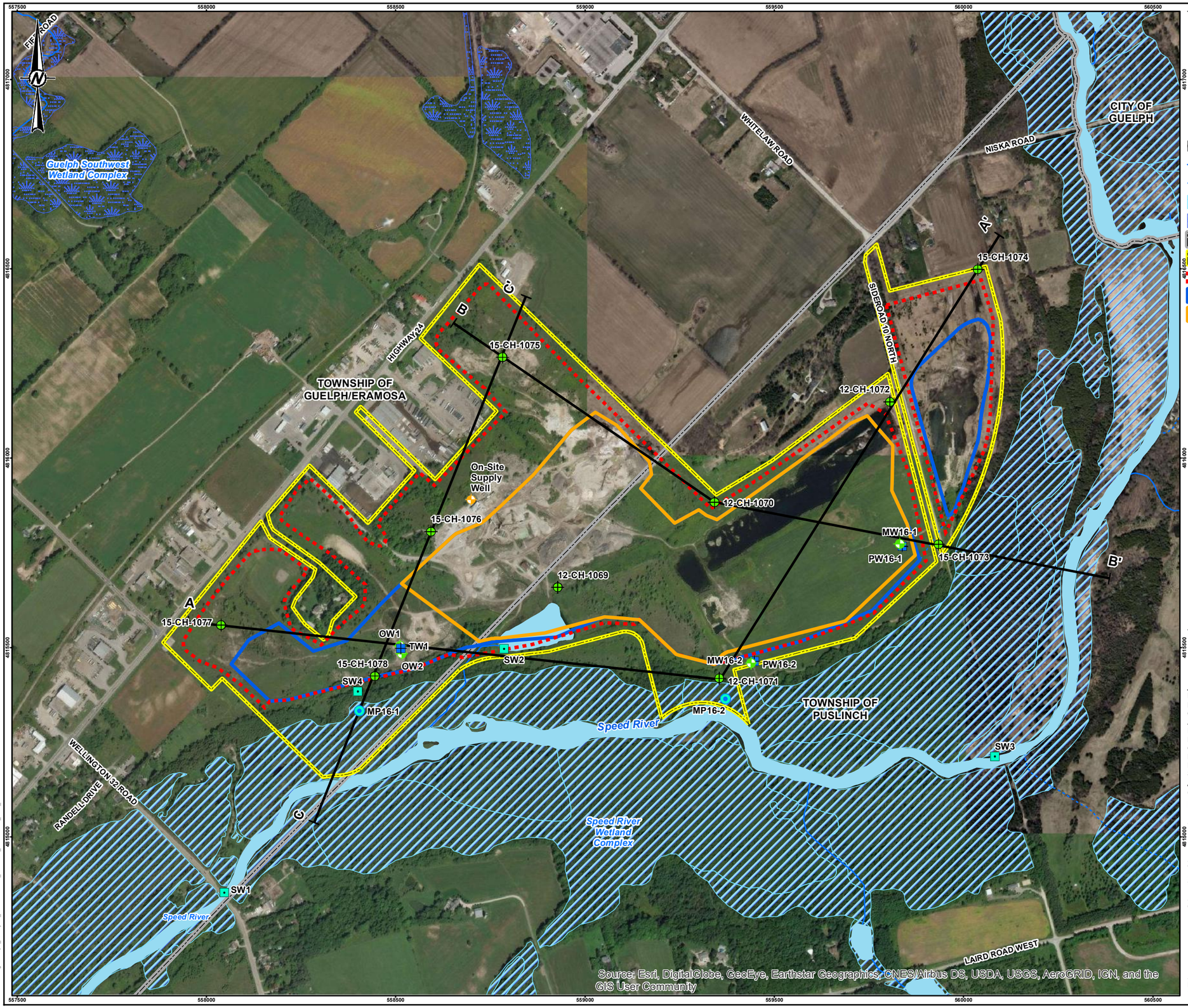

LEGEND

- Piezometer
- Corehole / Monitoring Well
- Monitoring Well
- Supply Well
- Test Well
- Surface Water Station
- Cross Section Location
- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
CONTAINS INFORMATION MADE AVAILABLE UNDER GRAND RIVER CONSERVATION AUTHORITY'S OPEN DATA LICENCE V1.0 - HTTPS://DATA.GRANDRIVER.CA/DOCS/GRCA%20OPEN%20DATA%20LICENCE%20V1.PDF
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-20
DESIGNED	KD
PREPARED	PR/RA
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0004	B	**2**

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

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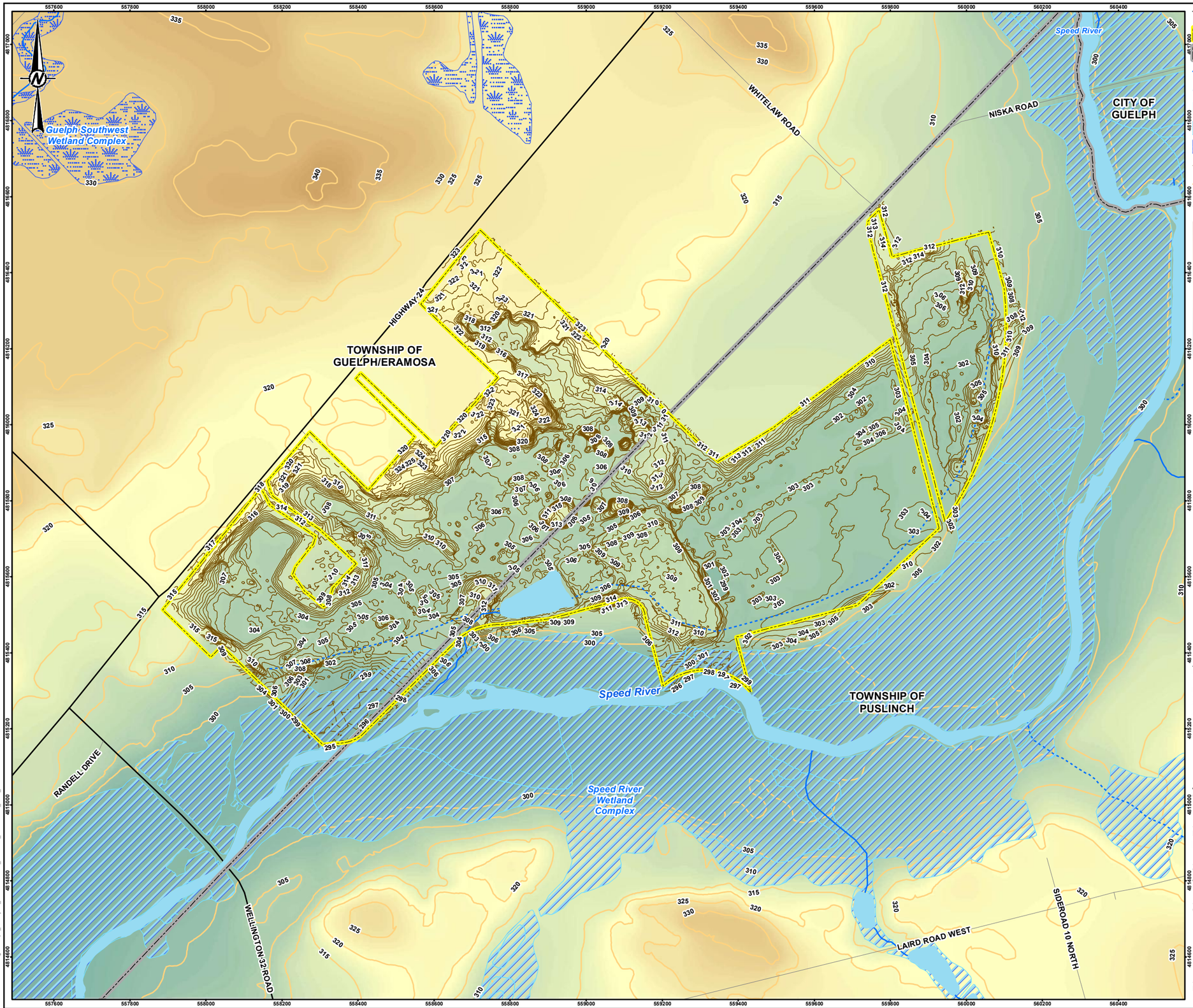

LEGEND

- License Boundary
- Municipal Boundary
- Watercourse
- Intermittent Watercourse
- Waterbody
- Provincially Significant Wetland
- Wetland
- On-Site Topography (masl)
- Regional Topography (masl)

Topographic Elevation (masl)

High : 355

Low : 280

0 150 300 450

1:10,000 Meters

REFERENCE(S)

1. BASE DATA - MNR LIO, OBTAINED 2016
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2016
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
TOPOGRAPHY AND DRAINAGE

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PM
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0001	0.0	3

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

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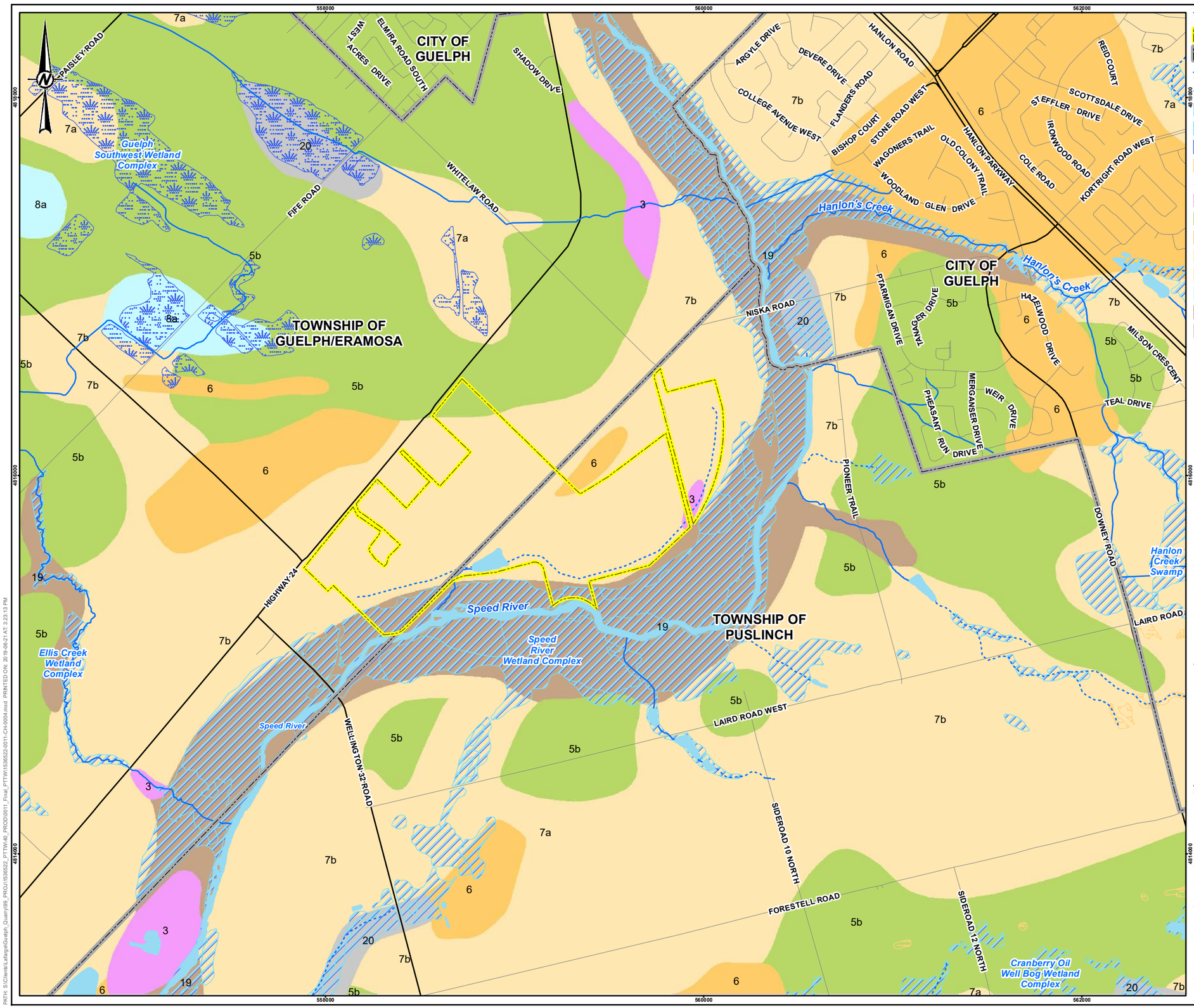

LEGEND

- License Boundary
- Municipal Boundary
- Watercourse
- Intermittent Watercourse
- Waterbody
- Provincially Significant Wetland
- Wetland
- Wetland not Evaluated

SURFICIAL GEOLOGY

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 19: Modern alluvial deposits
- 20: Organic deposits

0 0.5 1 1.5 Kilometers

1:20,000

REFERENCE(S)

1. BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
2. SURFICIAL GEOLOGY, MRD 128, ONTARIO GEOLOGICAL SURVEY, MINISTRY OF NORTHERN DEVELOPMENT AND MINES.
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CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
SURFICIAL GEOLOGY

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PM
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0001	0.0	**4**

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

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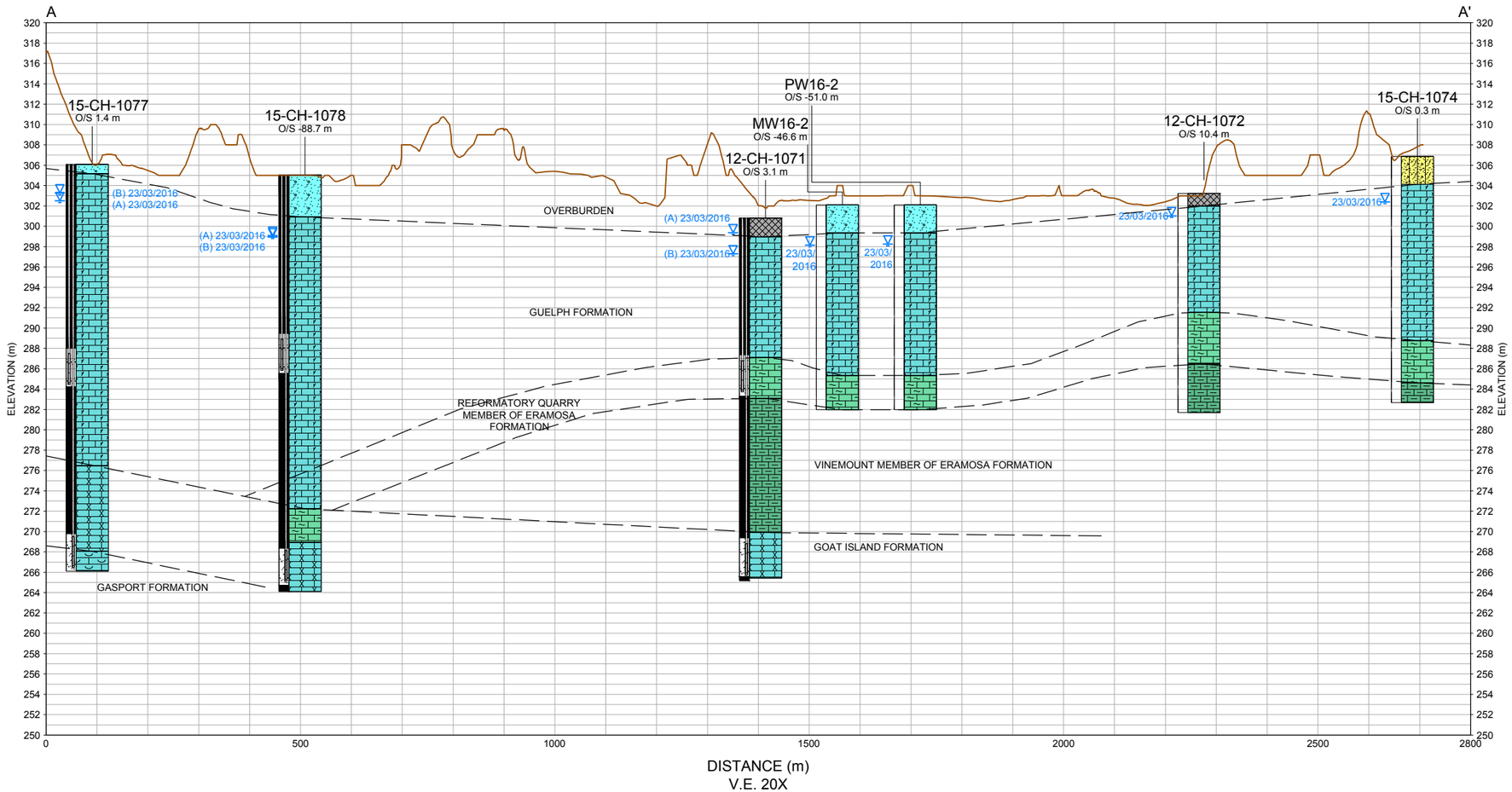


LEGEND

- OVERBURDEN
- SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- DOLOSTONE (GUELPH FORMATION)
- DOLOSTONE (REFORMATORY QUARRY MEMBER OF ERAMOSA FORMATION)
- SHALEY DOLOSTONE (VINEMOUNT MEMBER OF ERAMOSA FORMATION)
- DOLOSTONE (GOAT ISLAND FORMATION)
- DOLOSTONE (GASPORT FORMATION)
- WATER LEVEL (MARCH 23, 2016)

0 10 20
1:500 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
LAFARGE CANADA INC.

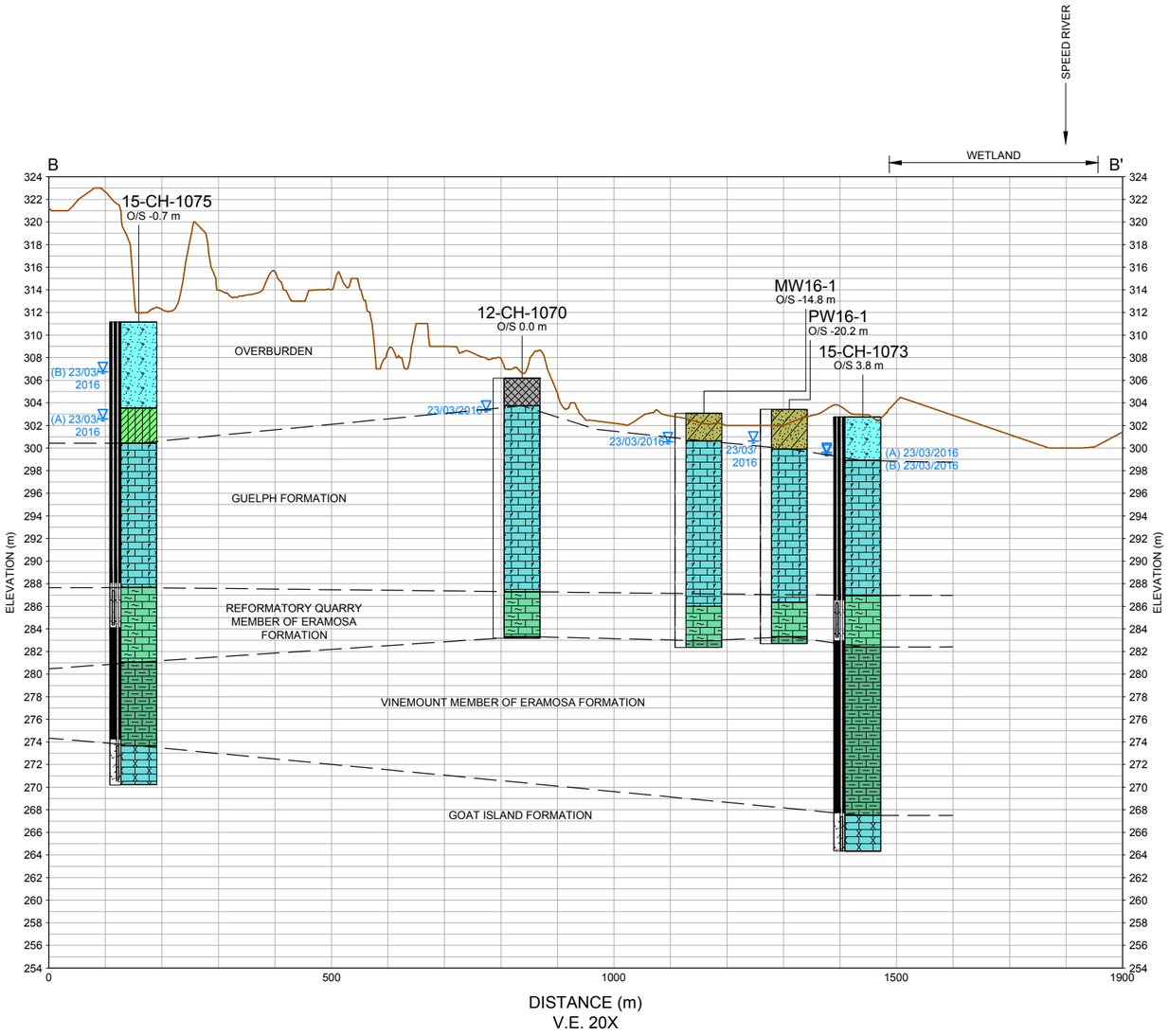
PROJECT
PERMIT TO TAKE WATER
GUELPH QUARRY

TITLE
CROSS SECTION A - A'

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-16
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	SM

PROJECT NO.	PHASE	REV.	FIGURE
1536522	1000	A	5



LEGEND

- OVERBURDEN
- SAND AND GRAVEL
- SILTY CLAY
- CLAYEY SAND
- DOLOSTONE (GUELPH FORMATION)
- DOLOSTONE (REFORMATORY QUARRY MEMBER OF ERAMOSA FORMATION)
- DOLOSTONE (VINEMOUNT MEMBER OF ERAMOSA FORMATION)
- DOLOSTONE (GOAT ISLAND FORMATION)
- WATER LEVEL (MARCH 23, 2016)

0 10 20
1:500 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER
GUELPH QUARRY

TITLE
CROSS SECTION B - B'

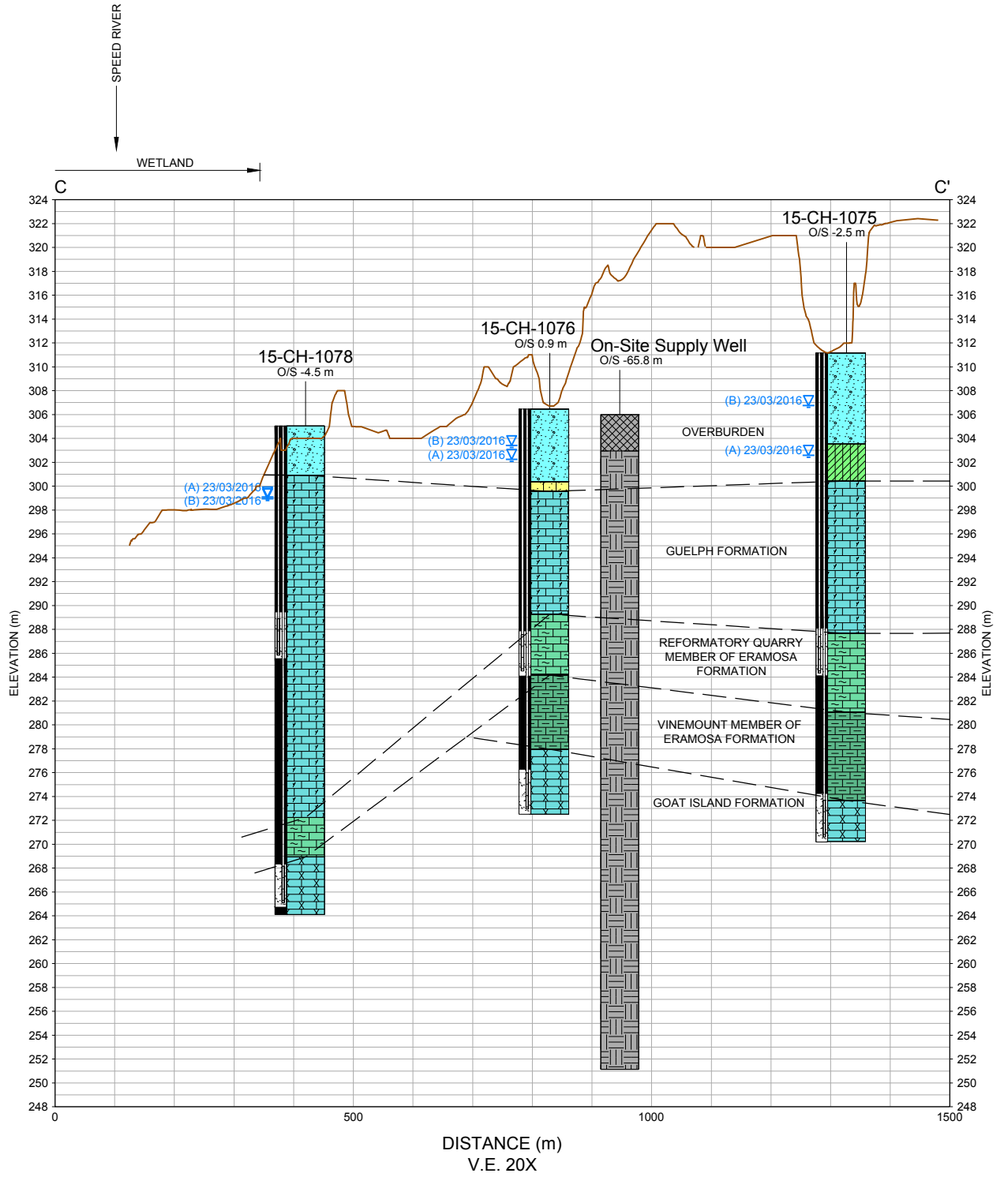
CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-16
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	SM

PROJECT NO.	PHASE	REV.	FIGURE
1536522	1000	A	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm



LEGEND

- OVERBURDEN
- SAND AND GRAVEL
- SILTY SAND
- SILTY CLAY
- DOLOSTONE (GUELPH FORMATION)
- DOLOSTONE (REFORMATORY QUARRY MEMBER OF ERAMOSA FORMATION)
- DOLOSTONE (VINEMOUNT MEMBER OF ERAMOSA FORMATION)
- DOLOSTONE (GOAT ISLAND FORMATION)
- BEDROCK
- WATER LEVEL (MARCH 23, 2016)

0 10 20
1:500 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER
GUELPH QUARRY

TITLE
CROSS SECTION C - C'

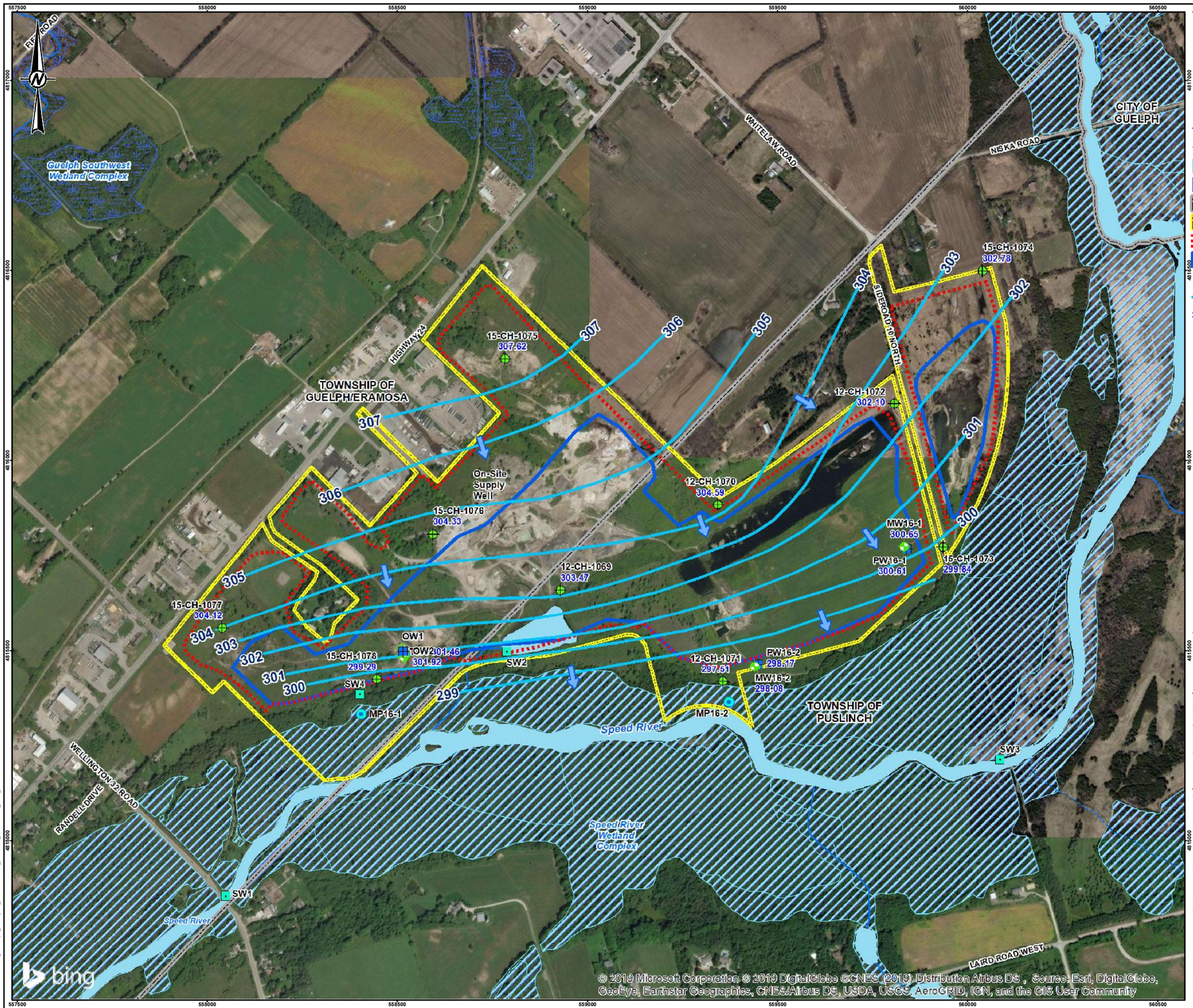
CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-16
DESIGNED	
PREPARED	DD
REVIEWED	GP
APPROVED	SM

PROJECT NO.	PHASE	REV.	FIGURE
1536522	1000	A	7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm



LEGEND

- Piezometer
- Corehole / Monitoring Well
- Monitoring Well
- Test Well
- Surface Water Station
- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Groundwater Flow Direction
- Groundwater Level Contour
- 302.78 Water Level (June 14, 2016)

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
POTENTIOMETRIC SURFACE IN GUELPH FORMATION/ERAMOSA FORMATION (REFORMATORY QUARRY)

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR/PM
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0001	0.0	8

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

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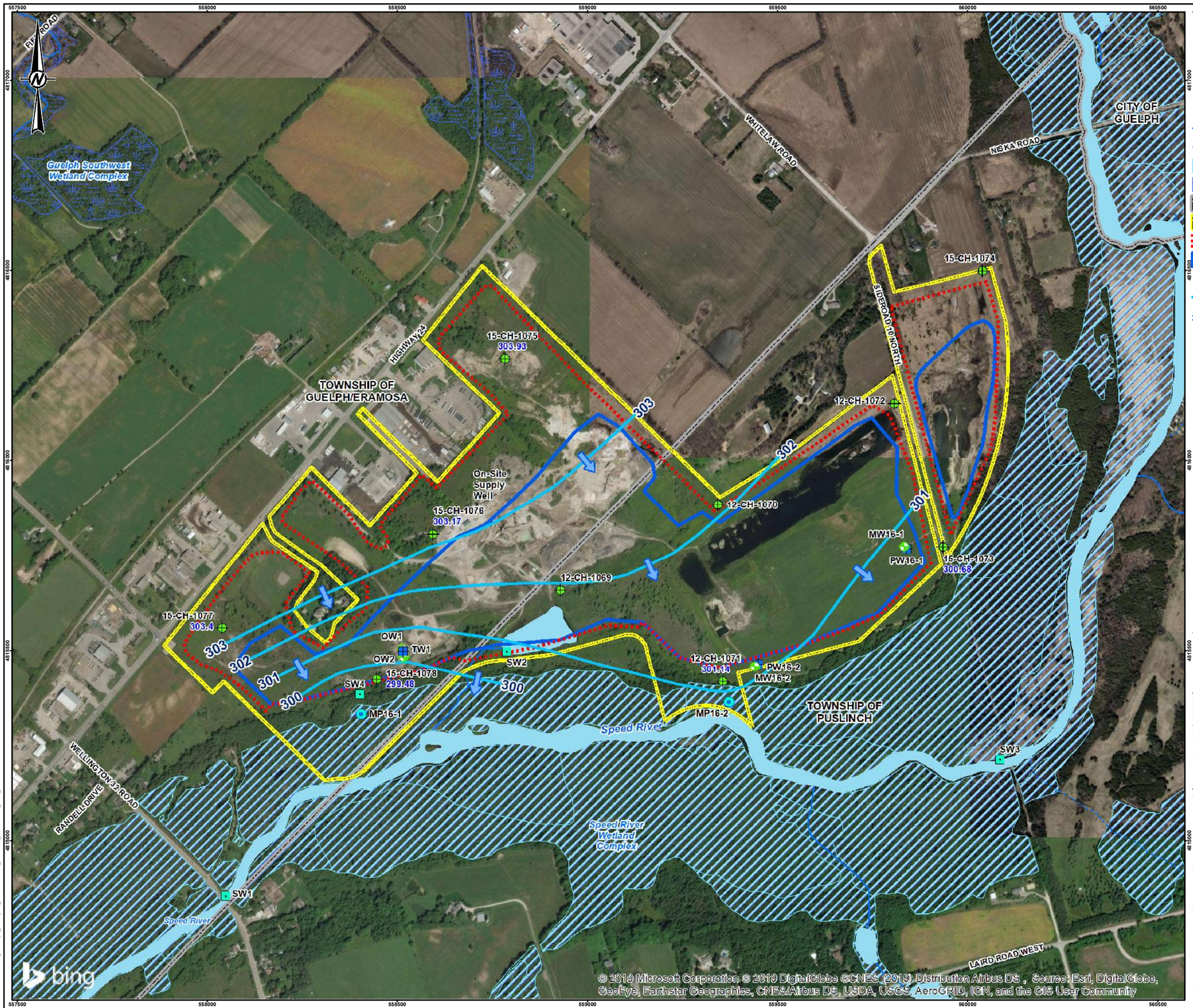

LEGEND

- Piezometer
- Corehole / Monitoring Well
- Monitoring Well
- Test Well
- Surface Water Station
- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Groundwater Flow Direction
- Groundwater Level Contour
- 300.68 Water Level (June 14, 2016)

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
POTENTIOMETRIC SURFACE IN GOAT ISLAND/GASPORT FORMATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR/PM
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0001	0.0	**9**

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

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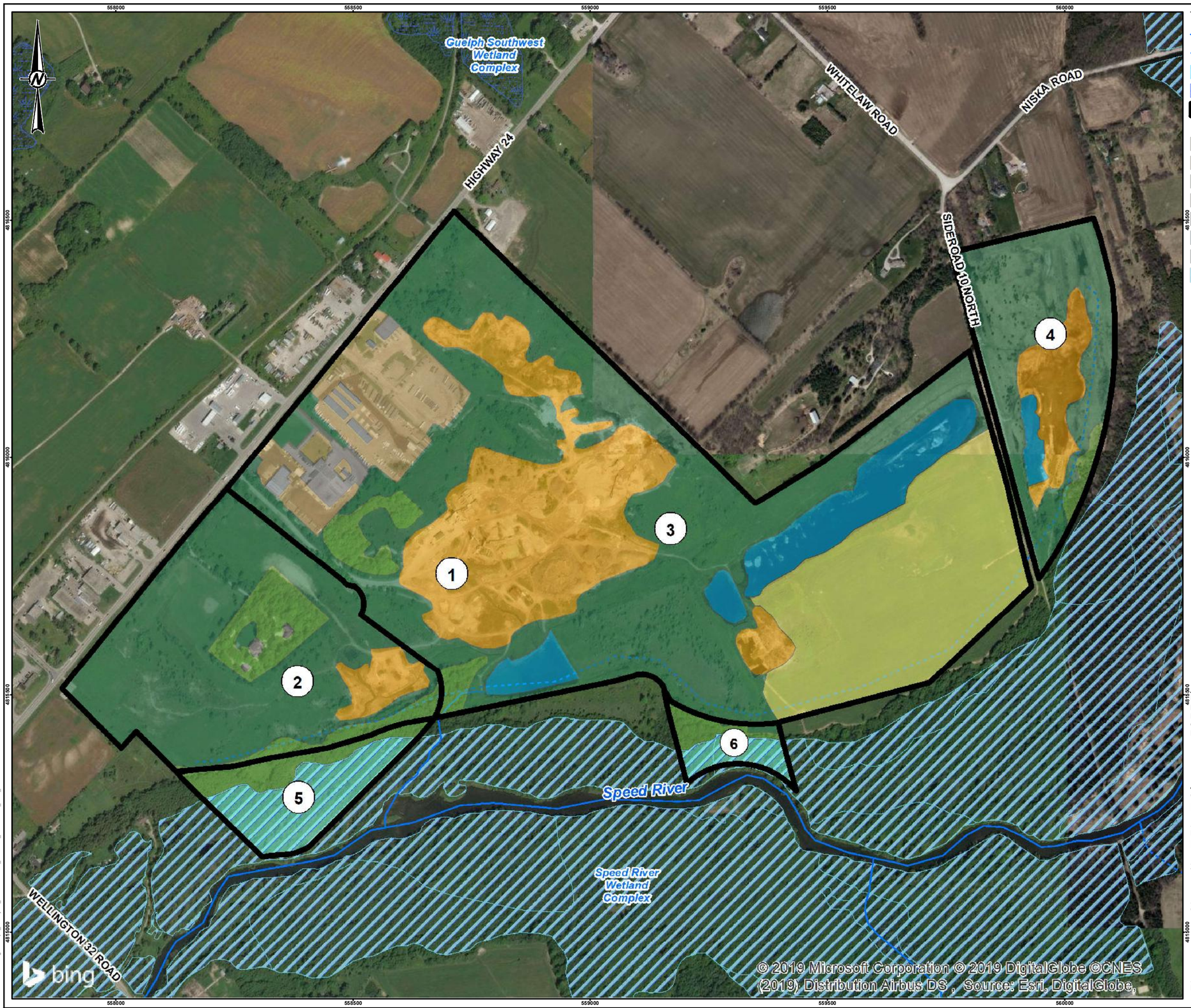

LEGEND

- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Catchment Boundary

Land Cover

- Agriculture
- Bare Open Pit
- Forest
- Gravel
- Impervious
- Open Water
- Vegetated
- Wetland

0 250 500

1:8,000 METRES

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
LAFARGE GUELPH

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
EXISTING SITE CATCHMENTS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	JMC
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0002	A	**10**

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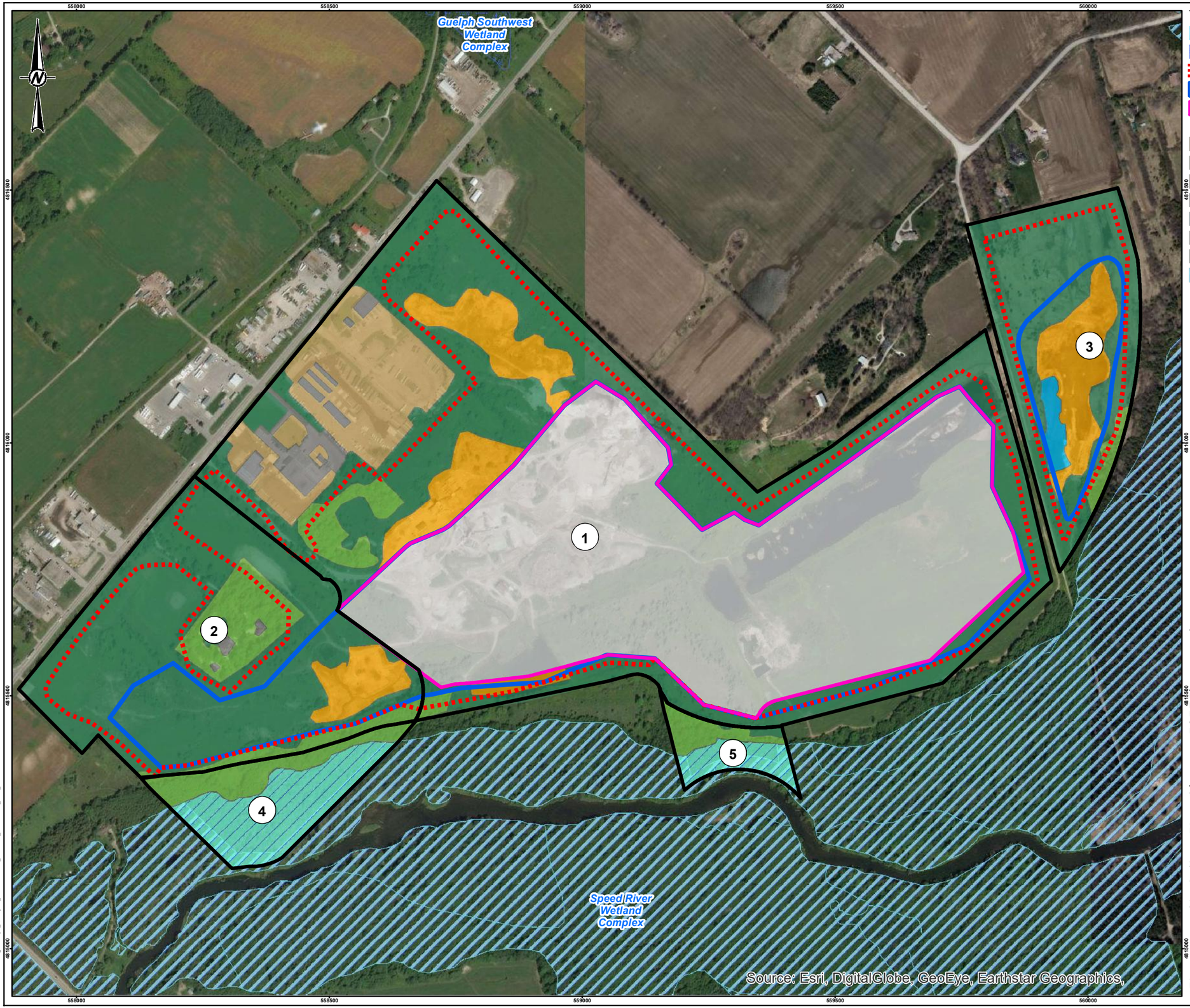


LEGEND

- Provincially Significant Wetland
- Wetland
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction

Land Cover

- Bare-Open Pit
- Forest
- Gravel
- Impervious
- Open Water
- Quarry
- Vegetated
- Wetland

0 250 500

1:7,500 METRES

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
LAFARGE GUELPH

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
OPERATIONAL SITE CATCHMENTS

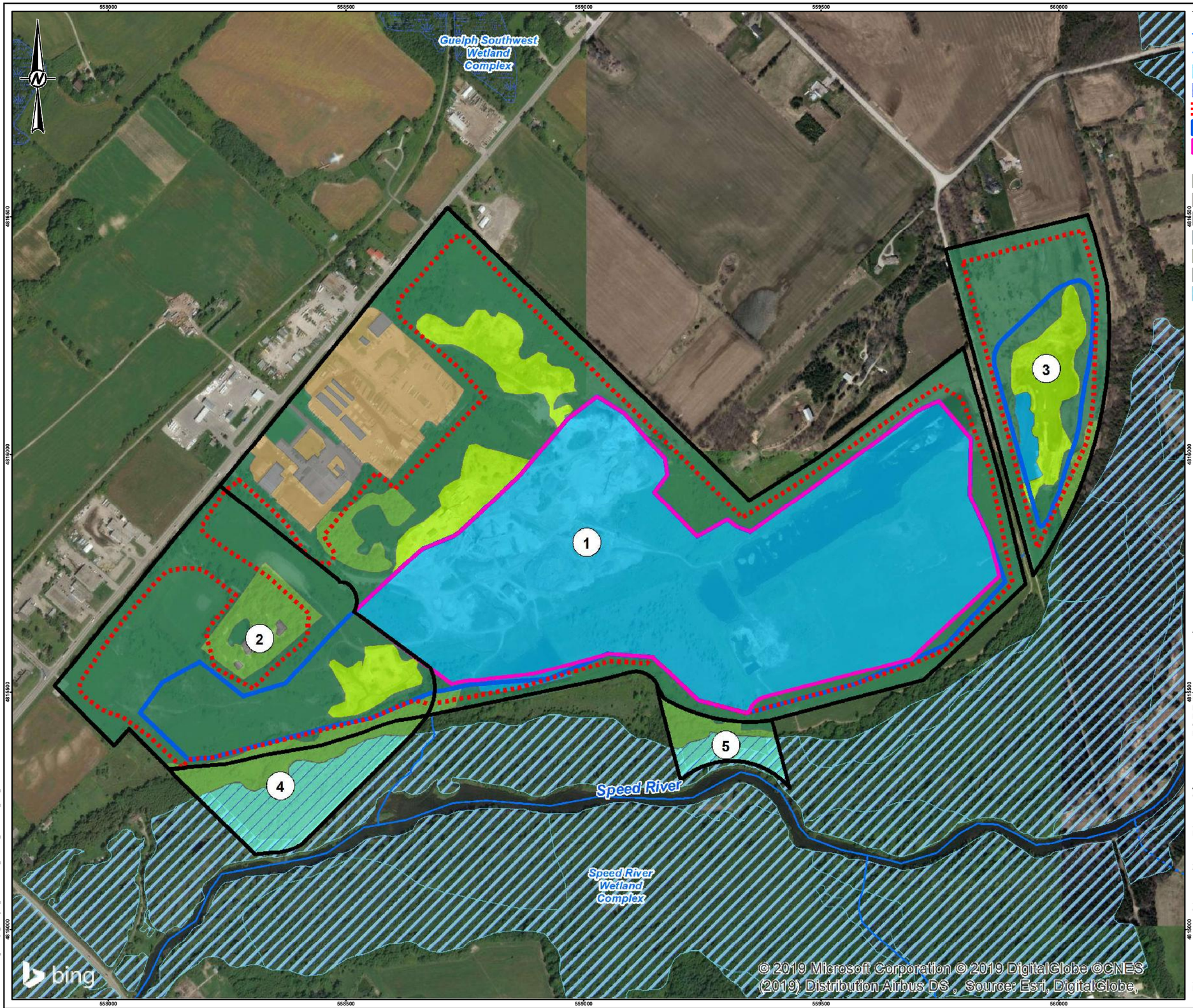
CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR
REVIEWED	MLE/DH
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0005	B	11

PATH: S:\Clients\Lafarge\Guelph_Quarry\99_PROJ\1536522_PTTW-AD_PRO\0011_Final_PTTW\1536522-0011-CH-0011.mxd PRINTED ON: 2019-06-21 AT: 3:31:44 PM

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



LEGEND

- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction

Land Cover

- Forest
- Gravel
- Impervious
- Open Water
- Pasture
- Vegetated
- Wetland

0 250 500
1:8,000 METRES

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
LAFARGE GUELPH

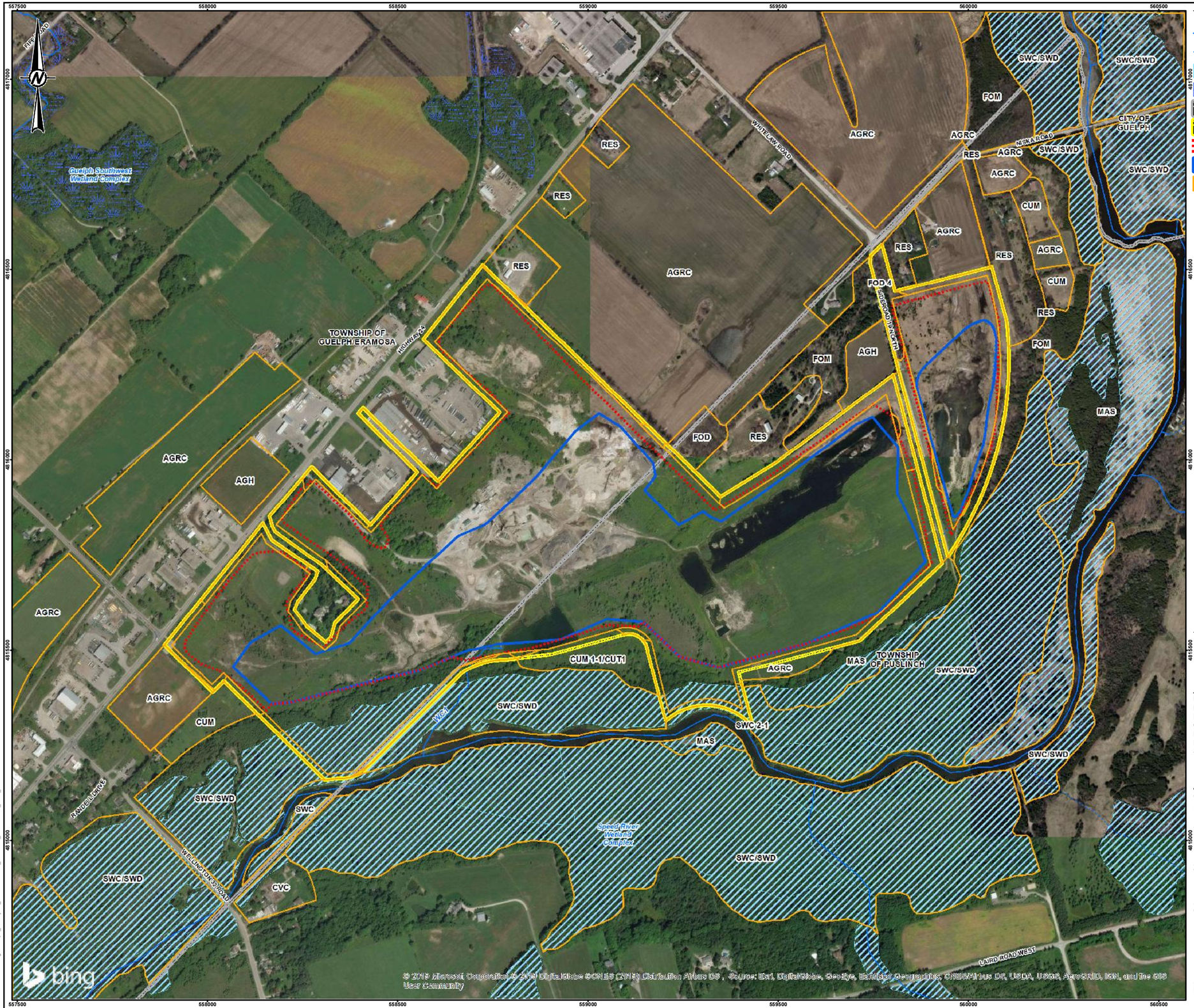
PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
REHABILITATED SITE CATCHMENTS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR
REVIEWED	MLE/DH
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0005	B	12



LEGEND

- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Ecological Land Classification (ELC)

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
ECOLOGICAL LAND CLASSIFICATION AND SURVEY STATIONS

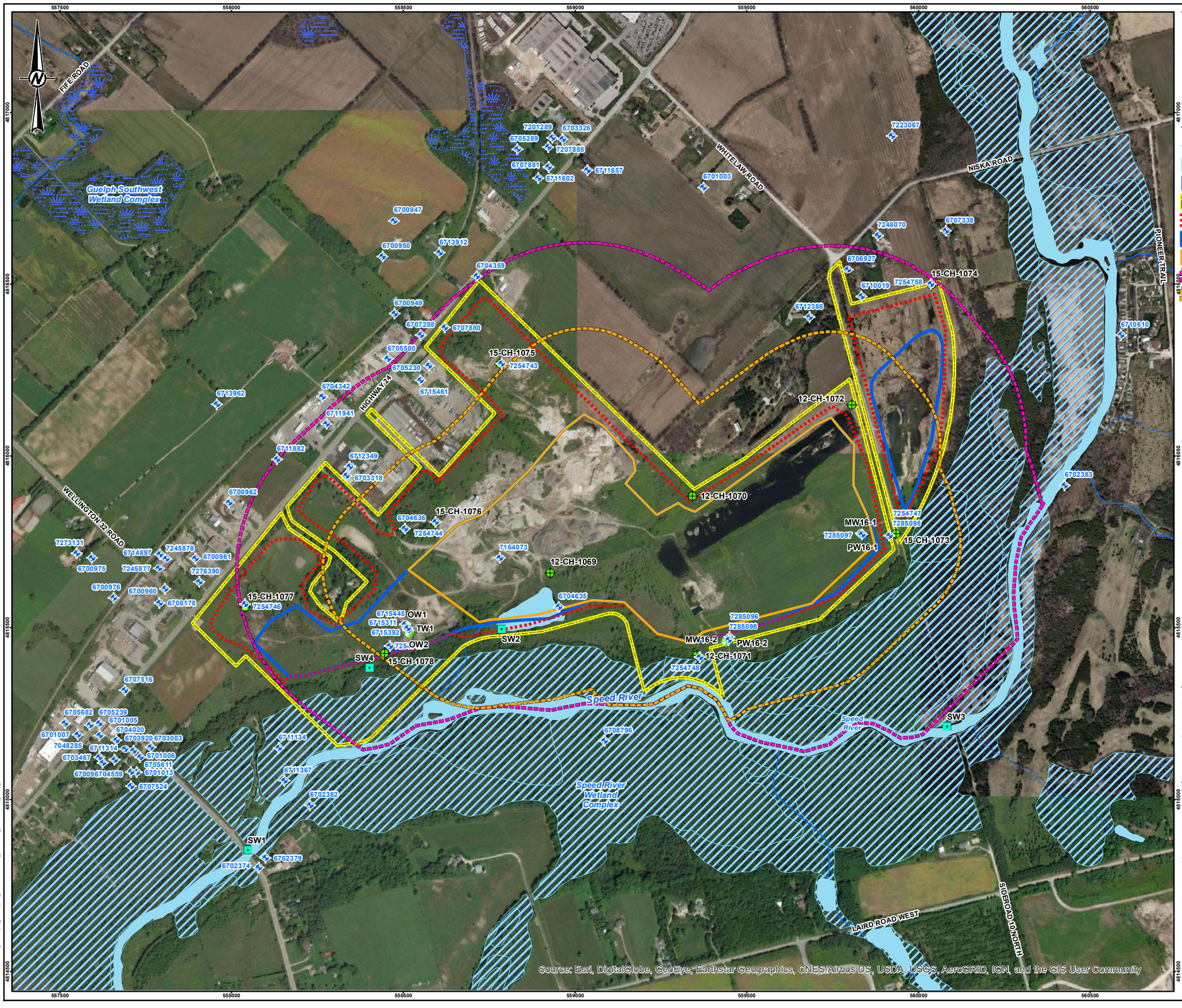
CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	JMC
REVIEWED	HM
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0005	A	**13**

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

PATH: S:\Clients\Lafarge\Guelph_Quarry\99_PROJ\1536522_PTTW-40_PROD\0011_Final_PTTW\1536522-0011-CH-0013.mxd PRINTED ON: 2019-06-21 AT 3:51:47 PM



LEGEND

- Corehole / Monitoring Well
- Monitoring Well
- Test Well
- Surface Water Station
- MECP Water Well Records
- Watercourse
- Intermittent Watercourse
- Provincially Significant Wetland
- Wetland
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction
- Approximate Dewatering Zone of Influence
- Approximate Dewatering Zone of Influence 1m Drawdown

0 200 400 600

1:10,968 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

MECP WATER WELL RECORDS - WATER WELL INFORMATION SYSTEM (WWIS) – WELL RECORD DATA RELEASE 2019
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
DEWATERING ZONE OF influence

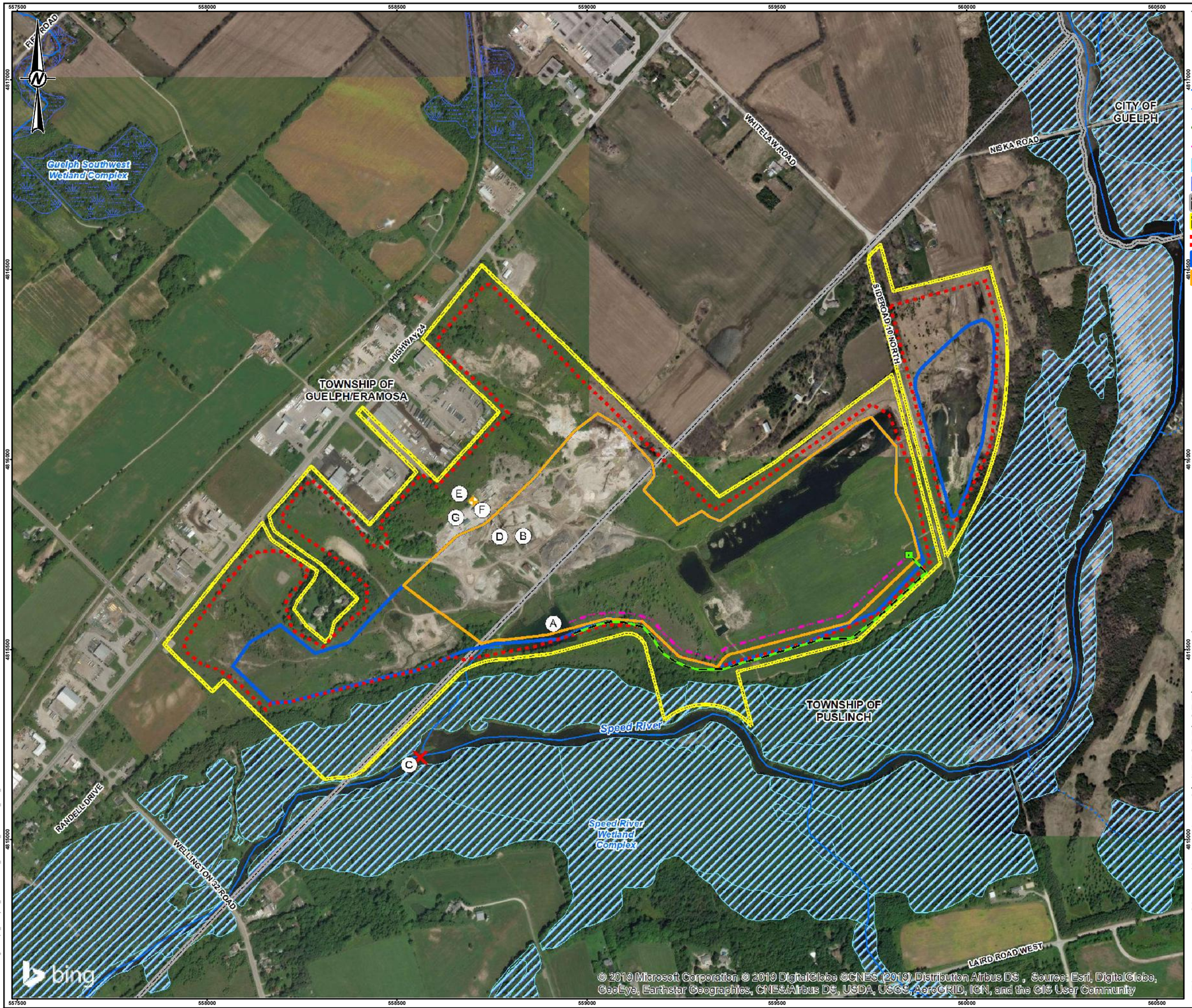
CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0005	B	14

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

PATH: S:\Clients\Lafarge\Guelph_Quarry\99_PROJ\1536522_PTTW-AD_PRO\0011_Final_PTTW\1536522-0011-CH-0014.mxd PRINTED ON: 2019-06-21 AT: 3:38:37 PM



LEGEND

- Supply Well
- Sump
- Discharge to Speed River
- Watercourse
- Intermittent Watercourse
- Infiltration Ditch or Weir or Diffusers
- Piped Discharge
- Provincially Significant Wetland
- Wetland
- Municipal Boundary
- License Boundary
- Approximate Above Water Limit of Extraction
- Approximate Below Water Limit of Extraction
- Initial Phase of Below Water Extraction
- (A) Source Pond / Quarry Water Management Pond
- (B) Holding Pond
- (C) River Intake
- (D) Asphalt Plant Wet Scrubber
- (E) On-Site Supply Well
- (F) Concrete Batching Plant
- (G) Concrete Plant Washout

0 200 400 600

1:10,000 Metres

NOTE(S)

1. THE AREA OF EXTRACTION IS SUBJECT TO THE CURRENT APPLICATION

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015
CONTAINS INFORMATION MADE AVAILABLE UNDER GRAND RIVER CONSERVATION AUTHORITY'S OPEN DATA LICENCE V1.0 - HTTPS://DATA.GRANDRIVER.CA/DOCS/GRCA%20OPEN%20DATA%20LICENCE%20V1.PDF
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17
EXTRACTION LIMITS WERE DIGITIZED FROM FILE NAMED "PROPERTY OUTLINE WITH SETBACKS.JPG" SUPPLIED BY LAFARGE, 20150915

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLINGTON COUNTY SITE

TITLE
PROPOSED DISCHARGE

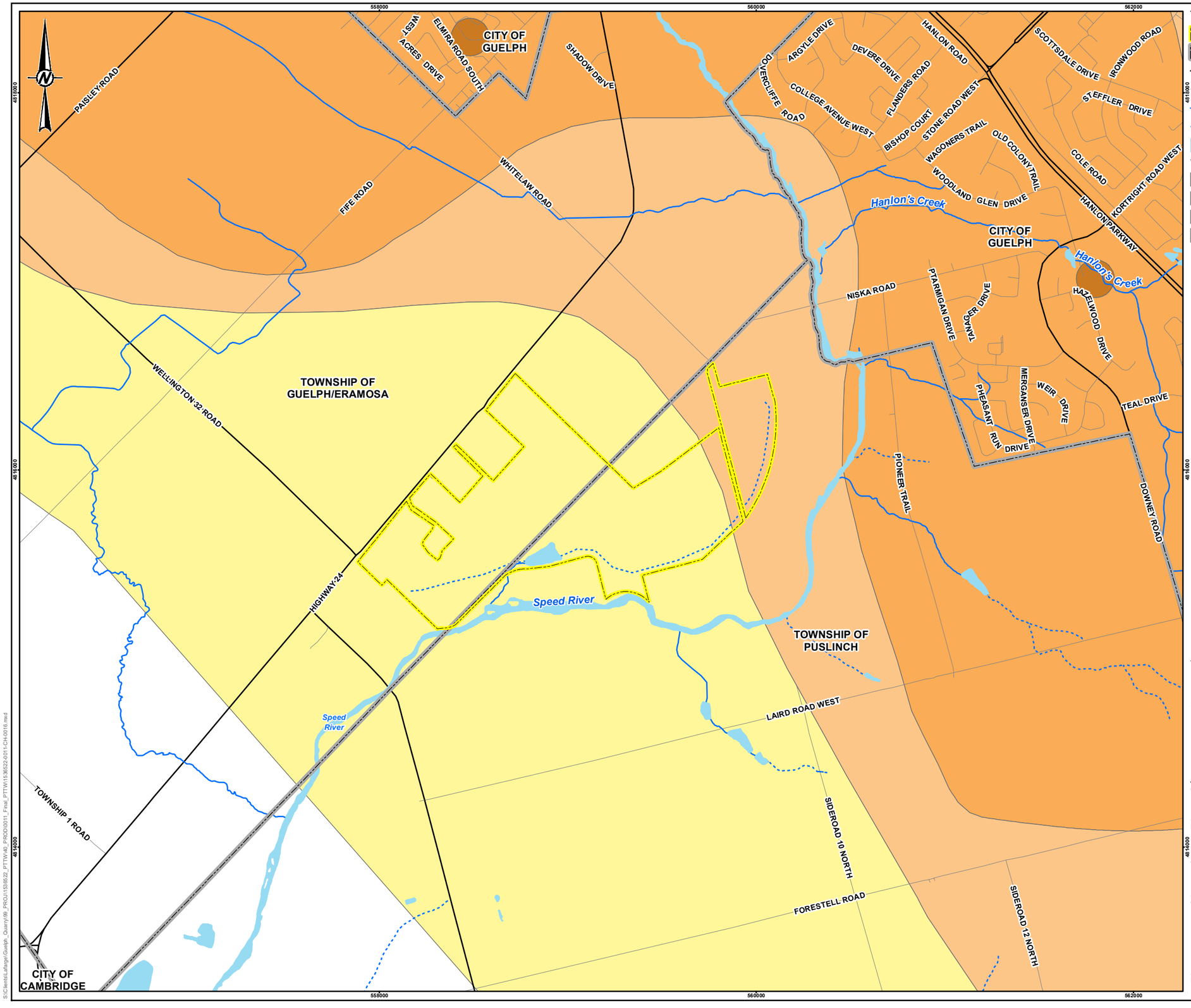
CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-21
DESIGNED	KD
PREPARED	PR
REVIEWED	GP
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0004	B	15

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

PATH: S:\Clients\Lafarge\Guelph_Quarry\99_PROJ\1536522_PTTW\40_PROD\0011_Final_PTTW\1536522-0011-CH-0015.mxd PRINTED ON: 2019-06-21 AT 3:41:17 PM



LEGEND

- License Boundary
- Municipal Boundary
- Major Road / Highway
- Local Road
- Watercourse
- Intermittent Watercourse
- Waterbody

Wellhead Protection Area Zone

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

0 500 1,000 1,500

1:20,000 Meters

REFERENCE(S)

1. BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
2. SOURCE WATER PROTECTION, WELLHEAD PROTECTION AREA ZONE, GRAND RIVER CONSERVATION AUTHORITY, 2018
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLIN GTON COUNTY SITE

TITLE
LOCAL SOURCE WATER PROTECTION AREAS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-20
DESIGNED	PR
PREPARED	PR
REVIEWED	CD
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0011	0.0	**16**

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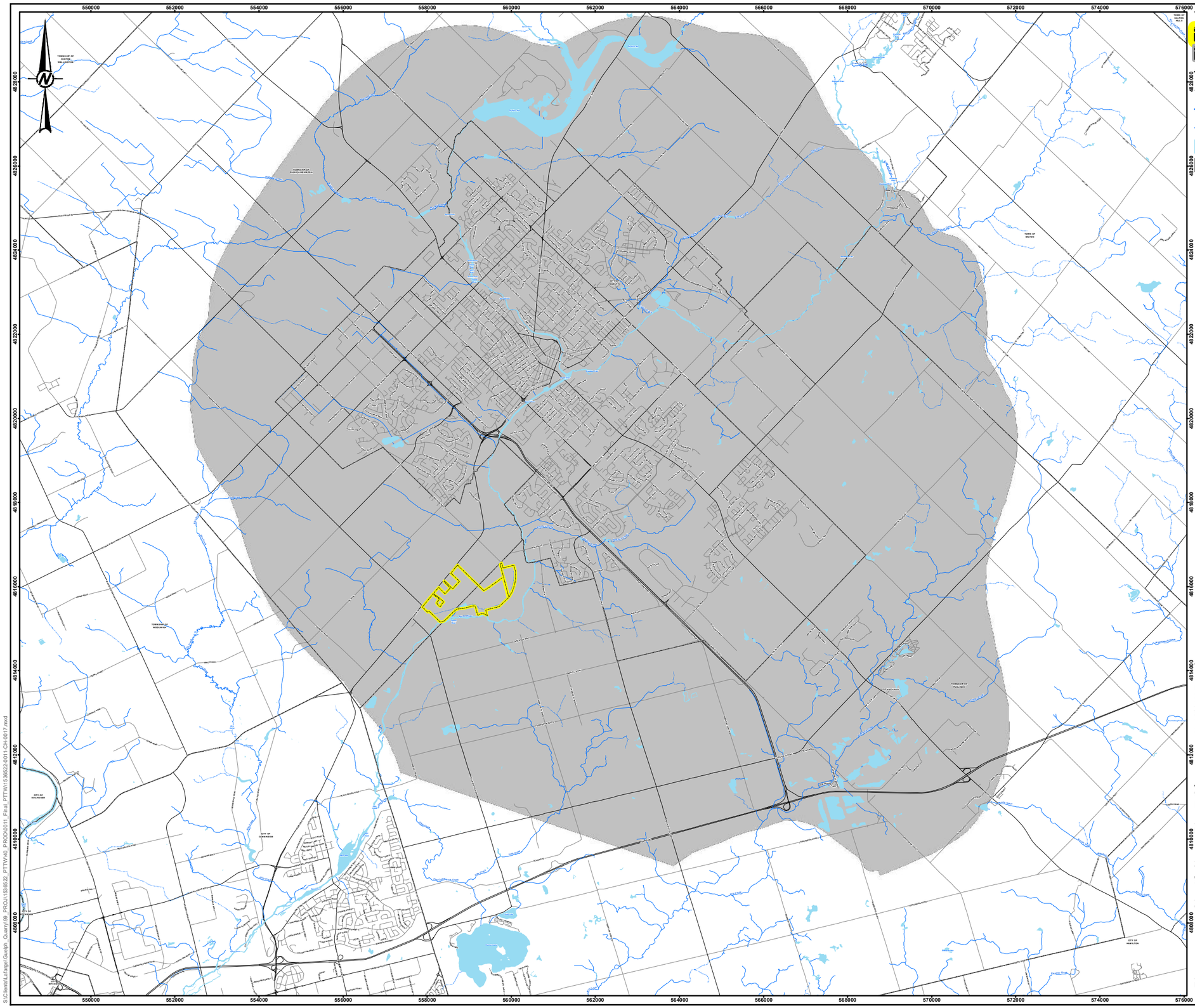
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- License Boundary
- Municipal Boundary
- Major Road / Highway
- Local Road
- Watercourse
- Intermittent Watercourse
- Waterbody
- WHPA-Q

0 1.5 3 4.5

1:90,000 KILOMETERS

REFERENCE(S)

1. BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015
2. GRCA FIGURE 1 MARCH 29, 2017 GLUEPH/GUELPH-ERAMOSA TIER 3 GROUNDWATER
WELLHEAD PROTECTION AREA FOR WATER QUANTITY (WHPA-Q)".
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17

CLIENT
LAFARGE CANADA INC.

PROJECT
PERMIT TO TAKE WATER WELLIN GTON COUNTY SITE

TITLE
WELLHEAD PROTECTION AREA FOR WATER QUANTITY

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-14
DESIGNED	PR
PREPARED	PR
REVIEWED	CD
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
1536522	0011	0.0	**17**

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

S:\Clients\Lafarge\Guelph_Quarry\09_PROJ\1536522_PTTW\40_PROD\0011_Final_PTTW\1536522-4011-CH-0017.mxd

APPENDIX A

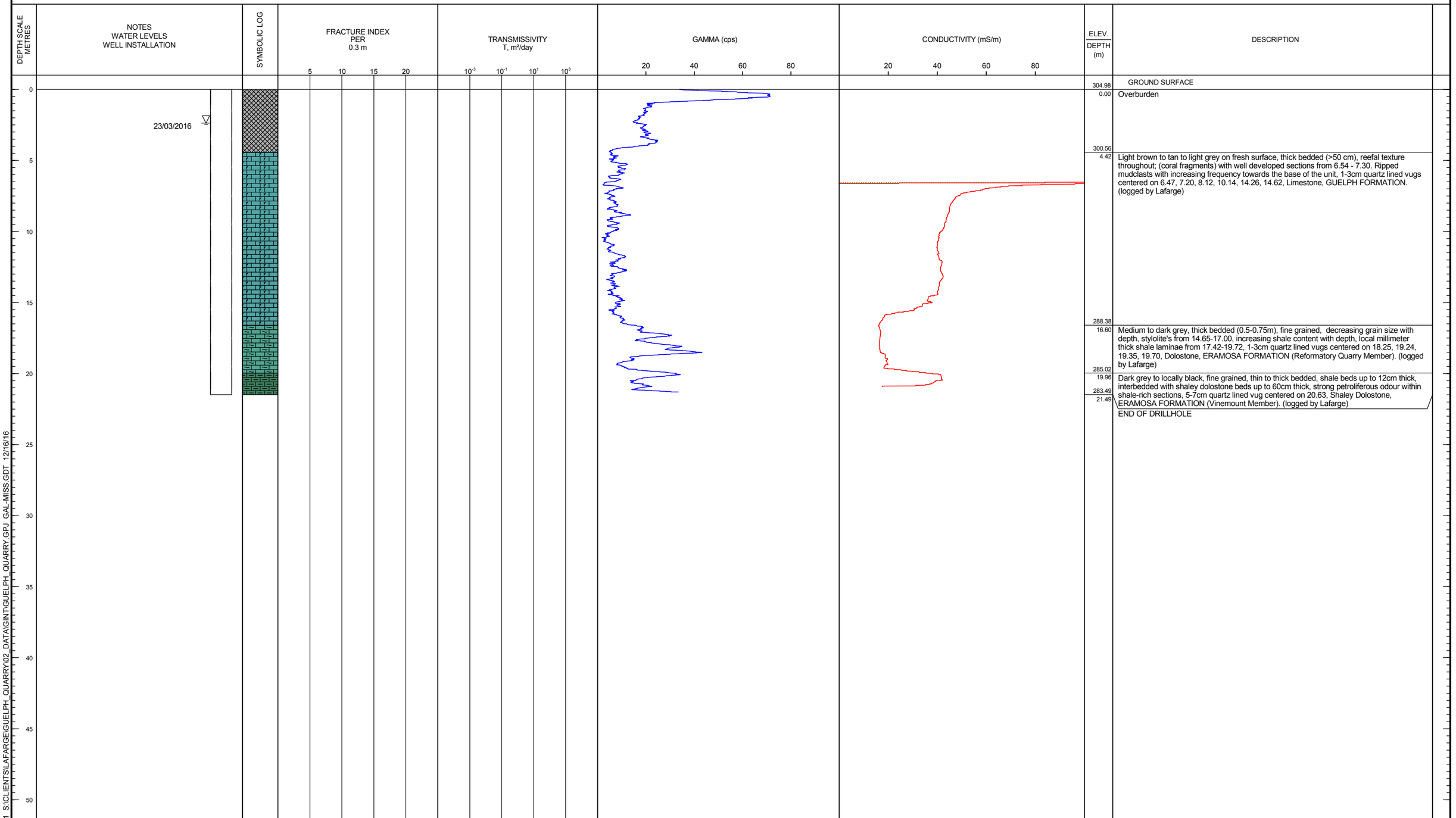
Borehole Logs

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 12-CH-1069

DATUM: Ground Surface



ELEV. / DEPTH (m)	DESCRIPTION
304.98	GROUND SURFACE
0.00	Overburden
300.56	
4.42	Light brown to tan to light grey on fresh surface, thick bedded (>50 cm), reefal texture throughout; (coral fragments) with well developed sections from 6.54 - 7.30. Ripped mudclasts with increasing frequency towards the base of the unit, 1-3cm quartz lined vugs centered on 6.47, 7.20, 8.12, 10.14, 14.26, 14.62, Limestone, GUELPH FORMATION. (logged by Lafarge)
288.38	
16.60	Medium to dark grey, thick bedded (0.5-0.75m), fine grained, decreasing grain size with depth, stylolite's from 14.65-17.00, increasing shale content with depth, local millimeter thick shale laminae from 17.42-19.72, 1-3cm quartz lined vugs centered on 18.25, 19.24, 19.35, 19.70, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member). (logged by Lafarge)
285.02	
19.96	Dark grey to locally black, fine grained, thin to thick bedded, shale beds up to 12cm thick, interbedded with shaley dolostone beds up to 60cm thick, strong petroliferous odour within shale-rich sections, 5-7cm quartz lined vug centered on 20.63, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member). (logged by Lafarge)
283.49	
21.49	END OF DRILLHOLE

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 12-CH-1070

DATUM: Ground Surface

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

DEPTH SCALE METRES

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m²/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
306.18	GROUND SURFACE
0.00	Overburden
303.74	
2.44	Light brown to tan on fresh surface, fine grained, thick bedded (>50 cm), weathered from 2.44 - 8.38m. Well preserved reefal texture (coral fragments) in sections from 3.05 - 3.93, 8.70 - 9.10, 9.58 - 10.30, 10.94 - 11.94; increase in ripped mudclasts towards the base of the unit along with an increase in interstitial mud. Limestone, GUELPH FORMATION. (logged by Lafarge)
287.29	
18.89	Medium to dark grey, medium to thick bedded (0.30-0.75m), fine grained, decreasing grain size with depth, increasing shale content with depth, vuggy throughout, 15 - 20% quartz lined vugs from 19.80 - 22.70, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member). (logged by Lafarge)
283.32	
23.00	Dark grey to locally black, fine grained, fine to medium bedded, shale beds 0.5 - 1cm thick, strong petroliferous odour within shale-rich sections, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member). (logged by Lafarge)
	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 12-CH-1071

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

(A) 23/03/2016

(B) 23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m^2/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
300.80	GROUND SURFACE
0.00	Overburden
298.97	
1.83	Light grey to light brown on fresh surface, fine grained, thickly bedded (>50cm), generally massive texture with poorly preserved reefal sections (coral fragments) from 2.03-2.24, 7.04-7.21; predominantly mudclasts, Limestone, GUELPH FORMATION. (logged by Lafarge)
287.09	
13.71	Medium to dark grey, thickly bedded (0.5-0.75m), fine grained, poorly developed nodular texture from 12.16-15.20m, increasing shale content with depth, vuggy throughout with large quartz lined vugs (5-8cm) centered on 14.50 and 15.93, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member). (logged by Lafarge)
283.10	
17.70	Fresh, weak to medium strong, dark grey to black, fine grained, laminated to medium bedded, some cross bedding present throughout, bituminous, locally vuggy, occasional heal veins throughout, clay gouge @ 30.3m, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
269.90	
30.90	Fresh, medium strong, dark to light grey, medium grained, medium to thickly bedded, fossiliferous, some cherty nodules and beddings throughout, locally stylolitic, crystalline Dolostone, GOAT ISLAND FORMATION.
265.42	
35.38	END OF DRILLHOLE

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 12-CH-1072

DATUM: Ground Surface

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

DEPTH SCALE METRES

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m²/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
303.22	GROUND SURFACE
0.00 / 302.00	Overburden
1.22 / 291.57	Light brown to tan on fresh surface, thick bedded (>50 cm), reefal texture throughout; (coral fragments) with well preserved sections from 1.22 - 2.00, 4.75 - 5.14, 6.30 - 7.17. Ripped mudclasts with increasing frequency towards the base of the unit, Limestone, GUELPH FORMATION. (logged by Lafarge)
11.65 / 286.46	Light grey at the top of the section becoming medium to dark grey with depth, thick bedded (0.5-0.75m), fine grained, medium to thick bedded (8 - 50cm), decreasing grain size with depth, increasing shale content with depth, abundant vugs lined with quartz, pyrite, sphalerite from 12.70 to 16.75, alteration associated with vug formation has obliterated much of the original texture, 1-2 mm chert nodules comprising 10% from 13.40 to 13.80, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member). (logged by Lafarge)
16.76 / 281.71	Dark grey to locally black, fine grained, thin bedded, shale beds up to 3cm thick, interbedded with shaley dolostone beds up to 60cm thick, strong petroliferous odour within shale-rich sections, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member). (logged by Lafarge)
21.51	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

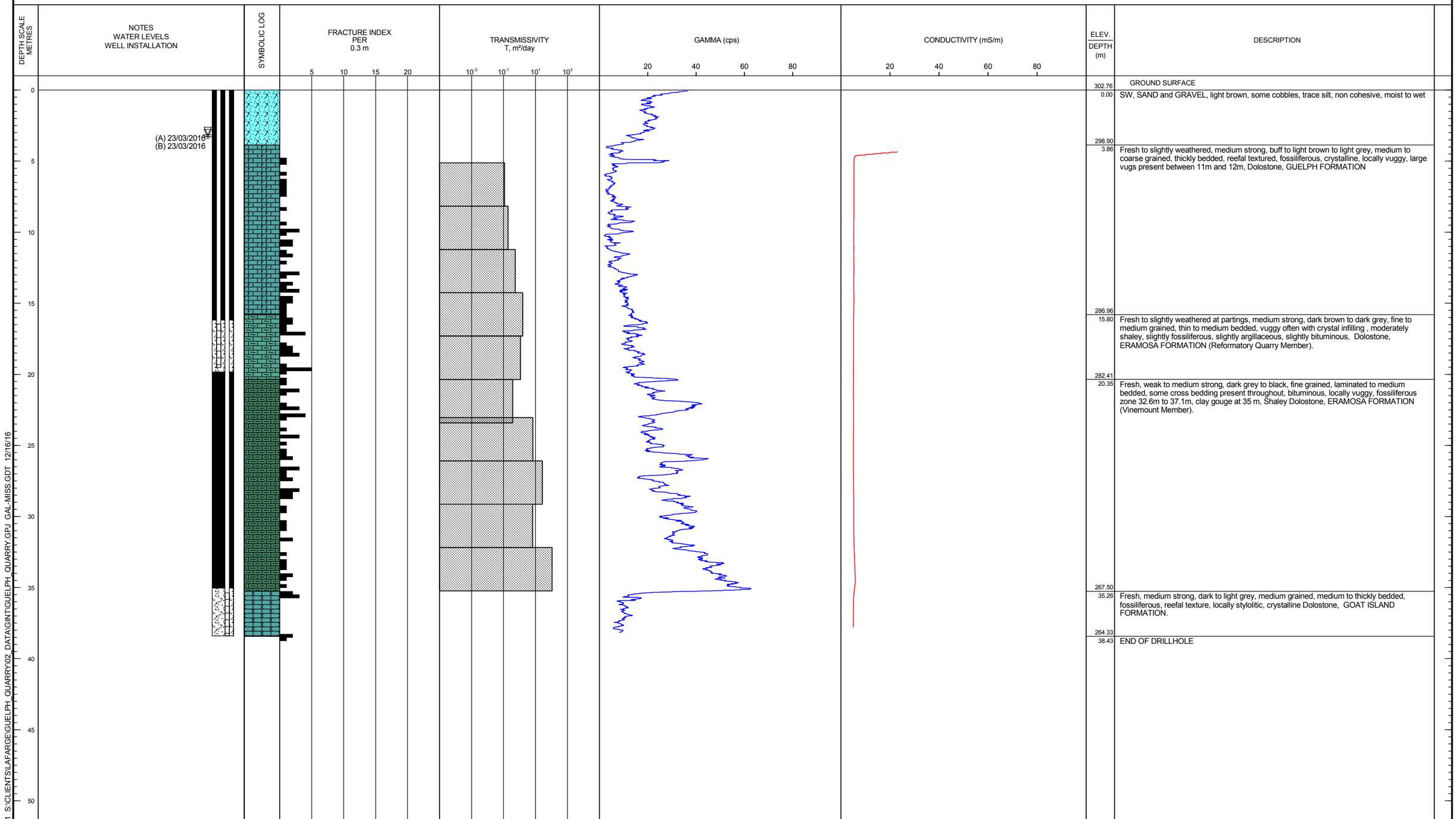
GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1073

DATUM: Ground Surface



ELEV. / DEPTH (m)	DESCRIPTION
302.76	GROUND SURFACE
0.00	SW, SAND and GRAVEL, light brown, some cobbles, trace silt, non cohesive, moist to wet
298.90	
3.86	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, fossiliferous, crystalline, locally vuggy, large vugs present between 11m and 12m, Dolostone, GUELPH FORMATION
286.96	
15.80	Fresh to slightly weathered at partings, medium strong, dark brown to dark grey, fine to medium grained, thin to medium bedded, vuggy often with crystal infilling , moderately shaley, slightly fossiliferous, slightly argillaceous, slightly bituminous, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member).
282.41	
20.35	Fresh, weak to medium strong, dark grey to black, fine grained, laminated to medium bedded, some cross bedding present throughout, bituminous, locally vuggy, fossiliferous zone 32.6m to 37.1m, clay gouge at 35 m, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
267.50	
35.26	Fresh, medium strong, dark to light grey, medium grained, medium to thickly bedded, fossiliferous, reefal texture, locally stylolitic, crystalline Dolostone, GOAT ISLAND FORMATION.
264.33	
38.43	END OF DRILLHOLE

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1074

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m²/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
306.86	GROUND SURFACE
0.00	SW, Silty, SAND and GRAVEL, light brown, some cobbles, non cohesive, moist to wet
304.12	
2.74	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, oxidation at partings, fossiliferous, occasional stylolite's, crystalline, vuggy, large vugs present @ 3.97m, 7.75m, 8.30m, 13.65m, circulation loss at 18.1m, Dolostone, GUELPH FORMATION
288.76	
18.10	Fresh to slightly weathered at partings, medium strong, dark brown to dark grey, fine to medium grained, thin to medium bedded, vuggy often with crystal infilling , moderately shaley, slightly fossiliferous, slightly argillaceous, slightly bituminous, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member).
284.61	
22.25	Fresh, weak to medium strong, dark grey to black, fine grained, laminated to medium bedded, some cross bedding present throughout, bituminous, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
282.68	
24.18	END OF DRILLHOLE

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1075

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

(B) 23/03/2016

(A) 23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m²/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
311.16	GROUND SURFACE
0.00	GW, SAND and GRAVEL, light brown, non cohesive, moist, becoming wet at 7m, becoming saturated at 7.62m
303.54	
7.62	CL, SILTY CLAY, some sand, TILL, traces of fine gravel, brown to grey, cohesive, W>pl
300.44	
10.72	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, oxidation at partings, fossiliferous, occasional stylolite's, crystalline, vuggy, large vugs present @ 3.97m, 7.75m, 8.30m, 13.65m, circulation loss at 18.1m, Dolostone, GUELPH FORMATION
287.66	
23.50	Fresh to slightly weathered at partings, medium strong, dark brown to dark grey, fine to medium grained, thin to medium bedded, vuggy often with crystal infilling , moderately shaley, slightly fossiliferous, slightly argillaceous, slightly bituminous, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member).
281.06	
30.10	Fresh, weak to medium strong, dark grey to black, fine grained, laminated to medium bedded, some cross bedding present throughout, bituminous, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
273.66	
37.50	Fresh, medium strong, dark to light grey, medium grained, medium to thickly bedded, fossiliferous, reefal texture, locally stylolitic, crystalline Dolostone, GOAT ISLAND FORMATION.
270.22	
40.94	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

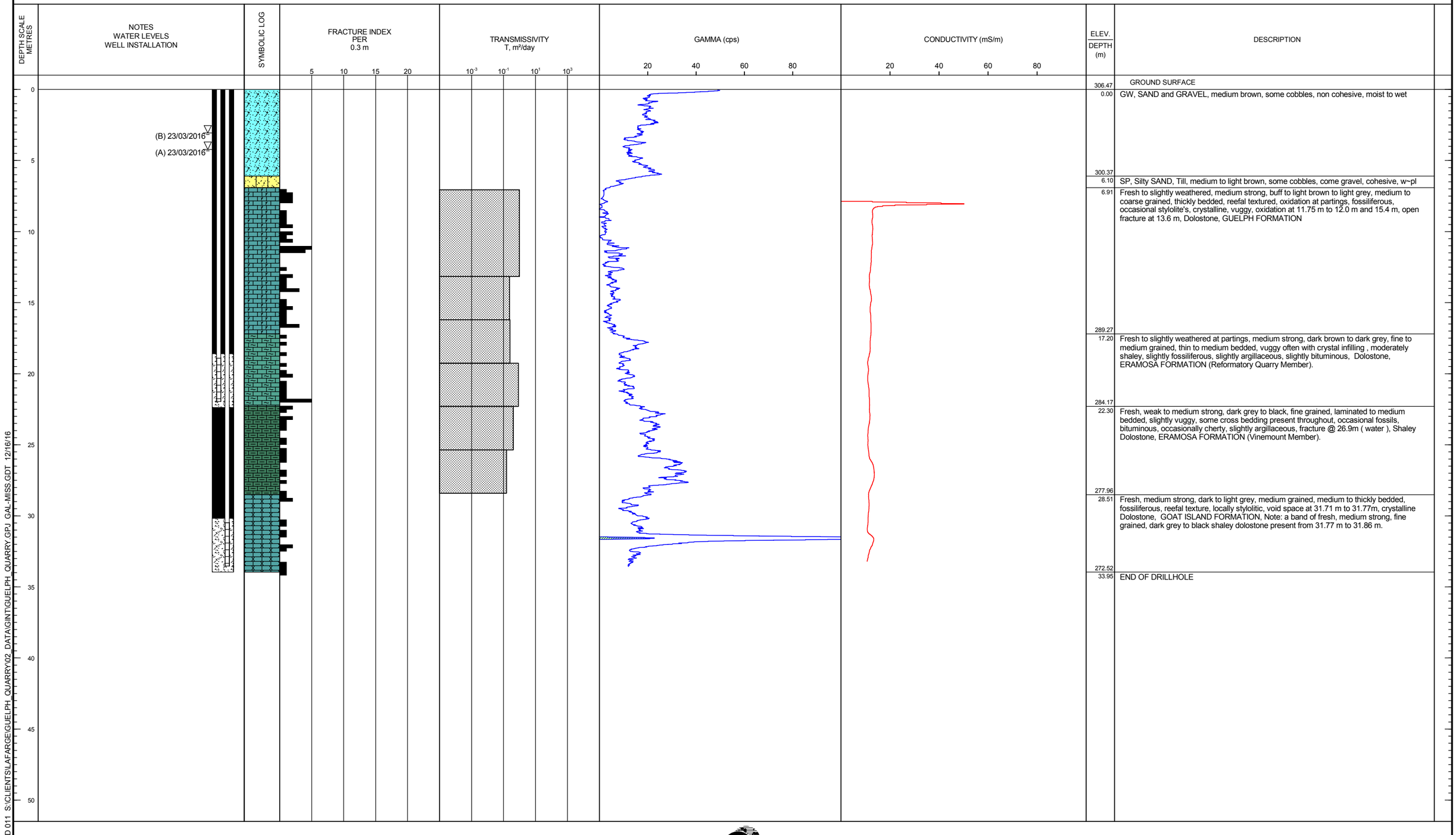
GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1076

DATUM: Ground Surface



ELEV. / DEPTH (m)	DESCRIPTION
306.47	GROUND SURFACE
0.00	GW, SAND and GRAVEL, medium brown, some cobbles, non cohesive, moist to wet
300.37	
6.10	SP, Silty SAND, Till, medium to light brown, some cobbles, come gravel, cohesive, w~pl
6.91	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, oxidation at partings, fossiliferous, occasional stylolite's, crystalline, vuggy, oxidation at 11.75 m to 12.0 m and 15.4 m, open fracture at 13.6 m, Dolostone, GUELPH FORMATION
289.27	
17.20	Fresh to slightly weathered at partings, medium strong, dark brown to dark grey, fine to medium grained, thin to medium bedded, vuggy often with crystal infilling , moderately shaley, slightly fossiliferous, slightly argillaceous, slightly bituminous, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member).
284.17	
22.30	Fresh, weak to medium strong, dark grey to black, fine grained, laminated to medium bedded, slightly vuggy, some cross bedding present throughout, occasional fossils, bituminous, occasionally cherty, slightly argillaceous, fracture @ 26.9m (water), Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
277.96	
28.51	Fresh, medium strong, dark to light grey, medium grained, medium to thickly bedded, fossiliferous, reefal texture, locally stylolitic, void space at 31.71 m to 31.77m, crystalline Dolostone, GOAT ISLAND FORMATION, Note: a band of fresh, medium strong, fine grained, dark grey to black shaley dolostone present from 31.77 m to 31.86 m.
272.52	
33.95	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1077

SHEET 1 OF 1

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

(B) 23/03/2016
(A) 23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m^2/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
306.08 / 0.00	GROUND SURFACE
305.17 / 0.91	GW, SAND and GRAVEL, dark brown, some cobbles, some organic material, loose, non cohesive, moist
	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, oxidation at partings, fossiliferous, occasional stylolite's, crystalline, vuggy, weathered zone at 4 m and at 12.35 m, open fracture at 9.25 m, Dolostone, GUELPH FORMATION
276.48 / 29.60	Fresh, medium strong, tan to light grey, medium grained, medium to thickly bedded, fossiliferous, reefal texture, slightly vuggy often infilled with crystals, stylolitic, moderately weathered zone and fracture rock at 35.05 m, crystalline Dolostone, GOAT ISLAND FORMATION, formation contact at open fracture with rust staining.
268.05 / 38.03	Fresh, medium strong, medium to light grey, fine to medium grained, medium to thickly bedded, fossiliferous, reefal texture, slightly vuggy and pitted, occasionally stylolitic, crystalline Dolostone, GASPORT FORMATION
266.10 / 39.98	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED:

CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF 15-CH-1078

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

(A) 23/03/2016
(B) 23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m²/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
305.03	GROUND SURFACE
0.00	GW, SAND and GRAVEL, light to medium brown, fine to medium grained, surrounded to subangular, non cohesive, moist to wet
300.91	
4.12	Fresh to slightly weathered, medium strong, buff to light brown to light grey, medium to coarse grained, thickly bedded, reefal textured, oxidation at partings, fossiliferous, occasional stylolite's, crystalline, vuggy, rusting present at breaks from 28.5 m to 29 m, clay gouging at 31.3 m, open clay seam at 31.87m, closed clay seams at 31.20m, 31.39m, 31.43m and 31.57m, Dolostone, GUELPH FORMATION
272.23	
32.80	Fresh to slightly weathered at partings, medium strong, medium brown turning medium grey at 35.8, fine to medium grained, thin to medium bedded, vuggy often with crystal infilling , moderately shaley, slightly fossiliferous, slightly argillaceous, slightly bituminous, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member).
268.93	
36.10	Fresh, medium strong, dark to light grey, medium grained, medium to thickly bedded, fossiliferous, reefal texture, locally stylolitic, crystalline Dolostone, GOAT ISLAND FORMATION
264.11	
40.92	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED: KS

CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF MW16-1

DATUM: Ground Surface

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

TRANSMISSIVITY T, m^2/day

GAMMA (cps)

CONDUCTIVITY (mS/m)

ELEV. / DEPTH (m)	DESCRIPTION
303.08	GROUND SURFACE
0.00	SC, Clayey SAND, medium grained, brown, some irregular gravel, cohesive
300.64	
2.44	Light brown to tan, Dolostone, GUELPH FORMATION
286.01	
17.07	Dark grey, slight bitumen odour, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member)
282.96	
20.12	Very dark Grey, strong bituminous odour, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
20.73	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED: AK

CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF MW16-2

DATUM: Ground Surface

DEPTH SCALE METRES	NOTES WATER LEVELS WELL INSTALLATION	SYMBOLIC LOG	FRACTURE INDEX PER 0.3 m (5, 10, 15, 20)	TRANSMISSIVITY T, m²/day (10^{-3}, 10^{-1}, 10^{1}, 10^{3})	GAMMA (cps) (20, 40, 60, 80)	CONDUCTIVITY (mS/m) (20, 40, 60, 80)	ELEV. / DEPTH (m)	DESCRIPTION
							302.10	GROUND SURFACE
0							0.00	GW, Gravely SAND, medium to course grained, subangular to angular, brown, trace silt, non cohesive, moist
							299.36	
	23/03/2016 ▽						2.74	Light brown or tan to light grey , Dolostone, GUELPH FORMATION, groundwater flow zone at 6.71 m and 15.85 m
5								
10								
15								
							285.35	
							16.75	Dark grey, slight bitumen odour, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member)
20							281.98	
							20.12	END OF DRILLHOLE
25								
30								
35								
40								
45								
50								

DEPTH SCALE
1 : 250

Golder Associates

LOGGED: AK
CHECKED:

GTA-HYD 011 S:\CLIENTS\LAFARGE\GUELPH_QUARRY\02_DATA\GINT\GUELPH_QUARRY.GPJ GAL-MISS.GDT 12/16/16

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF PW16-1

DATUM: Ground Surface

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

DEPTH SCALE METRES: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m: 5, 10, 15, 20

TRANSMISSIVITY T, m²/day: 10^{-3}, 10^{-1}, 10^{1}, 10^{3}

GAMMA (cps): 20, 40, 60, 80

CONDUCTIVITY (mS/m): 20, 40, 60, 80

ELEV. / DEPTH (m)	DESCRIPTION
303.43	GROUND SURFACE
0.00	SC, Clayey SAND, medium grained, brown, some irregular gravel, cohesive
299.93	
3.50	Light brown to tan becoming light grey at 9.1 m, Dolostone, GUELPH FORMATION, groundwater flow zone at 14.02 m and 17.07 m
286.36	
17.07	Dark grey, slight bitumen odour, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member), approximately 2 ipgm groundwater flow zone @ 17.07 m
283.31	
20.12	Very dark Grey, strong bituminous odour, Shaley Dolostone, ERAMOSA FORMATION (Vinemount Member).
20.73	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED: AK

CHECKED:

PROJECT: 1536522

LOCATION: Lafarge Wellington County Site

WELL RECORD OF PW16-2

DATUM: Ground Surface

DEPTH SCALE METRES

NOTES
WATER LEVELS
WELL INSTALLATION

23/03/2016

SYMBOLIC LOG

FRACTURE INDEX PER 0.3 m

5 10 15 20

TRANSMISSIVITY T, m^2/day

10^{-3} 10^{-1} 10^{1} 10^{3}

GAMMA (cps)

20 40 60 80

CONDUCTIVITY (mS/m)

20 40 60 80

ELEV. / DEPTH (m)	DESCRIPTION
302.10	GROUND SURFACE
0.00	GW, Gravely SAND, medium to course grained, subangular to angular, brown, trace silt, non cohesive, moist
299.36	
2.74	Light brown or tan to light grey , Dolostone, GUELPH FORMATION, groundwater flow zone at 6.1 m and 15.24 m
285.35	
16.75	Dark grey, slight bitumen odour, Dolostone, ERAMOSA FORMATION (Reformatory Quarry Member)
281.98	
20.12	END OF DRILLHOLE

DEPTH SCALE
1 : 250

Golder Associates

LOGGED: AK

CHECKED:

Figure 2. On-Site Supply Well Water Well Record

APR-02-2002 11:26 AM

Ministry of Environment and Energy — Ontario

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

45 - 98

County or District	Township/Borough/City/Town/Village	Con	block	tract	survey, etc.	Lot
WELLINGTON	GUELPH, TWP	CON 5-6				PT 7-8-9-10-11

Owner's surname / First name: LAFARGE CANADA INC
Address: 7051 WELLINGTON RD 124 P.O. BOX 188 NIH-6W9
Date completed: 01 (day) 06 (month) 98 (year)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	Depth - feet To
BROWN		SAND - GRAVEL		0	10
BROWN	ROCK			10	58
BROWN	ROCK			58	105
GREY	ROCK			105	180
			TOTAL DEPTH	180'	
		6" DRIVE SHOE			

WATER RECORD

Water found at – feet	Kind of water		
160	[X] Fresh [ ] Salty	[ ] Sulphur [ ] Minerals [ ] Gas	
180	[X] Fresh [ ] Salty	[ ] Sulphur [ ] Minerals [ ] Gas	
	[ ] Fresh [ ] Salty	[ ] Sulphur [ ] Minerals [ ] Gas	
	[ ] Fresh [ ] Salty	[ ] Sulphur [ ] Minerals [ ] Gas	
	[ ] Fresh [ ] Salty	[ ] Sulphur [ ] Minerals [ ] Gas	

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	Depth - feet To
6"	[X] Steel [ ] Galvanized [ ] Concrete [ ] Open hole [ ] Plastic	.188	+2	25'
6"	[ ] Steel [ ] Galvanized [ ] Concrete [X] Open hole [ ] Plastic		25	180
	[ ] Steel [ ] Galvanized [ ] Concrete [ ] Open hole [ ] Plastic			

SCREEN

Sizes of opening (Slot No.)	Diameter inches	Length feet
Material and type	Depth at top of screen feet	

PLUGGING & SEALING RECORD

[X] Annular space [ ] Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
0	25	BENTONITE

PUMPING TEST

Pumping test method: [X] Pump [ ] Bailer
Pumping rate: 75 GPM
Duration of pumping: 1 Hours 0 Mins

Static level	Water level end of pumping	Water levels during [X] Pumping [ ] Recovery: 15 minutes	30 minutes	45 minutes	60 minutes
208 ft.	10.89	8.86	9.94	10.06	10.89

If flowing give rate: GPM
Pump intake set at: feet
Water at end of test: [X] Clear [ ] Cloudy
Recommended pump type: [ ] Shallow [X] Deep
Recommended pump setting: 12 m feet
Recommended pump rate: 60 GPM

FINAL STATUS OF WELL

[X] Water supply [ ] Observation well [ ] Test hole [ ] Recharge well
[ ] Abandoned, insufficient supply [ ] Abandoned, poor quality [ ] Abandoned (Other) [ ] Dewatering
[ ] Unfinished [ ] Replacement well

WATER USE

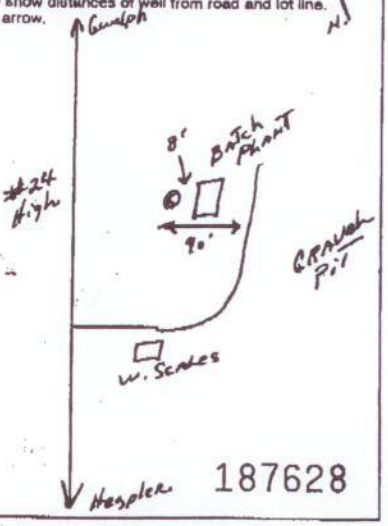
[ ] Domestic [ ] Stock [ ] Irrigation [ ] Industrial
[ ] Commercial [ ] Municipal [ ] Public supply [ ] Cooling & air conditioning
[ ] Not used [ ] Other

METHOD OF CONSTRUCTION

[ ] Cable tool [ ] Rotary (conventional) [ ] Rotary (reverse) [X] Rotary (air)
[ ] Air percussion [ ] Boring [ ] Diamond [ ] Jetting
[ ] Driving [ ] Digging [ ] Other

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



187628

Name of Well Contractor: GRAHAM WELL DRILLING LTD — Well Contractor's Licence No.: 2336
Address: RR#5 ROCKWOOD, ONT. N0B-2K0
Name of Well Technician: TIM WILSON — Well Technician's Licence No.: T-1924
Signature of Technician/Contractor: Robert J. Graham — Submission date: 030 (day) 06 (mo) 98 (yr)

MINISTRY USE ONLY

1 - CONTRACTOR'S COPY

0506 (07/94) Front Form 8

APPENDIX B

Packer Test Results

TABLE B1
PACKER TESTING SUMMARY
LAFARGE WELLINGTON COUNTY SITE

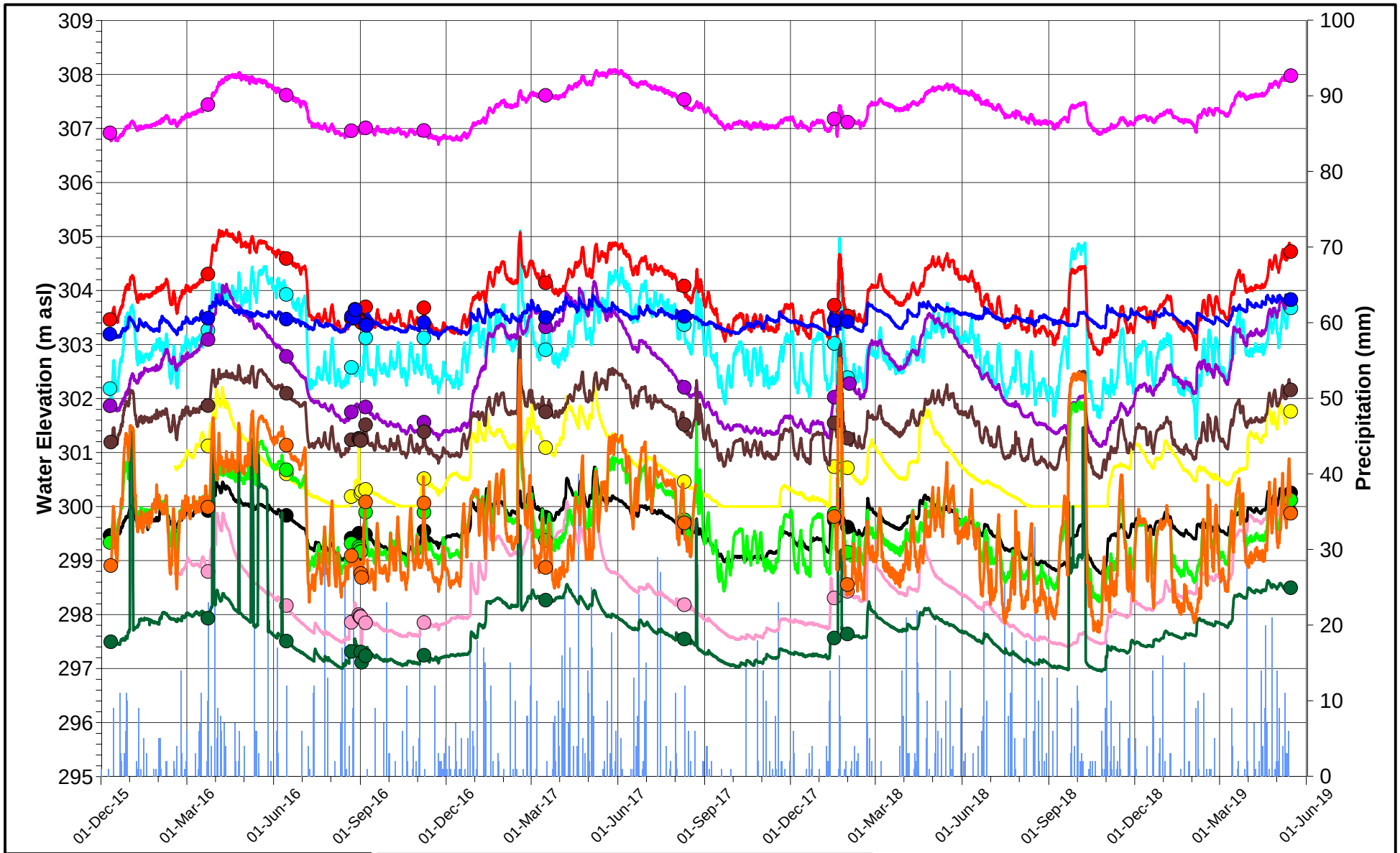
Well	Top of Packer Zone (m)	Bottom of Packer Zone (m)	Main Formation	Falling Head Test Completed Y/N	Constant Rate Test Completed Y/N	Interval Thickness (cm)	Calculated Hydraulic Conductivity (cm/sec)	Calculated Transmissivity (m2/day)
12-CH-1071	26.85	29.9	Vinemount	Y	Y	305	3.5E-03	9.3
	23.8	26.85	Vinemount	Y	N	305	1.1E-05	0.03
	20.756	23.8	Vinemount	Y	N	304.4	1.4E-04	0.4
	17.71	20.756	Vinemount	Y	N	304.6	2.1E-06	0.005
	14.66	17.7	Reformatory Quarry	Y	N	304	1.8E-05	0.05
	11.61	14.66	Reformatory Quarry/Guelph	Y	N	305	1.6E-05	0.04
	8.56	11.61	Guelph	Y	N	305	1.9E-05	0.05
	6.71	9.75	Guelph	Y	N	304	2.7E-05	0.07
15-CH-1073	32.19	35.23	Vinemount	Y	Y	304	4.1E-02	108.9
	29.14	32.19	Vinemount	Y	Y	305	2.5E-03	6.6
	26.09	29.14	Vinemount	Y	Y	305	1.0E-02	26.5
	23.04	26.09	Vinemount	Y	Y	305	2.6E-03	6.8
	20.36	23.41	Vinemount	Y	N	305	1.4E-04	0.4
	17.31	20.36	Reformatory Quarry	Y	Y	305	4.3E-04	1.1
	14.26	17.31	Reformatory Quarry/Guelph	Y	Y	305	6.0E-04	1.6
	11.22	14.26	Guelph	Y	N	304	2.1E-04	0.5
	8.17	11.22	Guelph	Y	N	305	7.2E-05	0.2
	5.12	8.17	Guelph	Y	N	305	4.3E-05	0.1
15-CH-1074	19.2	22.25	Reformatory Quarry	Y	Y	305	5.3E-03	13.9
	16.15	19.2	Reformatory Quarry/Guelph	Y	Y	305	4.2E-03	11.1
	13.1	16.15	Guelph	Y	Y	305	3.1E-03	8.2
	10.06	13.1	Guelph	Y	Y	304	1.1E-03	2.9
	7.01	10.06	Guelph	Y	N	305	1.8E-04	0.5

TABLE B1
PACKER TESTING SUMMARY
LAFARGE WELLINGTON COUNTY SITE

Well	Top of Packer Zone (m)	Bottom of Packer Zone (m)	Main Formation	Falling Head Test Completed Y/N	Constant Rate Test Completed Y/N	Interval Thickness (cm)	Calculated Hydraulic Conductivity (cm/sec)	Calculated Transmissivity (m2/day)
15-CH-1075	34.44	37.66	Vinemount	Y	N	322	3.4E-04	0.9
	33.07	36.29	Vinemount	Y	N	322	5.4E-05	0.1
	30.02	33.24	Vinemount	Y	N	322	1.9E-05	0.05
	26.97	30.19	Reformatory Quarry	Y	N	322	3.5E-05	0.1
	23.92	27.14	Reformatory Quarry	Y	N	322	3.5E-04	1.0
	17.83	24.09	Guelph	Y	N	626	6.0E-05	0.3
	11.73	17.99	Guelph	Y	Y	626	3.9E-04	2.1
15-CH-1076	25.36	28.41	Vinemount	Y	N	305	5.9E-05	0.2
	22.3	25.36	Vinemount	Y	N	306	1.5E-04	0.4
	19.26	22.3	Reformatory Quarry	Y	N	304	3.2E-04	0.8
	16.2	19.26	Reformatory Quarry/Guelph	Y	N	306	9.5E-05	0.3
	13.16	16.2	Guelph	Y	N	304	9.0E-05	0.2
	7.06	13.16	Guelph	Y	N	610	1.9E-04	1.0
15-CH-1077	34.75	37.95	Goat Island	Y	Y	320	1.5E-03	4.0
	31.7	34.91	Goat Island	Y	N	321	2.7E-04	0.8
	28.65	31.87	Goat Island/Guelph	Y	N	322	2.0E-04	0.6
	25.6	28.81	Guelph	Y	N	321	4.3E-04	1.2
	19.5	25.77	Guelph	Y	Y	627	4.1E-04	2.2
15-CH-1078	35.84	39.05	Goat Island	Y	N	321	4.7E-06	0.01
	32.8	36.01	Reformatory Quarry	Y	Y	321	1.0E-02	28.7
	29.75	32.96	Reformatory Quarry/Guelph	Y	Y	321	7.5E-04	2.1
	23.65	29.9	Guelph	Y	N	625	1.5E-04	0.8
	17.55	23.82	Guelph	Y	N	627	1.1E-04	0.6
	11.46	17.72	Guelph	Y	Y	626	7.3E-04	3.9
	8.4	11.63	Guelph	Y	Y	323	7.5E-04	2.1
	6.1	9.14	Guelph	Y	N	304	2.0E-04	0.5

APPENDIX C

Groundwater Hydrographs



GOLDER

DATE	May 2019
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT

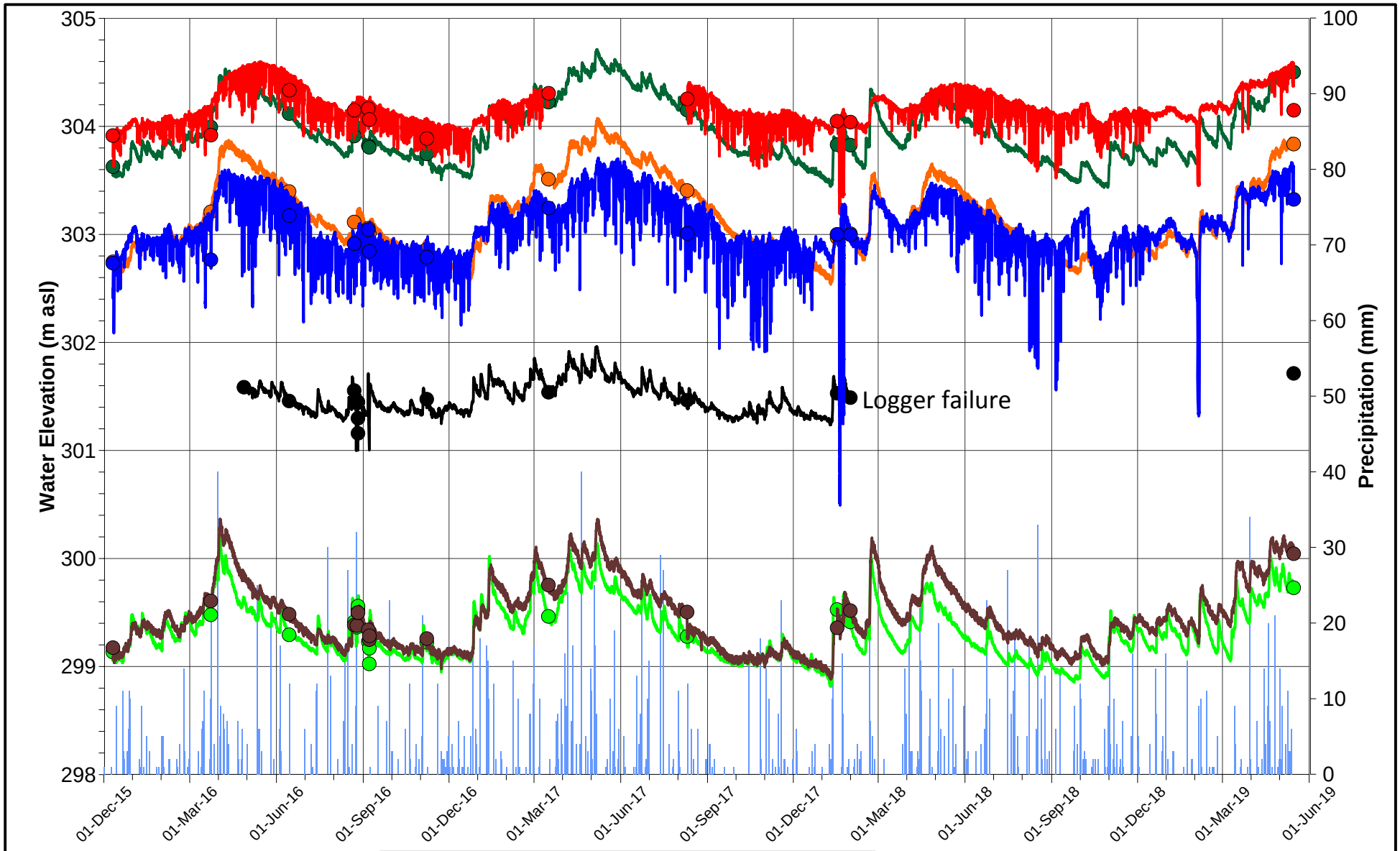
LAFARGE-HOLCIM CANADA

Wellington County

TITLE

GROUNDWATER MONITORING HYDROGRAPHS
EASTERN PROPERTY WELLS

PROJECT NO.	REV	FIGURE
1536522 (1000)	A	C1



GOLDER

DATE	May 2019
DESIGN	KS
REVIEW	GP
APPROVED	GP

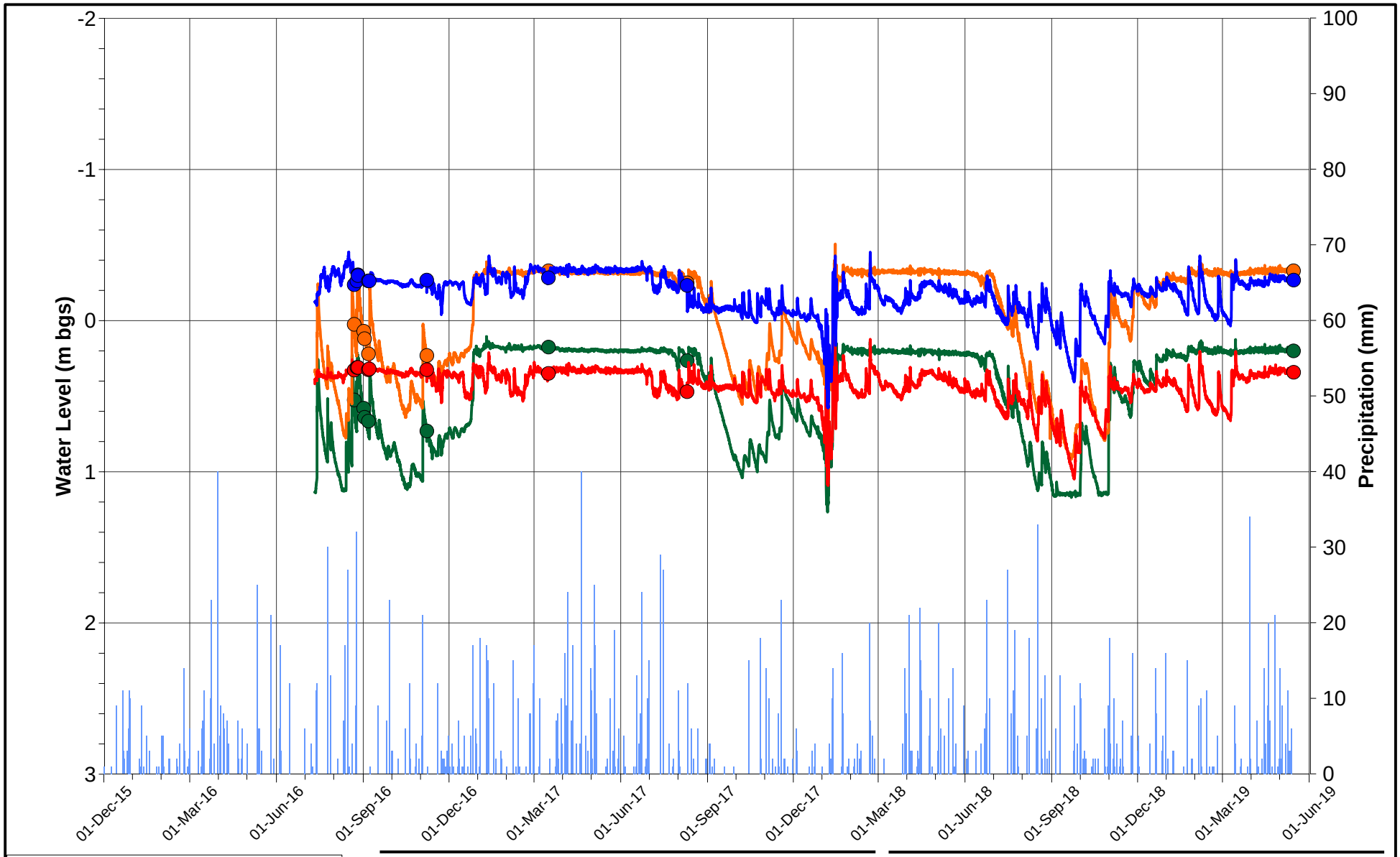
PROJECT

LAFARGE-HOLCIM CANADA
Wellington County

TITLE

GROUNDWATER MONITORING HYDROGRAPHS
WESTERN PROPERTY WELLS

PROJECT NO.	REV	FIGURE
1536522 (1000)	A	C2



PROJECT

LAFARGE-HOLCIM CANADA

Wellington County

TITLE

GROUNDWATER MONITORING HYDROGRAPHS
MINI-PIEZOMETERS

GOLDER

DATE	May 2019
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
1536522 (1000)	A	C3

APPENDIX D

Groundwater Quality

TABLE D1
GROUNDWATER QUALITY
LAFARGE WELLINGTON COUNTY SITE

	UNITS	PWQO	PW16-1	PW16-2	TW1	Onsite Well
			Sep/01/2016	Sep/02/2016	Aug/26/2016	Jan/25/2018
Calculated Parameters						
Anion Sum	me/L		7.84	6.30	7.82	8.10
Bicarb. Alkalinity (calc. as CaCO3)	mg/L		310	250	290	300
Calculated TDS	mg/L		410	320	420	420
Carb. Alkalinity (calc. as CaCO3)	mg/L		2.2	3.2	2.2	1.8
Cation Sum	me/L		7.73	5.90	7.78	7.54
Hardness (CaCO3)	mg/L		370	280	340	320
Ion Balance (% Difference)	%		0.730	3.32	0.300	3.58
Langelier Index (@ 20C)	N/A		0.920	0.992	0.901	0.746
Langelier Index (@ 4C)	N/A		0.671	0.743	0.653	0.498
Saturation pH (@ 20C)	N/A		6.95	7.14	7.01	7.05
Saturation pH (@ 4C)	N/A		7.20	7.39	7.26	7.30
Inorganics						
Total Ammonia-N	mg/L		<0.050	<0.050	<0.050	0.068
Unionized Ammonia (calculated)	mg/L	0.02 (unionized)	<0.0009	<0.0009	<0.0009	0.0012
Conductivity	umho/cm		720	580	750	770
Dissolved Organic Carbon	mg/L		1.0	1.2	0.82	1.2
Orthophosphate (P)	mg/L		<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-8.5	7.87	8.13	7.91	7.80
Dissolved Sulphate (SO4)	mg/L		52	26	23	41
Alkalinity (Total as CaCO3)	mg/L		310	260	290	300
Dissolved Chloride (Cl)	mg/L		10	13	39	40
Nitrite (N)	mg/L		0.031	<0.010	<0.010	0.012
Nitrate (N)	mg/L		3.15	3.79	6.43	1.18
Nitrate + Nitrite (N)	mg/L		3.18	3.79	6.43	1.19
Metals						
Dissolved Aluminum (Al)	ug/L	75	<5.0	<5.0	<5.0	<5.0
Dissolved Antimony (Sb)	ug/L	20	3.5	0.74	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	5	1.5	3.3	<1.0	1.3
Dissolved Barium (Ba)	ug/L		63	51	40	66
Dissolved Beryllium (Be)	ug/L	1100	<0.50	<0.50	<0.50	<0.50
Dissolved Boron (B)	ug/L	200	21	19	17	24
Dissolved Cadmium (Cd)	ug/L	0.5	<0.10	<0.10	<0.10	0.16
Dissolved Calcium (Ca)	ug/L		100000	76000	95000	84000
Dissolved Chromium (Cr)	ug/L	1	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	0.9	<0.50	<0.50	<0.50	0.88
Dissolved Copper (Cu)	ug/L	5	<1.0	1.1	<1.0	1.1
Dissolved Iron (Fe)	ug/L	300	<100	<100	<100	<100
Dissolved Lead (Pb)	ug/L	25	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	ug/L		30000	21000	24000	28000
Dissolved Manganese (Mn)	ug/L		20	<2.0	<2.0	2.4
Dissolved Molybdenum (Mo)	ug/L	40	12	5.2	<0.50	3.3
Dissolved Nickel (Ni)	ug/L	25	10	1.7	<1.0	3.2
Dissolved Phosphorus (P)	ug/L	10	<100	<100	<100	<100
Dissolved Potassium (K)	ug/L		1600	2600	1600	1800
Dissolved Selenium (Se)	ug/L	100	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L		4700	3700	4800	5000
Dissolved Silver (Ag)	ug/L	0.1	<0.10	<0.10	<0.10	<0.10
Dissolved Sodium (Na)	ug/L		4700	7000	23000	23000
Dissolved Strontium (Sr)	ug/L		1100	440	140	520
Dissolved Thallium (Tl)	ug/L	0.3	0.12	0.18	<0.050	0.053
Dissolved Titanium (Ti)	ug/L		<5.0	<5.0	<5.0	<5.0
Dissolved Uranium (U)	ug/L	5	**20**	1.7	0.24	0.24
Dissolved Vanadium (V)	ug/L	6	<0.50	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	ug/L	30	**110**	**84**	**36**	**51**

PWQO - Provinvial Water Quality Objective

Highlighted values exceed objectives

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 574913-01-01

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/09
Report #: R4160347
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I7642
Received: 2016/09/01, 15:52

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2016/09/03	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2016/09/06	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2016/09/04	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2016/09/03	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2016/09/03	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2016/09/08	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2016/09/08	CAM SOP-00447	EPA 6020A m
Ion Balance (% Difference)	1	N/A	2016/09/08		
Anion and Cation Sum	1	N/A	2016/09/08		
Total Ammonia-N	1	N/A	2016/09/08	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2016/09/03	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2016/09/03	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2016/09/06	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2016/09/08		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2016/09/08		
Sulphate by Automated Colourimetry	1	N/A	2016/09/04	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2016/09/08		

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

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 Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Your Project #: 1536522
Your C.O.C. #: 574913-01-01

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/09
Report #: R4160347
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I7642
Received: 2016/09/01, 15:52

Encryption Key 
Ema Gitej
09 Sep 2016 09:42:34 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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

Maxxam Job #: B6I7642
Report Date: 2016/09/09

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		CZP846	CZP846		
Sampling Date		2016/09/01 07:45	2016/09/01 07:45		
COC Number		574913-01-01	574913-01-01		
	UNITS	PW-1	PW-1 Lab-Dup	RDL	QC Batch
Calculated Parameters					
Anion Sum	me/L	7.84		N/A	4644187
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	310		1.0	4644163
Calculated TDS	mg/L	410		1.0	4644192
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.2		1.0	4644163
Cation Sum	me/L	7.73		N/A	4644187
Hardness (CaCO3)	mg/L	370		1.0	4645367
Ion Balance (% Difference)	%	0.730		N/A	4644186
Langelier Index (@ 20C)	N/A	0.920			4644189
Langelier Index (@ 4C)	N/A	0.671			4644190
Saturation pH (@ 20C)	N/A	6.95			4644189
Saturation pH (@ 4C)	N/A	7.20			4644190
Inorganics					
Total Ammonia-N	mg/L	<0.050	<0.050	0.050	4649993
Conductivity	umho/cm	720		1.0	4647464
Dissolved Organic Carbon	mg/L	1.0		0.20	4647583
Orthophosphate (P)	mg/L	<0.010		0.010	4647699
pH	pH	7.87			4647477
Dissolved Sulphate (SO4)	mg/L	52		1.0	4647700
Alkalinity (Total as CaCO3)	mg/L	310		1.0	4647460
Dissolved Chloride (Cl)	mg/L	10		1.0	4647698
Nitrite (N)	mg/L	0.031	0.032	0.010	4647167
Nitrate (N)	mg/L	3.15	3.13	0.10	4647167
Nitrate + Nitrite (N)	mg/L	3.18	3.17	0.10	4647167
Metals					
Dissolved Aluminum (Al)	ug/L	<5.0		5.0	4647841
Dissolved Antimony (Sb)	ug/L	3.5		0.50	4647841
Dissolved Arsenic (As)	ug/L	1.5		1.0	4647841
Dissolved Barium (Ba)	ug/L	63		2.0	4647841
Dissolved Beryllium (Be)	ug/L	<0.50		0.50	4647841
Dissolved Boron (B)	ug/L	21		10	4647841
Dissolved Cadmium (Cd)	ug/L	<0.10		0.10	4647841
Dissolved Calcium (Ca)	ug/L	100000		200	4647841
Dissolved Chromium (Cr)	ug/L	<5.0		5.0	4647841
Dissolved Cobalt (Co)	ug/L	<0.50		0.50	4647841

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Maxxam Job #: B6I7642
Report Date: 2016/09/09

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		CZP846	CZP846		
Sampling Date		2016/09/01 07:45	2016/09/01 07:45		
COC Number		574913-01-01	574913-01-01		
	UNITS	PW-1	PW-1 Lab-Dup	RDL	QC Batch
Dissolved Copper (Cu)	ug/L	<1.0		1.0	4647841
Dissolved Iron (Fe)	ug/L	<100		100	4647841
Dissolved Lead (Pb)	ug/L	<0.50		0.50	4647841
Dissolved Magnesium (Mg)	ug/L	30000		50	4647841
Dissolved Manganese (Mn)	ug/L	20		2.0	4647841
Dissolved Molybdenum (Mo)	ug/L	12		0.50	4647841
Dissolved Nickel (Ni)	ug/L	10		1.0	4647841
Dissolved Phosphorus (P)	ug/L	<100		100	4647841
Dissolved Potassium (K)	ug/L	1600		200	4647841
Dissolved Selenium (Se)	ug/L	<2.0		2.0	4647841
Dissolved Silicon (Si)	ug/L	4700		50	4647841
Dissolved Silver (Ag)	ug/L	<0.10		0.10	4647841
Dissolved Sodium (Na)	ug/L	4700		100	4647841
Dissolved Strontium (Sr)	ug/L	1100		1.0	4647841
Dissolved Thallium (Tl)	ug/L	0.12		0.050	4647841
Dissolved Titanium (Ti)	ug/L	<5.0		5.0	4647841
Dissolved Uranium (U)	ug/L	20		0.10	4647841
Dissolved Vanadium (V)	ug/L	<0.50		0.50	4647841
Dissolved Zinc (Zn)	ug/L	110		5.0	4647841

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Maxxam Job #: B6I7642
Report Date: 2016/09/09

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

TEST SUMMARY

Maxxam ID: CZP846
Sample ID: PW-1
Matrix: Water

Collected: 2016/09/01
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4647460	N/A	2016/09/03	Neil Dassanayake
Carbonate, Bicarbonate and Hydroxide	CALC	4644163	N/A	2016/09/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	4647698	N/A	2016/09/04	Deonarine Ramnarine
Conductivity	AT	4647464	N/A	2016/09/03	Neil Dassanayake
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4647583	N/A	2016/09/03	Anastasia Hamanov
Hardness (calculated as CaCO3)		4645367	N/A	2016/09/08	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4647841	N/A	2016/09/08	Arefa Dabhad
Ion Balance (% Difference)	CALC	4644186	N/A	2016/09/08	Automated Statchk
Anion and Cation Sum	CALC	4644187	N/A	2016/09/08	Automated Statchk
Total Ammonia-N	LACH/NH4	4649993	N/A	2016/09/08	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4647167	N/A	2016/09/03	Anastasia Hamanov
pH	AT	4647477	N/A	2016/09/03	Neil Dassanayake
Orthophosphate	KONE	4647699	N/A	2016/09/06	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4644189	N/A	2016/09/08	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4644190	N/A	2016/09/08	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4647700	N/A	2016/09/04	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	4644192	N/A	2016/09/08	Automated Statchk

Maxxam ID: CZP846 Dup
Sample ID: PW-1
Matrix: Water

Collected: 2016/09/01
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Ammonia-N	LACH/NH4	4649993	N/A	2016/09/08	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4647167	N/A	2016/09/03	Anastasia Hamanov

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Maxxam Job #: B6I7642
Report Date: 2016/09/09

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

GENERAL COMMENTS

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

Package 1	10.0°C

Results relate only to the items tested.

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Maxxam Job #: B6I7642
Report Date: 2016/09/09

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4647167	Nitrate (N)	2016/09/03	NC	80 - 120	91	80 - 120	<0.10	mg/L	0.63	25
4647167	Nitrite (N)	2016/09/03	109	80 - 120	106	80 - 120	<0.010	mg/L	NC	25
4647460	Alkalinity (Total as CaCO3)	2016/09/03			97	85 - 115	<1.0	mg/L	0.33	25
4647464	Conductivity	2016/09/03			101	85 - 115	<1.0	umho/cm	0	25
4647477	pH	2016/09/03			102	98 - 103			0.56	N/A
4647583	Dissolved Organic Carbon	2016/09/03	95	80 - 120	97	80 - 120	<0.20	mg/L	0.15	20
4647698	Dissolved Chloride (Cl)	2016/09/04	113	80 - 120	103	80 - 120	<1.0	mg/L	NC	20
4647699	Orthophosphate (P)	2016/09/06	109	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
4647700	Dissolved Sulphate (SO4)	2016/09/04	108	75 - 125	103	80 - 120	<1.0	mg/L	NC	20
4647841	Dissolved Aluminum (Al)	2016/09/08	101	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Antimony (Sb)	2016/09/08	105	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Arsenic (As)	2016/09/08	99	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Barium (Ba)	2016/09/08	100	80 - 120	98	80 - 120	<2.0	ug/L	0.13	20
4647841	Dissolved Beryllium (Be)	2016/09/08	100	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Boron (B)	2016/09/08	102	80 - 120	100	80 - 120	<10	ug/L	NC	20
4647841	Dissolved Cadmium (Cd)	2016/09/08	102	80 - 120	97	80 - 120	<0.10	ug/L	NC	20
4647841	Dissolved Calcium (Ca)	2016/09/08	NC	80 - 120	93	80 - 120	<200	ug/L	0.45	20
4647841	Dissolved Chromium (Cr)	2016/09/08	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Cobalt (Co)	2016/09/08	99	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Copper (Cu)	2016/09/08	102	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Iron (Fe)	2016/09/08	98	80 - 120	95	80 - 120	<100	ug/L	NC	20
4647841	Dissolved Lead (Pb)	2016/09/08	97	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Magnesium (Mg)	2016/09/08	NC	80 - 120	97	80 - 120	<50	ug/L	1.2	20
4647841	Dissolved Manganese (Mn)	2016/09/08	97	80 - 120	93	80 - 120	<2.0	ug/L	NC	20
4647841	Dissolved Molybdenum (Mo)	2016/09/08	105	80 - 120	96	80 - 120	<0.50	ug/L	1.9	20
4647841	Dissolved Nickel (Ni)	2016/09/08	95	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Phosphorus (P)	2016/09/08	107	80 - 120	102	80 - 120	<100	ug/L	NC	20
4647841	Dissolved Potassium (K)	2016/09/08	101	80 - 120	98	80 - 120	<200	ug/L	0.63	20
4647841	Dissolved Selenium (Se)	2016/09/08	99	80 - 120	94	80 - 120	<2.0	ug/L	NC	20
4647841	Dissolved Silicon (Si)	2016/09/08	99	80 - 120	97	80 - 120	<50	ug/L	1.8	20
4647841	Dissolved Silver (Ag)	2016/09/08	98	80 - 120	92	80 - 120	<0.10	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4647841	Dissolved Sodium (Na)	2016/09/08	101	80 - 120	96	80 - 120	<100	ug/L	1.6	20
4647841	Dissolved Strontium (Sr)	2016/09/08	NC	80 - 120	91	80 - 120	<1.0	ug/L	0.21	20
4647841	Dissolved Thallium (Tl)	2016/09/08	97	80 - 120	94	80 - 120	<0.050	ug/L	NC	20
4647841	Dissolved Titanium (Ti)	2016/09/08	99	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Uranium (U)	2016/09/08	100	80 - 120	99	80 - 120	<0.10	ug/L	1.5	20
4647841	Dissolved Vanadium (V)	2016/09/08	98	80 - 120	92	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Zinc (Zn)	2016/09/08	99	80 - 120	97	80 - 120	<5.0	ug/L	0.080	20
4649993	Total Ammonia-N	2016/09/08	94	80 - 120	96	85 - 115	<0.050	mg/L	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 spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of 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 (one or both samples < 5x RDL).

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Maxxam Job #: B6I7642
Report Date: 2016/09/09

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

VALIDATION SIGNATURE PAGE

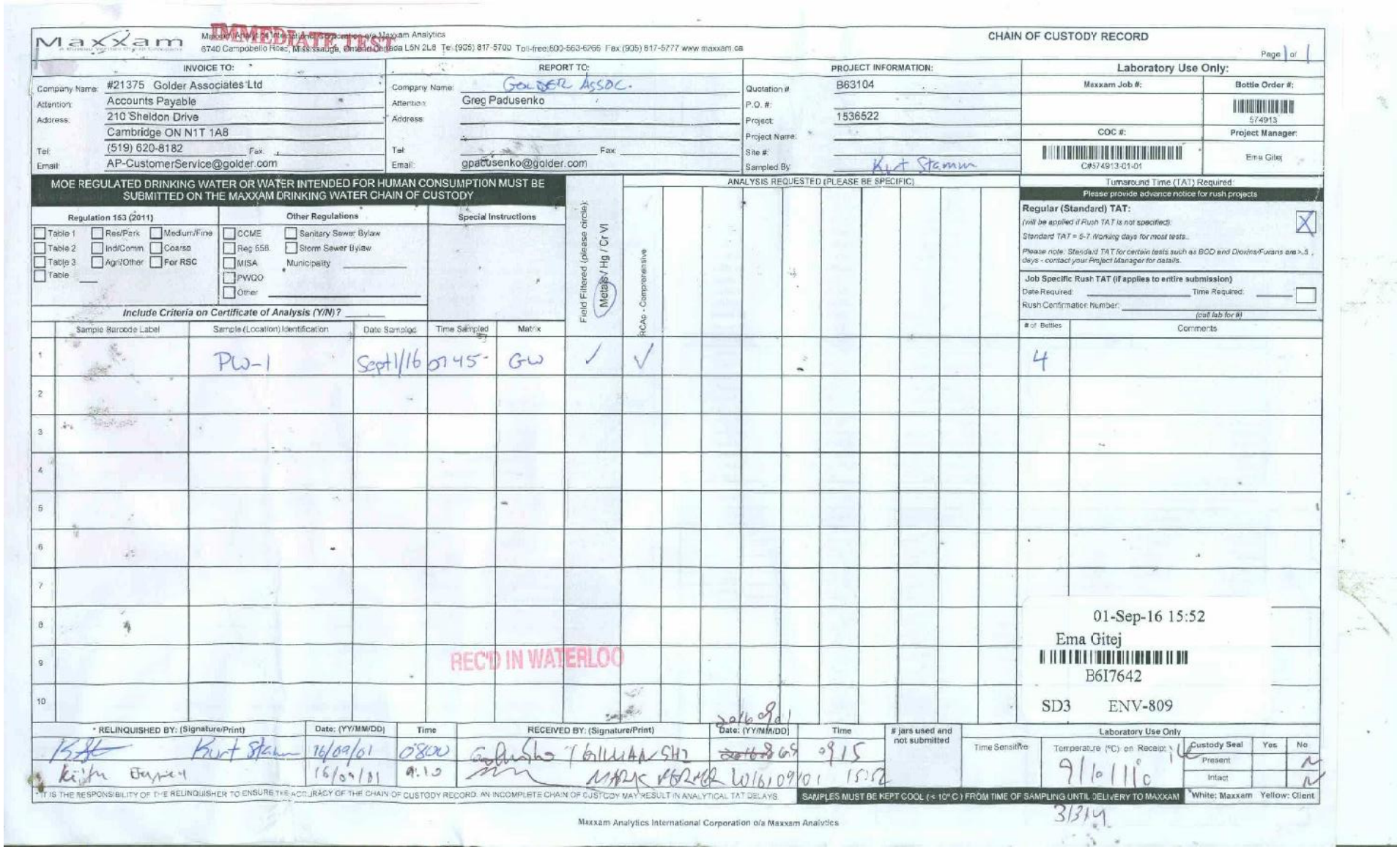
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services

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

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca



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MANDATORY FIELD

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:
Company Name: #21375 Golder Associates Ltd
Attention: Accounts Payable
Address: 210 Sheldon Drive, Cambridge ON N1T 1A8
Tel: (519) 620-8182 Fax:
Email: AP-CustomerService@golder.com

REPORT TO:
Company Name: GOLDER ASSOC.
Attention: Greg Padusenko
Address:
Tel: Fax:
Email: gpadusenko@golder.com

PROJECT INFORMATION:
Quotation #: B63104
P.O. #:
Project: 1536522
Project Name:
Site #:
Sampled By: Kurt Stamm

Laboratory Use Only:
Maxxam Job #:
Bottle Order #: 574913
COC #: C#574913-01-01
Project Manager: Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine; ☐ Table 2 ☐ Ind/Comm ☐ Coarse; ☐ Table 3 ☐ Agri/Other ☐ For RSC; ☐ Table ___
Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw; ☐ Reg 558 ☐ Storm Sewer Bylaw; ☐ MISA Municipality ___; ☐ PWQO; ☐ Other ___
Special Instructions:
Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):
Field Filtered (please circle): Metals / Hg / Cr VI
RCAp - Comprehensive

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: X
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered	Metals / Hg / Cr VI	RCAp - Comprehensive	# of Bottles	Comments
1		PW-1	Sept 1/16	0745	GW	✓	✓		4	
2										
3										
4										
5										
6										
7										
8										
9										
10										

REC'D IN WATERLOO

01-Sep-16 15:52
Ema Gitej
B6I7642
SD3 ENV-809

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Kurt Stamm	16/09/01	0800	[illegible]	2016 09 01	0915	
Keith Dayney	16/09/01	9:10	MARK KERR	16/09/01	15:52	

Laboratory Use Only
Time Sensitive
Temperature (°C) on Receipt: 9/10 11/10

Custody Seal	Yes	No
Present		
Intact		

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM
White: Maxxam Yellow: Client

3/3/14

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 574913-01-01

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/13
Report #: R4165508
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I8895
Received: 2016/09/02, 12:30

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2016/09/06	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2016/09/07	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2016/09/04	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2016/09/06	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2016/09/03	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2016/09/08	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2016/09/08	CAM SOP-00447	EPA 6020A m
Ion Balance (% Difference)	1	N/A	2016/09/08		
Anion and Cation Sum	1	N/A	2016/09/08		
Total Ammonia-N	1	N/A	2016/09/10	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2016/09/06	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2016/09/06	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2016/09/06	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2016/09/08		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2016/09/08		
Sulphate by Automated Colourimetry	1	N/A	2016/09/04	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2016/09/08		

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

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 Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Your Project #: 1536522
Your C.O.C. #: 574913-01-01

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/13
Report #: R4165508
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I8895
Received: 2016/09/02, 12:30

Encryption Key 
Ema Gitej
13 Sep 2016 22:50:04 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		CZV463	CZV463		
Sampling Date		2016/09/02 11:30	2016/09/02 11:30		
COC Number		574913-01-01	574913-01-01		
	UNITS	PW-2	PW-2 Lab-Dup	RDL	QC Batch
Calculated Parameters					
Anion Sum	me/L	6.30		N/A	4645894
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	250		1.0	4645890
Calculated TDS	mg/L	320		1.0	4645897
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.2		1.0	4645890
Cation Sum	me/L	5.90		N/A	4645894
Hardness (CaCO3)	mg/L	280		1.0	4647318
Ion Balance (% Difference)	%	3.32		N/A	4645893
Langelier Index (@ 20C)	N/A	0.992			4645895
Langelier Index (@ 4C)	N/A	0.743			4645896
Saturation pH (@ 20C)	N/A	7.14			4645895
Saturation pH (@ 4C)	N/A	7.39			4645896
Inorganics					
Total Ammonia-N	mg/L	<0.050	<0.050	0.050	4652490
Conductivity	umho/cm	580		1.0	4647604
Dissolved Organic Carbon	mg/L	1.2		0.20	4647765
Orthophosphate (P)	mg/L	<0.010		0.010	4647699
pH	pH	8.13			4647605
Dissolved Sulphate (SO4)	mg/L	26		1.0	4647700
Alkalinity (Total as CaCO3)	mg/L	260		1.0	4647602
Dissolved Chloride (Cl)	mg/L	13		1.0	4647698
Nitrite (N)	mg/L	<0.010		0.010	4647677
Nitrate (N)	mg/L	3.79		0.10	4647677
Nitrate + Nitrite (N)	mg/L	3.79		0.10	4647677
Metals					
Dissolved Aluminum (Al)	ug/L	<5.0	<5.0	5.0	4647841
Dissolved Antimony (Sb)	ug/L	0.74	0.70	0.50	4647841
Dissolved Arsenic (As)	ug/L	3.3	3.4	1.0	4647841
Dissolved Barium (Ba)	ug/L	51	51	2.0	4647841
Dissolved Beryllium (Be)	ug/L	<0.50	<0.50	0.50	4647841
Dissolved Boron (B)	ug/L	19	19	10	4647841
Dissolved Cadmium (Cd)	ug/L	<0.10	<0.10	0.10	4647841
Dissolved Calcium (Ca)	ug/L	76000	76000	200	4647841
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	5.0	4647841
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	0.50	4647841

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		CZV463	CZV463		
Sampling Date		2016/09/02 11:30	2016/09/02 11:30		
COC Number		574913-01-01	574913-01-01		
	UNITS	PW-2	PW-2 Lab-Dup	RDL	QC Batch
Dissolved Copper (Cu)	ug/L	1.1	1.1	1.0	4647841
Dissolved Iron (Fe)	ug/L	<100	<100	100	4647841
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	0.50	4647841
Dissolved Magnesium (Mg)	ug/L	21000	22000	50	4647841
Dissolved Manganese (Mn)	ug/L	<2.0	<2.0	2.0	4647841
Dissolved Molybdenum (Mo)	ug/L	5.2	5.3	0.50	4647841
Dissolved Nickel (Ni)	ug/L	1.7	1.6	1.0	4647841
Dissolved Phosphorus (P)	ug/L	<100	<100	100	4647841
Dissolved Potassium (K)	ug/L	2600	2600	200	4647841
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	2.0	4647841
Dissolved Silicon (Si)	ug/L	3700	3700	50	4647841
Dissolved Silver (Ag)	ug/L	<0.10	<0.10	0.10	4647841
Dissolved Sodium (Na)	ug/L	7000	6800	100	4647841
Dissolved Strontium (Sr)	ug/L	440	440	1.0	4647841
Dissolved Thallium (Tl)	ug/L	0.18	0.19	0.050	4647841
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	4647841
Dissolved Uranium (U)	ug/L	1.7	1.6	0.10	4647841
Dissolved Vanadium (V)	ug/L	<0.50	<0.50	0.50	4647841
Dissolved Zinc (Zn)	ug/L	84	84	5.0	4647841

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

TEST SUMMARY

Maxxam ID: CZV463
Sample ID: PW-2
Matrix: Water

Collected: 2016/09/02
Shipped:
Received: 2016/09/02

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4647602	N/A	2016/09/06	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	4645890	N/A	2016/09/07	Automated Statchk
Chloride by Automated Colourimetry	KONE	4647698	N/A	2016/09/04	Deonarine Ramnarine
Conductivity	AT	4647604	N/A	2016/09/06	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4647765	N/A	2016/09/03	Anastasia Hamanov
Hardness (calculated as CaCO3)		4647318	N/A	2016/09/08	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4647841	N/A	2016/09/08	Arefa Dabhad
Ion Balance (% Difference)	CALC	4645893	N/A	2016/09/08	Automated Statchk
Anion and Cation Sum	CALC	4645894	N/A	2016/09/08	Automated Statchk
Total Ammonia-N	LACH/NH4	4652490	N/A	2016/09/10	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4647677	N/A	2016/09/06	Chandra Nandlal
pH	AT	4647605	N/A	2016/09/06	Surinder Rai
Orthophosphate	KONE	4647699	N/A	2016/09/06	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4645895	N/A	2016/09/08	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4645896	N/A	2016/09/08	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4647700	N/A	2016/09/04	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	4645897	N/A	2016/09/08	Automated Statchk

Maxxam ID: CZV463 Dup
Sample ID: PW-2
Matrix: Water

Collected: 2016/09/02
Shipped:
Received: 2016/09/02

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Metals by ICPMS	ICP/MS	4647841	N/A	2016/09/08	Arefa Dabhad
Total Ammonia-N	LACH/NH4	4652490	N/A	2016/09/10	Charles Opoku-Ware

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

GENERAL COMMENTS

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

Package 1	12.7°C

Results relate only to the items tested.

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4647602	Alkalinity (Total as CaCO3)	2016/09/06			97	85 - 115	<1.0	mg/L	0.71	25
4647604	Conductivity	2016/09/06			100	85 - 115	<1.0	umho/cm	0.053	25
4647605	pH	2016/09/06			102	98 - 103			0.68	N/A
4647677	Nitrate (N)	2016/09/06	105	80 - 120	103	80 - 120	<0.10	mg/L	NC	25
4647677	Nitrite (N)	2016/09/06	107	80 - 120	105	80 - 120	<0.010	mg/L	NC	25
4647698	Dissolved Chloride (Cl)	2016/09/04	113	80 - 120	103	80 - 120	<1.0	mg/L	NC	20
4647699	Orthophosphate (P)	2016/09/06	109	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
4647700	Dissolved Sulphate (SO4)	2016/09/04	108	75 - 125	103	80 - 120	<1.0	mg/L	NC	20
4647765	Dissolved Organic Carbon	2016/09/03	100	80 - 120	100	80 - 120	<0.20	mg/L	2.4	20
4647841	Dissolved Aluminum (Al)	2016/09/08	101	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Antimony (Sb)	2016/09/08	105	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Arsenic (As)	2016/09/08	99	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Barium (Ba)	2016/09/08	100	80 - 120	98	80 - 120	<2.0	ug/L	0.13	20
4647841	Dissolved Beryllium (Be)	2016/09/08	100	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Boron (B)	2016/09/08	102	80 - 120	100	80 - 120	<10	ug/L	NC	20
4647841	Dissolved Cadmium (Cd)	2016/09/08	102	80 - 120	97	80 - 120	<0.10	ug/L	NC	20
4647841	Dissolved Calcium (Ca)	2016/09/08	NC	80 - 120	93	80 - 120	<200	ug/L	0.45	20
4647841	Dissolved Chromium (Cr)	2016/09/08	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Cobalt (Co)	2016/09/08	99	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Copper (Cu)	2016/09/08	102	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Iron (Fe)	2016/09/08	98	80 - 120	95	80 - 120	<100	ug/L	NC	20
4647841	Dissolved Lead (Pb)	2016/09/08	97	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Magnesium (Mg)	2016/09/08	NC	80 - 120	97	80 - 120	<50	ug/L	1.2	20
4647841	Dissolved Manganese (Mn)	2016/09/08	97	80 - 120	93	80 - 120	<2.0	ug/L	NC	20
4647841	Dissolved Molybdenum (Mo)	2016/09/08	105	80 - 120	96	80 - 120	<0.50	ug/L	1.9	20
4647841	Dissolved Nickel (Ni)	2016/09/08	95	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
4647841	Dissolved Phosphorus (P)	2016/09/08	107	80 - 120	102	80 - 120	<100	ug/L	NC	20
4647841	Dissolved Potassium (K)	2016/09/08	101	80 - 120	98	80 - 120	<200	ug/L	0.63	20
4647841	Dissolved Selenium (Se)	2016/09/08	99	80 - 120	94	80 - 120	<2.0	ug/L	NC	20
4647841	Dissolved Silicon (Si)	2016/09/08	99	80 - 120	97	80 - 120	<50	ug/L	1.8	20
4647841	Dissolved Silver (Ag)	2016/09/08	98	80 - 120	92	80 - 120	<0.10	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4647841	Dissolved Sodium (Na)	2016/09/08	101	80 - 120	96	80 - 120	<100	ug/L	1.6	20
4647841	Dissolved Strontium (Sr)	2016/09/08	NC	80 - 120	91	80 - 120	<1.0	ug/L	0.21	20
4647841	Dissolved Thallium (Tl)	2016/09/08	97	80 - 120	94	80 - 120	<0.050	ug/L	NC	20
4647841	Dissolved Titanium (Ti)	2016/09/08	99	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
4647841	Dissolved Uranium (U)	2016/09/08	100	80 - 120	99	80 - 120	<0.10	ug/L	1.5	20
4647841	Dissolved Vanadium (V)	2016/09/08	98	80 - 120	92	80 - 120	<0.50	ug/L	NC	20
4647841	Dissolved Zinc (Zn)	2016/09/08	99	80 - 120	97	80 - 120	<5.0	ug/L	0.080	20
4652490	Total Ammonia-N	2016/09/10	96	80 - 120	97	85 - 115	<0.050	mg/L	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 spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of 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 (one or both samples < 5x RDL).

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Maxxam Job #: B6I8895
Report Date: 2016/09/13

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

VALIDATION SIGNATURE PAGE

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

Cristina Carriere

Cristina Carriere, Scientific Services

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

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CHAIN OF CUSTODY RECORD

Page 1 of 1

IMMEDIATE TEST

Invoice To:		Report To:		Project Information:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B63104	Maxxam Job #:	Bottle Order #: 574913
Attention:	Accounts Payable	Attention:	Greg Padusenko	P.O. #:			
Address:	210 Sheldon Drive, Cambridge ON N1T 1A8	Address:		Project:	1536522	COC #: C#574913-01-01	Project Manager: Ema Gitej
Tel:	(519) 620-8182 Fax:	Tel:	Fax:	Project Name:			
Email:	AP-CustomerService@golder.com	Email:	gpadusenko@golder.com	Site #:			
				Sampled By:	Kurt.S		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle) (Metals / Hg / Cr VI)	RSC/Ap - Comprehensive	# of Bottles	Comments
1		PW-2	Sept 2/16	1130	GW	✓	✓	4	
2									
3									
4									
5									
6									
7									
8									
9									
10									

02-Sep-16 12:30
Ema Gitej
E6I8895
GK1 ENV-670

REC'D IN WATERLOO

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Time Sensitive	Laboratory Use Only: Temperature (°C) on Receipt	Custody Seal Present	Yes	No
KURT SAMM	16/09/02	1300	ASHLEE SUBRAMM	2016/09/02	12:30			11/13/14°C			
			ASHLEE SUBRAMM	2016/09/02	18:33				Intact	✓	

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

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

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

7/7/18

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 61291

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/02
Report #: R4153291
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I2353
Received: 2016/08/26, 11:43

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2016/09/01	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2016/09/01	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2016/09/01	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2016/09/01	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2016/08/28	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2016/08/31	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2016/08/31	CAM SOP-00447	EPA 6020A m
Ion Balance (% Difference)	1	N/A	2016/09/01		
Anion and Cation Sum	1	N/A	2016/09/01		
Total Ammonia-N	1	N/A	2016/09/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2016/09/01	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2016/09/01	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2016/09/01	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2016/09/01		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2016/09/01		
Sulphate by Automated Colourimetry	1	N/A	2016/09/01	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2016/09/01		

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

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 Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Your Project #: 1536522
Your C.O.C. #: 61291

Attention:Greg Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2016/09/02
Report #: R4153291
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I2353
Received: 2016/08/26, 11:43

Encryption Key

Augustyna Dobosz
Project Manager
02 Sep 2016 16:18:44 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		CYP341	CYP341		
Sampling Date		2016/08/26 08:30	2016/08/26 08:30		
COC Number		61291	61291		
	UNITS	TW-1	TW-1 Lab-Dup	RDL	QC Batch
Calculated Parameters					
Anion Sum	me/L	7.82		N/A	4642769
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	290		1.0	4642767
Calculated TDS	mg/L	420		1.0	4642772
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.2		1.0	4642767
Cation Sum	me/L	7.78		N/A	4642769
Hardness (CaCO3)	mg/L	340		1.0	4642423
Ion Balance (% Difference)	%	0.300		N/A	4642768
Langelier Index (@ 20C)	N/A	0.901			4642770
Langelier Index (@ 4C)	N/A	0.653			4642771
Saturation pH (@ 20C)	N/A	7.01			4642770
Saturation pH (@ 4C)	N/A	7.26			4642771
Inorganics					
Conductivity	umho/cm	750	750	1.0	4643097
Orthophosphate (P)	mg/L	<0.010	<0.010	0.010	4643121
pH	pH	7.91	7.88		4643098
Dissolved Sulphate (SO4)	mg/L	23	22	1.0	4643122
Alkalinity (Total as CaCO3)	mg/L	290	290	1.0	4643095
Dissolved Chloride (Cl)	mg/L	39	39	1.0	4643116
Nitrite (N)	mg/L	<0.010	<0.010	0.010	4643111
Nitrate (N)	mg/L	6.43	6.40	0.10	4643111
Nitrate + Nitrite (N)	mg/L	6.43	6.40	0.10	4643111

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

RESULTS OF ANALYSES OF WATER

Maxxam ID		CYP341		
Sampling Date		2016/08/26 08:30		
COC Number		61291		
	UNITS	TW-1	RDL	QC Batch
Inorganics				
Total Ammonia-N	mg/L	<0.050	0.050	4642899
Dissolved Organic Carbon	mg/L	0.82	0.20	4638183

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

O.REG 153 DISSOLVED ICPMS METALS (WATER)

Maxxam ID		CYP341		
Sampling Date		2016/08/26 08:30		
COC Number		61291		
	UNITS	TW-1	RDL	QC Batch
Metals				
Dissolved Aluminum (Al)	ug/L	<5.0	5.0	4639520
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	4639520
Dissolved Arsenic (As)	ug/L	<1.0	1.0	4639520
Dissolved Barium (Ba)	ug/L	40	2.0	4639520
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	4639520
Dissolved Boron (B)	ug/L	17	10	4639520
Dissolved Cadmium (Cd)	ug/L	<0.10	0.10	4639520
Dissolved Calcium (Ca)	ug/L	95000	200	4639520
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	4639520
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	4639520
Dissolved Copper (Cu)	ug/L	<1.0	1.0	4639520
Dissolved Iron (Fe)	ug/L	<100	100	4639520
Dissolved Lead (Pb)	ug/L	<0.50	0.50	4639520
Dissolved Magnesium (Mg)	ug/L	24000	50	4639520
Dissolved Manganese (Mn)	ug/L	<2.0	2.0	4639520
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	4639520
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	4639520
Dissolved Phosphorus (P)	ug/L	<100	100	4639520
Dissolved Potassium (K)	ug/L	1600	200	4639520
Dissolved Selenium (Se)	ug/L	<2.0	2.0	4639520
Dissolved Silicon (Si)	ug/L	4800	50	4639520
Dissolved Silver (Ag)	ug/L	<0.10	0.10	4639520
Dissolved Sodium (Na)	ug/L	23000	100	4639520
Dissolved Strontium (Sr)	ug/L	140	1.0	4639520
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	4639520
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	4639520
Dissolved Uranium (U)	ug/L	0.24	0.10	4639520
Dissolved Vanadium (V)	ug/L	<0.50	0.50	4639520
Dissolved Zinc (Zn)	ug/L	36	5.0	4639520

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

TEST SUMMARY

Maxxam ID: CYP341
Sample ID: TW-1
Matrix: Water

Collected: 2016/08/26
Shipped:
Received: 2016/08/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4643095	N/A	2016/09/01	Yogesh Patel
Carbonate, Bicarbonate and Hydroxide	CALC	4642767	N/A	2016/09/01	Automated Statchk
Chloride by Automated Colourimetry	KONE	4643116	N/A	2016/09/01	Deonarine Ramnarine
Conductivity	AT	4643097	N/A	2016/09/01	Yogesh Patel
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4638183	N/A	2016/08/28	Anastasia Hamanov
Hardness (calculated as CaCO3)		4642423	N/A	2016/08/31	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4639520	N/A	2016/08/31	Kevin Comerford
Ion Balance (% Difference)	CALC	4642768	N/A	2016/09/01	Automated Statchk
Anion and Cation Sum	CALC	4642769	N/A	2016/09/01	Automated Statchk
Total Ammonia-N	LACH/NH4	4642899	N/A	2016/09/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4643111	N/A	2016/09/01	Chandra Nandlal
pH	AT	4643098	N/A	2016/09/01	Yogesh Patel
Orthophosphate	KONE	4643121	N/A	2016/09/01	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4642770	N/A	2016/09/01	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4642771	N/A	2016/09/01	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4643122	N/A	2016/09/01	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	4642772	N/A	2016/09/01	Automated Statchk

Maxxam ID: CYP341 Dup
Sample ID: TW-1
Matrix: Water

Collected: 2016/08/26
Shipped:
Received: 2016/08/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4643095	N/A	2016/09/01	Yogesh Patel
Chloride by Automated Colourimetry	KONE	4643116	N/A	2016/09/01	Deonarine Ramnarine
Conductivity	AT	4643097	N/A	2016/09/01	Yogesh Patel
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4643111	N/A	2016/09/01	Chandra Nandlal
pH	AT	4643098	N/A	2016/09/01	Yogesh Patel
Orthophosphate	KONE	4643121	N/A	2016/09/01	Alina Dobreanu
Sulphate by Automated Colourimetry	KONE	4643122	N/A	2016/09/01	Alina Dobreanu

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

GENERAL COMMENTS

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

Package 1	9.0°C

Results relate only to the items tested.

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4638183	Dissolved Organic Carbon	2016/08/28	101	80 - 120	100	80 - 120	<0.20	mg/L	3.0	20
4639520	Dissolved Aluminum (Al)	2016/08/31	102	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
4639520	Dissolved Antimony (Sb)	2016/08/31	104	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Arsenic (As)	2016/08/31	99	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
4639520	Dissolved Barium (Ba)	2016/08/31	103	80 - 120	99	80 - 120	<2.0	ug/L	5.2	20
4639520	Dissolved Beryllium (Be)	2016/08/31	101	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Boron (B)	2016/08/31	103	80 - 120	98	80 - 120	<10	ug/L	NC	20
4639520	Dissolved Cadmium (Cd)	2016/08/31	103	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
4639520	Dissolved Calcium (Ca)	2016/08/31	NC	80 - 120	98	80 - 120	<200	ug/L	1.0	20
4639520	Dissolved Chromium (Cr)	2016/08/31	100	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
4639520	Dissolved Cobalt (Co)	2016/08/31	97	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Copper (Cu)	2016/08/31	103	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
4639520	Dissolved Iron (Fe)	2016/08/31	100	80 - 120	96	80 - 120	<100	ug/L	NC	20
4639520	Dissolved Lead (Pb)	2016/08/31	96	80 - 120	92	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Magnesium (Mg)	2016/08/31	100	80 - 120	97	80 - 120	<50	ug/L	0.28	20
4639520	Dissolved Manganese (Mn)	2016/08/31	100	80 - 120	97	80 - 120	<2.0	ug/L	0.99	20
4639520	Dissolved Molybdenum (Mo)	2016/08/31	104	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Nickel (Ni)	2016/08/31	97	80 - 120	95	80 - 120	<1.0	ug/L	NC	20
4639520	Dissolved Phosphorus (P)	2016/08/31	109	80 - 120	101	80 - 120	<100	ug/L		
4639520	Dissolved Potassium (K)	2016/08/31	102	80 - 120	97	80 - 120	<200	ug/L	0.95	20
4639520	Dissolved Selenium (Se)	2016/08/31	100	80 - 120	96	80 - 120	<2.0	ug/L	NC	20
4639520	Dissolved Silicon (Si)	2016/08/31	101	80 - 120	96	80 - 120	<50	ug/L	0.64	20
4639520	Dissolved Silver (Ag)	2016/08/31	100	80 - 120	96	80 - 120	<0.10	ug/L	NC	20
4639520	Dissolved Sodium (Na)	2016/08/31	100	80 - 120	96	80 - 120	<100	ug/L	2.6	20
4639520	Dissolved Strontium (Sr)	2016/08/31	100	80 - 120	96	80 - 120	<1.0	ug/L	3.5	20
4639520	Dissolved Thallium (Tl)	2016/08/31	97	80 - 120	94	80 - 120	<0.050	ug/L	NC	20
4639520	Dissolved Titanium (Ti)	2016/08/31	100	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
4639520	Dissolved Uranium (U)	2016/08/31	99	80 - 120	96	80 - 120	<0.10	ug/L	NC	20
4639520	Dissolved Vanadium (V)	2016/08/31	99	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
4639520	Dissolved Zinc (Zn)	2016/08/31	99	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
4642899	Total Ammonia-N	2016/09/01	94	80 - 120	98	85 - 115	<0.050	mg/L	NC	20

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

QUALITY ASSURANCE REPORT(CONT'D)

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4643095	Alkalinity (Total as CaCO3)	2016/09/01			98	85 - 115	<1.0	mg/L	0.79	25
4643097	Conductivity	2016/09/01			100	85 - 115	<1.0	umho/cm	0.13	25
4643098	pH	2016/09/01			102	98 - 103			0.37	N/A
4643111	Nitrate (N)	2016/09/01	NC	80 - 120	100	80 - 120	<0.10	mg/L	0.46	25
4643111	Nitrite (N)	2016/09/01	95	80 - 120	105	80 - 120	<0.010	mg/L	NC	25
4643116	Dissolved Chloride (Cl)	2016/09/01	NC	80 - 120	103	80 - 120	<1.0	mg/L	0.014	20
4643121	Orthophosphate (P)	2016/09/01	112	75 - 125	101	80 - 120	<0.010	mg/L	NC	25
4643122	Dissolved Sulphate (SO4)	2016/09/01	NC	75 - 125	103	80 - 120	<1.0	mg/L	2.2	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 spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of 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 (one or both samples < 5x RDL).

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Maxxam Job #: B6I2353
Report Date: 2016/09/02

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: GP

VALIDATION SIGNATURE PAGE

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

Cristina Carriere

Cristina Carriere, Scientific Services

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IMMEDIATE TEST

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01291/2

CHAIN OF CUSTODY RECORD 61291

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Golder Associates	Company Name:	Quotation #: B63604	☑ Regular TAT (5-7 days) Most analyses
Contact Name: Accounts Payable	Contact Name: Greg Paduszatko	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 216 Sheldon Dr Cambridge, ON N1T 1A8	Address:	Project #: 1536522	Rush TAT (Surcharges will be applied)
Phone: 519-620-5182 Fax:	Phone: Fax:	Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Email: AP-Cusbner_Service@golder.com	Email: gpaduszatko@golder.com	Site #:	Date Required:
		Sampled By:	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Rush Confirmation #:

Regulation 153	Other Regulations
☐ Table 1 ☐ Res/Park ☐ Med/ Fine	☐ CCME ☐ Sanitary Sewer Bylaw
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ MISA ☐ Storm Sewer Bylaw
☐ Table 3 ☐ Agri/ Other	☐ PWQO Region
☐ Table	☐ Other (Specify)
FOR RSC (PLEASE CIRCLE) Y / N	☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / N

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

Analysis Requested

LABORATORY USE ONLY

CUSTODY SEAL Y / N: Present N, Intact N

COOLER TEMPERATURES: 8.9 | 11.0

COOLING MEDIA PRESENT: (Y) / N

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX / PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS (REFER TO BACK OF COC)	REG 153 ICPMS METALS	REG 153 METALS (Hg, CrVI, ICPMS Metals, HWS B)	DOC	Nutrients	General Chem					HOLD - DO NOT ANALYZE	COMMENTS
1	TW-1	20160812	8:30	GW	4					✓			✓	✓	✓						
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

26-Aug-16 11:43
Ema Gitej
B612353
GK1 ENV-885

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
J. Bahan	20160812	11:40		16-08-26	11:43	

COC-1004 (10/14) - ENV. ENG.

White: Maxxam - Yellow: Client

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 645466-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2018/01/25
Report #: R4950851
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B814794
Received: 2018/01/22, 08:15

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/24	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/25	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/24	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/24	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/25	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/24	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2018/01/24	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2018/01/25		
Anion and Cation Sum	1	N/A	2018/01/25		
Total Ammonia-N	1	N/A	2018/01/24	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/24	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2018/01/24	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/24	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/25		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/25		
Sulphate by Automated Colourimetry	1	N/A	2018/01/24	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/25		

Remarks:

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

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

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

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 645466-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2018/01/25
Report #: R4950851
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B814794
Received: 2018/01/22, 08:15

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Ronklin Gracian
Project Manager
25 Jan 2018 16:40:31

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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Maxxam Job #: B814794
Report Date: 2018/01/25

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		FYI594		
Sampling Date		2018/01/19 16:00		
COC Number		645466-01-01		
	UNITS	GUELPH LAFARGE PW1	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	8.10	N/A	5363363
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	300	1.0	5363358
Calculated TDS	mg/L	420	1.0	5363366
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.8	1.0	5363358
Cation Sum	me/L	7.54	N/A	5363363
Hardness (CaCO3)	mg/L	320	1.0	5363361
Ion Balance (% Difference)	%	3.58	N/A	5363362
Langelier Index (@ 20C)	N/A	0.746		5363364
Langelier Index (@ 4C)	N/A	0.498		5363365
Saturation pH (@ 20C)	N/A	7.05		5363364
Saturation pH (@ 4C)	N/A	7.30		5363365
Inorganics				
Total Ammonia-N	mg/L	0.068	0.050	5365372
Conductivity	umho/cm	770	1.0	5365977
Dissolved Organic Carbon	mg/L	1.2	0.50	5367006
Orthophosphate (P)	mg/L	<0.010	0.010	5365947
pH	pH	7.80		5365979
Dissolved Sulphate (SO4)	mg/L	41	1.0	5365948
Alkalinity (Total as CaCO3)	mg/L	300	1.0	5365973
Dissolved Chloride (Cl)	mg/L	40	1.0	5365942
Nitrite (N)	mg/L	0.012	0.010	5365251
Nitrate (N)	mg/L	1.18	0.10	5365251
Nitrate + Nitrite (N)	mg/L	1.19	0.10	5365251
Metals				
Dissolved Aluminum (Al)	ug/L	<5.0	5.0	5366964
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	5366964
Dissolved Arsenic (As)	ug/L	1.3	1.0	5366964
Dissolved Barium (Ba)	ug/L	66	2.0	5366964
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	5366964
Dissolved Boron (B)	ug/L	24	10	5366964
Dissolved Cadmium (Cd)	ug/L	0.16	0.10	5366964
Dissolved Calcium (Ca)	ug/L	84000	200	5366964
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	5366964

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Job #: B814794
Report Date: 2018/01/25

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		FYI594		
Sampling Date		2018/01/19 16:00		
COC Number		645466-01-01		
	UNITS	GUELPH LAFARGE PW1	RDL	QC Batch
Dissolved Cobalt (Co)	ug/L	0.88	0.50	5366964
Dissolved Copper (Cu)	ug/L	1.1	1.0	5366964
Dissolved Iron (Fe)	ug/L	<100	100	5366964
Dissolved Lead (Pb)	ug/L	<0.50	0.50	5366964
Dissolved Magnesium (Mg)	ug/L	28000	50	5366964
Dissolved Manganese (Mn)	ug/L	2.4	2.0	5366964
Dissolved Molybdenum (Mo)	ug/L	3.3	0.50	5366964
Dissolved Nickel (Ni)	ug/L	3.2	1.0	5366964
Dissolved Phosphorus (P)	ug/L	<100	100	5366964
Dissolved Potassium (K)	ug/L	1800	200	5366964
Dissolved Selenium (Se)	ug/L	<2.0	2.0	5366964
Dissolved Silicon (Si)	ug/L	5000	50	5366964
Dissolved Silver (Ag)	ug/L	<0.10	0.10	5366964
Dissolved Sodium (Na)	ug/L	23000	100	5366964
Dissolved Strontium (Sr)	ug/L	520	1.0	5366964
Dissolved Thallium (Tl)	ug/L	0.053	0.050	5366964
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	5366964
Dissolved Uranium (U)	ug/L	0.24	0.10	5366964
Dissolved Vanadium (V)	ug/L	<0.50	0.50	5366964
Dissolved Zinc (Zn)	ug/L	51	5.0	5366964

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B814794
Report Date: 2018/01/25

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

TEST SUMMARY

Maxxam ID: FYI594
Sample ID: GUELPH LAFARGE PW1
Matrix: Water

Collected: 2018/01/19
Shipped:
Received: 2018/01/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5365973	N/A	2018/01/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5363358	N/A	2018/01/25	Automated Statchk
Chloride by Automated Colourimetry	KONE	5365942	N/A	2018/01/24	Alina Dobreanu
Conductivity	AT	5365977	N/A	2018/01/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5367006	N/A	2018/01/25	Nimarta Singh
Hardness (calculated as CaCO3)		5363361	N/A	2018/01/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5366964	N/A	2018/01/24	Prempal Bhatti
Ion Balance (% Difference)	CALC	5363362	N/A	2018/01/25	Automated Statchk
Anion and Cation Sum	CALC	5363363	N/A	2018/01/25	Automated Statchk
Total Ammonia-N	LACH/NH4	5365372	N/A	2018/01/24	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5365251	N/A	2018/01/24	Chandra Nandlal
pH	AT	5365979	N/A	2018/01/24	Surinder Rai
Orthophosphate	KONE	5365947	N/A	2018/01/24	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5363364	N/A	2018/01/25	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5363365	N/A	2018/01/25	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5365948	N/A	2018/01/24	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5363366	N/A	2018/01/25	Automated Statchk

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Maxxam Job #: B814794
Report Date: 2018/01/25

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

GENERAL COMMENTS

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

Package 1	0.7°C

Results relate only to the items tested.

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Maxxam Job #: B814794
Report Date: 2018/01/25

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5365251	Nitrate (N)	2018/01/24	94	80 - 120	95	80 - 120	<0.10	mg/L	0.80	20
5365251	Nitrite (N)	2018/01/24	97	80 - 120	99	80 - 120	<0.010	mg/L	3.8	20
5365372	Total Ammonia-N	2018/01/24	NC	75 - 125	100	80 - 120	<0.050	mg/L	0.15	20
5365942	Dissolved Chloride (Cl)	2018/01/24	NC	80 - 120	103	80 - 120	<1.0	mg/L	0.17	20
5365947	Orthophosphate (P)	2018/01/24	95	75 - 125	100	80 - 120	<0.010	mg/L	NC	25
5365948	Dissolved Sulphate (SO4)	2018/01/24	112	75 - 125	103	80 - 120	<1.0	mg/L	1.5	20
5365973	Alkalinity (Total as CaCO3)	2018/01/24			97	85 - 115	<1.0	mg/L	1.4	20
5365977	Conductivity	2018/01/24			103	85 - 115	<1.0	umho/cm	0.50	25
5365979	pH	2018/01/24			101	98 - 103			0.24	N/A
5366964	Dissolved Aluminum (Al)	2018/01/24	97	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
5366964	Dissolved Antimony (Sb)	2018/01/24	108	80 - 120	106	80 - 120	<0.50	ug/L	NC	20
5366964	Dissolved Arsenic (As)	2018/01/24	101	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5366964	Dissolved Barium (Ba)	2018/01/24	100	80 - 120	101	80 - 120	<2.0	ug/L	3.7	20
5366964	Dissolved Beryllium (Be)	2018/01/24	105	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
5366964	Dissolved Boron (B)	2018/01/24	99	80 - 120	96	80 - 120	<10	ug/L	7.1	20
5366964	Dissolved Cadmium (Cd)	2018/01/24	102	80 - 120	101	80 - 120	<0.10	ug/L	NC	20
5366964	Dissolved Calcium (Ca)	2018/01/24	NC	80 - 120	93	80 - 120	<200	ug/L	0.79	20
5366964	Dissolved Chromium (Cr)	2018/01/24	95	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
5366964	Dissolved Cobalt (Co)	2018/01/24	99	80 - 120	101	80 - 120	<0.50	ug/L	3.7	20
5366964	Dissolved Copper (Cu)	2018/01/24	100	80 - 120	104	80 - 120	<1.0	ug/L	1.8	20
5366964	Dissolved Iron (Fe)	2018/01/24	102	80 - 120	99	80 - 120	<100	ug/L	NC	20
5366964	Dissolved Lead (Pb)	2018/01/24	101	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
5366964	Dissolved Magnesium (Mg)	2018/01/24	99	80 - 120	99	80 - 120	<50	ug/L	6.5	20
5366964	Dissolved Manganese (Mn)	2018/01/24	100	80 - 120	97	80 - 120	<2.0	ug/L	6.0	20
5366964	Dissolved Molybdenum (Mo)	2018/01/24	100	80 - 120	97	80 - 120	<0.50	ug/L	6.4	20
5366964	Dissolved Nickel (Ni)	2018/01/24	96	80 - 120	97	80 - 120	<1.0	ug/L	0.48	20
5366964	Dissolved Phosphorus (P)	2018/01/24	109	80 - 120	103	80 - 120	<100	ug/L	NC	20
5366964	Dissolved Potassium (K)	2018/01/24	104	80 - 120	100	80 - 120	<200	ug/L	5.2	20
5366964	Dissolved Selenium (Se)	2018/01/24	98	80 - 120	95	80 - 120	<2.0	ug/L	NC	20
5366964	Dissolved Silicon (Si)	2018/01/24	101	80 - 120	97	80 - 120	<50	ug/L	0.38	20
5366964	Dissolved Silver (Ag)	2018/01/24	100	80 - 120	100	80 - 120	<0.10	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5366964	Dissolved Sodium (Na)	2018/01/24	NC	80 - 120	96	80 - 120	<100	ug/L	6.3	20
5366964	Dissolved Strontium (Sr)	2018/01/24	103	80 - 120	99	80 - 120	<1.0	ug/L	5.9	20
5366964	Dissolved Thallium (Tl)	2018/01/24	97	80 - 120	99	80 - 120	<0.050	ug/L	NC	20
5366964	Dissolved Titanium (Ti)	2018/01/24	103	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
5366964	Dissolved Uranium (U)	2018/01/24	100	80 - 120	100	80 - 120	<0.10	ug/L	8.7	20
5366964	Dissolved Vanadium (V)	2018/01/24	98	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
5366964	Dissolved Zinc (Zn)	2018/01/24	99	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5367006	Dissolved Organic Carbon	2018/01/24	92	80 - 120	94	80 - 120	<0.50	mg/L	0.17	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).

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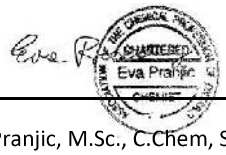
Maxxam Job #: B814794
Report Date: 2018/01/25

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: PM

VALIDATION SIGNATURE PAGE

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



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B70916	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			645456
Address:	210 Sheldon Drive Cambridge ON N1T 1A8	Address:		Project:	1536522	COC #:	Project Manager:
Tel:	(519) 620-8182 x Fax:	Tel:	(519) 620-8182 x6509 Fax: (519) 620-9878 x	Project Name:		C#645456-01-01	Ema Gitej
Email:	AP_CustomerService@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Med./Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ PWQO ☐ Other

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	# of Bottles	Comments
1		Guelph Lafarge PW1	2018/01/17	16:00	GW	✓	✓	4	
2									
3									
4									
5									
6									
7									
8									
9									
10									

22-Jan-18 08:15
Ema Gitej
B814794
TST WAT-001

REC'D IN WATERLOO

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Present	Yes	No
Paul Mankell / Paul Mankell	18/01/19	17:35	[illegible]	2018/01/22	08:15			1° 1° 0	Intact		
			[illegible]	01/22	15:35						

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

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

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIC-COC.PDF.

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

White: Maxxa Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

APPENDIX E

Water Balance Assessment

Table E1
Water Balance for Existing Conditions

Catchment 1
Draining to SW2

					Vegetated			Open Water			Gravel / Bare			Forest			Impervious					
					WHC	150 mm		WHC	Precip - PET		WHC	75 mm		WHC	300 mm		WHC	3 mm				
					Total Area (m^2)	85,515		Total Area (m^2)	14,102		Total Area (m^2)	137,735		Total Area (m^2)	22,880		Total Area (m^2)	17,572		Total Area (m^2)	277,803	
					Infiltration Factor	0.85		Infiltration Factor	0.0		Infiltration Factor	0.7		Infiltration Factor	0.9		Infiltration Factor	0.10				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	3,164	2	58	818	2	42	5,785	2	26	595	2	43	756	**11,117**	7,350	3,768
February	28	-5.8	52	1	1	45	3,848	1	51	719	1	47	6,474	1	39	892	1	48	843	**12,777**	8,690	4,087
March	31	-0.9	58	10	10	74	6,328	10	48	677	10	76	10,468	10	68	1,556	10	76	1,335	**20,364**	14,240	6,124
April	30	6.1	67	33	33	37	3,164	33	34	479	33	37	5,096	33	37	847	33	37	650	**10,236**	7,084	3,153
May	31	12.3	78	76	76	16	1,368	76	2	28	75	16	2,204	76	16	366	63	16	281	**4,247**	3,063	1,184
June	30	17.4	81	110	110	3	257	110	-29	-409	103	3	413	110	3	69	77	5	88	**417**	578	-161
July	31	19.8	94	128	123	2	171	128	-34	-479	105	2	275	128	2	46	87	7	123	**136**	392	-256
August	31	18.9	73	112	95	2	171	112	-39	-550	81	2	275	111	2	46	70	4	70	**13**	386	-374
September	30	14.7	87	75	66	9	770	75	12	169	65	9	1,240	73	9	206	62	24	422	**2,806**	1,749	1,057
October	31	8.5	75	39	38	8	684	39	36	508	38	16	2,204	38	8	183	36	37	650	**4,229**	2,354	1,875
November	30	2.4	78	12	12	26	2,223	12	66	931	12	44	6,060	12	23	526	12	64	1,125	**10,865**	6,718	4,147
December	31	-3.4	62	2	2	37	3,164	2	60	846	2	45	6,198	2	32	732	2	48	843	**11,784**	7,771	4,012
Total			***865***	***600***	***568***	***296***	***25,312***	***600***	***265***	***3,737***	***527***	***339***	***46,692***	***596***	***265***	***46,692***	***455***	***409***	***7,187***	***88,992***	***60,375***	***28,616***

Catchment 2
Draining to SW 4

					Vegetated			Gravel / Bare			Forest			Impervious							
					WHC	150 mm		WHC	75 mm		WHC	300 mm		WHC	3 mm						
					Total Area (m^2)	222,821		Total Area (m^2)	18,275		Total Area (m^2)	42,910		Total Area (m^2)	1,459		Total Area (m^2)	285,465		
					Infiltration Factor	0.85		Infiltration Factor	0.7		Infiltration Factor	0.9		Infiltration Factor	0.10						
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff		
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)		
January	31	-6.2	60	2	2	37	8,244	2	42	768	2	26	1,116	2	43	63	**10,190**	**8,555**	1,635		
February	28	-5.8	52	1	1	45	10,027	1	47	859	1	39	1,673	1	48	70	**12,629**	**10,637**	1,992		
March	31	-0.9	58	10	10	74	16,489	10	76	1,389	10	68	2,918	10	76	111	**20,906**	**17,625**	3,282		
April	30	6.1	67	33	33	37	8,244	33	37	676	33	37	1,588	33	37	54	**10,562**	**8,915**	1,647		
May	31	12.3	78	76	76	16	3,565	75	16	292	76	16	687	63	16	23	**4,567**	**3,855**	712		
June	30	17.4	81	110	110	3	668	103	3	55	110	3	129	77	5	7	**859**	**723**	136		
July	31	19.8	94	128	123	2	446	105	2	37	128	2	86	87	7	10	**578**	**483**	96		
August	31	18.9	73	112	95	2	446	81	2	37	111	2	86	70	4	6	**574**	**482**	92		
September	30	14.7	87	75	66	9	2,005	65	9	164	73	9	386	62	24	35	**2,591**	**2,171**	420		
October	31	8.5	75	39	38	8	1,783	38	16	292	38	8	343	36	37	54	**2,472**	**2,034**	438		
November	30	2.4	78	12	12	26	5,793	12	44	804	12	23	987	12	64	93	**7,678**	**6,385**	1,293		
December	31	-3.4	62	2	2	37	8,244	2	45	822	2	32	1,373	2	48	70	**10,510**	**8,826**	1,684		
Total			***865***	***600***	***568***	***296***	***65,955***	***527***	***339***	***6,195***	***596***	***265***	***6,195***	***455***	***409***	***597***	***84,118***	***70,692***	***13,426***		

Catchment 3
Draining to Infiltration Pond

					Vegetated/Agricultural			Open Water			Gravel / Bare			Impervious							
					WHC	150 mm		WHC	Precip - PET		WHC	75 mm		WHC	3 mm						
					Total Area (m^2)	491,889		Total Area (m^2)	59,284		Total Area (m^2)	148,435		Total Area (m^2)	1,526		Total Area (m^2)	701,133		
					Infiltration Factor	0.85		Infiltration Factor	0.0		Infiltration Factor	0.7		Infiltration Factor	0.1						
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff		
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)		
January	31	-6.2	60	2	2	37	18,200	2	58	3,438	2	42	6,234	2	43	66	**27,875**	19,840	8,034		
February	28	-5.8	52	1	1	45	22,135	1	51	3,024	1	47	6,976	1	48	73	**32,136**	23,706	8,430		
March	31	-0.9	58	10	10	74	36,400	10	48	2,846	10	76	11,281	10	76	116	**50,536**	38,848	11,688		
April	30	6.1	67	33	33	37	18,200	33	34	2,016	33	37	5,492	33	37	56	**25,741**	19,320	6,421		
May	31	12.3	78	76	76	16	7,870	76	2	119	75	16	2,375	63	16	24	**10,440**	8,355	2,085		
June	30	17.4	81	110	110	3	1,476	110	-29	-1,719	103	3	445	77	5	8	**312**	1,567	-1,255		
July	31	19.8	94	128	123	2	984	128	-34	-2,016	105	2	297	87	7	11	**-607**	1,045	-1,652		
August	31	18.9	73	112	95	2	984	112	-39	-2,312	81	2	297	70	4	6	**-919**	1,045	-1,964		
September	30	14.7	87	75	66	9	4,427	75	12	711	65	9	1,336	62	24	37	**6,549**	4,702	1,848		
October	31	8.5	75	39	38	8	3,935	39	36	2,134	38	16	2,375	36	37	56	**8,483**	5,013	3,470		
November	30	2.4	78	12	12	26	12,789	12	66	3,913	12	44	6,531	12	64	98	**23,245**	15,452	7,793		
December	31	-3.4	62	2	2	37	18,200	2	60	3,557	2	45	6,680	2	48	73	**28,439**	20,153	8,286		
Total			***865***	***600***	***568***	***296***	***145,599***	***600***	***265***	***15,710***	***527***	***339***	***50,319***	***455***	***409***	***624***	***212,229***	***159,045***	***53,184***		

Table E1
Water Balance for Existing Conditions

Catchment 4
Draining to Infiltration Pond

					Vegetated			Open Water			Gravel (Quarry or Lot)			Forest					
					WHC	150 mm		WHC	Precip - PET		WHC	75 mm		WHC	300 mm				
					Total Area (m^2)	110,354		Total Area (m^2)	6,743		Total Area (m^2)	34,133		Total Area (m^2)	6,494		Total Area (m^2)	157,724	
					Infiltration Factor	0.85		Infiltration Factor	0.0		Infiltration Factor	0.7		Infiltration Factor	0.9				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	0.0	60	2	2	37	4,083	2	58	391	2	42	1,434	2	26	169	**6,077**	**4,626**	1,451
February	28	-5.8	52	1	1	45	4,966	1	51	344	1	47	1,604	1	39	253	**7,167**	**5,572**	1,595
March	31	-5.7	58	10	10	74	8,166	10	48	324	10	76	2,594	10	68	442	**11,526**	**9,155**	2,371
April	30	-1.5	67	33	33	37	4,083	33	34	229	33	37	1,263	33	37	240	**5,816**	**4,571**	1,245
May	31	3.9	78	76	76	16	1,766	76	2	13	75	16	546	76	16	104	**2,429**	**1,977**	453
June	30	9.8	81	110	110	3	331	110	-29	-196	103	3	102	110	3	19	**257**	**371**	-113
July	31	14.9	94	128	123	2	221	128	-34	-229	105	2	68	128	2	13	**73**	**247**	-174
August	31	18.6	73	112	95	2	221	112	-39	-263	81	2	68	111	2	13	**39**	**247**	-208
September	30	18.6	87	75	66	9	993	75	12	81	65	9	307	73	9	58	**1,440**	**1,112**	328
October	31	14.4	75	39	38	8	883	39	36	243	38	16	546	38	8	52	**1,724**	**1,179**	544
November	30	8.7	78	12	12	26	2,869	12	66	445	12	44	1,502	12	23	149	**4,965**	**3,625**	1,341
December	31	3.4	62	2	2	37	4,083	2	60	405	2	45	1,536	2	32	208	**6,231**	**4,733**	1,499
Total			***865***	***600***	***568***	***296***	***32,665***	***600***	***265***	***1,787***	***527***	***339***	***11,571***	***596***	***265***	***1,721***	***47,744***	***37,414***	***10,330***

Catchment 5
Draining to Wetland (D/S of Outlet Point)

					Vegetated			Forest			Gravel (Quarry or Lot)			Wetland					
					WHC	150 mm		WHC	300 mm		WHC	75 mm		WHC	Precip - PET				
					Total Area (m^2)	0		Total Area (m^2)	21,175		Total Area (m^2)	0		Total Area (m^2)	45,354.7		Total Area (m^2)	66,529	
					Infiltration Factor	0.85		Infiltration Factor	0.9		Infiltration Factor	0.7		Infiltration Factor	0.0				
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	0.0	60	2	2	37	0	2	26	551	2	42	0	2	58	2,631	3,181	495	2,686
February	28	-5.8	52	1	1	45	0	1	39	826	1	47	0	1	51	2,313	3,139	743	2,396
March	31	-5.7	58	10	10	74	0	10	68	1,440	10	76	0	10	48	2,177	3,617	1,296	2,321
April	30	-1.5	67	33	33	37	0	33	37	783	33	37	0	33	34	1,542	2,326	705	1,620
May	31	3.9	78	76	76	16	0	76	16	339	75	16	0	76	2	91	430	305	125
June	30	9.8	81	110	110	3	0	110	3	64	103	3	0	110	-29	-1,315	-1,252	57	-1,309
July	31	14.9	94	128	123	2	0	128	2	42	105	2	0	128	-34	-1,542	-1,500	38	-1,538
August	31	18.6	73	112	95	2	0	111	2	42	81	2	0	112	-39	-1,769	-1,726	38	-1,765
September	30	18.6	87	75	66	9	0	73	9	191	65	9	0	75	12	544	735	172	563
October	31	14.4	75	39	38	8	0	38	8	169	38	16	0	39	36	1,633	1,802	152	1,650
November	30	8.7	78	12	12	26	0	12	23	487	12	44	0	12	66	2,993	3,480	438	3,042
December	31	3.4	62	2	2	37	0	2	32	678	2	45	0	2	60	2,721	3,399	610	2,789
Total			***865***	***600***	***568***	***296***	***0***	***596***	***265***	***5611***	***527***	***339***	***0***	***600***	***265***	***12,019***	***17,630***	***5,050***	***12,580***

Catchment 6
Drainig to Wetland (US of Discharge Point)

					Vegetated			Forest			Wetland						
					WHC	150 mm		WHC	300 mm		WHC	Precip - PET					
					Total Area (m^2)	1,568		Total Area (m^2)	9,437		Total Area (m^2)	14,203		Total Area (m^2)	25,208		
					Infiltration Factor	0.85		Infiltration Factor	0.9		Infiltration Factor	0.0					
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)	
January	31	0.0	60	2	2	37	58	2	26	245	2	58	824	**1,127**	270	857	
February	28	-5.8	52	1	1	45	71	1	39	368	1	51	724	**1,163**	391	772	
March	31	-5.7	58	10	10	74	116	10	68	642	10	48	682	**1,439**	676	763	
April	30	-1.5	67	33	33	37	58	33	37	349	33	34	483	**890**	364	527	
May	31	3.9	78	76	76	16	25	76	16	151	76	2	28	**204**	157	47	
June	30	9.8	81	110	110	3	5	110	3	28	110	-29	-412	**-379**	29	-408	
July	31	14.9	94	128	123	2	3	128	2	19	128	-34	-483	**-461**	20	-481	
August	31	18.6	73	112	95	2	3	111	2	19	112	-39	-554	**-532**	20	-552	
September	30	18.6	87	75	66	9	14	73	9	85	75	12	170	**269**	88	181	
October	31	14.4	75	39	38	8	13	38	8	75	39	36	511	**599**	79	521	
November	30	8.7	78	12	12	26	41	12	23	217	12	66	937	**1,195**	230	965	
December	31	3.4	62	2	2	37	58	2	32	302	2	60	852	**1,212**	321	891	
Total			***865***	***600***	***568***	***296***	***464***	***596***	***265***	***2501***	***600***	***265***	***3764***	***6,729***	***2,645***	***4,083***	

Table E2
Water Balance for Operational Conditions

Catchment 1
Draining to Phase 1 Extraction Area

					Vegetated			Gravel / Bare			Forest			Impervious			Quarry (bedrock)					
					WHC	150 mm		WHC	75 mm		WHC	300 mm		WHC	3 mm		WHC	10 mm		Total Area (m^2)	993,917	
					Total Area (m^2)	301,569		Total Area (m^2)	140,842		Total Area (m^2)	19,940		Total Area (m^2)	19,097		Total Area (m^2)	512,469				
					Infiltration Factor	0.85		Infiltration Factor	0.4		Infiltration Factor	0.9		Infiltration Factor	0.10		Infiltration Factor	0.00				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	11,158	2	42	5,915	2	26	518	2	43	821	2	43	22,036	**40,449**	**12,373**	28,076
February	28	-5.8	52	1	1	45	13,571	1	47	6,620	1	39	778	1	48	917	1	48	24,599	**46,483**	**14,936**	31,547
March	31	-0.9	58	10	10	74	22,316	10	76	10,704	10	68	1,356	10	76	1,451	10	76	38,948	**74,775**	**24,548**	50,227
April	30	6.1	67	33	33	37	11,158	33	37	5,211	33	37	738	33	37	707	33	37	18,961	**36,775**	**12,267**	24,508
May	31	12.3	78	76	76	16	4,825	75	16	2,253	76	16	319	63	16	306	66	16	8,200	**15,903**	**5,304**	10,598
June	30	17.4	81	110	110	3	905	103	3	423	110	3	60	77	5	95	80	4	2,050	**3,532**	**998**	2,534
July	31	19.8	94	128	123	2	603	105	2	282	128	2	40	87	7	134	89	6	3,075	**4,133**	**673**	3,461
August	31	18.9	73	112	95	2	603	81	2	282	111	2	40	70	4	76	71	4	2,050	**3,051**	**667**	2,384
September	30	14.7	87	75	66	9	2,714	65	9	1,268	73	9	179	62	24	458	63	20	10,249	**14,869**	**3,012**	11,856
October	31	8.5	75	39	38	8	2,413	38	16	2,253	38	8	160	36	37	707	37	35	17,936	**23,469**	**3,158**	20,310
November	30	2.4	78	12	12	26	7,841	12	44	6,197	12	23	459	12	64	1,222	12	62	31,773	**47,492**	**9,656**	37,836
December	31	-3.4	62	2	2	37	11,158	2	45	6,338	2	32	638	2	48	917	2	48	24,599	**43,649**	**12,654**	30,996
Total			***865***	***600***	***568***	***296***	***89,264***	***527***	***339***	***#####***	***596***	***265***	***5,284***	***455***	***409***	***7,811***	***466***	***399***	***204,475***	***354,580***	***100,245***	***254,334***

Catchment 2
Draining to SW 4

					Vegetated			Gravel / Bare			Forest			Impervious					
					WHC	150 mm		WHC	75 mm		WHC	300 mm		WHC	3 mm		Total Area (m^2)	270,025	
					Total Area (m^2)	210,215		Total Area (m^2)	18,078		Total Area (m^2)	40,273		Total Area (m^2)	1,459				
					Infiltration Factor	0.85		Infiltration Factor	0.7		Infiltration Factor	0.9		Infiltration Factor	0.10				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	7,778	2	42	759	2	26	1,047	2	43	63	**9,647**	**8,091**	1,556
February	28	-5.8	52	1	1	45	9,460	1	47	850	1	39	1,571	1	48	70	**11,950**	**10,056**	1,894
March	31	-0.9	58	10	10	74	15,556	10	76	1,374	10	68	2,739	10	76	111	**19,779**	**16,660**	3,119
April	30	6.1	67	33	33	37	7,778	33	37	669	33	37	1,490	33	37	54	**9,991**	**8,426**	1,565
May	31	12.3	78	76	76	16	3,363	75	16	289	76	16	644	63	16	23	**4,320**	**3,644**	677
June	30	17.4	81	110	110	3	631	103	3	54	110	3	121	77	5	7	**813**	**683**	130
July	31	19.8	94	128	123	2	420	105	2	36	128	2	81	87	7	10	**547**	**456**	91
August	31	18.9	73	112	95	2	420	81	2	36	111	2	81	70	4	6	**543**	**456**	87
September	30	14.7	87	75	66	9	1,892	65	9	163	73	9	362	62	24	35	**2,452**	**2,052**	400
October	31	8.5	75	39	38	8	1,682	38	16	289	38	8	322	36	37	54	**2,347**	**1,927**	420
November	30	2.4	78	12	12	26	5,466	12	44	795	12	23	926	12	64	93	**7,281**	**6,046**	1,235
December	31	-3.4	62	2	2	37	7,778	2	45	814	2	32	1,289	2	48	70	**9,950**	**8,348**	1,603
Total			***865***	***600***	***568***	***296***	***62,224***	***527***	***339***	***6,129***	***596***	***265***	***6,129***	***455***	***409***	***597***	***79,621***	***66,845***	***12,776***

Catchment 3
Draining to Infiltration Pond

					Vegetated			Open Water			Gravel (Quarry or Lot)			Forest					
					WHC	150 mm		WHC	Precip - PET		WHC	75 mm		WHC	300 mm		Total Area (m^2)	157,560	
					Total Area (m^2)	110,149		Total Area (m^2)	6,743		Total Area (m^2)	34,133		Total Area (m^2)	6,534				
					Infiltration Factor	0.85		Infiltration Factor	0.0		Infiltration Factor	0.7		Infiltration Factor	0.9				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	4,076	2	58	391	2	42	1,434	2	26	170	**6,070**	**4,621**	1,450
February	28	-5.8	52	1	1	45	4,957	1	51	344	1	47	1,604	1	39	255	**7,160**	**5,566**	1,594
March	31	-0.9	58	10	10	74	8,151	10	48	324	10	76	2,594	10	68	444	**11,513**	**9,144**	2,369
April	30	6.1	67	33	33	37	4,076	33	34	229	33	37	1,263	33	37	242	**5,810**	**4,566**	1,244
May	31	12.3	78	76	76	16	1,762	76	2	13	75	16	546	76	16	105	**2,427**	**1,974**	452
June	30	17.4	81	110	110	3	330	110	-29	-196	103	3	102	110	3	20	**257**	**370**	-113
July	31	19.8	94	128	123	2	220	128	-34	-229	105	2	68	128	2	13	**72**	**247**	-174
August	31	18.9	73	112	95	2	220	112	-39	-263	81	2	68	111	2	13	**39**	**247**	-208
September	30	14.7	87	75	66	9	991	75	12	81	65	9	307	73	9	59	**1,438**	**1,111**	328
October	31	8.5	75	39	38	8	881	39	36	243	38	16	546	38	8	52	**1,722**	**1,178**	544
November	30	2.4	78	12	12	26	2,864	12	66	445	12	44	1,502	12	23	150	**4,961**	**3,621**	1,340
December	31	-3.4	62	2	2	37	4,076	2	60	405	2	45	1,536	2	32	209	**6,225**	**4,728**	1,498
Total			***865***	***600***	***568***	***296***	***32,604***	***600***	***265***	***1,787***	***527***	***339***	***11,571***	***596***	***265***	***1,732***	***47,694***	***37,372***	***10,322***

Table E2
Water Balance for Operational Conditions

Catchment 4
Draining to Wetland (D/S of Outlet Point)

					Forest			Wetland					
					WHC	300 mm		WHC	Precip - PET				
					Total Area (m^2)	21,175		Total Area (m^2)	45,355		Total Area (m^2)	66,529	
					Infiltration Factor	0.9		Infiltration Factor	0.0				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	26	551	2	58	2,631	**3,181**	495	2,686
February	28	-5.8	52	1	1	39	826	1	51	2,313	**3,139**	743	2,396
March	31	-0.9	58	10	10	68	1,440	10	48	2,177	**3,617**	1,296	2,321
April	30	6.1	67	33	33	37	783	33	34	1,542	**2,326**	705	1,620
May	31	12.3	78	76	76	16	339	76	2	91	**430**	305	125
June	30	17.4	81	110	110	3	64	110	-29	-1,315	**-1,252**	57	-1,309
July	31	19.8	94	128	128	2	42	128	-34	-1,542	**-1,500**	38	-1,538
August	31	18.9	73	112	111	2	42	112	-39	-1,769	**-1,726**	38	-1,765
September	30	14.7	87	75	73	9	191	75	12	544	**735**	172	563
October	31	8.5	75	39	38	8	169	39	36	1,633	**1,802**	152	1,650
November	30	2.4	78	12	12	23	487	12	66	2,993	**3,480**	438	3,042
December	31	-3.4	62	2	2	32	678	2	60	2,721	**3,399**	610	2,789
Total			***865***	***600***	***596***	***265***	***5,611***	***600***	***265***	***12019***	***17,630***	***5,050***	***12,580***

Catchment 5
Drainig to Wetland (US of Discharge Point)

					Vegetated			Forest			Wetland					
					WHC	150 mm		WHC	300 mm		WHC	Precip - PET				
					Total Area (m^2)	1,563		Total Area (m^2)	9,431		Total Area (m^2)	14,187		Total Area (m^2)	25,181	
					Infiltration Factor	0.85		Infiltration Factor	0.9		Infiltration Factor	0.0				
Month	Days	Temp	Precipitation	Potential Evapotransp.	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	58	2	26	245	2	58	823	**1,126**	270	856
February	28	-5.8	52	1	1	45	70	1	39	368	1	51	724	**1,162**	391	771
March	31	-0.9	58	10	10	74	116	10	68	641	10	48	681	**1,438**	675	762
April	30	6.1	67	33	33	37	58	33	37	349	33	34	482	**889**	363	526
May	31	12.3	78	76	76	16	25	76	16	151	76	2	28	**204**	157	47
June	30	17.4	81	110	110	3	5	110	3	28	110	-29	-411	**-378**	29	-408
July	31	19.8	94	128	123	2	3	128	2	19	128	-34	-482	**-460**	20	-480
August	31	18.9	73	112	95	2	3	111	2	19	112	-39	-553	**-531**	20	-551
September	30	14.7	87	75	66	9	14	73	9	85	75	12	170	**269**	88	181
October	31	8.5	75	39	38	8	13	38	8	75	39	36	511	**599**	79	520
November	30	2.4	78	12	12	26	41	12	23	217	12	66	936	**1,194**	230	964
December	31	-3.4	62	2	2	37	58	2	32	302	2	60	851	**1,211**	321	890
Total			***865***	***600***	***568***	***296***	***463***	***596***	***265***	***2,499***	***600***	***265***	***3760***	***6,721***	***2,642***	***4,079***

Table E3
Water Balance for Rehabilitated Conditions

Catchment 1
Draining to Ponded Quarry Area

					Vegetated			Gravel/Bare			Forest			Impervious			Open Water (Rehabilitated Quarry)					
					WHC	150 mm		WHC	75 mm		WHC	300 mm		WHC	3 mm		WHC	Precip - PET		Total Area (m^2)	993,917	
					Total Area (m^2)	356,134		Total Area (m^2)	80,944		Total Area (m^2)	19,940		Total Area (m^2)	19,097		Total Area (m^2)	517,802				
					Infiltration Factor	0.85		Infiltration Factor	0.4		Infiltration Factor	0.9		Infiltration Factor	0.10		Infiltration Factor	0.00				
Month	**Days**	**Temp**	**Precipitation**	**Potential Evapotransp.**	**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Total Surplus**	**Total Infiltr.**	**Total Runoff**
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	13,177	2	42	3,400	2	26	518	2	43	821	2	58	30,033	**47,949**	**13,083**	34,866
February	28	-5.8	52	1	1	45	16,026	1	47	3,804	1	39	778	1	48	917	1	51	26,408	**47,933**	**15,897**	32,036
March	31	-0.9	58	10	10	74	26,354	10	76	6,152	10	68	1,356	10	76	1,451	10	48	24,854	**60,167**	**26,159**	34,008
April	30	6.1	67	33	33	37	13,177	33	37	2,995	33	37	738	33	37	707	33	34	17,605	**35,222**	**13,096**	22,125
May	31	12.3	78	76	76	16	5,698	75	16	1,295	76	16	319	63	16	306	76	2	1,036	**8,653**	**5,663**	2,990
June	30	17.4	81	110	110	3	1,068	103	3	243	110	3	60	77	5	95	110	-29	-15,016	**-13,550**	**1,066**	-14,615
July	31	19.8	94	128	123	2	712	105	2	162	128	2	40	87	7	134	128	-34	-17,605	**-16,558**	**717**	-17,275
August	31	18.9	73	112	95	2	712	81	2	162	111	2	40	70	4	76	112	-39	-20,194	**-19,204**	**712**	-19,916
September	30	14.7	87	75	66	9	3,205	65	9	728	73	9	179	62	24	458	75	12	6,214	**10,785**	**3,214**	7,571
October	31	8.5	75	39	38	8	2,849	38	16	1,295	38	8	160	36	37	707	39	36	18,641	**23,651**	**3,146**	20,505
November	30	2.4	78	12	12	26	9,259	12	44	3,562	12	23	459	12	64	1,222	12	66	34,175	**48,677**	**9,807**	38,870
December	31	-3.4	62	2	2	37	13,177	2	45	3,642	2	32	638	2	48	917	2	60	31,068	**49,442**	**13,291**	36,151
Total			***865***	***600***	***568***	***296***	***105,416***	***527***	***339***	***27,440***	***596***	***265***	***5,284***	***455***	***409***	***7,811***	***600***	***265***	***137,217***	***283,168***	***105,852***	***177,316***

Catchment 2
Draining to SW 4

					Vegetated			Forest			Impervious					
					WHC	150 mm		WHC	300 mm		WHC	3 mm				
					Total Area (m^2)	228,293		Total Area (m^2)	40,273		Total Area (m^2)	1,459		Total Area (m^2)	270,025	
					Infiltration Factor	0.85		Infiltration Factor	0.9		Infiltration Factor	0.10				
Month	**Days**	**Temp**	**Precipitation**	**Potential Evapotranspiration**	**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Total Surplus**	**Total Infiltr.**	**Total Runoff**
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	8,447	2	26	1,047	2	43	63	**9,557**	**8,128**	1,428
February	28	-5.8	52	1	1	45	10,273	1	39	1,571	1	48	70	**11,914**	**10,153**	1,761
March	31	-0.9	58	10	10	74	16,894	10	68	2,739	10	76	111	**19,743**	**16,835**	2,908
April	30	6.1	67	33	33	37	8,447	33	37	1,490	33	37	54	**9,991**	**8,526**	1,465
May	31	12.3	78	76	76	16	3,653	76	16	644	63	16	23	**4,320**	**3,687**	633
June	30	17.4	81	110	110	3	685	110	3	121	77	5	7	**813**	**692**	121
July	31	19.8	94	128	123	2	457	128	2	81	87	7	10	**547**	**462**	86
August	31	18.9	73	112	95	2	457	111	2	81	70	4	6	**543**	**461**	82
September	30	14.7	87	75	66	9	2,055	73	9	362	62	24	35	**2,452**	**2,076**	376
October	31	8.5	75	39	38	8	1,826	38	8	322	36	37	54	**2,203**	**1,848**	355
November	30	2.4	78	12	12	26	5,936	12	23	926	12	64	93	**6,955**	**5,888**	1,067
December	31	-3.4	62	2	2	37	8,447	2	32	1,289	2	48	70	**9,806**	**8,347**	1,459
Total			***865***	***600***	***568***	***296***	***67,575***	***596***	***265***	***#REF!***	***455***	***409***	***597***	***78,844***	***67,103***	***11,740***

Catchment 3
Draining to Infiltration Pond

					Vegetated			Open Water			Forest					
					WHC	150 mm		WHC	10 mm		WHC	300 mm				
					Total Area (m^2)	144,283		Total Area (m^2)	6,743		Total Area (m^2)	6,534		Total Area (m^2)	157,560	
					Infiltration Factor	0.85		Infiltration Factor	0.0		Infiltration Factor	0.9				
Month	**Days**	**Temp**	**Precipitation**	**Potential Evapotranspiration**	**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Actual Evapotransp.**	**Surplus**		**Total Surplus**	**Total Infiltr.**	**Total Runoff**
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	5,338	2	58	391	2	26	170	**5,899**	4,691	1,209
February	28	-5.8	52	1	1	45	6,493	1	51	344	1	39	255	**7,091**	5,748	1,343
March	31	-0.9	58	10	10	74	10,677	10	48	324	10	68	444	**11,445**	9,475	1,970
April	30	6.1	67	33	33	37	0	33	34	229	33	37	242	**471**	218	253
May	31	12.3	78	76	76	16	2,309	76	2	13	76	16	105	**2,427**	2,056	370
June	30	17.4	81	110	110	3	433	110	-29	-196	110	3	20	**257**	386	-129
July	31	19.8	94	128	123	2	289	128	-34	-229	128	2	13	**72**	257	-185
August	31	18.9	73	112	95	2	289	112	-39	-263	111	2	13	**39**	257	-218
September	30	14.7	87	75	66	9	1,299	75	12	81	73	9	59	**1,438**	1,157	282
October	31	8.5	75	39	38	8	1,154	39	36	243	38	8	52	**1,449**	1,028	421
November	30	2.4	78	12	12	26	3,751	12	66	445	12	23	150	**4,347**	3,324	1,023
December	31	-3.4	62	2	2	37	5,338	2	60	405	2	32	209	**5,952**	4,726	1,226
Total			***865***	***600***	***568***	***296***	***37,369***	***600***	***265***	***1,787***	***596***	***265***	***1,732***	***40,888***	***33,322***	***7,566***

Table E3
Water Balance for Rehabilitated Conditions

Catchment 4
Draining to Wetland (D/S of Outlet Point)

					Forest			Wetland					
					WHC	300 mm		WHC	Precip - PET				
					Total Area (m^2)	21,175		Total Area (m^2)	45,355		Total Area (m^2)	66,529	
					Infiltration Factor	0.9		Infiltration Factor	0.0				
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	26	551	2	58	2,631	**3,181**	495	2,686
February	28	-5.8	52	1	1	39	826	1	51	2,313	**3,139**	743	2,396
March	31	-0.9	58	10	10	68	1,440	10	48	2,177	**3,617**	1,296	2,321
April	30	6.1	67	33	33	37	783	33	34	1,542	**2,326**	705	1,620
May	31	12.3	78	76	76	16	339	76	2	91	**430**	305	125
June	30	17.4	81	110	110	3	64	110	-29	-1,315	**-1,252**	57	-1,309
July	31	19.8	94	128	128	2	42	128	-34	-1,542	**-1,500**	38	-1,538
August	31	18.9	73	112	111	2	42	112	-39	-1,769	**-1,726**	38	-1,765
September	30	14.7	87	75	73	9	191	75	12	544	**735**	172	563
October	31	8.5	75	39	38	8	169	39	36	1,633	**1,802**	152	1,650
November	30	2.4	78	12	12	23	487	12	66	2,993	**3,480**	438	3,042
December	31	-3.4	62	2	2	32	678	2	60	2,721	**3,399**	610	2,789
Total			***865***	***600***	***596***	***265***	***5,611***	***600***	***265***	***12019***	***17,630***	***5,050***	***12,580***

Catchment 5
Drainig to Wetland (US of Discharge Point)

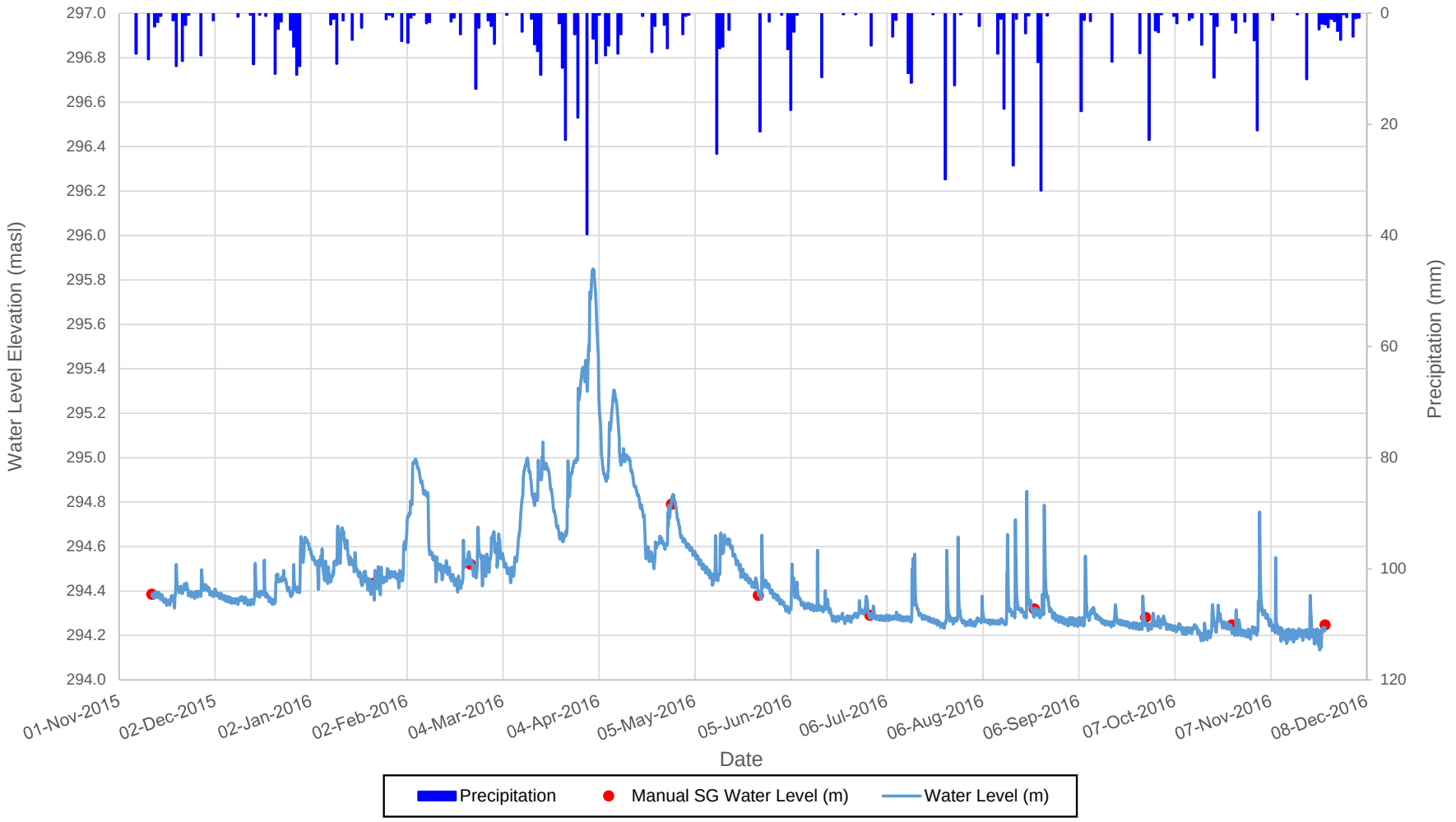
					Vegetated			Forest			Wetland					
					WHC	150 mm		WHC	300 mm		WHC	Precip - PET				
					Total Area (m^2)	1,563		Total Area (m^2)	9,431		Total Area (m^2)	14,187		Total Area (m^2)	25,181	
					Infiltration Factor	0.85		Infiltration Factor	0.9		Infiltration Factor	0.0				
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Actual Evapotransp.	Surplus		Total Surplus	Total Infiltr.	Total Runoff
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(m^3)	(m^3)
January	31	-6.2	60	2	2	37	58	2	26	245	2	58	823	**1,126**	270	856
February	28	-5.8	52	1	1	45	70	1	39	368	1	51	724	**1,162**	391	771
March	31	-0.9	58	10	10	74	116	10	68	641	10	48	681	**1,438**	675	762
April	30	6.1	67	33	33	37	58	33	37	349	33	34	482	**889**	363	526
May	31	12.3	78	76	76	16	25	76	16	151	76	2	28	**204**	157	47
June	30	17.4	81	110	110	3	5	110	3	28	110	-29	-411	**-378**	29	-408
July	31	19.8	94	128	123	2	3	128	2	19	128	-34	-482	**-460**	20	-480
August	31	18.9	73	112	95	2	3	111	2	19	112	-39	-553	**-531**	20	-551
September	30	14.7	87	75	66	9	14	73	9	85	75	12	170	**269**	88	181
October	31	8.5	75	39	38	8	13	38	8	75	39	36	511	**599**	79	520
November	30	2.4	78	12	12	26	41	12	23	217	12	66	936	**1,194**	230	964
December	31	-3.4	62	2	2	37	58	2	32	302	2	60	851	**1,211**	321	890
Total			***865***	***600***	***568***	***296***	***463***	***596***	***265***	***2,499***	***600***	***265***	***3760***	***6,721***	***2,642***	***4,079***

APPENDIX F

Surface Water Hydrographs

Continuous Water Level Hydrograph at SW1

Figure F1



DATE: May 2019

PROJECT: 1536522

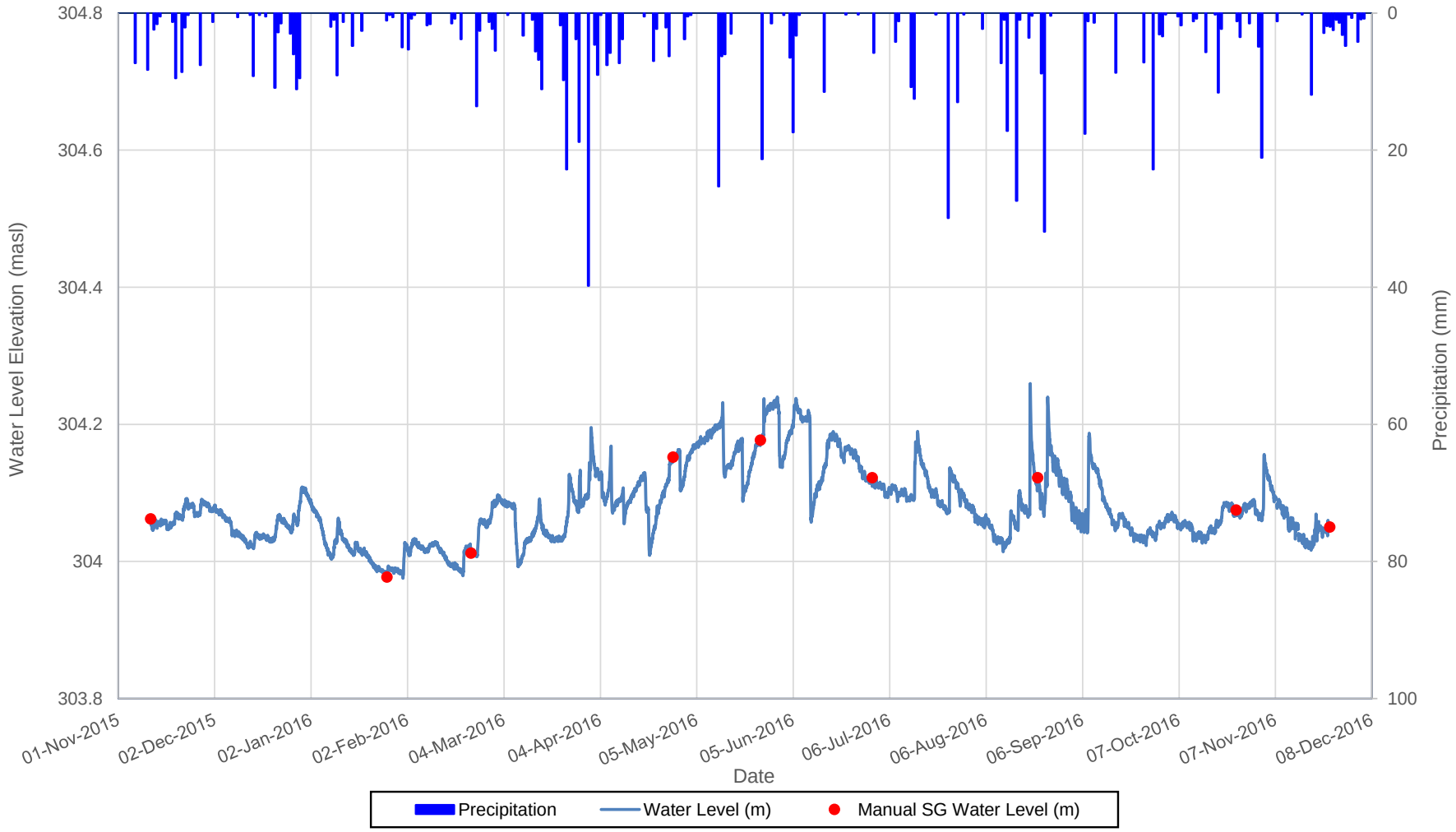
GOLDER

CAD: NP

CHK: CDV

Continuous Water Level Hydrograph at SW2

Figure F2



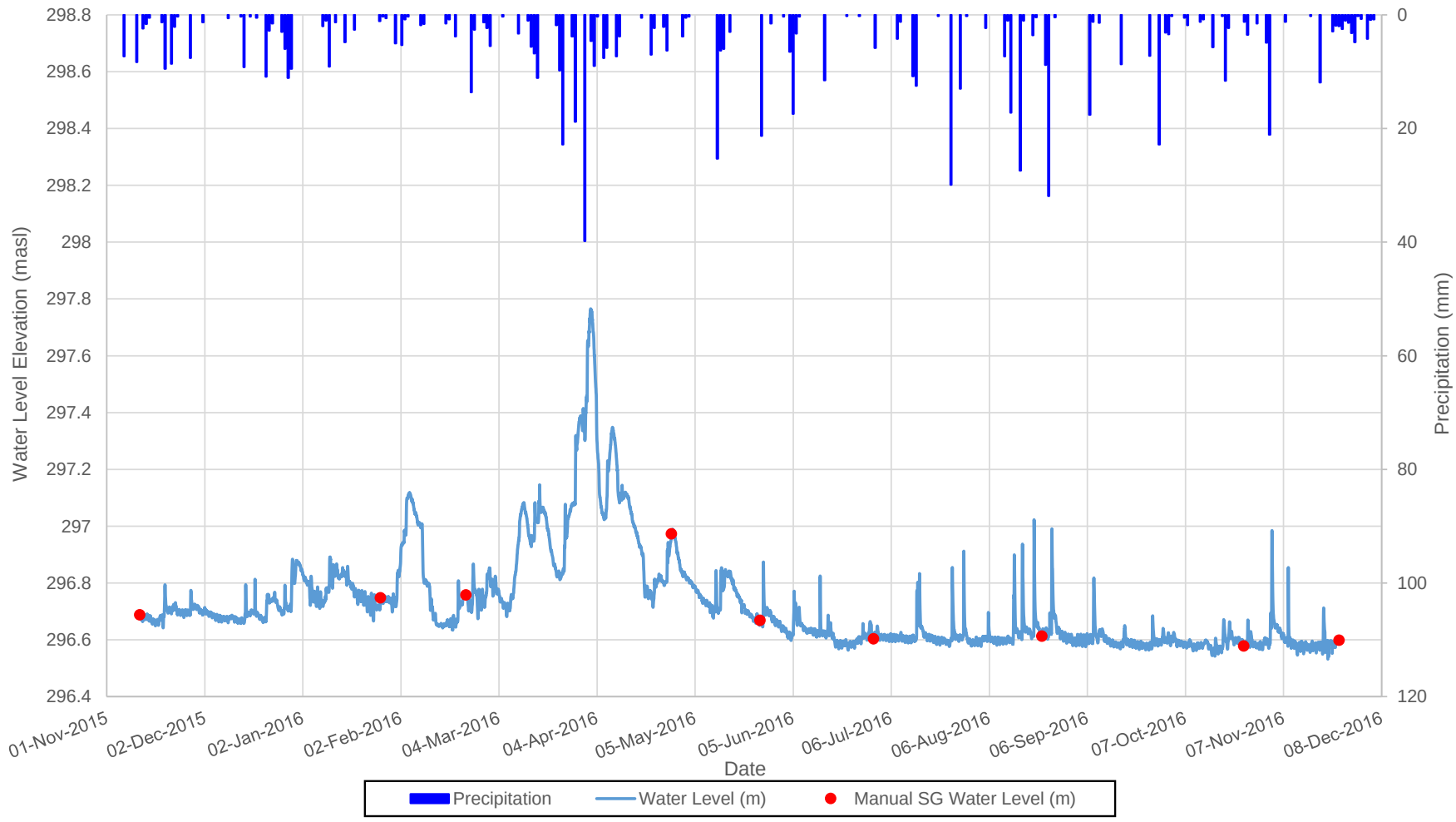
DATE: May 2019
PROJECT: 1536522

GOLDER

CAD: NP
CHK: CDV

Continuous Water Level Hydrograph at SW3

Figure F3



DATE: May 2019

PROJECT: 1536522

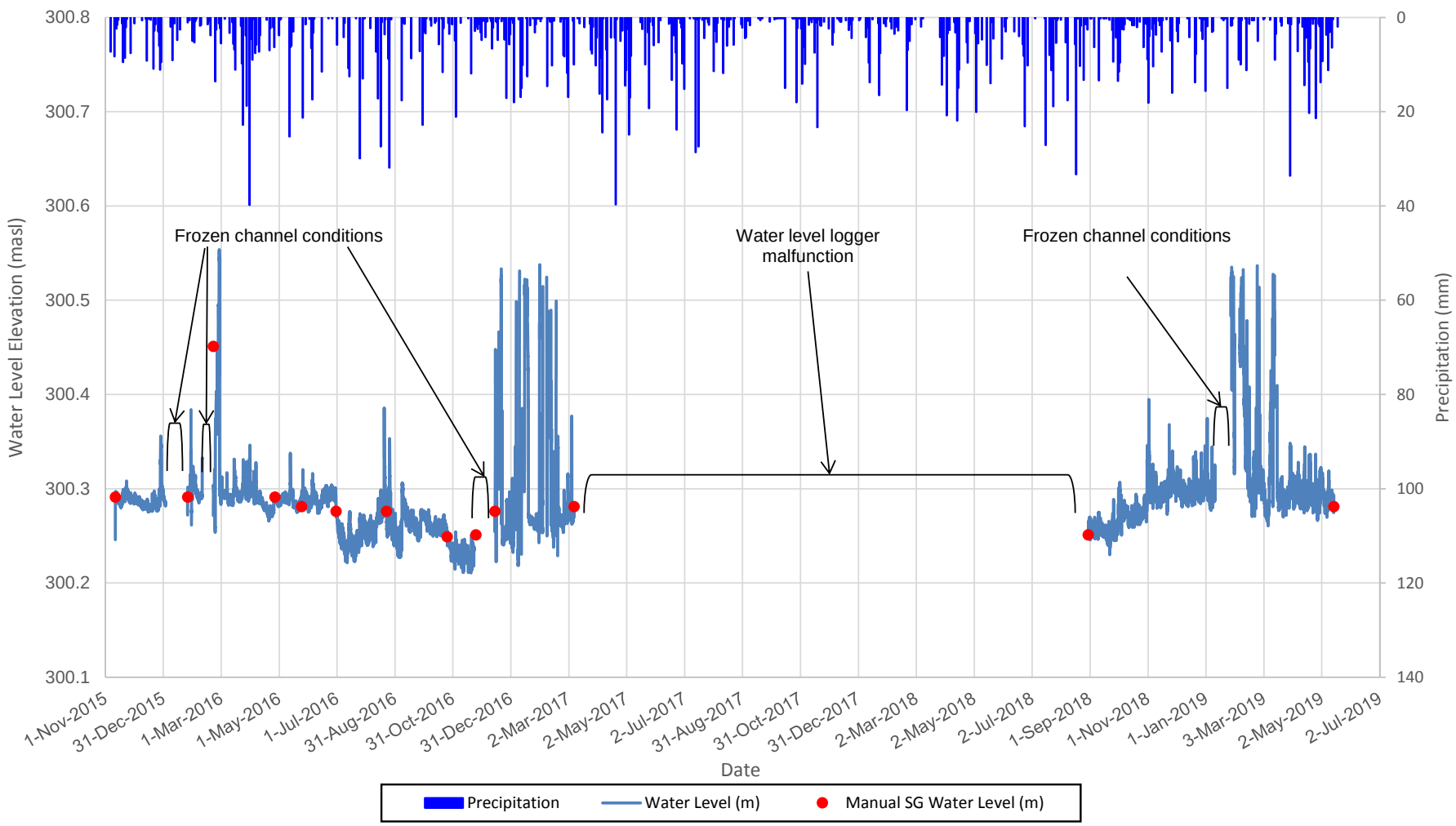
GOLDER

CAD: NP

CHK: CDV

Continuous Water Level Hydrograph at SW4

Figure F4



DATE: May 2019

PROJECT: 1536522

GOLDER

CAD: NP

CHK: CDV

APPENDIX G

Surface Water Quality

		Sample ID	Date / Time	Field Measured Parmeters			Turbidty[1]	Total Suspended Solids[1]
				pH	Temperature	Conductivity		
	Units			-	°C	uS	NTU	mg/L
2016	Event 1	SW1	26-Jan-16	6.71	3.2	1070	---	---
		SW2	26-Jan-16	6.5	1.5	920	---	---
		SW3	26-Jan-16	6.36	3.2	1210	---	---
		SW4	26-Jan-16	6.6	0.4	800	---	---
	Event 2	SW1	31-Aug-16	8.28	23.3	1116	1.3	<10
		SW2	31-Aug-16	8.11	26	703	0.5	<10
		SW3	31-Aug-16	8.15	23.1	1043	1.6	<10
		SW4	31-Aug-16	8.22	23.1	689	1.4	10
	Event 3	SW1	24-Nov-16	8.20 [1]	4.4 [2]	1250 [1]	2.1	<10
		SW2	24-Nov-16	8.22 [1]	3.4 [2]	867 [1]	1.0	<10
		SW3	24-Nov-16	8.18 [1]	4.6 [2]	1410 [1]	1.3	<10
		SW4	24-Nov-16	8.13 [1]	2.3 [2]	827 [1]	1.0	<10

1. Laboratory reported values
2. Temperature recorded by water level datalogger.

Maxxam
A Bureau Veritas Group Company

Your Project #: 1536522
Your C.O.C. #: 575851-01-01

Attention:Taylor Bliss

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/09/08
Report #: R4158114
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6I7334
Received: 2016/09/01, 11:25

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Total Suspended Solids	5	N/A	2016/09/02	CAM SOP-00428	SM 22 2540D m
Turbidity	5	N/A	2016/09/02	CAM SOP-00417	SM 22 2130 B m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

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.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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

Maxxam Job #: B6I7334
Report Date: 2016/09/08

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

RESULTS OF ANALYSES OF WATER

Maxxam ID		CZO328	CZO329	CZO330	CZO331	CZO332		
Sampling Date		2016/08/31 10:58	2016/08/31 11:50	2016/08/31 12:08	2016/08/31 12:25	2016/08/31		
COC Number		575851-01-01	575851-01-01	575851-01-01	575851-01-01	575851-01-01		
	UNITS	SW-3	SW-2	SW-4	SW-1	DUP	RDL	QC Batch
Inorganics								
Total Suspended Solids	mg/L	<10	<10	10	<10	10	10	4646673
Turbidity	NTU	1.6	0.5	1.4	1.3	1.6	0.1	4646695

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B6I7334
Report Date: 2016/09/08

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

TEST SUMMARY

Maxxam ID: CZO328
Sample ID: SW-3
Matrix: Water

Collected: 2016/08/31
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	4646673	N/A	2016/09/02	Arpan Shah
Turbidity	AT	4646695	N/A	2016/09/02	Neil Dassanayake

Maxxam ID: CZO329
Sample ID: SW-2
Matrix: Water

Collected: 2016/08/31
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	4646673	N/A	2016/09/02	Arpan Shah
Turbidity	AT	4646695	N/A	2016/09/02	Neil Dassanayake

Maxxam ID: CZO330
Sample ID: SW-4
Matrix: Water

Collected: 2016/08/31
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	4646673	N/A	2016/09/02	Arpan Shah
Turbidity	AT	4646695	N/A	2016/09/02	Neil Dassanayake

Maxxam ID: CZO331
Sample ID: SW-1
Matrix: Water

Collected: 2016/08/31
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	4646673	N/A	2016/09/02	Arpan Shah
Turbidity	AT	4646695	N/A	2016/09/02	Neil Dassanayake

Maxxam ID: CZO332
Sample ID: DUP
Matrix: Water

Collected: 2016/08/31
Shipped:
Received: 2016/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Suspended Solids	BAL	4646673	N/A	2016/09/02	Arpan Shah
Turbidity	AT	4646695	N/A	2016/09/02	Neil Dassanayake

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B6I7334
Report Date: 2016/09/08

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

GENERAL COMMENTS

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

Package 1	9.7°C

Cooler custody seal present and intact

Results relate only to the items tested.

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Maxxam Job #: B6I7334
Report Date: 2016/09/08

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

			SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4646673	Total Suspended Solids	2016/09/02			<10	mg/L	NC	25	95	85 - 115
4646695	Turbidity	2016/09/02	100	85 - 115	0.2, RDL=0.1	NTU	NC	20		

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

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

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

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

NC (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 (one or both samples < 5x RDL).

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Maxxam Job #: B6I7334
Report Date: 2016/09/08

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: KS

VALIDATION SIGNATURE PAGE

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

Cristina Carriere

Cristina Carriere, Scientific Services

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Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

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A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B63104	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Taylor Bliss	P.O. #:			575851
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:		Project:	1536522	COC #:	Project Manager:
Tel:	(905) 567-4444 Fax: (905) 567-6561	Tel:	Fax:	Project Name:		C#575851-01-01	Ema Gitaj
Email:	AP-CustomerService@golder.com	Email:	taylor_bliss@golder.com	Site #:			
				Sampled By:	Kurt.S		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☒ PWQO ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Total Suspended Solids	Turbidity							# of Bottles	Comments
1		SW-3	Aug 31/16	10:58	SW		✓	✓							2	
2		SW-2	Aug 31/16	11:50	SW		✓	✓							2	
3		SW-4	Aug 31/16	12:08	SW		✓	✓							2	
4		SW-1	Aug 31/16	12:25	SW		✓	✓							2	
5		Dup	Aug 31/16	NA	SW		✓	✓							2	
6																
7																
8																
9																
10																

01-Sep-16 11:25
Ema Gitej
B6I7334
RK6 ENV-979

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Kurt Stamm	16/08/31		DANY MARQAS	16/09/01	11:25	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
	9.1 / 10.1 / 10	Present	✓	
		Intact	✓	

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

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

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Your Project #: 1536522
Your C.O.C. #: 588092-01-01

Attention:Dean Luciani

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/12/07
Report #: R4278117
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B6P6733
Received: 2016/11/24, 15:32

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Conductivity	5	N/A	2016/12/06	CAM SOP-00414	SM 22 2510 m
pH	5	N/A	2016/12/06	CAM SOP-00413	SM 4500H+ B m
Total Suspended Solids	5	2016/11/25	2016/11/25	CAM SOP-00428	SM 22 2540D m
Turbidity	4	N/A	2016/11/28	CAM SOP-00417	SM 22 2130 B m
Turbidity	1	N/A	2016/11/29	CAM SOP-00417	SM 22 2130 B m

Remarks:

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

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

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

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

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.

Your Project #: 1536522
Your C.O.C. #: 588092-01-01

Attention:Dean Luciani

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/12/07
Report #: R4278117
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B6P6733
Received: 2016/11/24, 15:32

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

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

Maxxam Job #: B6P6733
Report Date: 2016/12/07

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

RESULTS OF ANALYSES OF WATER

Maxxam ID		DMZ836	DMZ836	DMZ837	DMZ838	DMZ839	DMZ839		
Sampling Date		2016/11/24	2016/11/24	2016/11/24	2016/11/24	2016/11/24	2016/11/24		
COC Number		588092-01-01	588092-01-01	588092-01-01	588092-01-01	588092-01-01	588092-01-01		
	UNITS	SW1	SW1 Lab-Dup	SW2	SW3	SW4	SW4 Lab-Dup	RDL	QC Batch
Inorganics									
Conductivity	mS/cm	1.25		0.867	1.41	0.827	0.826	0.001	4779711
pH	pH	8.20		8.22	8.18	8.13	8.21		4779712
Total Suspended Solids	mg/L	<10		<10	<10	<10		10	4766299
Turbidity	NTU	2.1	2.3	1.0	1.3	1.0		0.1	4766296

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam ID		DMZ840		
Sampling Date		2016/11/24		
COC Number		588092-01-01		
	UNITS	DUP	RDL	QC Batch
Inorganics				
Conductivity	mS/cm	1.41	0.001	4779711
pH	pH	8.19		4779712
Total Suspended Solids	mg/L	<10	10	4766299
Turbidity	NTU	1.7	0.1	4766296

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B6P6733
Report Date: 2016/12/07

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

TEST SUMMARY

Maxxam ID: DMZ836
Sample ID: SW1
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai
Total Suspended Solids	BAL	4766299	2016/11/25	2016/11/25	Arpan Shah
Turbidity	AT	4766296	N/A	2016/11/29	Tahir Anwar

Maxxam ID: DMZ836 Dup
Sample ID: SW1
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Turbidity	AT	4766296	N/A	2016/11/29	Tahir Anwar

Maxxam ID: DMZ837
Sample ID: SW2
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai
Total Suspended Solids	BAL	4766299	2016/11/25	2016/11/25	Arpan Shah
Turbidity	AT	4766296	N/A	2016/11/28	Tahir Anwar

Maxxam ID: DMZ838
Sample ID: SW3
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai
Total Suspended Solids	BAL	4766299	2016/11/25	2016/11/25	Arpan Shah
Turbidity	AT	4766296	N/A	2016/11/28	Tahir Anwar

Maxxam ID: DMZ839
Sample ID: SW4
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai
Total Suspended Solids	BAL	4766299	2016/11/25	2016/11/25	Arpan Shah
Turbidity	AT	4766296	N/A	2016/11/28	Tahir Anwar

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Maxxam Job #: B6P6733
Report Date: 2016/12/07

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

TEST SUMMARY

Maxxam ID: DMZ839 Dup
Sample ID: SW4
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai

Maxxam ID: DMZ840
Sample ID: DUP
Matrix: Water

Collected: 2016/11/24
Shipped:
Received: 2016/11/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	4779711	N/A	2016/12/06	Surinder Rai
pH	AT	4779712	N/A	2016/12/06	Surinder Rai
Total Suspended Solids	BAL	4766299	2016/11/25	2016/11/25	Arpan Shah
Turbidity	AT	4766296	N/A	2016/11/28	Tahir Anwar

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Maxxam Job #: B6P6733
Report Date: 2016/12/07

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

GENERAL COMMENTS

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

Package 1	5.3°C

Revised report (2016/12/07): Additional pH and Conductivity analysis are included for all samples as requested.

Results relate only to the items tested.

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Maxxam Job #: B6P6733
Report Date: 2016/12/07

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

			SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4766296	Turbidity	2016/11/29	97	85 - 115	<0.1	NTU	11	20		
4766299	Total Suspended Solids	2016/11/25			<10	mg/L	NC	25	100	85 - 115
4779711	Conductivity	2016/12/06	103	85 - 115	0.001, RDL=0.001	mS/cm	0.12	25		
4779712	pH	2016/12/06	102	98 - 103			1.0	N/A		

N/A = Not Applicable

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

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

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

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

NC (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 (one or both samples < 5x RDL).

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Maxxam Job #: B6P6733
Report Date: 2016/12/07

Golder Associates Ltd
Client Project #: 1536522
Sampler Initials: DL

VALIDATION SIGNATURE PAGE

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

Brad Newman, Scientific Specialist

Cristina Carriere, Scientific Services

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

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CHAIN OF CUSTODY RECORD

Page of

IMMEDIATE TAT

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:	Laboratory Use Only:
Company Name: #1326 Golder Associates Ltd	Company Name: Golder Associates	Quotation #: B52596	Maxxam Job #: / Bottle Order #: 588092
Attention:	Attention: Dean Luciani	P.O. #: 153522	COC #: C#588092-01-01 / Project Manager: Ema Gitej
Address: 6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address: 6925 Century Ave Mississauga, ON	Project:	
Tel: (905) 567-4444 Fax: (905) 567-6561	Tel:	Project Name:	
Email:	Email: dean_luciani@golder.com	Site #:	
		Sampled By: Dean Luciani	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☒ PWQO ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle) Metals / Hg / Cr VI	Total Suspended Solids	Turbidity	# of Bottles	Comments
1	SW1		NOV 24/16	AM	SW	N/A	✓	✓	2	
2	SW2		"	"	"	"	✓	✓	2	
3	SW3		"	"	"	"	✓	✓	2	
4	SW4		"	"	"	"	✓	✓	2	
5	DUP		"	"	"	"	✓	✓	2	
6										
7										
8										
9										
10										

24-Nov-16 15:32
Ema Gitej
B6P6733
PS4 ENV-127

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Dean Luciani	16/11/24	3:30	GURPREET KAUR	16/11/24	15:32	

Laboratory Use Only
Time Sensitive | Temperature (°C) on Receipt: 5/5/6 | Custody Seal: Present ☐ Yes ☐ No, Intact ☐

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

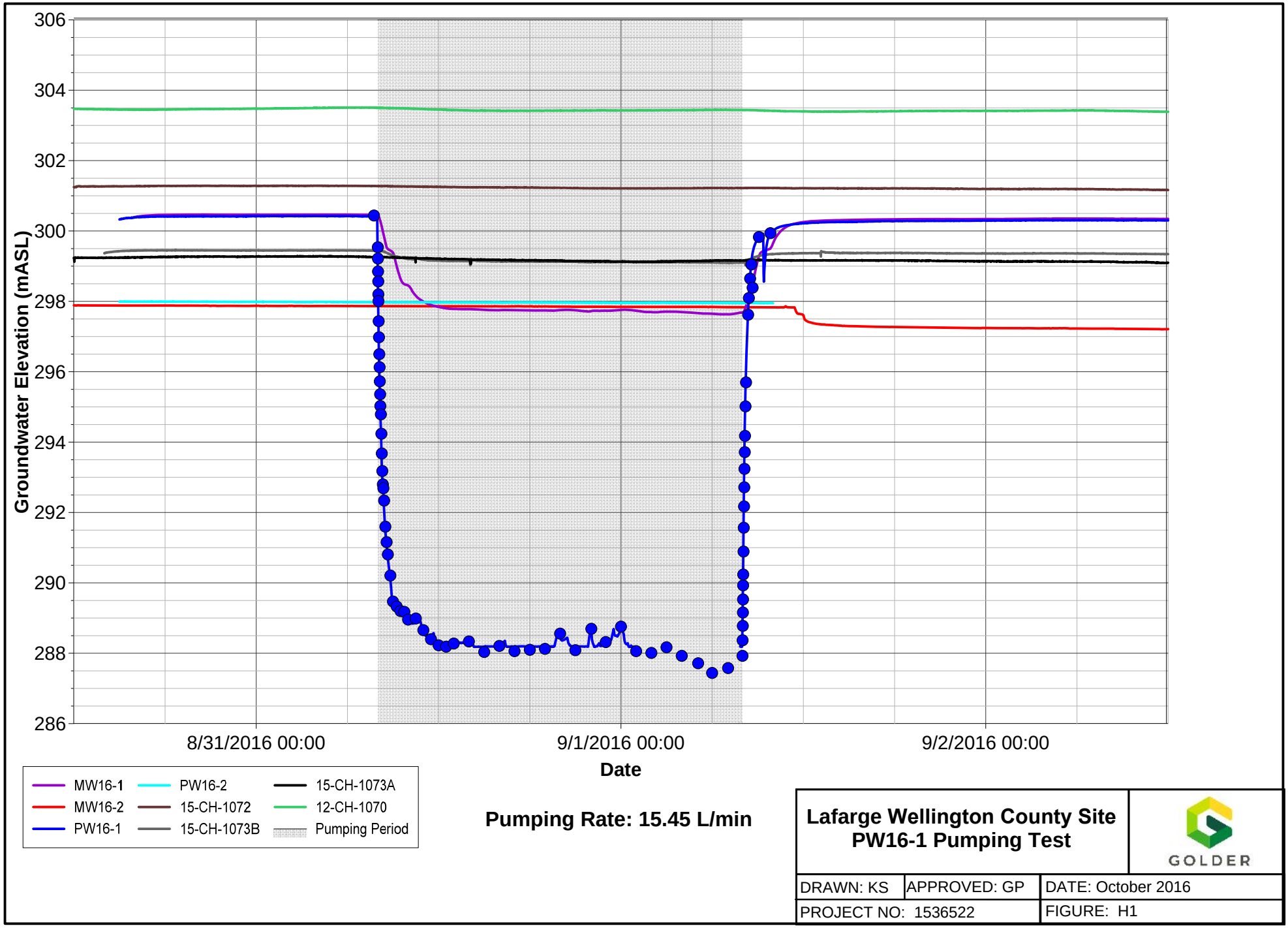
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

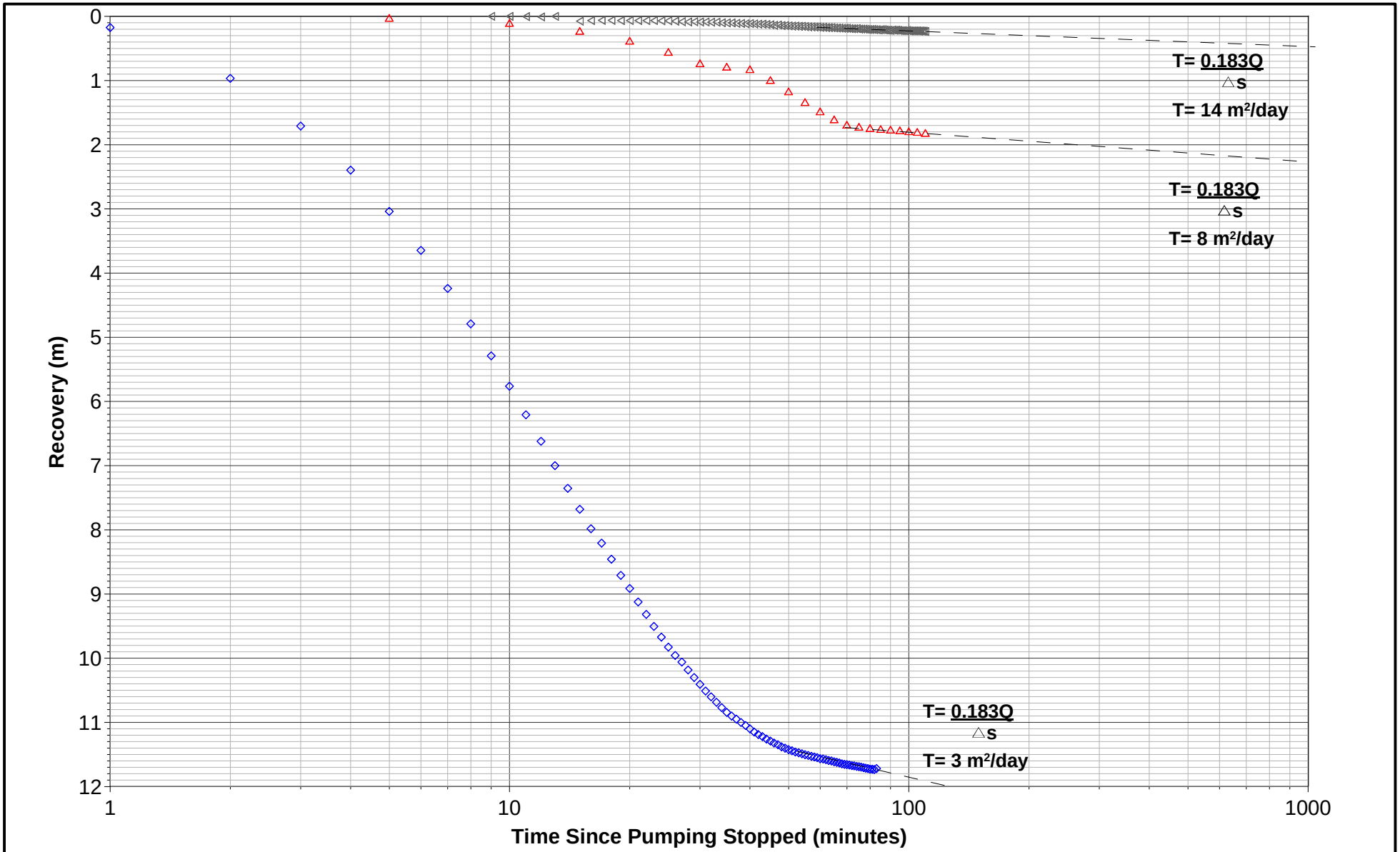
APPENDIX H

Aquifer Test Results



Pumping Rate: 15.45 L/min

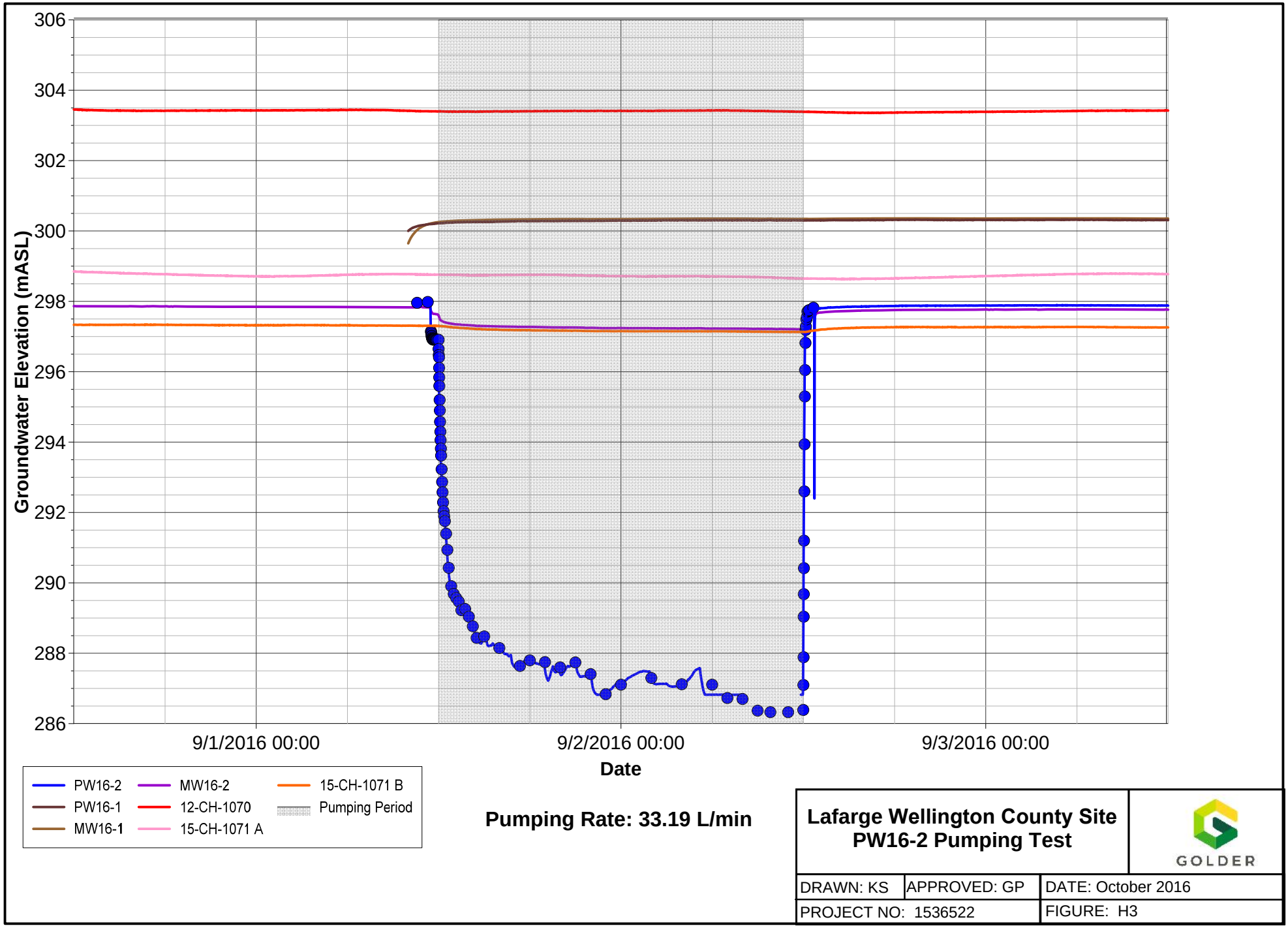
Lafarge Wellington County Site **PW16-1 Pumping Test**		GOLDER
DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H1



Observed Recovery Versus Elapsed Time PW16-1 Pumping Test

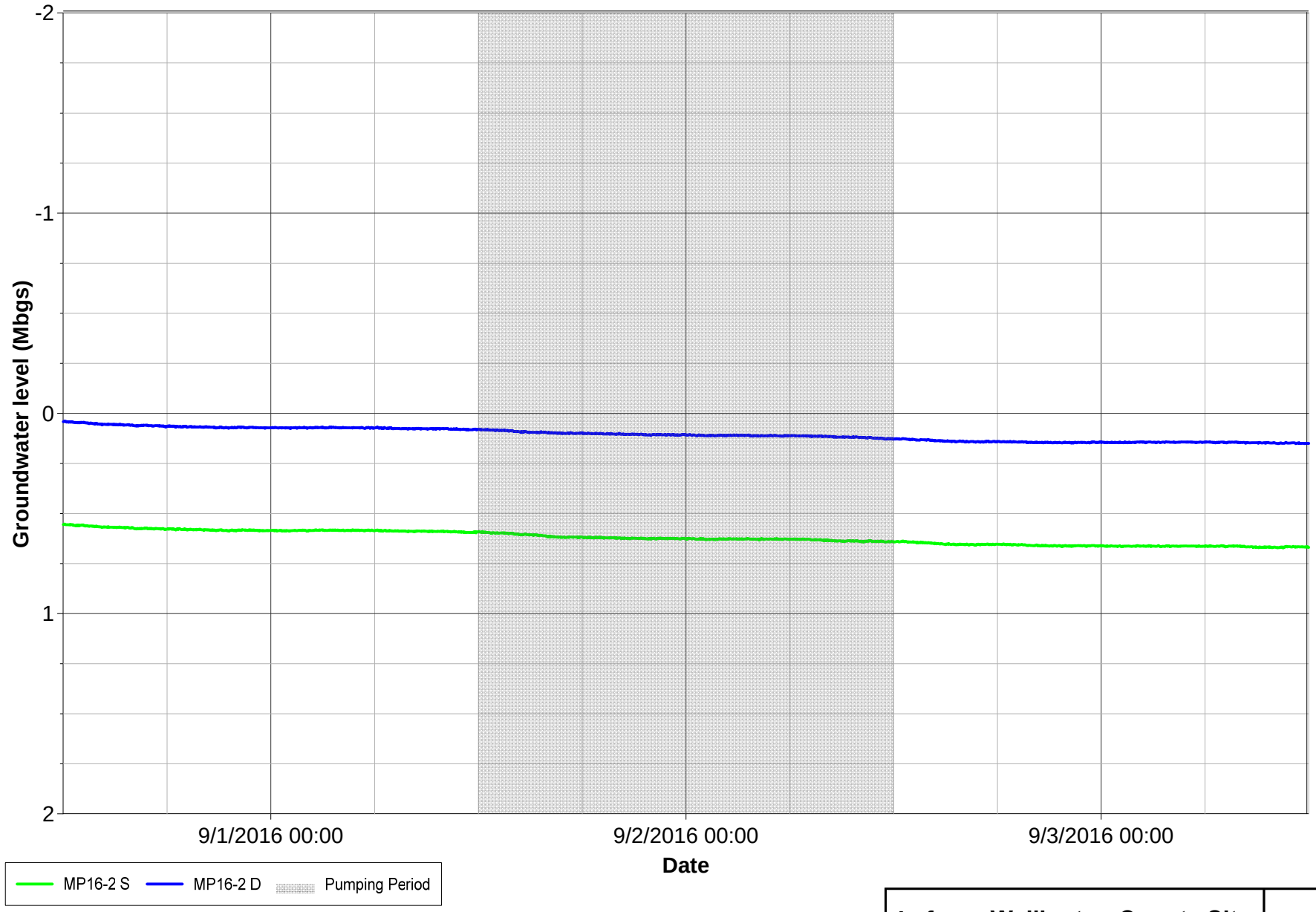
GOLDER

DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H2



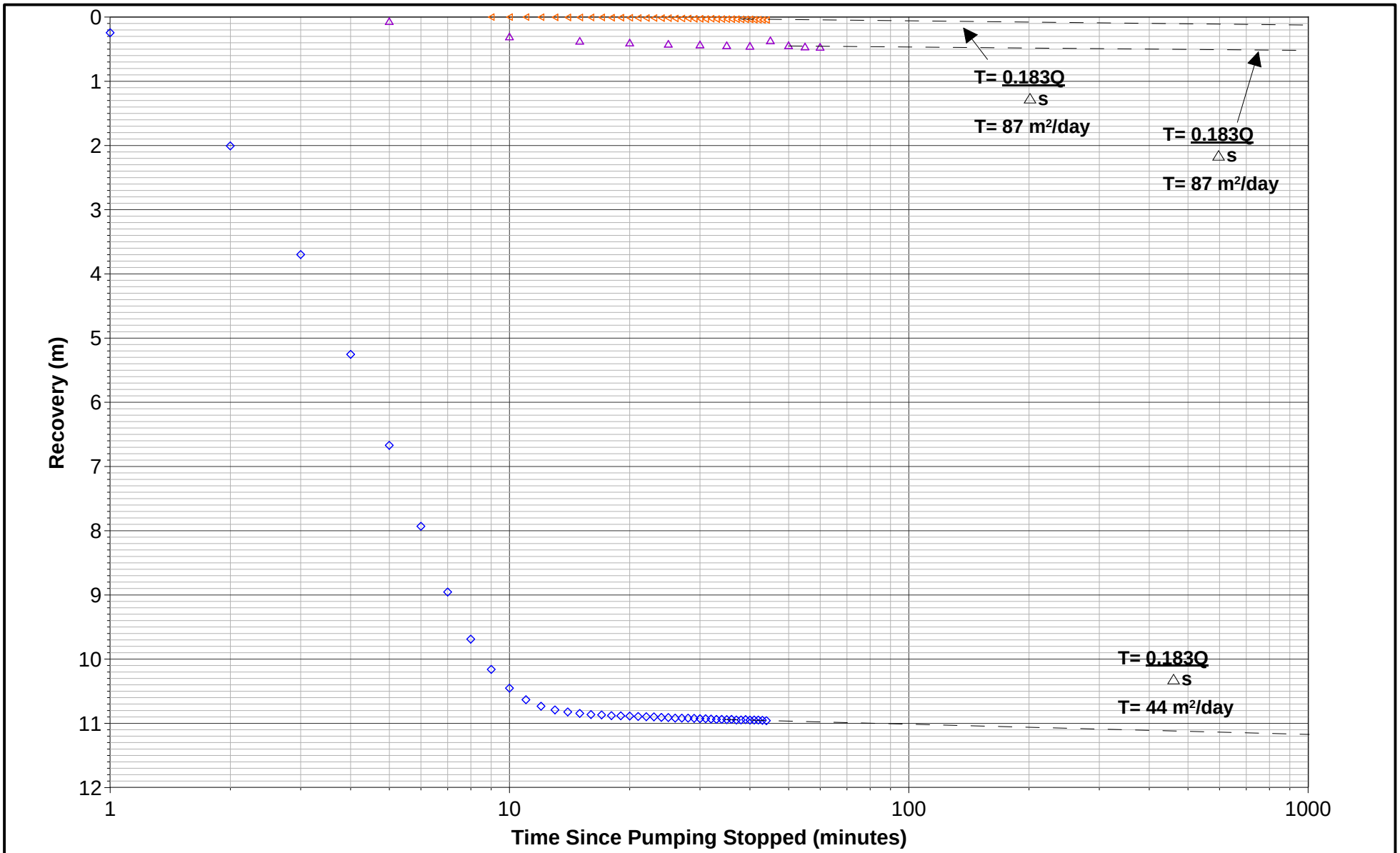
Pumping Rate: 33.19 L/min

Lafarge Wellington County Site **PW16-2 Pumping Test**		GOLDER
DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H3



Pumping Rate: 33.19 L/min

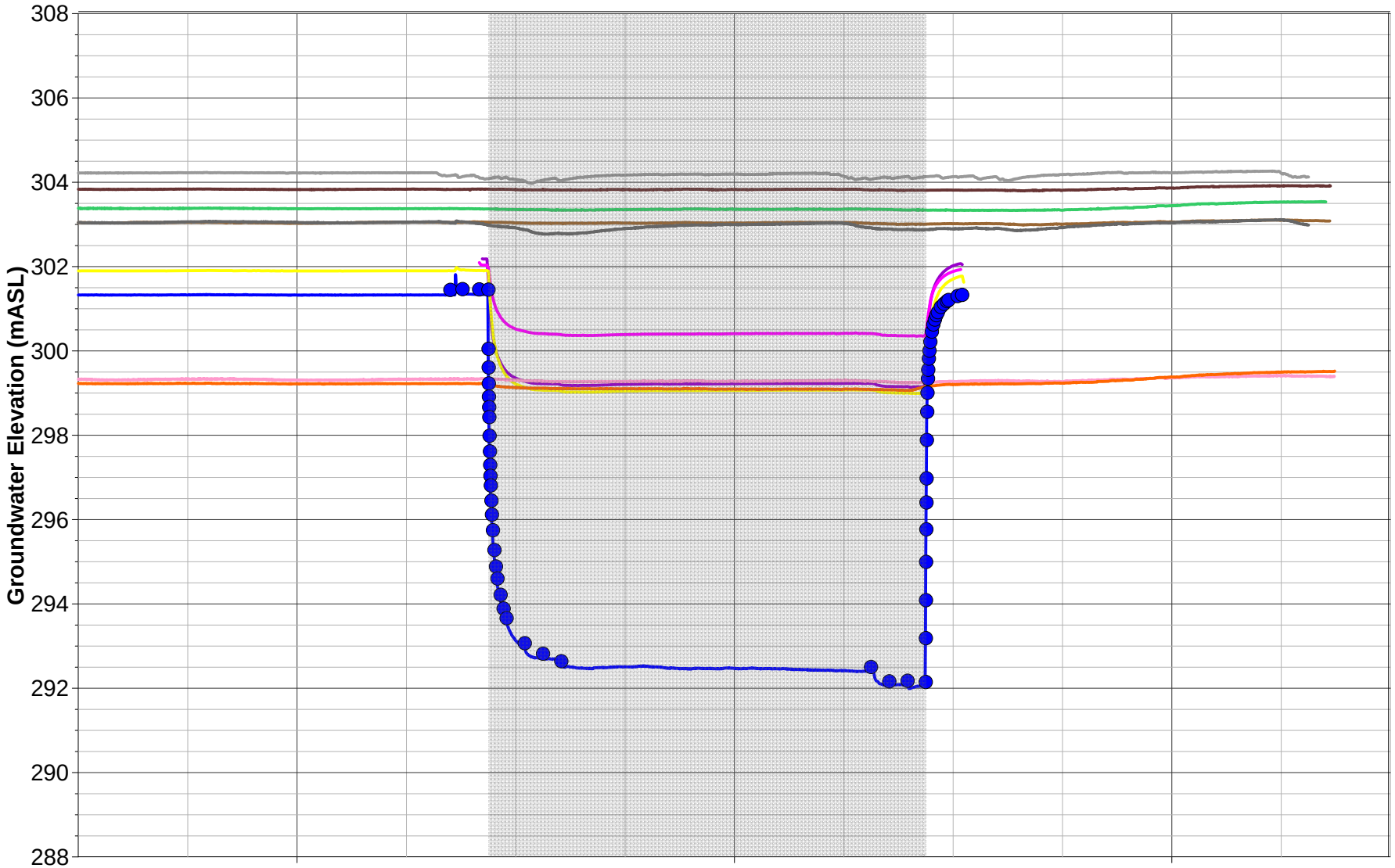
Lafarge Wellington County Site PW16-2 Pumping Test		GOLDER
DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H4



Observed Recovery Versus Elapsed Time PW16-2 Pumping Test

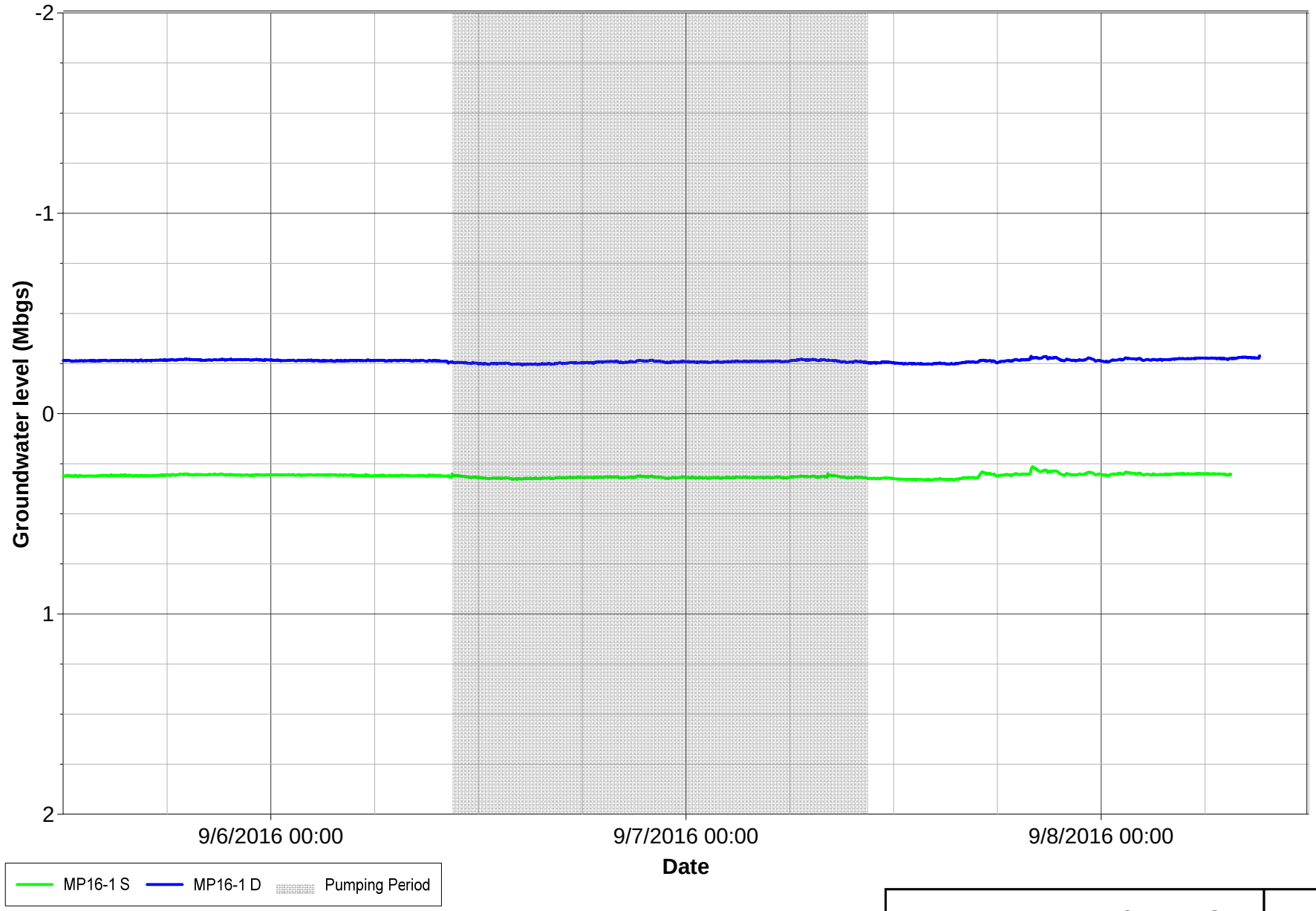
GOLDER

DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H5



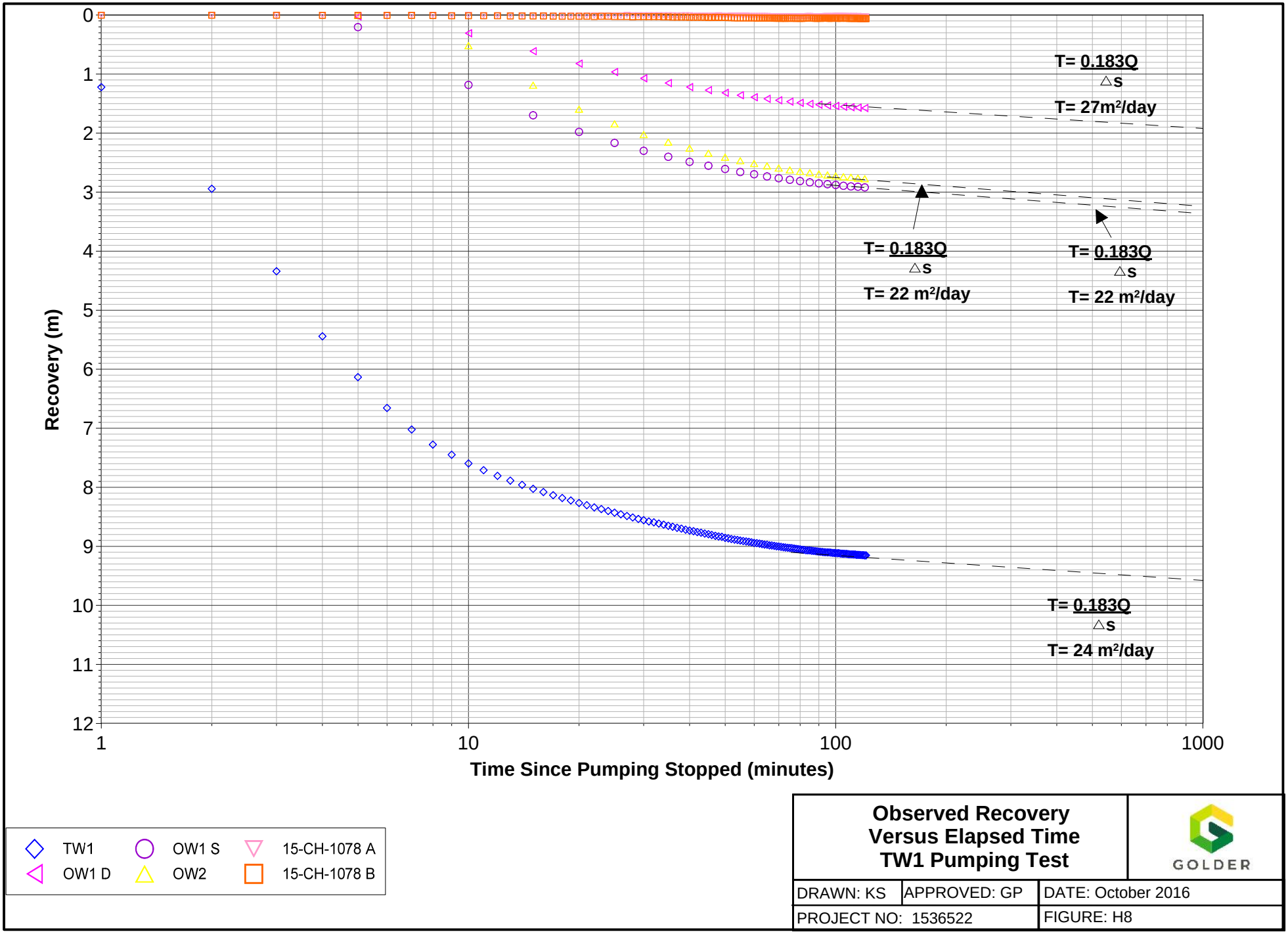
Pumping Rate: 40.91 L/min

Lafarge Wellington County Site TW1 Pumping Test		GOLDER
DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H6



Pumping Rate: 40.91 L/min

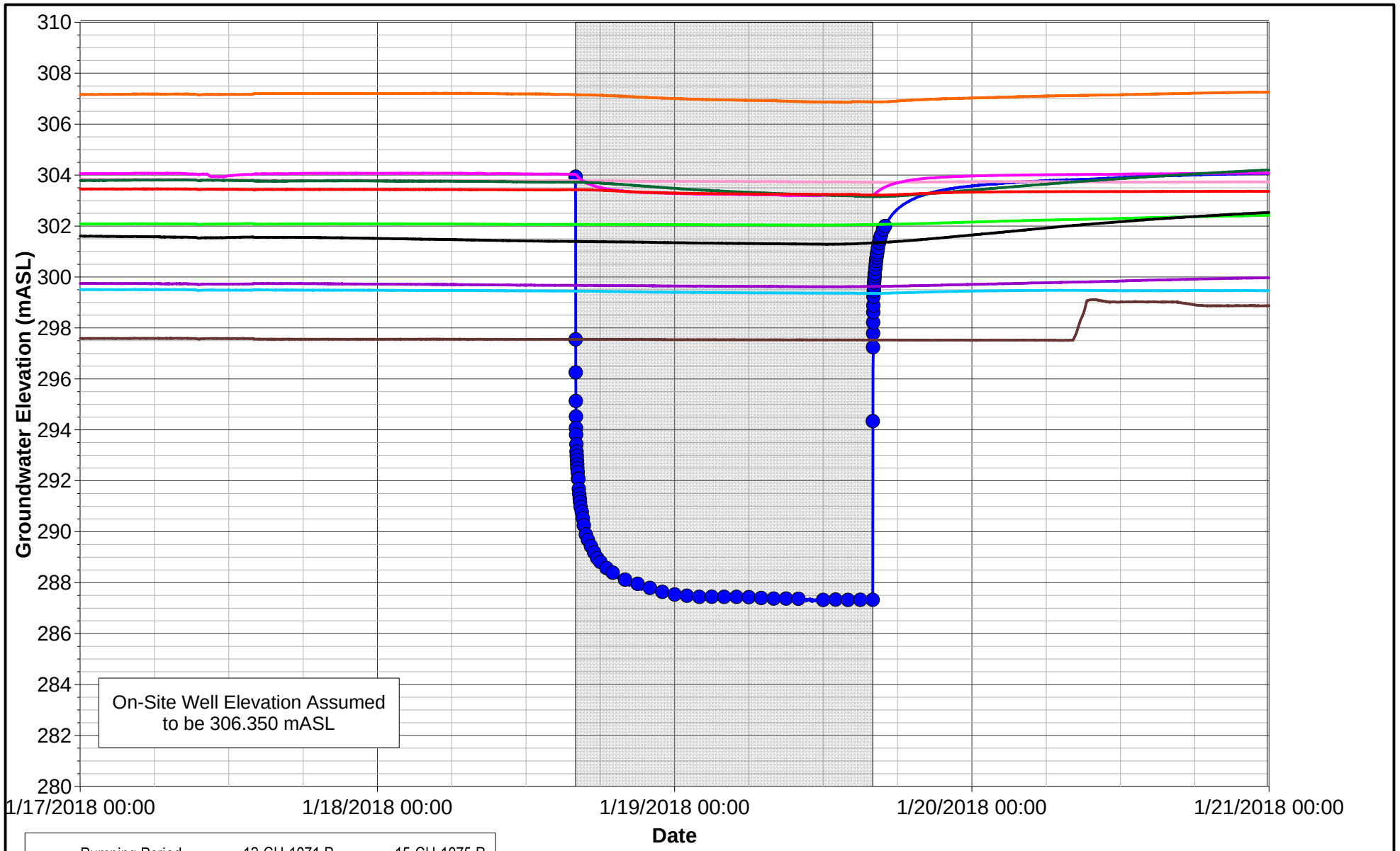
Lafarge Wellington County Site TW1 Pumping Test		GOLDER
DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H7



Observed Recovery Versus Elapsed Time TW1 Pumping Test

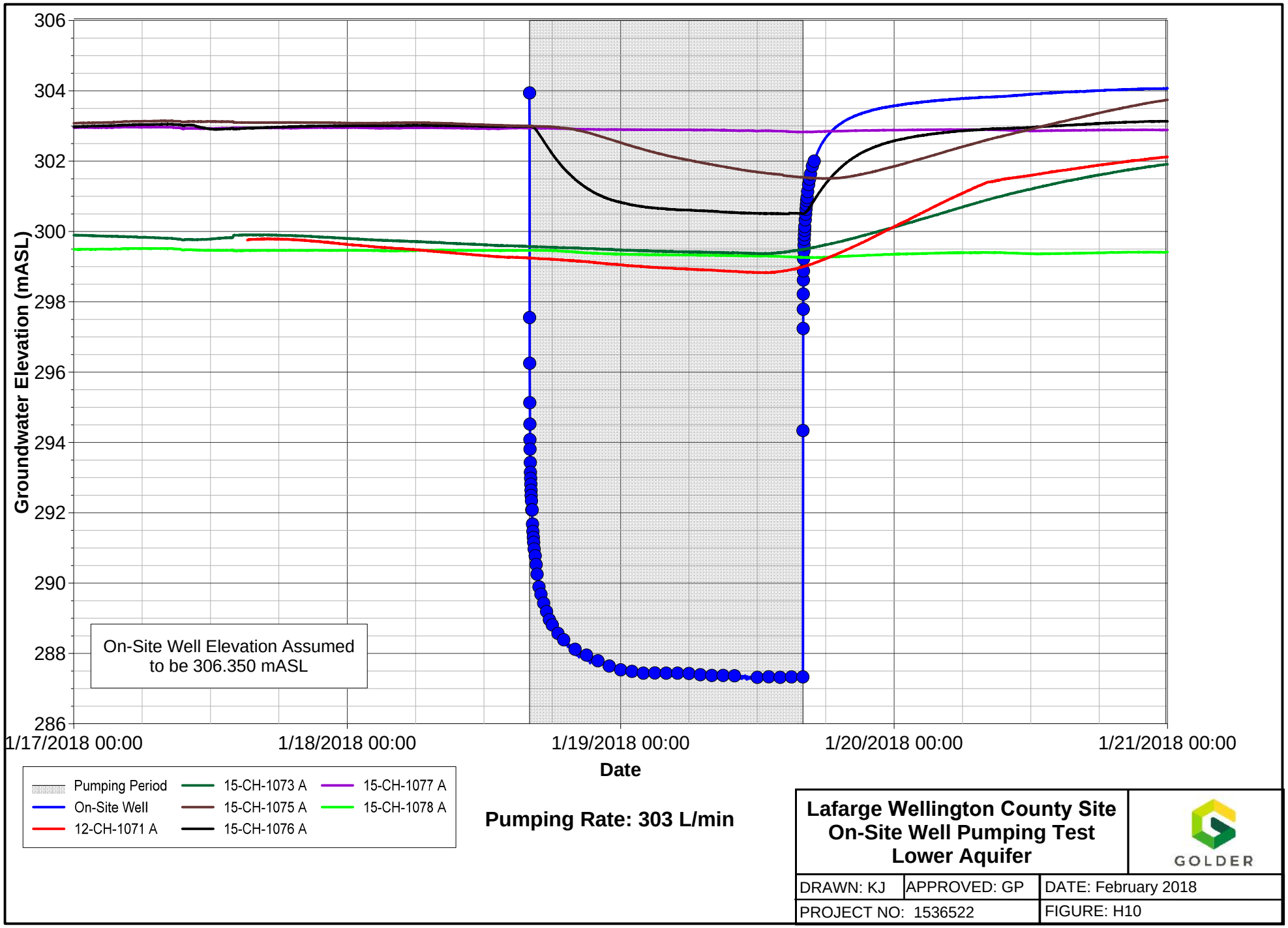
GOLDER

DRAWN: KS	APPROVED: GP	DATE: October 2016
PROJECT NO: 1536522		FIGURE: H8



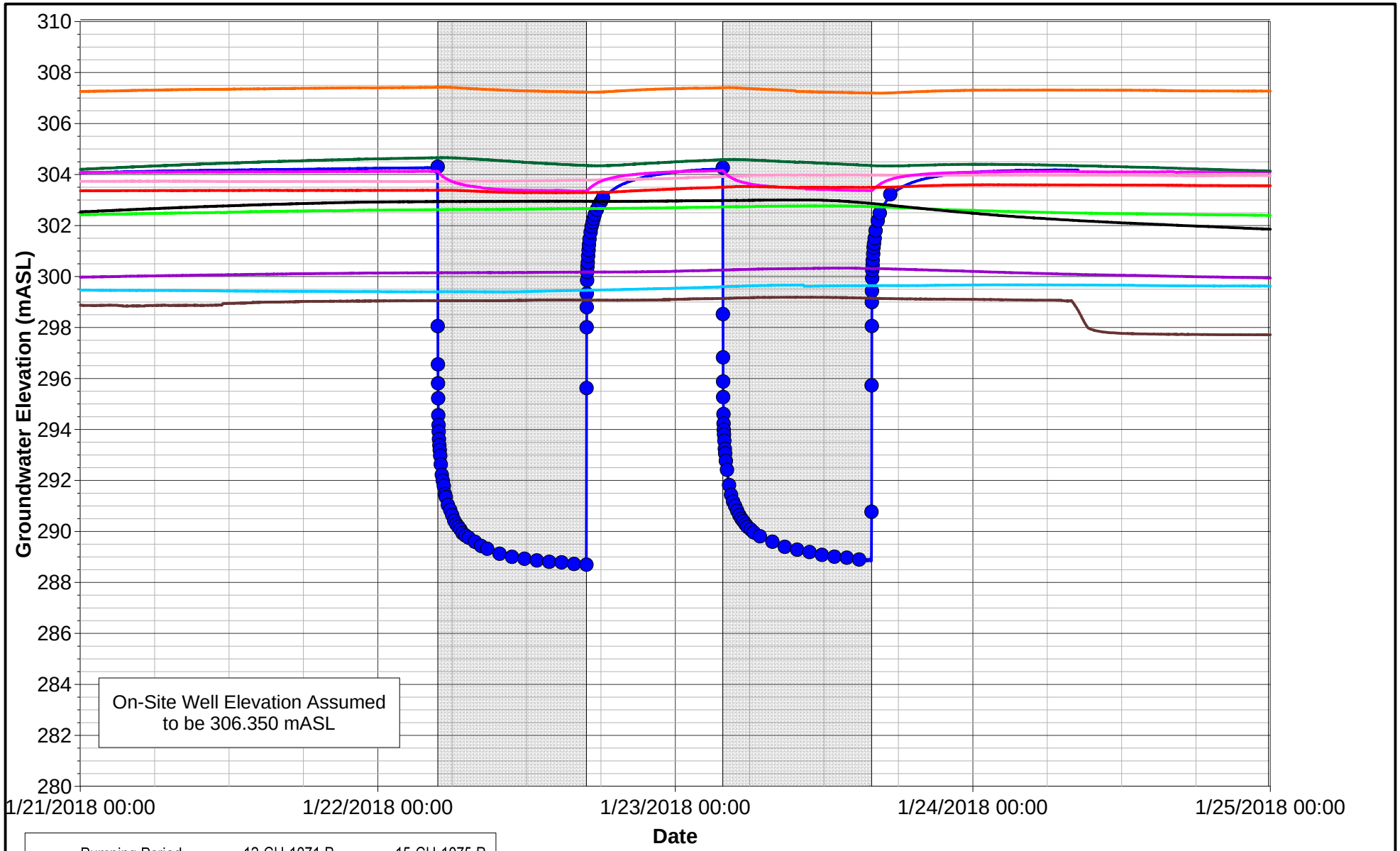
Pumping Rate: 303 L/min

Lafarge Wellington County Site On-Site Well Pumping Test Upper Aquifer		GOLDER
DRAWN: KJ	APPROVED: GP	DATE: February 2018
PROJECT NO: 1536522		FIGURE: H9



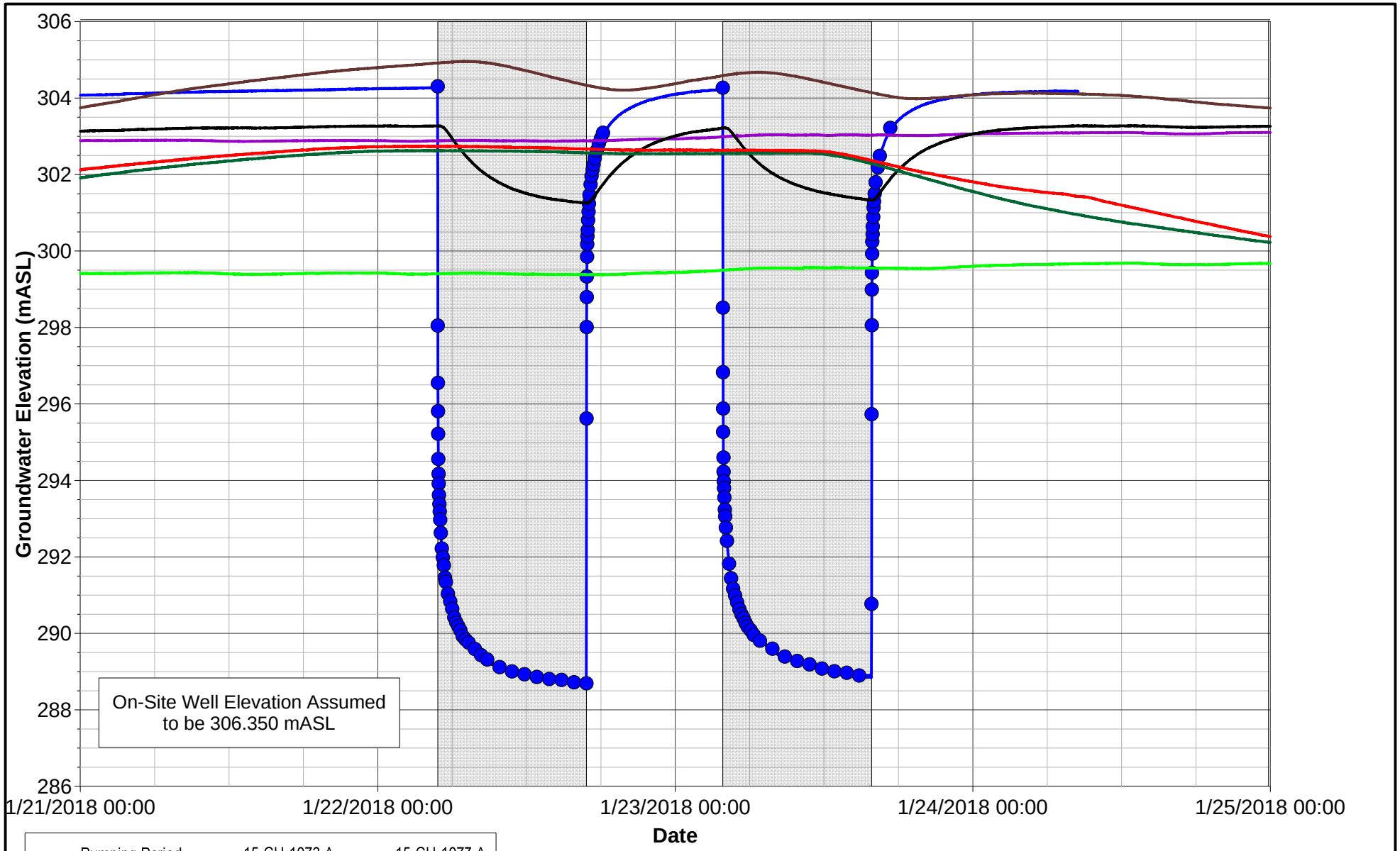
Pumping Rate: 303 L/min

Lafarge Wellington County Site On-Site Well Pumping Test Lower Aquifer		GOLDER
DRAWN: KJ	APPROVED: GP	DATE: February 2018
PROJECT NO: 1536522		FIGURE: H10



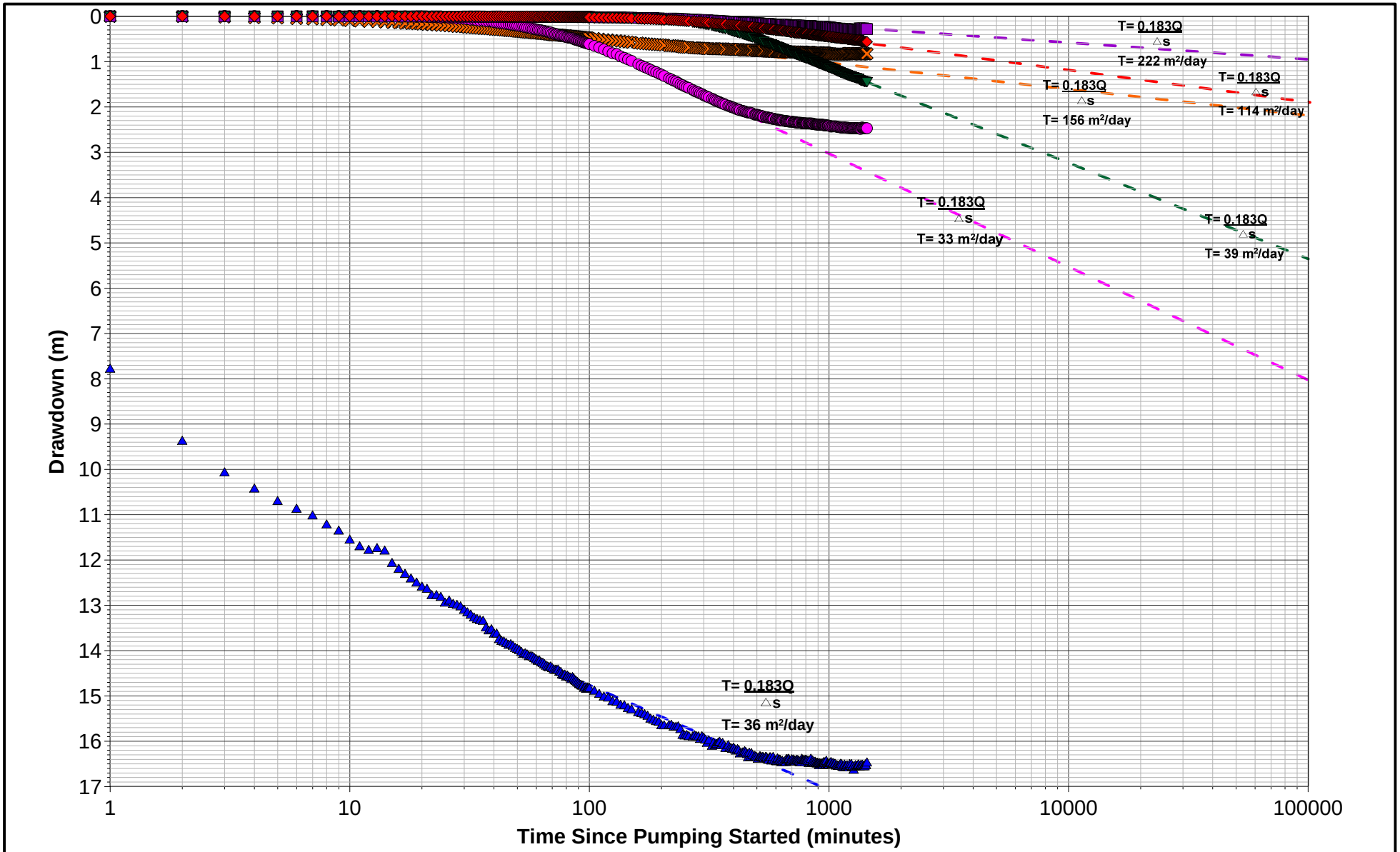
Pumping Rate: 303 L/min

Lafarge Wellington County Site On-Site Well Pumping Test Upper Aquifer		GOLDER
DRAWN: KJ	APPROVED: GP	DATE: February 2018
PROJECT NO: 1536522		FIGURE: H11



Pumping Rate: 303 L/min

Lafarge Wellington County Site On-Site Well Pumping Test Lower Aquifer		GOLDER
DRAWN: KJ	APPROVED: GP	DATE: February 2018
PROJECT NO: 1536522		FIGURE: H12



Observed Drawdown Versus Elapsed Time On-Site Well Pumping Test

GOLDER

DRAWN: KJ	APPROVED: GP	DATE: February 2018
PROJECT NO: 1536522		FIGURE: H13

APPENDIX I

Species at Risk Screening

APPENDIX I – SPECIES AT RISK SCREENING

Common Name	Scientific Name	Species At Risk Act (Sch 1)[1]	Endangered Species Act[2]	COSEWIC[3]	Provincial (SRank)[4]	Habitat Requirements[5]	Potential to Occur in the Study Area
Jefferson salamander	*Ambystoma jeffersonianum*	END	END	END	S2	In Ontario, Jefferson salamander is found only in southern Ontario, along southern portions of the Niagara Escarpment and western portions of the Oak Ridges Moraine. Jefferson salamander prefers moist, well-drained deciduous and mixed forests with a closed canopy. It overwinters underground in mammal burrows and rock fissures, and moves to vernal pools and ephemeral wetlands in the early spring to breed. Breeding ponds are typically located in or near to forested habitats, and contain submerged debris (i.e., sticks, vegetation) for egg attachment sites. Ephemeral breeding pools need to have water until at least mid-summer (mid to late July) (Jefferson Salamander Recovery Team 2010).	Low There are no recent occurrence records of Jefferson salamander in the region. There are no suitable breeding ponds in the Study Area and the coniferous swamp along the Speed River does not provide preferred terrestrial habitat.
Western chorus frog - Great Lakes St. Lawrence / Canadian Shield Population	*Pseudacris triseriata*	THR	—	THR	S3	In Ontario, habitat of this amphibian species typically consists of marshes or wooded wetlands, particularly those with dense shrub layers and grasses, as this species is a poor climber. They will breed in almost any fishless pond including roadside ditches, gravel pits and flooded swales in meadows. This species hibernates in terrestrial habitats under rocks, dead trees or leaves, in loose soil or in animal burrows. During hibernation, this species is tolerant of flooding (Environment Canada 2015b).	Moderate There may be seasonal breeding habitat in the coniferous swamp along the Speed River south of the Site.
Monarch	*Danaus plexippus*	SC	SC	END	S2N, S4B	In Ontario, monarch is found throughout the northern and southern regions of the province. This butterfly is found wherever there are milkweed (*Asclepius* spp.) plants for its caterpillars and wildflowers that supply a nectar source for adults. It is often found on abandoned farmland, meadows, open wetlands, prairies and roadsides, but also in city gardens and parks. Important staging areas during migration occur along the north shores of the Great Lakes (COSEWIC 2010b).	High Suitable open or shrub meadow and edge habitat in the Study Area may provide suitable host or foraging plants. Although individuals were not observed in the Study Area during the field surveys, they were observed in the vicinity of the Study Area.
Rusty-patched bumble bee	*Bombus affinis*	END	END	END	S1	In Ontario, rusty-patched bumble bee is found in areas from the southern Great Lakes – St. Lawrence forest region southwards into the Carolinian forest. It is a habitat generalist, but it is typically found in open habitats, such as mixed farmland, savannah, marshes, sand dunes, urban and lightly wooded areas. It is cold –tolerant and can be found at high elevations. Most recent sightings in Ontario have been in oak savannah habitat with well-drained, sandy soils and moderately open canopy. It requires an abundance of flowering plants for forage. This species most often builds nests underground in old rodent burrows, but also in hollow tree stumps and fallen dead wood (Colla and Taylor-Pindar 2011). The only recent sightings in Ontario are from the Pinery Provincial Park.	Low This species is only historically known in the region.
Tawny emperor	*Asterocampa clyton*	—	—	—	S3	In Ontario, tawny emperor occurs in densely wooded riparian areas, dry, open woodlands, along fencerows as well as in city parks and suburban areas (Opler et al. 2012). Tawny emperor feeds on hackberry leaves.	Low Although the coniferous swamp along the Speed River in the Study Area, hackberry is not known to occur in the PSW based on the evaluation report. In addition, there are no recent occurrence records.
West Virginia white	*Pieris virginiensis*	—	SC	—	S3	In Ontario, West Virginia white is found primarily in the central and southern regions of the province. This butterfly lives in moist, mature, deciduous and mixed woodlands, and the caterpillars feed only on the leaves of toothwort (*Cardamine* spp.), which are small, spring-blooming plants of the forest floor. These woodland habitats are typically maple-beech-birch dominated. This species is associated with woodlands growing on calcareous bedrock or thin soils over bedrock (Burke 2013).	Low The limited deciduous forest habitat in the Study Area is associated with a residential property and is likely too disturbed to support this species.

Common Name	Scientific Name	Species At Risk Act (Sch 1)[1]	Endangered Species Act[2]	COSEWIC[3]	Provincial (SRank)[4]	Habitat Requirements[5]	Potential to Occur in the Study Area
Bank swallow	*Riparia riparia*	THR	THR	THR	S4B	In Ontario, the bank swallow breeds in a variety of natural and anthropogenic habitats, including lake bluffs, stream and river banks, sand and gravel pits, and roadcuts. Nests are generally built in a vertical or near-vertical bank. Breeding sites are typically located near open foraging sites such as rivers, lakes, grasslands, agricultural fields, wetlands and riparian woods. Forested areas are generally avoided (Garrison 1999).	Low There are no steep, sandy slopes or banks in the Study Area to support nesting.
Barn swallow	*Hirundo rustica*	THR	THR	THR	S4B	In Ontario, barn swallow breeds in areas that contain a suitable nesting structure, open areas for foraging, and a body of water. This species nests in human made structures including barns, buildings, sheds, bridges, and culverts. Preferred foraging habitat includes grassy fields, pastures, agricultural cropland, lake and river shorelines, cleared right-of-ways, and wetlands (COSEWIC 2011a). Mud nests are fastened to vertical walls or built on a ledge underneath an overhang. Suitable nests from previous years are reused (Brown and Brown 1999).	High Suitable nesting structures occur in the Study Area, and barn swallow was observed foraging in the vicinity of the Study Area during field surveys.
Black tern	*Chlidonias niger*	—	SC	NAR	S3B	In Ontario, black tern breeds in freshwater marshlands where it forms small colonies. It prefers marshes or marsh complexes greater than 20 ha in area and which are not surrounded by wooded area. Black terns are sensitive to the presence of agricultural activities. The black tern nests in wetlands with an even combination of open water and emergent vegetation, and still waters of 0.5-1.2 m deep. Preferred nest sites have short dense vegetation or tall sparse vegetation often consisting of cattails, bulrushes and occasionally burreed or other marshland plants. Black terns also require posts or snags for perching (Weseloh 2007).	Low There is no large marsh habitat on the Site to provide suitable nesting habitat. In addition, this species was not observed on the Site during field surveys.
Bobolink	*Dolichonyx oryzivorus*	THR	THR	THR	S4B	In Ontario, bobolink breeds in grasslands or graminoid dominated hayfields with tall vegetation (Gabhauer 2007a). Bobolink prefers grassland habitat with a forb component and a moderate litter layer. They have low tolerance for presence of woody vegetation and are sensitive to frequent mowing within the breeding season. They are most abundant in established, but regularly maintained, hayfields, but also breed in lightly grazed pastures, old or fallow fields, cultural meadows and newly planted hayfields. Their nest is woven from grasses and forbs. It is built on the ground, in dense vegetation, usually under the cover of one or more forbs (Martin and Gavin 1995).	Moderate Although no individuals were observed during field surveys, agricultural fields in the Study Area may provide suitable habitat. At least one hay field was identified off-Site north of Highway 24. In addition, bobolink has been recently observed in the vicinity of the Study Area (eBird).
Canada warbler	*Cardellina canadensis*	THR	SC	THR	S4B	In Ontario, breeding habitat for Canada warbler consists of moist mixed forests with a well-developed shrubby understory. This includes low-lying areas such as cedar and alder swamps, and riparian thickets (McLaren 2007). It is also found in densely vegetated regenerating forest openings. Suitable habitat often contains a developed moss layer and an uneven forest floor. Nests are well concealed on or near the ground in dense shrub or fern cover, often in stumps, fallen logs, overhanging stream banks or mossy hummocks (Reitsma et al. 2010).	Low There is no suitable forest habitat in the Study Area. In addition, this species was not observed in the vicinity of the Study Area during field surveys.
Cerulean warbler	*Setophaga cerulea*	END	THR	END	S3B	In Ontario, breeding habitat of cerulean warbler consists of second-growth or mature deciduous forest with a tall canopy of uneven vertical structure and a sparse understory. This habitat occurs in both wet bottomland forests and upland areas, and often contains large hickory and oak trees. This species may be attracted to gaps or openings in the upper canopy. The cerulean warbler is associated with large forest tracks, but may occur in woodlots as small as 10 ha (COSEWIC 2010a). Nests are usually built on a horizontal limb in the mid-story or canopy of a large deciduous tree (Buehler et al. 2013).	Low There is no large deciduous forest habitat on the Site. In addition, this species was not observed in the Study Area during field surveys.

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Chimney swift	*Chaetura pelagica*	THR	THR	THR	S4B, S4N	In Ontario, chimney swift breeding habitat is varied and includes urban, suburban, rural and wooded sites. They are most commonly associated with towns and cities with large concentrations of chimneys. Preferred nesting sites are dark, sheltered spots with a vertical surface to which the bird can grip. Unused chimneys are the primary nesting and roosting structure, but other anthropogenic structures and large diameter cavity trees are also used (COSEWIC 2007).	Moderate Although this species was not observed during field surveys, buildings in the Study Area may provide nesting habitat. In addition, it has been recently recorded along the Speed River within the Study Area (eBird).
Common nighthawk	*Chordeiles minor*	THR	SC	THR	S4B	These aerial foragers require areas with large open habitat. This includes farmland, open woodlands, clearcuts, burns, rock outcrops, alvars, bog ferns, prairies, gravel pits and gravel rooftops in cities (Sandilands 2007).	Low - Moderate Although the open and shrub meadow in the Study Area may provide suitable nesting habitat, there are no recent occurrence records in the Study Area. They were not observed during field surveys, but targeted surveys for this species were not completed.
Eastern meadowlark	*Sturnella magna*	THR	THR	THR	S4B	In Ontario, the eastern meadowlark breeds in pastures, hayfields, meadows and old fields. Eastern meadowlark prefers moderately tall grasslands with abundant litter cover, high grass proportion, and a forb component (Hull 2003). They prefer well drained sites or slopes, and sites with different cover layers (Roseberry and Klimstra 1970).	High Agricultural fields in the Study Area may provide suitable habitat. At least one hay field was identified north of Highway 24. In addition, eastern meadowlark was observed breeding in the vicinity of the Study Area during field surveys.
Eastern wood-pewee	*Contopus virens*	SC	SC	SC	S4B	In Ontario, the eastern wood-pewee inhabits a wide variety of wooded upland and lowland habitats, including deciduous, coniferous, or mixed forests. It occurs most frequently in forests with some degree of openness. Intermediate-aged forests with a relatively sparse midstory are preferred. In younger forests having a relatively dense midstory, it tends to inhabit the edges. Also occurs in anthropogenic habitats providing an open forested aspect such as parks and suburban neighborhoods. Nest is constructed atop a horizontal branch, 1-2 m above the ground, in a wide variety of deciduous and coniferous trees (COSEWIC 2012b).	High The swamp along the Speed River south of the Site provides suitable habitat. In addition, eastern wood-pewee was observed in the vicinity of the Study Area during field surveys.
Grasshopper sparrow *pratensis* subspecies	*Ammodramus savannarum* (*pratensis* subspecies)	SC	SC	SC	S4B	In Ontario, grasshopper sparrow is found in medium to large grasslands with low herbaceous cover and few shrubs. It also uses a wide variety of agricultural fields, including cereal crops and pastures. Close-grazed pastures and limestone plains (e.g., Carden and Napanee Plains) support highest density of this bird in the province (COSEWIC 2013).	Moderate Agricultural fields in the Study Area may provide suitable habitat. At least suitable one hay field was identified north of Highway 24. In addition, grasshopper sparrow was observed in the vicinity of the Study Area during field surveys.
Henslow's sparrow	*Ammodramus henslowii*	END	END	END	SHB	In Ontario, Henslow's sparrow breeds in large grasslands with low disturbance, such as lightly grazed and ungrazed pastures, fallow hayfields, grassy swales in open farmland, and wet meadows. Preferred habitat contains tall, dense grass cover, typically over 30 cm high, with a high percentage of ground cover, and a thick mat of dead plant material. Henslow's sparrow generally avoids areas with emergent woody shrubs or trees, and fence lines. Areas of standing water or ephemerally wet patches appear to be important. This species breeds more frequently in patches of habitat greater than 30 ha and preferably greater than 100 ha (COSEWIC 2011b).	Low There are no large areas of suitable open meadow/field or hay field habitat in the Study Area. In addition, this species was not observed during field surveys.

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Least bittern	*Ixobrychus exilis*	THR	THR	THR	S4B	In Ontario, the least bittern breeds in marshes, usually greater than 5 ha, with emergent vegetation, relatively stable water levels and areas of open water. Preferred habitat has water less than 1 m deep (usually 10 – 50 cm). Nests are built in tall stands of dense emergent or woody vegetation (Woodliffe 2007a). Clarity of water is important as siltation, turbidity, or excessive eutrophication hinders foraging efficiency (COSEWIC 2009).	Low The coniferous swamp along the Speed River south of the Site does not provide the preferred species composition. In addition, this species was not observed during field surveys.
Louisiana waterthrush	*Parkesia motacilla (*formerly *Seiurus motacilla)*	SC	THR	THR	S3B	The Louisiana waterthrush inhabits mature forests along steeply sloped ravines adjacent to running water. It prefers clear, cold streams and densely wooded swamps. Trees, bushes, exposed roots, cliffs, banks and mossy logs are favoured nesting spots. Riparian woodlands are preferred stopover sites during migration. Nests are concealed from view at the base of uprooted trees, among mosses, or under logs and in cavities along the stream bank (COSEWIC 2006a).	Low Although the coniferous swamp habitat along the Speed River south of the Site may provide suitable habitat, there are no recent occurrence records for this species in the region and no individuals were observed during field surveys.
Red-headed woodpecker	*Melanerpes erythrocephalus*	THR	SC	THR	S4B	In Ontario, the red-headed woodpecker breeds in open, deciduous woodlands or woodland edges and are often found in parks, cemeteries, golf courses, orchards and savannahs (Woodliffe 2007b). They may also breed in forest clearings or open agricultural areas provided that large trees are available for nesting. They prefer forests with little or no understory vegetation. They are often associated with beech or oak forests, beaver ponds and swamp forests where snags are numerous. Nests are excavated in the trunks of large dead trees (Smith et al. 2000).	Low Woodlands in the Study Area and the coniferous swamp along the Speed River south of the Site are likely too dense to provide suitable habitat.
Short-eared owl	*Asio flammeus*	SC	SC	SC	S2N,S4B	In Ontario, the short-eared owl breeds in a variety of open habitats including grasslands, tundra, bogs, marshes, clearcuts, burns, pastures and occasionally agricultural fields. The primary factor in determining breeding habitat is proximity to small mammal prey resources (COSEWIC 2008a). Nests are built on the ground at a dry site and usually adjacent to a clump of tall vegetation used for cover and concealment (Gahbauer 2007b).	Low There are no large grasslands in the Study Area to provide preferred habitat. Areas of hay field are likely too small to support this species. In addition, this species was not observed during field surveys.
Wood thrush	*Hylocichla mustelina*	THR	SC	THR	S4B	In Ontario, wood thrush breeds in moist, deciduous hardwood or mixed stands that are often previously disturbed, with a dense deciduous undergrowth and with tall trees for singing perches. This species selects nesting sites with the following characteristics: lower elevations with trees less than16 m in height, a closed canopy cover (>70%), a high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soil, and decaying leaf litter (COSEWIC 2012d).	High There is suitable deciduous forest in the Study Area and wood thrush was observed south of the Site during field surveys.
Yellow-breasted chat	*Icteria virens virens*	END	END	END	S2B	In Ontario, yellow-breasted chat breeds in early successional, shrub-thicket habitats including woodland edges, regenerating old fields, railway and hydro right-of-ways, young coniferous reforestations, and wet thickets bordering wetlands. Tangles of grape (*Vitis* spp.) and raspberry (*Rubus* spp.) vines are features of most breeding sites. There is some evidence that the yellow-breasted chat is an area sensitive species. Nests are located in dense shrubbery near to the ground (COSEWIC 2011d).	Low There is no suitable successional or shrub-thicket habitat in the Study Area to provide habitat. In addition, this species was not observed during field surveys.

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Lake sturgeon - Great Lakes / upper St. Lawrence Population	*Acipenser fulvescens*	—	THR	THR	S2	In Ontario, the lake sturgeon, a large prehistoric freshwater fish, is found in all the Great Lakes and in all drainages of the Great Lakes and of Hudson Bay. This species typically inhabits highly productive shoal areas of large lakes and rivers. They are bottom dwellers, and prefer depths between 5-10 m and mud or gravel substrates. Small sturgeons are often found on gravelly shoals near the mouths of rivers. They spawn in depths of 0.5 to 4.5 m in areas of swift water or rapids. Where suitable spawning rivers are not available, such as in the lower Great Lakes, they are known to spawn in wave action over rocky ledges or around rocky islands (Golder Associates Ltd. 2011).	Low Lake sturgeon is not known to occur in the Speed River.
Redside dace	*Clinostomus elongatus*	—	END	END	S2	In Ontario, the redside dace, a small coolwater species common in the USA but less so in Canada, is found in tributaries of western Lake Ontario, Lake Erie, Lake Huron and Lake Simcoe. They are found in pools and slow-moving areas of small headwater streams with clear to turbid water. Overhanging grasses, shrubs, and undercut banks, are an important part of their habitat, as are instream boulders and large woody debris. Preferred substrates are variable and include silt, sand, gravel and boulders. Spawning occurs in shallow riffle areas (Redside Dace Recovery Team 2010).	Low Redside dace is not known to occur in the Speed River.
Silver shiner	*Notropis photogenis*	—	THR	THR	S2S3	In Ontario, the silver shiner is found in the Thames and Grand Rivers, and it has been recently reported in Bronte Creek and Sixteen Mile Creek which flow into Lake Ontario. They prefer moderately-flowing sections of larger streams with clear water and moderate currents. Usual substrates include gravel, rubble, boulder, and sand. Aquatic vegetation may be present or absent. The silver shiner most frequently occurs in deep, swift riffles and faster currents of pools below riffles. Spawning habitat is suggested to occur in relatively deep riffles (COSEWIC 2011c).	Low Silver shiner is not known to occur in the Speed River.
American badger *jacksoni* subspecies (southwestern population)	*Taxidea taxus jacksoni*	END	END	END	S2	In Ontario, American badger's preferred habitats include undisturbed grasslands, shrubby areas and open woodlands, but the species will also utilize old fields, pastures, edges of agricultural fields and roadsides. The key factor for habitat suitability for this species is presence of prey, comprised mainly of woodchuck and eastern cottontail, and Franklin's ground squirrel in northwestern Ontario (Ontario American Badger Recovery Team 2010).	Low The Study Area is likely too disturbed and populated to provide suitable habitat
Eastern cougar	*Puma concolor couguar*	—	END	DD	SU	This species historically inhabited extensive forested areas in Ontario. It is found in habitats suitable for white-tailed deer and mule deer, which are the preferred prey of the cougar. Dense cover is considered the key habitat feature for cougar. An average home range for males is 300 square kilometers, and for females, 150 square kilometers (Environment Canada and Canadian Wildlife Federation 2013).	Low Overall, the region is too developed and fragmented to provide suitable habitat.
Gray fox	*Urocyon cinereoargenteus*	THR	THR	THR	S1	While the Ontario range of this species extends across much of southern and southeastern Ontario, the only known population in the province is on Pelee Island, with very rare sightings elsewhere in the province at points close to the border with the United States. This species inhabits deciduous forests and marshes, and will den in a variety of features including rock outcroppings, hollow trees, burrows or brush piles, usually where dense brush provides cover and in close proximity to water. This species is considered a habitat generalist (COSEWIC 2002).	Low This species is only currently known to occur on Pelee Island.

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Eastern small-footed myotis	*Myotis leibii*	—	END	—	S2S3	This species is not known to roost within trees, but there is very little known about its roosting habits. The species generally roosts on the ground under rocks, in rock crevices, talus slopes and rock piles. It occasionally inhabits buildings. Areas near the entrances of caves or abandoned mines may be used for hibernaculum, where the conditions are drafty with low humidity, and may be subfreezing (Humprehy 2017).	Low No suitable rock piles or talus slopes were observed in the Study Area to provide roosting habitat.
Little brown myotis	*Myotis lucifugus*	END	END	END	S4	In Ontario, this species range is extensive and covers much of the province. It will roost in both natural and man-made structures. They require a number of large dead trees, in specific stages of decay and that project above the canopy in relatively open areas. May form nursery colonies in the attics of buildings within 1 km of water. Caves or abandoned mines may be used for hibernaculum, but high humidity and stable above freezing temperatures are required (Environment Canada 2015a).	Moderate The coniferous swamp along the Speed River south of the Site, and other woodlands in the Study Area, may provide suitable roosting habitat. There is also abundant foraging habitat in the vicinity of the Study Area. Several snags, which may be suitable for this species, were observed in the coniferous swamp during field surveys.
Tri-colored bat	*Perimyotis subflavus*	END	END	END	S3?	In Ontario, tri-colored bat may roost in foliage, in clumps of old leaves, hanging moss or squirrel nests. They are occasionally found in buildings although there are no records of this in Canada. They typically feed over aquatic areas with an affinity to large-bodied water and will likely roost in close proximity to these. Hibernation sites are found deep within caves or mines in areas of relatively warm temperatures. These bats have strong roost fidelity to their winter hibernation sites and may choose the exact same spot in a cave or mine from year to year (Environment Canada 2015a).	Moderate The coniferous swamp along the Speed River south of the Site, and other woodlands in the Study Area, may provide suitable roosting habitat. There is also abundant foraging habitat in the vicinity of the Study Area.
Northern myotis	*Myotis septentrionalis*	END	END	END	S3	In Ontario, this species range is extensive and covers much of the province. It will usually roost in hollows, crevices, and under loose bark of mature trees. Roosts may be established in the main trunk or a large branch of either living or dead trees. Caves or abandoned mines may be used for hibernaculum, but high humidity and stable above freezing temperatures are required (Environment Canada 2015a).	Moderate The coniferous swamp along the Speed River south of the Site, and other woodlands in the Study Area, may provide suitable roosting habitat. There is also abundant foraging habitat in the vicinity of the Study Area. Several snags, which may be suitable for this species, were observed in the coniferous swamp during field surveys
Rainbow mussel	*Villosa iris*	—	SC	SC	S2S3	In Ontario, the rainbow mussel is found in shallow, well- oxygenated waters of small to medium-sized rivers and sometimes lakes. It is most abundant in waters less than 1 m deep. Preferred substrates are cobble, gravel, sand and occasionally mud (COSEWIC 2006b).	Low Rainbow mussel is not known to occur in the Speed River.
Pygmy pocket moss	*Fissidens exilis*	SC	—	SC	S2	In Ontario, pygmy pocket moss grows in the southwestern region of the province. Pygmy pocket moss typically grows on bare, moist, clay soil. It occurs primarily in woodlands, but also on disturbed soils, such as in floodplains (COSEWIC 2005b).	Low Soils in the Study Area are not clay based and do not provide suitable habitat.

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Blanding's turtle - Great Lakes / St. Lawrence population	*Emydoidea blandingii*	THR	THR	END	S3	In Ontario, Blanding's turtle will use a range of aquatic habitats, but favor those with shallow, standing or slow-moving water, rich nutrient levels, organic substrates and abundant aquatic vegetation. They will use rivers, but prefer slow-moving currents and are likely only transients in this type of habitat. This species is known to travel great distances over land in the spring in order to reach nesting sites, which can include dry conifer or mixed forests, partially vegetated fields, and roadsides. Suitable nesting substrates include organic soils, sands, gravel and cobble. They hibernate underwater and infrequently under debris close to water bodies (COSEWIC 2005a).	Moderate Suitable wetland and aquatic habitat may occur in the Speed River and Speed River PSW south of the Site.
Eastern ribbonsnake - (Great Lakes population)	*Thamnophis sauritius*	SC	SC	SC	S4	In Ontario, eastern ribbonsnake is semi-aquatic, and is rarely found far from shallow ponds, marshes, bogs, streams or swamps bordered by dense vegetation. They prefer sunny locations and bask in low shrub branches. Hibernation occurs in mammal burrows, rock fissures or even ant mounds (COSEWIC 2012a).	Moderate There is potentially suitable aquatic habitat in the Study Area in the Speed River PSW.
Milksnake	*Lampropeltis triangulum*	SC	NAR	SC	S4	In Ontario, milksnake uses a wide range of habitats including prairies, pastures, hayfields, wetlands and various forest types, and is well-known in rural areas where it frequents older buildings. Proximity to water and cover enhances habitat suitability. Hibernation takes place in mammal burrows, hollow logs, gravel or soil banks, and old foundations (COSEWIC 2014).	Moderate Open meadow and forest habitat in the Study Area may provide suitable habitat for milksnake.
Northern map turtle	*Graptemys geographica*	SC	SC	SC	S3	In Ontario, the northern map turtle prefers large waterbodies with slow-moving currents, soft substrates, and abundant aquatic vegetation. Ideal stretches of shoreline contain suitable basking sites, such as rocks and logs. Along Lakes Erie and Ontario, this species occurs in marsh habitat and undeveloped shorelines. It is also found in small to large rivers with slow to moderate flow. Hibernation takes place in soft substrates under deep water (COSEWIC 2012d).	Low Flow in the Speed River is likely too fast to provide preferred habitat conditions.
Snapping turtle	*Chelydra serpentina*	SC	SC	SC	S3	In Ontario, snapping turtle utilizes a wide range of waterbodies, but shows preference for areas with shallow, slow-moving water, soft substrates and dense aquatic vegetation. Hibernation takes place in soft substrates under water. Nesting sites consist of sand or gravel banks along waterways or roadways (COSEWIC 2008b).	High The Speed River provides suitable habitat, and snapping turtle was observed in the vicinity of the Study Area during field surveys.
American ginseng	*Panax quinquefolius*	END	END	END	S2	In Ontario, American ginseng is found in moist, undisturbed and relatively mature deciduous woods often dominated by sugar maple. It is commonly found on well-drained, south-facing slopes. American ginseng grows under closed canopies in neutral, loamy soils (COSEWIC 2000).	Low There is no suitable, undisturbed mature deciduous forest habitat in the Study Area.
Butternut	*Juglans cinerea*	END	END	END	S2?	In Ontario, butternut is found along stream banks, on wooded valley slopes, and in deciduous and mixed forests. It is commonly associated with beech, maple, oak and hickory (Voss and Reznicek 2012). Butternut prefers moist, fertile, well-drained soils, but can also be found in rocky limestone soils. This species is shade intolerant (Farrar 1995).	Low Although there may be suitable habitat in the Study Area, there are no occurrence records. In addition, butternut was not observed during the field surveys
Carey's sedge	*Carex careyana*	—	—	—	S2	In Ontario, Carey's sedge grows in rich deciduous woods, often on floodplains or slopes (Hilty 2017).	Low There is no suitable deciduous forest in the Study Area.
Green dragon	*Arisaema dracontium*	—	SC	SC	S3	In Ontario, green dragon occurs in somewhat-wet to wet deciduous forests along streams. In particular, it grows in maple forest and forest dominated by green ash and white elm trees. Green dragon is restricted to shaded or partially shaded seasonally inundated floodplains (Donley et al. 2013). It is primarily restricted to southwestern Ontario.	Low Although the coniferous swamp along the Speed River may provide habitat, there are no occurrence records in the region and this species is restricted to southwestern Ontario.

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Harbinger-of-spring	*Erigenia bulbosa*	—	—	—	S2S3	Harbinger-of-spring grows in rich woods and moist deciduous woods. Often associated with flood plains, bottomlands and riverbanks. Also found along limestone shingle shorelines (Hilty 2017).	Moderate The coniferous swamp along the Speed River south of the Site may provide suitable habitat.
Ram's-head lady's-slipper	*Cypripedium arietinum*	—	—	—	S3	Ram's-head lady's-slipper can be found in moist coniferous swamps, dry sandy woods and limestone barrens (Muma 2018).	Moderate The coniferous swamp along the Speed River south of the Site may provide suitable habitat.

[1] *Species at Risk Act* (SARA), 2002. Schedule 1 (Last amended 02 Nov 2017); Part 1 (Extirpated), Part 2 (Endangered), Part 3 (Threatened), Part 4 (Special Concern)

[2] *Endangered Species Act* (ESA), 2007 (O.Reg 242/08 last amended 27 March 2018 as O.Reg 219/18). Species at Risk in Ontario List, 2007 (O.Reg 230/08 last amended 2 June 2017 as O. Reg 167/17, s. 1.); Schedule 1 (Extirpated - EXP), Schedule 2 (Endangered - END), Schedule 3 (Threatened - THR), Schedule 4 (Special Concern - SC)

[3] Committee on the Status of Endangered Wildlife in Canada (COSEWIC) http://www.cosewic.gc.ca/

[4] Provincial Ranks (SRANK) are Rarity Ranks assigned to a species or ecological communities, by the Natural Heritage Information Centre (NHIC). These ranks are not legal designations. SRANKS are evaluated by NHIC on a continual basis and updated lists produced annually. SX (Presumed Extirpated), SH (Possibly Extirpated - Historical), S1 (Critically Imperiled), S2 (Imperiled), S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure), SNA (Not Applicable), S#S# (Range Rank), S? (Not ranked yet), SAB (Breeding Accident), SAN (Non-breeding Accident), SX (Apparently Extirpated). Last assessed November 2017.

[5] References:

Brown, C.R. and M.B. Brown. 1999. Barn Swallow (*Hirundo rustica*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. URL: http://bna.birds.cornell.edu/bna/species/452

Buehler, D.A., P.B. Hamel, and T. Boves. 2013. Cerulean Warbler (*Setophaga cerulean*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. URL: http://bna.birds.cornell.edu/bna/species/511

Burke, P.S. 2013. Management Plan for the West Virginia White (*Pieris virginiensis*) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. v + 44 pp.

Colla, S.R. and A. Taylor-Pindar. 2011. Recovery Strategy for the Rusty-patched Bumble Bee (*Bombus affinis*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 21 pp.

COSEWIC. 2000. COSEWIC assessment and update status report on the American ginseng *Panax quinquefolius* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 17 pp.

COSEWIC. 2002. COSEWIC assessment and update status report on the grey fox *Urocyon cinereoargenteus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 32 pp.

COSEWIC. 2005a. COSEWIC assessment and update status report on the Blanding's Turtle *Emydoidea blandingii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 40 pp.

COSEWIC. 2005b. COSEWIC assessment and status report on the pygmy pocket moss *Fissidens exilis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 18 pp.

COSEWIC. 2006a. COSEWIC assessment and update status report on the Louisiana Waterthrush, *Seiurus motacilla*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 26 pp.

COSEWIC. 2006b. COSEWIC assessment and status report on the Rainbow mussel *Villosa iris* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 38 pp.

COSEWIC. 2007. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 49 pp.

COSEWIC. 2008a. COSEWIC assessment and update status report on the Short-eared Owl *Asio flammeus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp.

COSEWIC. 2008b. COSEWIC assessment and status report on the Snapping Turtle *Chelydra serpentina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 47 pp.

COSEWIC. 2009. COSEWIC assessment and update status report on the Least Bittern *Ixobrychus exilis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 36 pp.

COSEWIC. 2010a. COSEWIC assessment and status report on the Cerulean Warbler *Dendroica cerulean* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 40 pp.

COSEWIC. 2010b. COSEWIC assessment and status report on the Monarch *Danaus plexippus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 pp.

COSEWIC. 2011a. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp.

COSEWIC. 2011b. COSEWIC assessment and status report on the Henslow's Sparrow Am*modramus henslowii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 37 pp.

COSEWIC. 2011c. COSEWIC assessment and status report on the Silver Shiner *Notropis photogenis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 45 pp.

COSEWIC. 2011d. COSEWIC assessment and status report on the Yellow-breasted Chat *auricollis* subspecies *Icteria virens auricollis* and the Yellow-breasted Chat *virens* subspecies *Icteria virens virens* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xvi + 51 pp.

COSEWIC. 2012a. COSEWIC assessment and status report on the Eastern Ribbonsnake *Thamnophis sauritus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 39 pp.

COSEWIC. 2012b. COSEWIC assessment and status report on the Eastern Wood-pewee in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp.

COSEWIC. 2012c. COSEWIC assessment and status report on the Northern Map Turtle *Graptemys geographica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 63 pp.

COSEWIC. 2012d. COSEWIC assessment and status report on the Wood Thrush *Hylocichla mustelina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 46 pp.

COSEWIC. 2013. COSEWIC assessment and status report on the Grasshopper Sparrow *pratensis* subspecies *Ammodramus savannarum pratensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 36 pp.

COSEWIC. 2014. COSEWIC assessment and status report on the Milksnake *Lampropeltis triangulum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x +61 pp.

Donley, R., J.V. Jalava and J. van Overbeeke. 2013. Management plan for the Green Dragon (A*risaema dracontium*) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 43 pp.

Environment Canada and Canadian Wildlife Federation. 2013. Hinterland Who's Who – Cougar. URL: http://www.hww.ca/en/species/mammals/cougar-1.html#sid2. Accessed May 10, 2013.

Environment Canada. 2015a. Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ix + 110 pp.

Environment Canada. 2015b. Recovery Strategy for the Western Chorus Frog (Pseudacris triseriata), Great Lakes/ St. Lawrence - Canadian Shield population, in Canada, Species at Risk Act Recovery Strategy Series, Environment Canada, Ottawa, vi + 50 pp.

Farrar, J.L. 1995. Trees in Canada. Fitzhenry & Whiteside Limited, Markham, Ontario and Canadian Forest Service, Natural Resources Canada, Ottawa, Ontario. 502 pp. ISBN: 1-55041-199-3.

Gabhauer, M.A. 2007a. Bobolink, pp. 586-587 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.T. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Envoronment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto, xxii + 706 pp.

Gahbauer, M.A. 2007b. Short-eared Owl, pp. 302-303 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp.

Garrison, B.A. 1999. Bank Swallow (*Riparia riparia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. URL: http://bna.birds.cornell.edu/bna/species/414

Golder Associates Ltd (Golder). 2011. Recovery Strategy for Lake Sturgeon (*Acipenser fulvescens*) – Northwestern Ontario, Great Lakes-Upper St. Lawrence River and Southern Hudson Bay-James Bay populations in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario.

Hilty, J. Illinois Wildflowers. URL: http://www.illinoiswildflowers.info/woodland/woodland_index.htm#harbinger

Hull, S. D. 2003. Effects of management practices on grassland birds: Eastern Meadowlark. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/literatr/grasbird/eame/eame.htm (Version 12DEC2003).

Humphrey, C. 2017. Recovery Strategy for the Eastern Small-footed Myotis (*Myotis leibii*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 76 pp.

Jefferson Salamander Recovery Team. 2010. Recovery strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 29 pp.

McLaren, P. 2007. Canada Warbler, pp. 528-529 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto, xxii + 706 pp.

Muma, W. 2018. Ontario Wildflowers. URL: http://ontariowildflowers.com/main/species.php?id=288

Ontario American Badger Recovery Team. 2010. Recovery strategy for the American Badger (*Taxidea taxus*) in Ontario. Ontario Recovery Strategy Series. Prepared for Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 27 pp.

Opler PA, Lotts K, Naberhaus T. 2012. Tawny Emperor *Asterocampa clyton* (Boisduval & LeConte, [1835]). Butterflies and Moths of North America.

Redside Dace Recovery Team. 2010. Recovery Strategy for Redside Dace (*Clinostomus elongatus*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 29 pp.

Reitsma, L., M. Goodnow, M.T. Hallworth and C.J. Conway. 2010. Canada Warbler (*Cardellina canadensis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. URL: http://bna.birds.cornell.edu/bna/species/421

Renfrew, R., A.M. Strong, N.G. Perlut, S.G. Martin and T.A. Gavin. 2015. Bobolink (*Dolichonyx oryzivorus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/boboli

Roseberry, J. L. and W. D. Klimstra. 1970. The nesting ecology and reproductive performance of the Eastern Meadowlark. Wilson Bull. 82:243-267.

Sandilands, A. 2007. Common Nighthawk, pp. 308-309 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto, xxii + 706 pp.

Smith, K.G., J.H. Withgott and P.G. Rodewald. 2000. Red-headed Woodpecker (Mel*anerpes erythrocephalus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. URL: http://bna.birds.cornell.edu/bna/species/518 doi:10.2173/bna.518

Voss, E.G. and A.A. Reznicek. 2012. Field Manual of Michigan Flora. The University of Michigan Press, Ann Arbor, Michigan. 990 pp.

Weseloh, C. 2007. Black Tern, pp. 590-591 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto, xxii + 706 pp.

Woodliffe, P.A. 2007a. Least Bittern, pp. 156-157 in Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier, eds. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto, xxii + 706 pp.

Woodliffe, P.A. 2007b. Red-headed Woodpecker, pp. 320-321 in Cadman, M.D., D.A. Sutherland, G.G.Beck, D. Lepage, and A.R. Couturier, eds. Altlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp.

APPENDIX J

Potential Interference with Private Wells

TABLE J1
POTENTIAL IMPACTS TO PRIVATE WELLS
LAFARGE WELLINGTON COUNTY SITE

MECP Well ID	Well Use	Approximate Distance to Quarry (m)	Depth (m)	Static Water Level (m)	Available Water (m)	Estimated Drawdown (m)	Drawdown Percent of Available Water
6703318	Domestic	320	48.8	12.8	36	0.5	1.4
6705230	Domestic	415	42.7	11.6	31.1	0.3	1.0
6706927	Domestic	430	32.6	7.6	25	0.2	0.8
6707288	Domestic	495	40.5	9.8	30.7	0.1	0.3
6707880	Domestic	455	23.2	14.9	8.3	0.2	2.4
6708796	Domestic	345	32	9.1	22.9	0.3	1.3
6710019	Domestic	355	60	10.7	49.3	0.4	0.8
6712388	Domestic	300	30.5	9.1	21.4	0.7	3.3
6711882	Industrial	495	39.6	12.2	27.4	0.1	0.4
6711941	Commerical	470	36	10.7	25.3	0.2	0.8
6712349	Commerical	335	43	15.2	27.8	0.4	1.4

Note: Well details obtained from Ministry of the Environment, Conservation and Parks Water Well Record Database

TABLE J2
MECP WATER WELL RECORD DATA
LAFARGE WELLINGTON COUNTY SITE

Well ID	Easting (m)	Northing (m)	Elevation (m)	Date Completed	Well Type	Depth to Bedrock (m)	Well Depth (m)	Water Found Depth (m)	Static Water Level (m)	Final Status	Well Use	UTM Reliability
6700947	558473	4816685	334.8	11/22/1963	Bedrock	16.8	42.7	42.7	9.1	Water Supply	Domestic	margin of error : 100 m - 300 m
6700948	557625	4815107	309.7	02/17/1964	Bedrock	0.0	36.9	36.9	9.1	Water Supply	Domestic	margin of error : 100 m - 300 m
6700949	558475	4816415	324.6	04/02/1964	Bedrock	14.3	45.7	42.7	10.7	Water Supply	Public	margin of error : 100 m - 300 m
6700950	558439	4816581	330.7	04/03/1965	Bedrock	18.3	32.9	32.9	9.1	Water Supply	Domestic	margin of error : 100 m - 300 m
6700960	557806	4815614	317.6	03/24/1952	Bedrock	19.8	41.1	41.1	12.2	Water Supply	Domestic	unknown UTM
6700961	557894	4815702	320.5	02/23/1964	Bedrock	15.5	47.2	47.2	15.8	Water Supply	Industrial	margin of error : 100 m - 300 m
6700962	557992	4815865	320.0	05/26/1965	Bedrock	14.6	30.5	16.8	9.8	Water Supply	Commerical	margin of error : 100 m - 300 m
6700975	557593	4815704	319.2	08/19/1964	Bedrock	16.2	39.6	37.5	15.2	Water Supply	Domestic	margin of error : 100 m - 300 m
6700976	557656	4815587	317.1	09/23/1963	Bedrock	15.8	46.3	45.1	13.4	Water Supply	Industrial	margin of error : 100 m - 300 m
6701003	559373	4816782	322.5	11/16/1952	Bedrock	8.5	27.1	24.4	13.4	Water Supply	Domestic	unknown UTM
6701005	557587	4815218	312.3	10/06/1951	Bedrock	3.7	33.2	33.2	7.6	Water Supply	Domestic	unknown UTM
6701006	557714	4815143	307.2	11/10/1952	Bedrock	0.9	38.1	38.1	7.3	Water Supply	Domestic	unknown UTM
6701007	557552	4815189	312.4	08/24/1959	Bedrock	2.7	36.6	30.5	9.1	Water Supply	Domestic	margin of error : 100 m - 300 m
6701013	557724	4815080	304.2	10/21/1966	Bedrock	0.3	38.7	38.1	5.2	Water Supply	Domestic	margin of error : 100 m - 300 m
6702374	558078	4814802	299.4	08/23/1957	Overburden	0.0	11.3	11.3	4.9	Water Supply	Domestic	unknown UTM
6702379	558099	4814831	299.2	10/07/1954	Bedrock	6.1	21.9	21.3	6.1	Water Supply	Domestic	unknown UTM
6702382	558228	4814984	296.9	12/07/1966	Bedrock	5.5	31.4	31.4	8.5	Water Supply	Domestic	margin of error : 100 m - 300 m
6702383	560426	4815915	299.4	10/27/1966	Bedrock	11.3	32.0	29.9	4.6	Water Supply	Livestock	margin of error : 100 m - 300 m
6703083	557764	4815153	305.8	05/20/1968	Bedrock	0.0	31.1	31.1	1.5	Water Supply	Domestic	margin of error : 100 m - 300 m
6703318	558334	4815943	320.2	03/04/1969	Bedrock	16.2	48.8	37.5	12.8	Water Supply	Domestic	margin of error : 100 m - 300 m
6703326	558964	4816923	321.2	04/12/1969	Bedrock	11.3	30.5	29.3	2.7	Water Supply	Domestic	margin of error : 100 m - 300 m
6703467	557614	4815123	310.0	09/11/1969	Bedrock	0.0	38.7	38.7	8.2	Water Supply	Domestic	margin of error : 30 m - 100 m
6703920	557689	4815148	308.1	04/15/1971	Bedrock	0.0	38.1	36.6	3.7	Water Supply	Domestic	margin of error : 30 m - 100 m
6704020	557664	4815173	309.5	09/29/1971	Bedrock	1.5	43.3	43.3	8.5	Water Supply	Domestic	margin of error : 30 m - 100 m
6704342	558264	4816173	321.2	02/01/1972	Bedrock	12.2	32.9	19.2	10.4	Water Supply	Commerical	margin of error : 30 m - 100 m
6704359	558714	4816523	324.2	09/30/1972	Bedrock	17.4	43.3	43.3	4.6	Water Supply	Livestock	margin of error : 30 m - 100 m
6704559	557707	4815081	305.5	03/19/1973	Bedrock	0.9	29.6		3.7	Water Supply	Domestic	margin of error : 30 m - 100 m
6704635	558953	4815561	309.7	05/29/1973	Bedrock	7.3	27.7	27.7	4.6	Water Supply	Domestic	margin of error : 30 m - 100 m
6704636	558504	4815789	314.4	06/08/1973	Bedrock	8.5	28.7	28.7	6.1	Water Supply	Domestic	margin of error : 30 m - 100 m
6705230	558574	4816263	321.4	08/15/1974	Bedrock	15.2	42.7	41.1	11.6	Water Supply	Domestic	margin of error : 30 m - 100 m
6705239	557614	4815223	311.8	08/12/1974	Bedrock	3.0	43.3	43.3	10.7	Water Supply	Commerical	margin of error : 30 m - 100 m
6705289	558832	4816893	321.2	09/10/1974	Bedrock	9.1	31.1	30.5	3.0	Water Supply	Industrial	margin of error : 30 m - 100 m
6705580	558454	4816283	322.8	05/07/1975	Bedrock	11.9	61.0	30.5	10.1	Water Supply	Commerical	margin of error : 30 m - 100 m
6705611	557734	4815123	306.1	04/14/1975	Bedrock	0.3	41.1	40.8	5.5	Water Supply	Domestic	margin of error : 30 m - 100 m
6705682	557514	4815223	313.8	08/08/1975	Bedrock	4.9	31.7	31.7	9.1	Water Supply	Industrial	margin of error : 30 m - 100 m
6706927	559794	4816543	312.4	11/25/1978	Bedrock	6.4	32.6	24.7	7.6	Water Supply	Domestic	margin of error : 30 m - 100 m
6707288	558550	4816352	322.4	06/05/1980	Bedrock	13.1	40.5	21.3	9.8	Water Supply	Domestic	margin of error : 10 - 30 m
6707338	560079	4816656	307.5	10/17/1980	Bedrock	3.7	35.1	13.1	5.5	Water Supply	Domestic	margin of error : 10 - 30 m
6707516	557688	4815319	311.2	10/08/1981	Bedrock	4.6	50.0	18.3	10.1	Water Supply	Industrial	margin of error : 10 - 30 m
6707524	557707	4815039	301.1	11/06/1981	Bedrock	2.1	51.8	50.3	6.1	Water Supply	Domestic	margin of error : 10 - 30 m
6707880	558620	4816374	322.0	05/22/1984	Bedrock	13.4	23.2	23.2	14.9	Water Supply	Domestic	margin of error : 10 - 30 m
6707881	558922	4816842	321.4	04/12/1984	Bedrock	11.3	38.1	35.1	2.7	Water Supply	Domestic	margin of error : 100 m - 300 m

TABLE J2
MECP WATER WELL RECORD DATA
LAFARGE WELLINGTON COUNTY SITE

Well ID	Easting (m)	Northing (m)	Elevation (m)	Date Completed	Well Type	Depth to Bedrock (m)	Well Depth (m)	Water Found Depth (m)	Static Water Level (m)	Final Status	Well Use	UTM Reliability
6708178	557790	4815572	316.6	04/01/1985	Bedrock	10.7	30.5	28.3	9.4	Water Supply	Commerical	margin of error : 10 - 30 m
6708796	559085	4815171	297.4	03/24/1987	Bedrock	11.9	32.0	32.0	9.1	Water Supply	Domestic	unknown UTM
6710019	559834	4816465	311.3	09/09/1989	Bedrock	5.8	60.0	45.7	10.7	Water Supply	Domestic	margin of error : 10 - 30 m
6710610	560590	4816352	299.5	03/26/1991	Bedrock	20.1	36.6	36.0	0.9	Water Supply	Commerical	margin of error : 10 - 30 m
6711134	558137	4815151	297.1	05/25/1992	Bedrock	14.0	29.9	21.3	2.1	Water Supply	Domestic	margin of error : 10 - 30 m
6711314	557659	4815116	308.7	10/30/1993	Bedrock	4.3	36.0	36.0	9.4	Water Supply	Domestic	margin of error : 10 - 30 m
6711367	558153	4815055	295.8	11/02/1993	Bedrock	9.1	36.0	36.0	11.9	Water Supply	Domestic	margin of error : 10 - 30 m
6711602	558893	4816809	321.8	11/30/1994	Bedrock	13.7	36.6	36.6	18.3	Water Supply	Domestic	margin of error : 10 - 30 m
6711657	559036	4816832	321.8	11/10/1994	Bedrock	12.5	36.9	15.2	7.6	Water Supply	Domestic	margin of error : 10 - 30 m
6711882	558132	4815991	320.3	10/03/1995	Bedrock	16.8	39.6	39.6	12.2	Water Supply	Industrial	margin of error : 10 - 30 m
6711941	558276	4816094	320.2	03/11/1996	Bedrock	13.7	36.0	36.0	10.7	Water Supply	Commerical	margin of error : 10 - 30 m
6712349	558344	4815969	320.3	09/19/1997	Bedrock	16.5	43.0	42.1	15.2	Water Supply	Commerical	margin of error : 10 - 30 m
6712388	559682	4816405	312.3	11/20/1997	Bedrock	9.1	30.5	29.0	9.1	Water Supply	Domestic	margin of error : 10 - 30 m
6713644	558276	4816094	320.2	02/06/2001		0.0	0.0		0.0	Abandoned-Quality	Commerical	margin of error : 10 - 30 m
6713912	558605	4816592	325.8	10/04/2001	Bedrock	13.7	42.7	42.7	5.2	Water Supply	Commerical	margin of error : 10 - 30 m
6713962	557957	4816151	324.4	12/12/2001	Bedrock	11.0	30.5	25.0	13.7	Water Supply	Commerical	unknown UTM
6714897	557791	4815714	317.6	04/27/2004	Bedrock	10.4	48.5	47.2	11.3	Water Supply	Commerical	margin of error : 100 m - 300 m
6715311	558505	4815510	311.0	03/31/2005	Bedrock	0.6	27.4	24.4	2.4	Observation Wells		margin of error : 30 m - 100 m
6715392	558514	4815493	310.9	07/06/2005	Bedrock	0.3	21.3	16.3	2.7	Observation Wells	Not Used	margin of error : 30 m - 100 m
6715393	558512	4815499	310.9	07/06/2005	Bedrock	0.3	21.3	16.5	2.7	Observation Wells	Not Used	margin of error : 30 m - 100 m
6715445	558505	4815510	311.0	07/08/2005		0.0	90.0		0.0	Observation Wells		margin of error : 30 m - 100 m
6715461	558550	4816220	321.5	07/27/2005	Overburden	0.0	6.3		0.0	Observation Wells	Livestock	margin of error : 30 m - 100 m
6715920	557643	4815222	310.8	09/01/2006		0.0	0.0		0.0	Abandoned-Other	Not Used	margin of error : 10 - 30 m
7045188	558815	4815811	307.4	05/02/2007		0.0	3.4	1.4	0.0	Abandoned-Other		margin of error : 10 - 30 m
7045189	558814	4815812	307.4	05/02/2007		0.0	0.0	1.4	0.0	Abandoned-Other		margin of error : 10 - 30 m
7048285	557616	4815187	310.8	07/31/2007		0.0	36.6	36.6	9.8	Water Supply	Domestic	margin of error : 10 - 30 m
7164073	558781	4815704	306.9	04/29/2010		0.0	0.0		0.0			margin of error : 10 - 30 m
7201289	558934	4816927	320.9	04/01/2013		0.0	0.0		0.0	Water Supply	Industrial	margin of error : 30 m - 100 m
7207888	558922	4816899	320.8	04/15/2013		0.0	0.0		0.0			margin of error : 30 m - 100 m
7223067	559923	4816932	310.2	04/15/2013		0.0	0.0		0.0			margin of error : 30 m - 100 m
7245877	557788	4815673	317.4	06/30/2015		0.0	7.6		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7245878	557809	4815701	318.2	06/30/2015		0.0	9.1		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7247905	558925	4816935	320.8	08/24/2015		0.0	0.0		0.0	Abandoned-Other	Monitoring	margin of error : 30 m - 100 m
7248070	559882	4816642	311.5	08/04/2015		0.0	50.3		5.9	Water Supply	Domestic	margin of error : 30 m - 100 m
7253606	558931	4816937	320.9	10/06/2015		0.0	0.0		0.0	Abandoned-Other	Monitoring	margin of error : 30 m - 100 m
7254743	558786	4816269	321.5	12/03/2015		0.0	40.8		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254744	558594	4815808	311.8	12/04/2015		0.0	6.7		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254745	558461	4815448	310.5	12/07/2015		0.0	39.9		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254746	558039	4815569	313.7	12/07/2015		0.0	39.6		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254747	559915	4815769	310.4	12/04/2015		0.0	38.4		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254748	559363	4815415	301.1	12/03/2015		0.0	22.9		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m
7254758	560036	4816501	308.1	12/04/2015		0.0	27.7		0.0	Observation Wells	Monitoring	margin of error : 30 m - 100 m

TABLE J2
MECP WATER WELL RECORD DATA
LAFARGE WELLINGTON COUNTY SITE

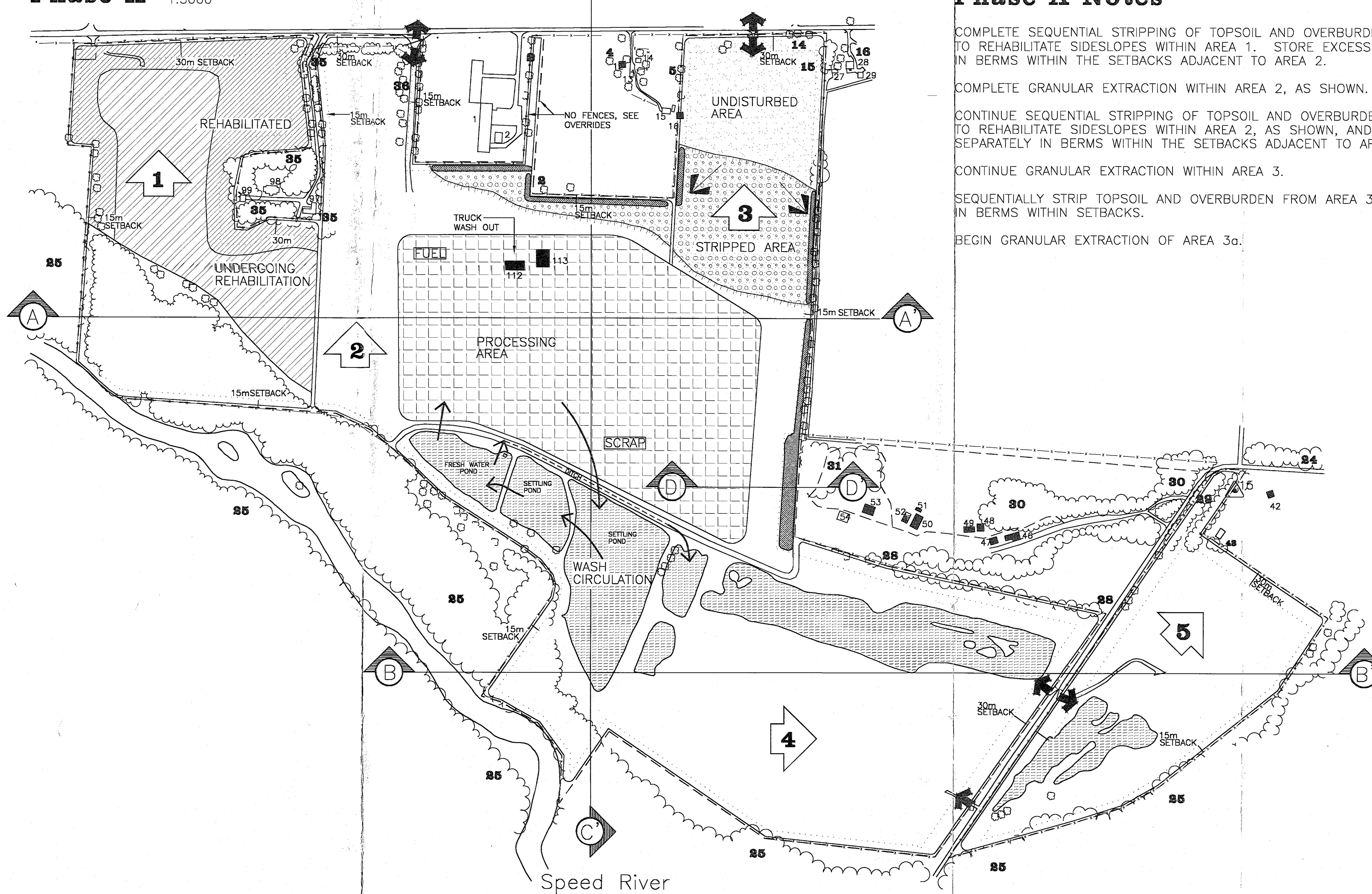
Well ID	Easting (m)	Northing (m)	Elevation (m)	Date Completed	Well Type	Depth to Bedrock (m)	Well Depth (m)	Water Found Depth (m)	Static Water Level (m)	Final Status	Well Use	UTM Reliability
7264012	559944	4815727	305.8	10/08/2015		0.0	0.0		0.0	Abandoned-Other		margin of error : 30 m - 100 m
7273131	557549	4815717	321.1	09/21/2016		0.0	30.5	27.4	11.3	Water Supply	Domestic	margin of error : 30 m - 100 m
7276390	557905	4815634	320.3	11/29/2016		0.0	30.5	30.5	14.6	Water Supply	Domestic	margin of error : 30 m - 100 m
7285095	559835	4815772	311.5	01/19/2016		0.0	20.7	14.0	3.5	Test Hole	Test Hole	margin of error : 30 m - 100 m
7285096	559447	4815465	307.9	01/21/2016		0.0	20.1	6.4	4.7	Test Hole	Test Hole	margin of error : 30 m - 100 m
7285097	559832	4815776	311.6	01/20/2016		0.0	20.7		3.5	Test Hole	Test Hole	margin of error : 30 m - 100 m
7285098	559449	4815474	308.6	01/21/2016		0.0	20.1	6.7	4.7	Test Hole	Test Hole	margin of error : 30 m - 100 m

Notes: Well details obtained from the Ministry of the Environment, Convservation and Parks Water Well Record Database
Wells are within 500 m of the property boundary

APPENDIX K

Operational Site Plans

Phase A 1:5000



Phase A Notes

COMPLETE SEQUENTIAL STRIPPING OF TOPSOIL AND OVERBURDEN FROM AREA 2 AND USE TO REHABILITATE SIDESLOPES WITHIN AREA 1. STORE EXCESS MATERIAL SEPARATELY IN BERMS WITHIN THE SETBACKS ADJACENT TO AREA 2.

COMPLETE GRANULAR EXTRACTION WITHIN AREA 2, AS SHOWN.

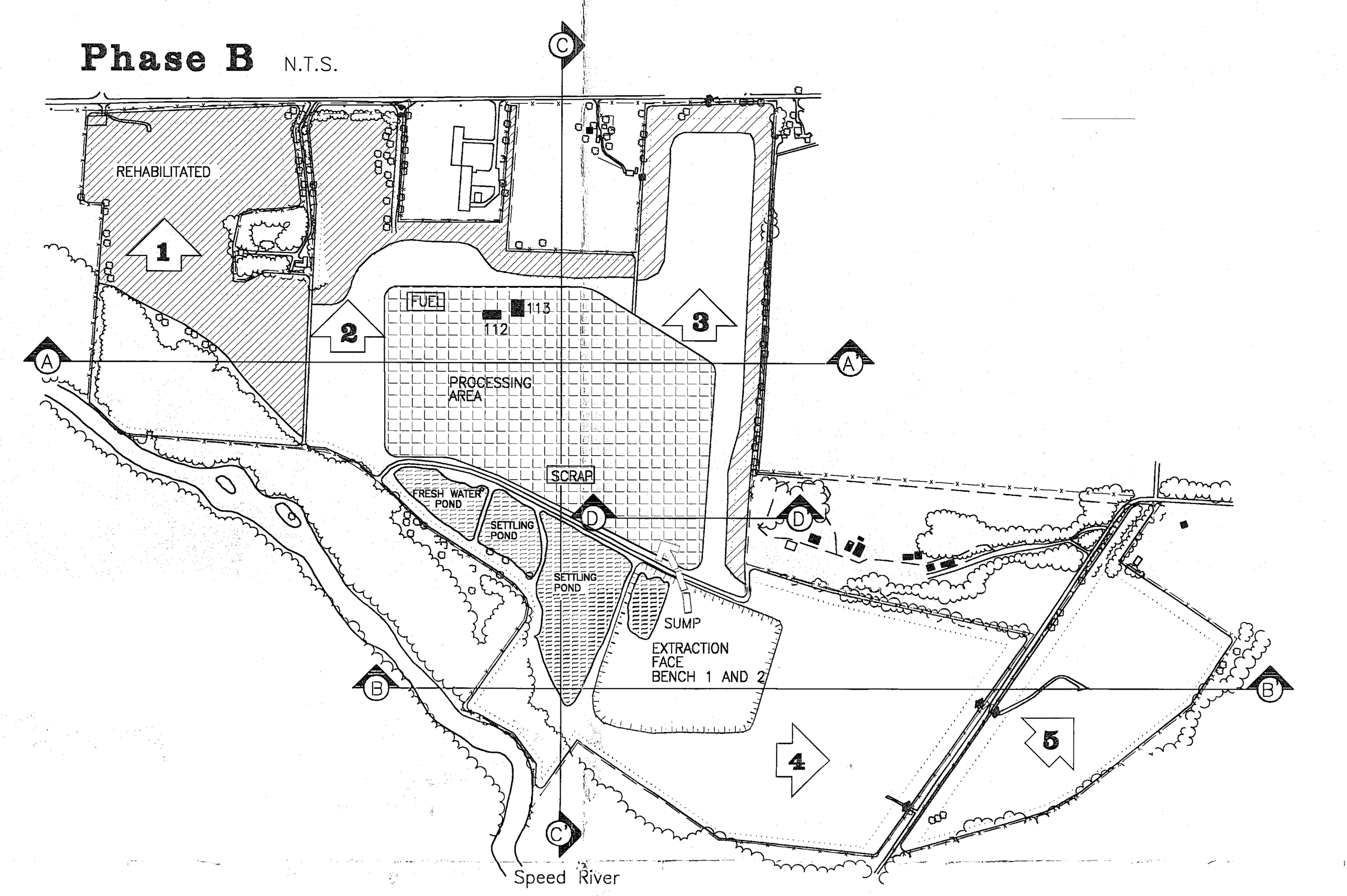
CONTINUE SEQUENTIAL STRIPPING OF TOPSOIL AND OVERBURDEN FROM AREA 3 AND USE TO REHABILITATE SIDESLOPES WITHIN AREA 2, AS SHOWN, AND STORE EXCESS MATERIAL SEPARATELY IN BERMS WITHIN THE SETBACKS ADJACENT TO AREA 3.

CONTINUE GRANULAR EXTRACTION WITHIN AREA 3.

SEQUENTIALLY STRIP TOPSOIL AND OVERBURDEN FROM AREA 3a AND STORE SEPERATELY IN BERMS WITHIN SETBACKS.

BEGIN GRANULAR EXTRACTION OF AREA 3a.

Phase B N.T.S.



Phase B Notes

COMPLETE SEQUENTIAL STRIPPING OF TOPSOIL AND OVERBURDEN FROM AREA 3.

COMPLETE GRANULAR EXTRACTION OF AREA 3a.

COMPLETE GRANULAR EXTRACTION WITHIN AREA 3.

BEGIN QUARRY EXTRACTION OF BENCH 1 AND 2 WITHIN AREA 4, IN DIRECTION SHOWN, TO DEPTH INDICATED ON FINAL REHABILITATION PLAN.

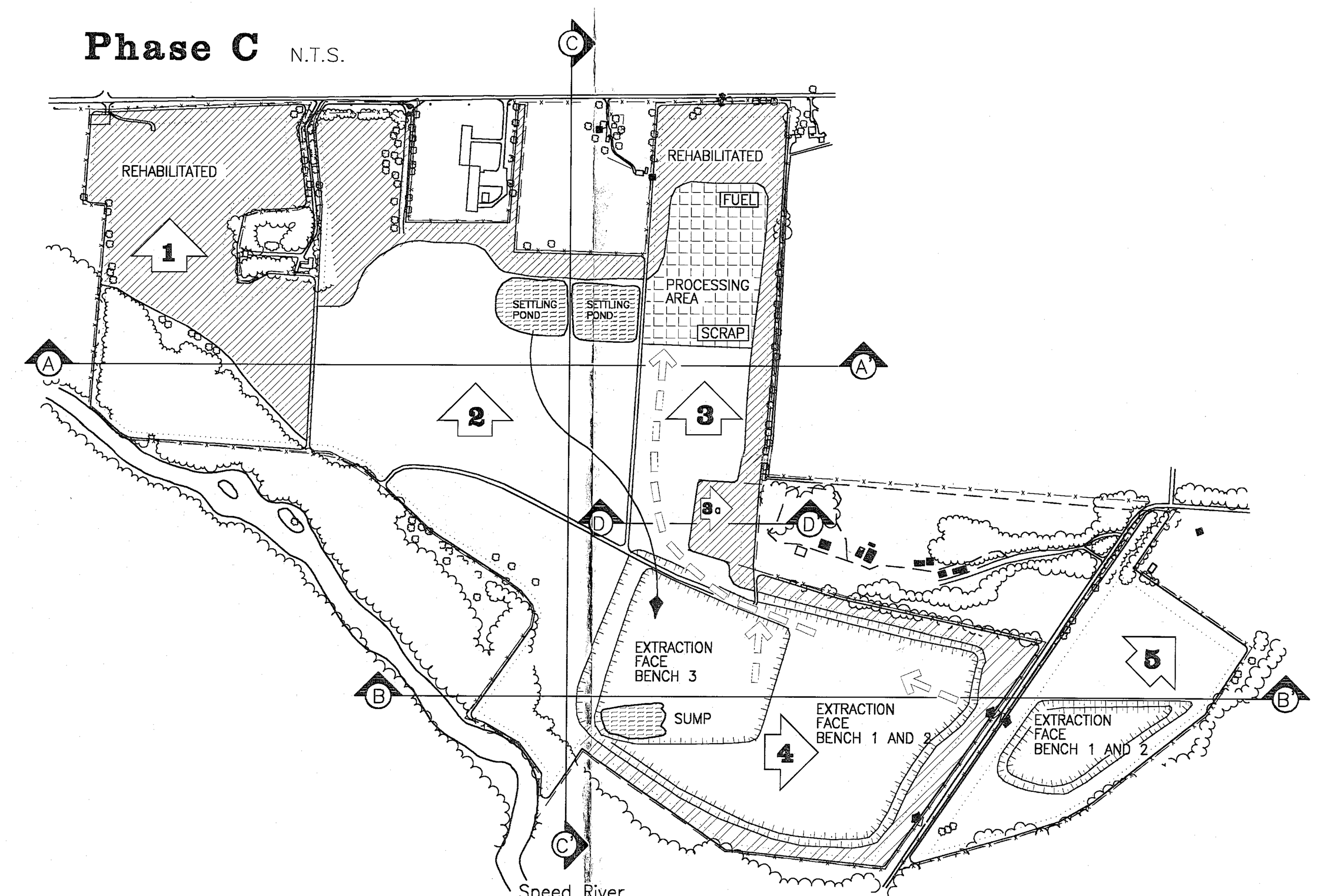
COMPLETE REHABILITATION OF SIDESLOPES WITHIN AREA 2, AS SHOWN. SIDESLOPES TO BE BACKFILLED WITH SILT AND OVERBURDEN FROM ON SITE SOURCES. STOCKPILED TOPSOIL STORED IN BERMS WILL BE SPREAD ON SIDESLOPES PRIOR TO SEEDING. SEE NOTE #5, DRAWING 3, FOR FURTHER DETAIL.

QUARRY WATER IS CIRCULATED THROUGH EXISTING SILT POND SYSTEM.

BEGIN REHABILITATION OF SIDESLOPES WITHIN AREA 3 USING TOPSOIL AND OVERBURDEN STORED IN BERMS.

BEGIN REHABILITATION OF SIDESLOPES WITHIN AREA 3a USING TOPSOIL AND OVERBURDEN STORED IN BERMS.

Phase C N.T.S.



Phase C Notes

COMPLETE QUARRY EXTRACTION OF BENCHES 1 AND 2 WITHIN AREA 4.

COMPLETE REHABILITATION OF AREA 3A AND SIDESLOPES WITHIN AREA 3 AS SHOWN. SIDESLOPES TO BE BACKFILLED WITH SILT AND OVERBURDEN FROM ON SITE SOURCES. STOCKPILED TOPSOIL STORED IN BERMS WILL BE SPREAD ON SIDESLOPES PRIOR TO SEEDING. SEE NOTE #5, DRAWING 3, FOR FURTHER DETAIL.

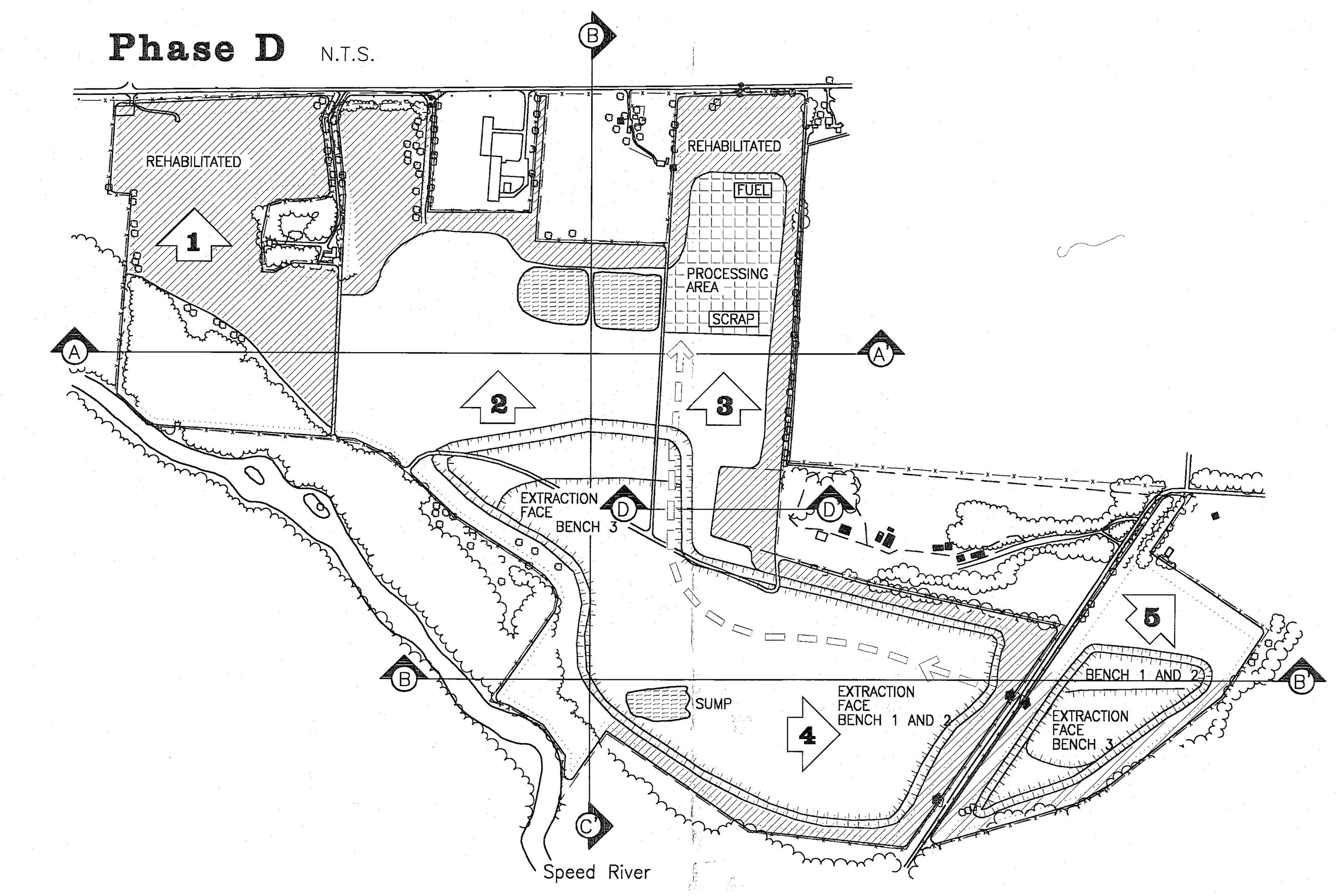
BEGIN REHABILITATION OF SIDESLOPES WITHIN AREA 4 USING TOPSOIL AND OVERBURDEN STORED IN BERMS.

BEGIN QUARRY EXTRACTION OF BENCH 3 WITHIN AREA 4 TO DEPTH INDICATED ON THE FINAL REHABILITATION PLAN.

REMOVE EXISTING SILT POND SYSTEM AND RECONSTRUCT THE SETTLING PONDS WITHIN AREA 2, AS SHOWN. FRESH WATER WILL FLOW BACK INTO EXISTING QUARRY SUMP AS SHOWN.

RELOCATE PROCESSING AREA TO AREA 3, AS SHOWN.

Phase D N.T.S.



Phase D Notes

COMPLETE QUARRY EXTRACTION OF BENCH 3 WITHIN AREA 4.

COMPLETE REHABILITATION OF SIDESLOPES WITHIN AREA 4. SIDESLOPES TO BE BACKFILLED WITH SILT AND OVERBURDEN FROM ON SITE SOURCES. STOCKPILED TOPSOIL STORED IN BERMS WILL BE SPREAD ON SIDESLOPES PRIOR TO SEEDING. SEE NOTE #5, DRAWING 3 FOR FURTHER DETAIL.

COMPLETE QUARRY EXTRACTION OF BENCHES 1 AND 2 WITHIN AREA 5.

BEGIN REHABILITATION OF SIDESLOPES WITHIN AREA 5 USING TOPSOIL AND OVERBURDEN STORED IN BERMS.

BEGIN QUARRY EXTRACTION OF BENCH 3 WITHIN AREA 5 TO DEPTH INDICATED ON FINAL REHABILITATION PLAN.

CONTINUE SEQUENTIAL QUARRY EXTRACTION THROUGH AREAS 3, 2, AND 1, RESPECTIVELY, TO DEPTHS INDICATED ON FINAL REHABILITATION PLAN.

REHABILITATION OF SIDESLOPES TO 3:1 SLOPES SHALL BE COMPLETED TO 1 METRE BELOW WATER TABLE (±298.0m A.S.L.). SIDESLOPES BELOW THE WATER TABLE SHALL BE REHABILITATED TO A VERTICAL FACE OR SLOPED AT 2:1 GRADE TO BOTTOM ON BENCH 1(SEE DRAWING 4 FOR FURTHER DETAILS

Phase E Notes (not shown)

COMPLETE QUARRY EXTRACTION OF BENCH 3 WITHIN AREA 5.

COMPLETE REHABILITATION OF SIDESLOPES WITHIN AREA 5. SIDESLOPES TO BE BACKFILLED WITH SILT AND OVERBURDEN FROM ON SITE SOURCES. STOCKPILED TOPSOIL STORED IN BERMS WILL BE SPREAD ON SIDESLOPES PRIOR TO SEEDING. SEE NOTE #5, DRAWING 3, FOR FURTHER DETAILS.

COMPLETE QUARRY EXTRACTION WITHIN AREAS 1, 2, AND 3.

REHABILITATE QUARRY FLOOR USING PILES OF CRUSHED STONE, STUMPS AND LOGS.

REMOVE ALL BUILDINGS AND EQUIPMENT FROM LICENSED PROPERTY.

COMPLETE REHABILITATION OF PROCESSING AREA AND HAUL ROUTES.

DISCONTINUE DEWATERING ACTIVITY.

Legend

- BOUNDARY OF LICENCED AREA
- SETBACK
- 1.2 m POST & WIRE FENCE
- SCRAP FUEL — STORAGE OF FUEL AND/OR SCRAP MATERIAL
- BERM
- DIRECTION OF EXTRACTION
- SECTION LINE
- HAUL ROUTE
- TOPSOIL/OVERBURDEN MOVEMENT
- WASH CIRCULATION ARROWS
- ---- DITCH ---- WASH CIRCULATION DITCH
- UNDISTURBED AREA
- REHABILITATED AREA
- UNDERGOING REHABILITATION
- STRIPPED AREA
- OPEN WATER
- PROCESSING AREA
- EXISTING ENTRANCE/EXIT WITH 1.2m GATE
- EXISTING BUILDINGS
- EXTRACTION FACE
- 1.2m GATE
- OVERLAND DRAINAGE ARROW

Notes

1. THIS PLAN DEPICTS A SCHEMATIC OPERATIONS SEQUENCE FOR THESE PROPERTIES BASED UPON THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION. PHASES SHOWN ARE SCHEMATIC AND MAY VARY SLIGHTLY WITH DEMAND. PHASES DO NOT REPRESENT ANY SPECIFIC OR EQUAL TIME PERIOD. ANY MAJOR DEVIATIONS FROM THE OPERATIONS SEQUENCE SHOWN WILL REQUIRE APPROVAL OF MNR.

2. TOPOGRAPHIC INFORMATION WAS PREPARED THROUGH AIR PHOTO INTERPRETATION BY NORTHWAY MAP TECHNOLOGY, DON MILLS, ONT., DATED OCTOBER 5, 1992. TOPOGRAPHIC INFORMATION WITHIN THE 500m BOUNDARY OBTAINED FROM ONTARIO BASE MAPS 10–17–5550–48150, 10–17–5600–48150, 10–17–5550–48100, AND 10–17–5600–48100.

3. REFER TO DRAWING 1, EXISTING FEATURES, FOR DESCRIPTIONS OF EXISTING TREES.

4. REFER TO DRAWING 1, EXISTING FEATURES, FOR A DESCRIPTION OF BUILDINGS WITHIN THE LICENSED BOUNDARY AND WITHIN THE 500 METRE BOUNDARY.

5. SITE PLAN OVERRIDES ARE LISTED IN A TABLE ON DRAWING 1, EXISTING FEATURES.

6. THE LICENSED AREAS ARE PRESENTLY FENCED WITH A 1.2m POST AND WIRE FENCE EXCEPT FOR INSTANCES NOTED IN THE SITE PLAN OVERRIDE TABLE.

7. TOPSOIL AND OVERBURDEN SHALL BE STRIPPED AND STORED SEPARATELY IN BERMS OR STOCKPILES. BERMS AND STOCKPILES IF TOPSOIL SHALL BE GRADED TO STABLE SLOPES AND SEEDED TO PREVENT EROSION AND MINIMIZE DUST.

8. BERMS SHALL CREATE AN EFFECTIVE VISUAL BARRIER TO A MINIMUM OF 3.5m ABOVE EXISTING GRADE AND SIDE SLOPES SHALL NOT EXCEED 2:1. REFER TO TYPICAL BERM CROSS SECTION DETAIL ON DRAWING 3, PROGRESSIVE REHABILITATION AND FINAL REHABILITATION PLAN. ALL VEGETATION PLANTED DURING THE OPERATION OF THIS LICENCE WILL BE MAINTAINED IN A HEALTHY VIGOROUS GROWING CONDITION. DEAD PLANTS WILL BE REPLACED WITHIN TWO YEARS.

9. EXTRACTION OF AGGREGATES ABOVE THE WATER TABLE IS BY FRONT END LOADER. PERMANENT PROCESSING EQUIPMENT USED ON SITE CONSISTS OF 4 CRUSHERS, 5 SCREENS, STACKERS, A WASH PLANT AND AN ASPHALT PLANT. PROCESSING MAY INCLUDE INTERNAL HAULAGE BY CONVEYOR, CRUSHING, SCREENING, WASHING, BLENDING, STACKING AND LOADING FOR DELIVERY BY TRUCK. EXTRACTION OF AGGREGATES ABOVE THE WATER TABLE WILL TAKE PLACE IN 1 10m LIFT. STONE EXTRACTION SHALL EXTEND BELOW THE WATER TABLE TO A MAXIMUM DEPTH OF ±280.0m A.S.L., AND WILL CONSIST OF 3 6m BENCHES. UNDERWATER STONE EXTRACTION IS BY DRILLING AND BLASTING, DEWATERING, AND TRANSFER TO CONVEYOR OR TRUCKS IS BY FRONT END LOADER. REFER TO SECTIONS A–A', B–B',C–C' AND D–D' ON DRAWING 4 FOR FURTHER DETAILS.

   PROCESSING EQUIPMENT, STACKERS AND MATERIAL STOCKPILES WILL NOT EXCEED 20 METRES IN HEIGHT.

   THERE SHALL BE NO DIRECT OFFSITE DISCHARGE OF PROCESSING WATER.

   THE WASH PROCESS WILL CIRCULATE AS SHOWN ON THE PHASING DIAGRAMS. WASH WATER WILL BE CONTAINED IN SILTATION PONDS. DURING PHASES D, E AND F, FRESH WATER FOR THE PROCESSING PLANT WILL BE PUMPED FROM THE SUMP SHOWN IN AREA 4.

   CLEAN FILL MAY BE IMPORTED INTO THIS SITE FOR REHABILITATION PURPOSES.

   MATERIAL FROM OTHER LICENCED PROPERTIES OF STANDARD AGGREGATES MAY BE USED AT THIS SITE FOR BLENDING AND CUSTOM PRODUCTS. MATERIAL USED FOR RECYCLING SHALL BE STOCKPILED IN THE PROCESSING AREA. ALL MATERIALS USED FOR PROGRESSIVE AND FINAL REHABILITATION WORK WILL BE FROM AN ON–SITE SOURCE.

10. THE WATER TABLE ELEVATION ON THIS PROPERTY IS +\– 298 METRES A.S.L. BASED ON THE ORIGINAL SITE PLANS BY W.E.COATES AND ASSOC. AS WELL AS ON SITE WATER LEVELS.

11. FUEL STORAGE SHALL BE IN ABOVE AND BELOW GROUND CONTAINERS WITHIN PROCESSING AREA AND SHALL MEET THE REQUIREMENTS OF THE GASOLINE HANDLING ACT, 1980, AND THE GASOLINE HANDLING CODE AND REGULATIONS, 1980, OR AS AMENDED BY THE TECHNICAL STANDARDS AND SAFETY ACT (TSSA) AND LIQUID FUELS HANDLING CODE. REFUELLING SHALL BE WITHIN A CONTAINMENT PAD AND ANY SPILLS SHALL BE REMOVED AND DISPOSED OF AT AN APPROPRIATE FACILITY.

12. SCRAP WILL BE STORED ON SITE IN THE SCRAP STORAGE AREA AND DISPOSED OF ON A REGULAR BASIS. STUMPS AND LOGS MAY REMAIN ON SITE FOR FUTURE PROGRESSIVE AND FINAL UNDERWATER REHABILITATION.

13. DESPITE APPROVALS PROVIDED BY THIS SITE PLAN, COMPLIANCE WITH OTHER PROVINCIAL AND FEDERAL LEGISLATION IS REQUIRED.

14. REFER TO DRAWING 3, PROGRESSIVE REHABILITATION AND FINAL RE–HABILITATION PLAN, FOR FURTHER DETAIL ON REHABILITATION OF SIDESLOPES.

Pre Licence Review

NO.	DATE	REVISION			
3	JUNE 1994	AS PER M.N.R. COMMENTS			
2	APRIL 1994	AS PER M.N.R. AND CLIENT COMMENTS			
1	JUNE 1993	UPDATE TO AGGREGATE RESOURCES ACT.			

Site Plan Amendments

NO.	DATE	REVISION	OWNER	H.H.	MNR
2	SEPT 2006	ADDED BUILDING #112 &113. DEMARCATED BUILDING #109 AND 110 AS DISMANTLED IN BUILDING LIST. REVISED NOTE OPERATIONS NOTE#11.			
1	NOV 2000	FENCE OVERRIDE 1 ADDED. PROCESSING AREA EXPANDED. INERT FILL FOR REHAB. REDUCE INTERNAL SETBACK TO 15m.			

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Fax: (905) 294–7623
Offices in Markham and Cambridge

PROJECT NAME

GUELPH PLANT

LICENCE NUMBER 5514

PARTS OF LOTS 4, 5, 6, 7, 8, AND 9, CONCESSIONS 1, 2, AND 3, DIVISION B, TOWNSHIP OF GUELPH, AND PARTS OF LOTS 7, 8, 9, 10, AND 11, CONCESSIONS 5 AND 6, TOWNSHIP OF PUSLINCH.

LAFARGE
LAFARGE CANADA INC.
7880 KEELE STREET
CONCORD, ONTARIO
L4K 4G7
Telephone: (905) 738–7070

SCALE 1:5000

0 125 250 400m

NORTH

ONTARIO ASSOCIATION OF LANDSCAPE ARCHITECTS
RICHARD MCAVAN
MEMBER

DRAWING STATUS			
FINAL			
DRAWN BY	CHECKED BY	ISSUE DATE	PROJECT NO.
R.J.P.	M.M.	JUNE 1993	90-48

DRAWING TITLE

OPERATIONAL PLAN

DRAWING NO. **2 OF 4**

THESE SITE PLANS MEET THE REQUIREMENTS OF THE AGGREGATE RESOURCES ACT. FEB 14/07

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