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October 03, 2022

Ms. Debra Walker MHBC Planning 7050 Weston Road, Suite 230 Woodbridge, ON L4L 8G7

Subject: Response to JART Hydrogeological Comments Proposed Upper's Quarry WSP Project No. 161-11633-03

Dear Ms. Walker:

We are pleased to provide our response to agency review comments on the WSP Canada Inc. (WSP) Level 1 and 2 Water Report for the proposed the proposed Upper's Quarry (Site).

The Level 1 and 2 Water Report and Maximum Predicted Water Table Report (WSP, October 2021) were submitted as part of the ARA Licence Application package in 2021. A number of comments related to the reports were provided by the Joint Agency Review Team (JART) in their correspondence dated August 23, 2022. Comments from the peer reviewer (Terra-Dynamics Consulting Inc.) and Niagara Peninsula Conservation Authority (NPCA) staff related to the Level 1 and 2 Water Report are provided in Appendix 4 of the JART correspondence and reproduced below in blue font. WSP responses to the comments are provided.

A number of tables and figures from the Level 1 and 2 Water Report have been revised as part of this response to comments. References to this appended material are also provided in the response to comments below.

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PEER REVIEW COMMENTS (TERRA-DYNAMICS CONSULTING INC.)

1. S. 3.1 Field investigations – The field investigations followed standard acceptable industry practice, however it is recommended borehole logs that are final have the "draft" watermark removed in the report.

Agreed. Finalized borehole logs (i.e., **Appendix C-1**) are appended to this memorandum.

- 2. S. 3.1.1 Water Quality:
 - a. The summary of the 2019 PW1 Pumping Test Discharge as presented on page 55 of Section 4.1.2.2 utilizes values from four different sample dates without explanation of presentation (e.g. pH and calcium from February 22, 2019, hardness, chloride, sodium, boron and iron from February 23, 2019, sulphate and alkalinity from February 24, 2019 and hydrogen sulphide from February 26, 2019), please clarify the data selection procedure for this table.

The table from page 55 of **Section 4.1.2.2** is reproduced below. The values included in the column representing the 2019 PW1 Pumping Test Discharge are the median concentrations of the seven (7) samples obtained during the pumping test, as shown in **Table D.7.2**. The column title has been clarified as "median" in the reproduced table below.

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		2019 PW1		Ва	aseline Me	edian	
Parameter	PWQO	Pumping Test Discharge Median	Surface Water	Contact Aquifer	Shallow Bedrock Aquifer	Goat Island Member Bedrock	DeCew / Rochester Formation Bedrock
General Parameters							
pH (lab) (pH units)	6.5 – 8.5	7.52	7.98	7.90	7.64	7.52	6.68
Total Dissolved Solids			273	982	951	13,200	127,500
Total Suspended Solids		<2 – 14	27				
Hardness		824	215	710	730	3,500	44,000
Turbidity	(a)	Visually clear	32				
Hydrogen Sulphide (undissociated)	0.002	3.7		<0.005	0.9	0.6	1.8
Major Ions							
Chloride		150	85	46	74	9,000	75,500
Sulphate		352	68	240	310	780	1,000
Alkalinity	(b)	443	125	440	420	230	99
Calcium		188	55	98	140	950	9,350
Magnesium		88	17	110	91	270	4,850
Sodium		80	53	65	47	3,600	29,500
Potassium		4.0	4.0	3.2	3.1	51	435
Nutrients							
Nitrate			0.4	0.3	<0.1	<0.1	<1
Un-ionized Ammonia	0.02	<0.001	<0.001				
Total Phosphorus	0.03		0.14	0.80	0.07	0.30	0.40
Metals *							
Aluminum	0.075	<0.01	0.009	0.006	<0.005	<0.005	<0.175
Boron	0.2	0.15	0.03	0.04	0.06	0.92	3.2
Total Chromium	0.0089	<0.001	<0.005	<0.005	<0.005	<0.025	<0.175
Cobalt	0.0009	<0.0002	0.0009	<0.0005	<0.0005	<0.0025	<0.0175
Copper	0.005	<0.001	0.0054	0.001	<0.001	<0.005	<0.035
Iron	0.3	0.73	2.15	<0.1	<0.1	<0.5	1.3
Lead	0.025	<0.001	0.0013	<0.0005	<0.0005	<0.0025	<0.0175
Molybdenum	0.04	<0.005	0.0008	0.0032	<0.0005	<0.0025	<0.0175
Nickel	0.025	<0.005	0.004	0.001	<0.001	<0.005	<0.035
Uranium	0.005		0.0008	0.0091	0.0018	0.008	<0.0015
Vanadium	0.006	<0.001	0.0030	0.0014	<0.0005	<0.001	<0.0175
Zinc	0.03	<0.01	0.010	0.011	<0.005	<0.025	<0.175

Notes: Concentrations in mg/L unless otherwise noted.

PWQO – Provincial Water Quality Objectives (MECP 1994 and updates)

Shaded values exceed the PWQO.

(a) Turbidity does not have a firm objective

(b) Alkalinity should not decrease by more than 25% of the natural concentration

* Total metals concentrations shown for 2019 pumping test and baseline surface water median; dissolved

metals concentrations shown for baseline groundwater median.



b. The Provincial Water Quality Objective for nickel of 0.025 µg/L is missing from surface water quality table criteria, please add and discuss any exceedances (MECP, 1994).

Agreed. **Table G-1** has been revised to include the PWQO for nickel, please see attached. Only one (1) exceedance of the nickel PWQO was observed during the baseline monitoring period, at DP1 on May 1, 2017. This single exceedance suggests that locally, background nickel PWQO exceedances in surface water are not a widespread or continuous water quality concern.

- 3. S. 3.1.2 Groundwater Levels:
- a. The water levels at groundwater monitoring wells MW5A-GP and MW5AR-GP are different by approximately 3-4m. Is the difference between the two monitors believe related to gas production or another cause?

Natural gas has been observed at both MW16-5A and MW16-5AR, although qualitatively, a greater amount of gas has been noted by WSP at MW16-5AR. We are unable to provide a definitive conclusion as to the difference in water levels between these two wells based on the available data. However, we would agree that a greater rate of natural gas infiltration to MW16-5AR could be the cause of the elevated water levels. The seasonal water level pattern at MW16-5AR is similar to that of MW16-5A, albeit at a higher elevation.

b. Also, it is recommended a different colour line be used for one of the Gasport monitors on Figure E-6 in order to distinguish between locations (Groundwater Hydrograph for Well Nest MW16-5).

Agreed. **Figure E-6** has been revised to distinguish the graph colours for MW16-5A and MW16-5AR, please see attached.

c. It is recommended, if appropriate, that MW16-6A be listed in Section 2.5.2.4 (Page 30) as having slow water level recovery inhibiting specific interpretation.

Agreed. The third paragraph of **Section 2.5.2.4** (on page 30) should be revised as follows (underlined for emphasis):

"The majority of the deep bedrock aquifer wells show no response to precipitation events. Long recovery periods of a year or more following sampling are observed at most wells. Following the April 2018 sampling event, groundwater levels in most deep bedrock aquifer wells appear to have stabilized to static conditions and indicate a muted response to seasonal fluctuations observed in the overlying hydrostratigraphic units. Slow water level recovery at <u>MW16-6A</u>, MW16-9A, MW16-10A and MW16-13A inhibits specific interpretation with the available data set."

d. It is recommended to fix what appears to be a typographical error (page 33, Section 2.5.3.1, underlined added here for clarity): "These observations show that an <u>upward</u> vertical gradient between the contact aquifer and the Existing Watercourse exists at MW16-16/DP3 near the south end of the Site, except for the summer months when an <u>upward</u> hydraulic gradient occurs."

Agreed. The last sentence of the second paragraph of **Section 2.5.3.1** (on page 33) should be revised as follows (underlined for emphasis):



"These observations show that an upward vertical gradient between the contact aquifer and the Existing Watercourse exists at MW16-16 / DP3 near the south end of the Site, except for the summer months when <u>a</u> <u>downward</u> hydraulic gradient occurs."

4. S. 3.1.3 Surface Water – The calculation of 35 mm/year of runoff at SW1 for 2017 (page 13, Section 2.3.1) is incredibly low compared to existing reporting for the area (e.g. 288 mm/year and 196 mm/year for NPCA catchments BDSC_BRDC_W100 and W200, respectively, AquaResource Inc. and NPCA, 2009). It is acknowledged that WSP has already provided clarification by email to Terra-Dynamics of the surface water flow measurement challenges at this station that may have erroneously influenced calculation of flows from stage measurements (WSP, 2022). It is recommended that this value be removed given it appears unrealistic. It is also consequently recommended the analyses in the second last paragraph of Section 2.3.1 with respect to Site recharge rates in 2017 be reworded based on removal of this low value.

Agreed. The fourth paragraph of **Section 2.3.1** (on page 13) should be revised as follows (underlined for emphasis):

"Station SW1 monitors flow along Beaverdams Creek from the east of the Site. None of the flow passing though this station originates from the Site itself, and this station is considered a background / upstream monitoring station for the Beaverdams Creek reservoir / wetland complex present to the north of the Site. The catchment area for this upstream station is approximately 3.26 km². The hydrograph on **Figure E-26** shows that flow within this upstream branch of the Beaverdams Creek is intermittent, with flow occurring only following large precipitation or melt events. During 2017, the estimated total flow at SW1 is approximately 112,844 cubic metres (m³), with daily average flow rates ranging between 150 L/s to no measurable flow. When the catchment area is considered, this results in a total runoff of 35 mm/year. As shown on **Table I-12**, the estimated water surplus during 2017 is about 474 mm. Therefore, a runoff coefficient of 7% is calculated for 2017. <u>It is noted that the calculated runoff appears to be erroneously low compared to published NPCA values, which WSP attributes to underestimation of flows measured in the field due to the presence of thick vegetation in the creek. Therefore, this calculated runoff value is not considered further in the analysis."</u>

Furthermore, the second last paragraph of **Section 2.3.1** (on page 15) should be revised as follows (underlined for emphasis):

"It is noted that the published runoff values for the study area (AquaResource Inc. and NPCA, 2009) range between 196 mm/year and 288 mm/year. Excluding the erroneous value calculated for SW1, the 2017 runoff amounts calculated for the SW2, SW3 and SW4 catchment areas are between 114 mm/year and 317 mm/year, similar to the published range."

- 5. S. 3.2 Identification of Features features were adequately identified. However, it is recommended
 - a. Figures 16 through 21 not truncate well identifiers;

Agreed. Figures 16 through 21 have been revised, please see attached.

b. References to the 'Brown Road Landfill' (Sections 2.4.1, Table C-2, Figure 8 and Figures H-1 and H-4) be changed to the 'Cytec Canada Inc. Welland Plant Site', as the 'Brown Road Landfill' is only a small part of that site; and



Agreed. Figures 8, H-1 and H-4 and Table C-2 have been revised, please see attached. In addition, references to "*Brown Road Landfill Site*" (two in Section 2.4.1 on page 16 and one in Section 2.4.2.1 on page 19) should be revised to read "*Cytec Canada Inc. Welland Plant Site*".

c. Section H.4.3.1, 3rd paragraph reference Figure 9, not Figure 8, with respect to the Welland Canal.

Agreed. The first sentence of the third paragraph of **Section H.4.3.1** (on page H-13) should be revised as follows (underlined for emphasis):

"The Welland Canal is located west of the Site and is shown on the conceptual east-west cross section (*Figure 9* of the main report)."

- 6. S. 3.3 Monitoring, Trigger Mechanisms and Contingency Plans The proposed groundwater monitoring and response program is acceptable:
 - a. However, it is recommended that clarification be provided with respect to the specific meaning of the columns "Interpolated" and "Predicted" on Tables 2 and 3 as it is not clear.

Interpolated available drawdown was defined earlier in **Section 2.5.4.5** (on page 42), but we agree that a reference should have been included in **Section 5.2.2** for improved clarity. The interpolated available drawdown in the shallow and deep bedrock aquifers was calculated using ArcGIS by subtracting the elevation of the interpolated lower contact of the Gasport member bedrock from the potentiometric surface elevation shown on **Figure 15**. The interpolated available drawdown is shown in **Figure 24**.

The predicted available drawdown was defined in **Section 4.1.1.1** (on page 51), and again, we agree that a reference should have been included in **Section 5.2.2** for improved clarity. Numerical groundwater modeling was completed to simulate the predicted available drawdown in the shallow and deep bedrock aquifers as a result of the proposed quarry dewatering during the drier summer and fall months as shown on **Figure 26**.

Both the interpolated and predicted available drawdown from **Figures 24 and 26** are provided for each well location included on **Tables 2 and 3**.

Also, it is acknowledged that WSP (2021a) has stated that "There is currently limited continuous water level data for most private wells", but a specific reason was not provided for the discontinuous hydrographs for private well monitoring locations R1, R2, R3, R4 and R7. Please clarify if these locations are still appropriate for listing on the Proposal Monitoring Program (Table 1) given collection of baseline background water levels appear incomplete.

We can confirm that R1, R2, R3, R4 and R7 are still equipped with data loggers and are included in the on-going monitoring program. Data logger downloads were only completed at R5, R6, R8 and R12 in July 2020, during the early portion of the Covid-19 pandemic. Data loggers were not downloaded at the remaining private wells at that time in order to limit potential contact between WSP staff and the well owners. The most recent download of all residential wells was completed in August 2022.

NPCA STAFF COMMENTS

7. Section 2.5.3 Groundwater / Surface Water Interaction – The NPCA offers no objection to the conclusion that the site's surface water features are underlain with a thick layer of silt and clay. As



such, the surface water features are not anticipated to be impacted by the quarry dewatering as there is minimal groundwater/surface water interaction occurring.

Acknowledged.

8. Section 2.5.3.1 Existing Watercourse and Associated Wetland Complex – The NPCA offers no objection to the conclusion that the site's surface water and wetland features are underlain with a thick layer of silt and clay. As a result, there is minimal groundwater/surface water interaction occurring in these features.

Acknowledged.

9. Section 2.6.1 Groundwater Quality – The NPCA offers no objection to the characterization of the quality of the groundwater in the area. Within the shallow overburden, groundwater is fresh and similar in quality to precipitation. Within the bedrock aquifers, the groundwater varies between fresh and sulfur type waters.

Acknowledged.

10. Section 2.6.3 Surface Water Quality – The NPCA offers no objection to the conclusion that the ambient surface water quality is generally in poor condition and is typically turbid with elevated nutrient loads.

Acknowledged.

11. Section 3.1 Proposed Development Phases – The NPCA has no general objection to the proposed phasing of this development.

Acknowledged.

12. Section 4.1.2.1 Impact Assessment Surface Water Flow – The NPCA understands that during the quarry's operational life approximately 50L/s (4,268 cubic meters/day) will be discharged from the quarry into the receiving watercourse. The NPCA will require that an erosion assessment be undertaken in order to determine the impact of these discharge rates and volumes on the receiving watercourse.

The impacts of future quarry discharge on erosion in the designed watercourse channel are addressed by others (Stantec) in the report accompanying the Licence application.

13. Section 4.1.2.2 Impact Assessment Surface Water – The NPCA has no objection to the comparison between the quality of the surface water and the local groundwater regime. Staff note that the groundwater contains elevated levels of Hydrogen Sulphide.

Acknowledged.

14. Section 4.1.2.2 Impact Assessment Surface Water – Staff have no objection to the conclusion that the proposed quarry discharge into the existing watercourse is predicted to generally improve the surface water quality in the watercourse downstream of the site. However, NPCA staff still remain



concerned about the ability of this development to mitigate the elevated levels of Hydrogen Sulphide prior to discharge into the watercourse.

Acknowledged.

15. Section 4.2 Final Rehabilitation Conditions – NPCA staff offer no objection to the proposal that the quarry be rehabilitated as a series of lakes from an engineering perspective.

Acknowledged.

16. Section 5.1 Proposed Monitoring Program – NPCA staff have no objection to the proposed monitoring plan as described in Table 1 and Figure 29. However, with respect to preventing elevated levels of Hydrogen Sulphide from being discharged for a prolonged period of time into the existing watercourse, Staff would recommend that the Quarry Sump Discharge be sampled at least once a week for this parameter.

Paragraph 7 of **Section 5.4** (on page 67) outlines the quarry discharge trigger mechanism with respect to hydrogen sulphide. Routine monthly sampling is recommended, with weekly confirmatory sampling completed in the event of a trigger exceedance. This proposed routine sampling frequency for hydrogen sulphide is consistent with the Environmental Compliance Approval for Industrial Sewage Works (ECA) no. 4148-89YHGE for the closest known quarry where hydrogen sulphide is included as a trigger for quarry discharge.

17. Section 5.4 Discharge Trigger Mechanism and Contingency Plan:

a. NPCA has no objection to the proposed trigger concentrations.

Acknowledged.

b. Staff recommend that the trigger mechanism for total phosphorus be added. The trigger concentration should be that the quarry discharge concentration be less than the concentration in the watercourse upstream of the quarry.

We agree that the proponent should monitor and report on total phosphorus in quarry discharge as per the future Site ECA. We are, however, unaware of any other operating pit or quarry on the Niagara peninsula that has a discharge trigger for total phosphorus as a condition of licence. Given that the upstream and downstream total phosphorus concentrations in the Existing Watercourse, Beaverdams Creek and the Welland Canal south turn basin surface waters generally exceed the Provincial Water Quality Objective (PWQO), we would recommend that total phosphorus not be included in the proposed trigger mechanism for quarry discharge. Because of their ubiquitous nature on the Niagara peninsula, concerns over total phosphorus concentrations should be addressed on an annual basis as part of the proposed routine long term hydrogeological monitoring.

c. Should monthly sample results indicate exceedances above the trigger criteria, staff would recommend that weekly sampling be initiated until all parameter concentrations fall below the trigger thresholds.

Agreed. Paragraph 5 of Section 5.4 (on page 66) should be modified as shown below (underlined for emphasis):

"The monthly sump discharge sample results will be compared with the background conditions in the Existing Watercourse (station SW3) and Beaverdams Creek (station SW1). If parameter concentrations in the sump



discharge exceed the above trigger concentrations without a corresponding exceedance in the background surface water, then weekly sampling of the quarry sump will be initiated. Weekly sampling will continue until less than two parameter concentrations in the sump discharge exceed fall below any trigger concentrations."

d. After 4 weeks of exceedances of the pH, TSS, and oil/grease trigger thresholds, this would initiate a review and redesign of quarry discharge concentrations. There is no timeline provided for implementing these changes. The NPCA recommends adding a timeline and the immediate reduction in quarry discharge until the issue is addressed.

Agreed. Paragraph 6 of **Section 5.4** (on page 66) should be modified as shown below (underlined for emphasis):

"If weekly sampling is required for a period of more than four (4) weeks, contingency measures would be implemented to reduce concentrations in the future quarry discharge <u>within four (4) weeks of receipt of the laboratory results confirming a fourth consecutive trigger exceedance.</u> Trigger exceedances for pH, TSS and total oil and grease <u>all trigger parameters</u> would initiate a review of the design and operation of the quarry discharge system. Where required, improvements would be made to reduce discharge concentrations."

e. After 4 weeks of exceedances of the Hydrogen Sulphide trigger threshold, the NPCA recommends that this should initiate a review and redesign of quarry discharge concentrations. There is no timeline provided for implementing these changes. The NPCA recommends adding a timeline and the immediate reduction in quarry discharge until the issue is addressed.

Agreed. Please refer to the response to comment 17 (d) above.

18. Other General Comments:

a. The "study area" needs to be defined as it appears to different than the "site area". This is important because NPCA ambient monitoring is mentioned study area sections 2.6.1 and 2.6.3 and it's not clear what is being referred too.

The study area is defined in **Section 1.3** (on page 3), reproduced below for clarity.

"The study area extends to the Niagara Escarpment brow to the north, the Queenston-Chippewa Power Canal to the east, the Welland River to the South, and the modern Welland Canal to the west. This area roughly coincides with the extent of **Figure 1**."

b. Section 2.6.1 Groundwater Quality – This section mentions that the NPCA has completed "ongoing ambient monitoring". While the NPCA does have ambient groundwater monitoring program throughout its watershed jurisdiction, there is no NPCA monitoring near the study area of the proposed work. This report should include the monitoring NPCA sites/data that are relevant to this study. NPCA is willing to provide any groundwater data from it's ambient monitoring program to assist.

The text included in the Level 1 and 2 report was a general comment on the regional groundwater quality, rather than refer to specific monitoring stations operated by the NPCA. The second paragraph of **Section 2.6.1** (on page 43 of the Level 2 report) was intended to reference Section 2.4.1 (on page 25) of the Updated Assessment Report for the Niagara Peninsula Source Protection Area (2013). This section notes that NPCA operates 15 monitoring wells as part of the Provincial Groundwater Monitoring Network (PGMN), as shown in Figure 2.11 of the Updated Assessment Report. Figure 2.11 indicates that there are four (4) PGMN wells situated in relatively



close proximity to the study area (GA-356-A, GA290, GA362-A and GA362-B). Nonetheless, we propose that the second paragraph of **Section 2.6.1** should be modified as shown below (underlined for emphasis):

"On-going monitoring of ambient groundwater quality has been completed by NPCA. Within the study area <u>At</u> <u>various locations throughout the Niagara peninsula</u>, ambient groundwater quality for the contact and shallow bedrock aquifers generally meets Ontario Drinking Water Quality Standards (ODWQS) (MECP 2006 and updates) for parameters with health-related standards. Exceptions include sporadic exceedances of some dissolved metals concentrations. Agricultural and / or septic system impacts are also observed regionally, resulting in elevated nitrate concentrations in the groundwater."

c. Section 2.6.3 Surface Water Quality- This section also mentions that the NPCA has completed "on-going ambient monitoring". It would be helpful to include the NPCA monitoring sites/data or reference to provide context. The NPCA currently has two ongoing water quality monitoring stations in the Beaver Dams/Shriner Creek watershed. The Beaver Dams Creek station is located on the west side of the canal and rated as "Fair" water quality using Canadian Water Quality index based on the last five years (2020-2016) of data. The Shriners Creek station is located on Thorold Stone Road just west of Kalar Road as rated as "Poor" water quality using again Canada WQI (2020-2016 - 5 yrs of data). There is also historic NPCA data (2008-2010) that was generated from the Beaver Dams/Shriners Creek watershed study may provide additional background watershed information. Both of these data sets are available from the NPCA.

The text included in the Level 1 and 2 report was a general comment on the regional surface water quality, rather than refer to specific monitoring stations operated by the NPCA. The second paragraph of **Section 2.6.3** (on page 44 of the Level 2 report) was intended to reference Section 2.3.5 (on page 24 of the Updated Assessment Report), in particular, paragraph four. The stations referenced in this section are spread throughout the entire Niagara peninsula as shown in Figure 2.10 of the Updated Assessment Report. Therefore, we propose that the second paragraph of **Section 2.6.3** should be modified as shown below (underlined for emphasis):

"On-going monitoring of ambient surface water quality has been completed by the NPCA. Within the study area <u>At various locations throughout the Niagara peninsula</u>, results from over two-thirds of the surface water quality stations operated by the NPCA suggest surface water conditions are poor or impaired, and only 5% of the stations regularly indicate good conditions. The main contaminants of concern are total phosphorus, E. coli, suspended solids and chloride, originating from sources including agricultural activities, poorly maintained septic systems, road salting activities and untreated stormwater runoff from urban areas."

The 2008-2010 Beaverdams Creek / Shriners Creek surface water results were provided by NPCA to WSP following the JART meeting of May 2022. These data can be incorporated into future reports.

d. Section 5.4 Discharge Trigger Mechanism and Contingency Plan - NPCA staff would recommend that dissolved oxygen be considered as trigger owing to the potential present of hydrogen sulphide in dewatering discharge. The NPCA has observed DO depletion in watercourses downstream of sulphur springs in the Hamilton portion of the NPCA watershed. DO concentrations should meet PWQO before quarry discharge into the receiving watercourse.

Similar to our response to comment 17 (b) above, we agree that the proponent should monitor and report on dissolved oxygen in quarry discharge as per the future Site ECA. We are, however, unaware of any other operating pit or quarry on the Niagara peninsula that has a discharge trigger for dissolved oxygen as a condition of licence. We would recommend that dissolved oxygen not be included in the proposed trigger mechanism for



quarry discharge. Concerns over dissolved oxygen concentrations should be addressed on an annual basis as part of the proposed routine long term hydrogeological monitoring.

e. Staff note that the closest NPCA monitoring well to the site is located at Baden-Powell Park. Annual geochemistry and hourly water level elevation data is available as far back as 2015 if there is interest. The data from the Baden-Powell NPCA monitoring well appears to be consistent with the groundwater elevation and chemistry data findings of the report.

Acknowledged.

f. Under Section 2.5.4- NPCA staff agree that the water levels within the Welland Canal that supply the DeCew Falls Water Treatment Plant will not be impacted by the proposed quarry dewatering.

Acknowledged.

g. Under Section 2.5.4.4 – NPCA staff agree that they have identified the groundwater takings surrounding the site that likely have had an impact on the regional potentiometric surface, including the lesser-known impacts from the Welland Canal tunnel dewatering.

Acknowledged.

CLOSING

We trust that the responses to comments above meet your expectations. Please contact us if you have additional questions or concerns.

Yours truly, **WSP Canada Inc.**

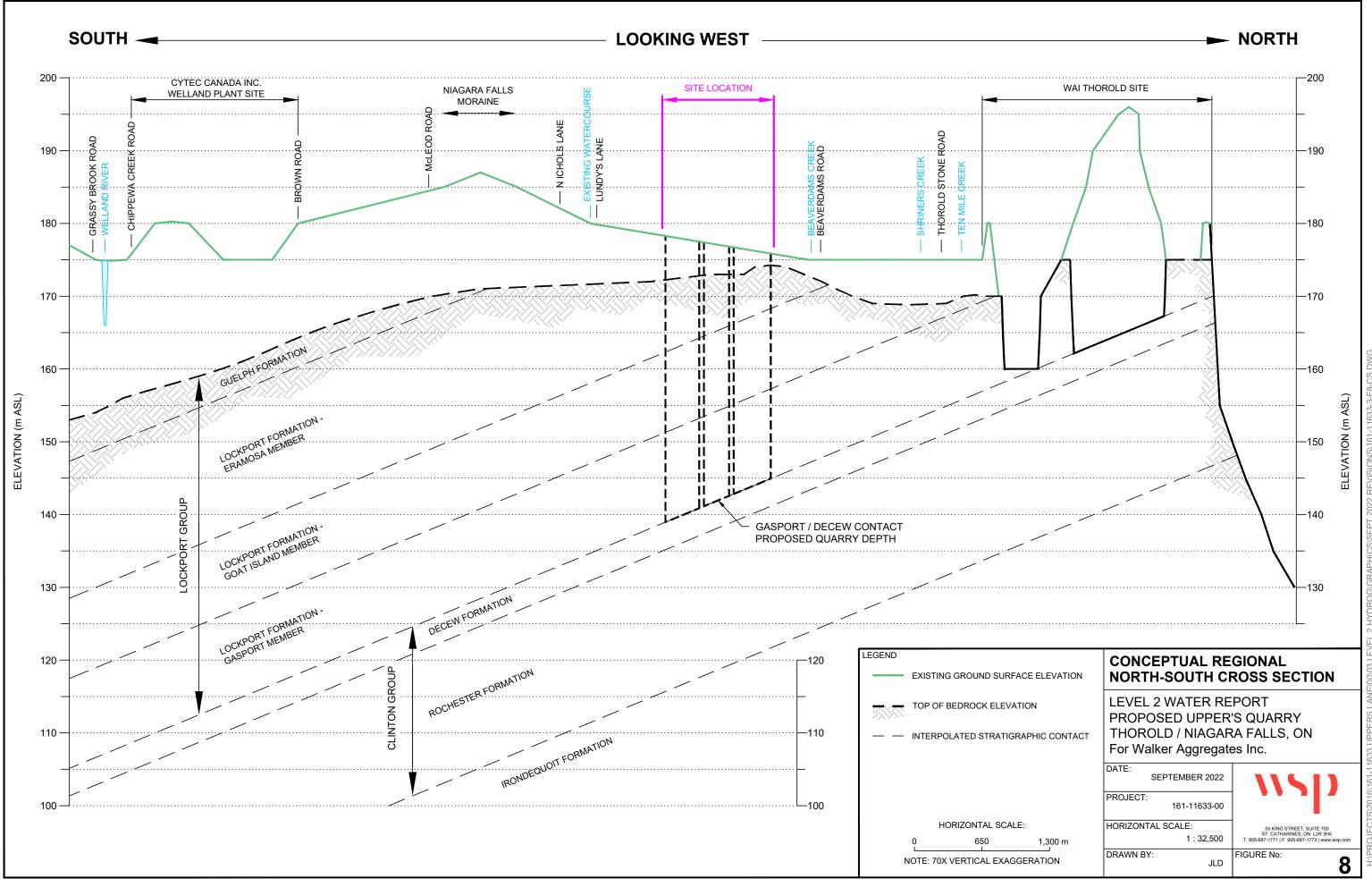
Leigh Davis

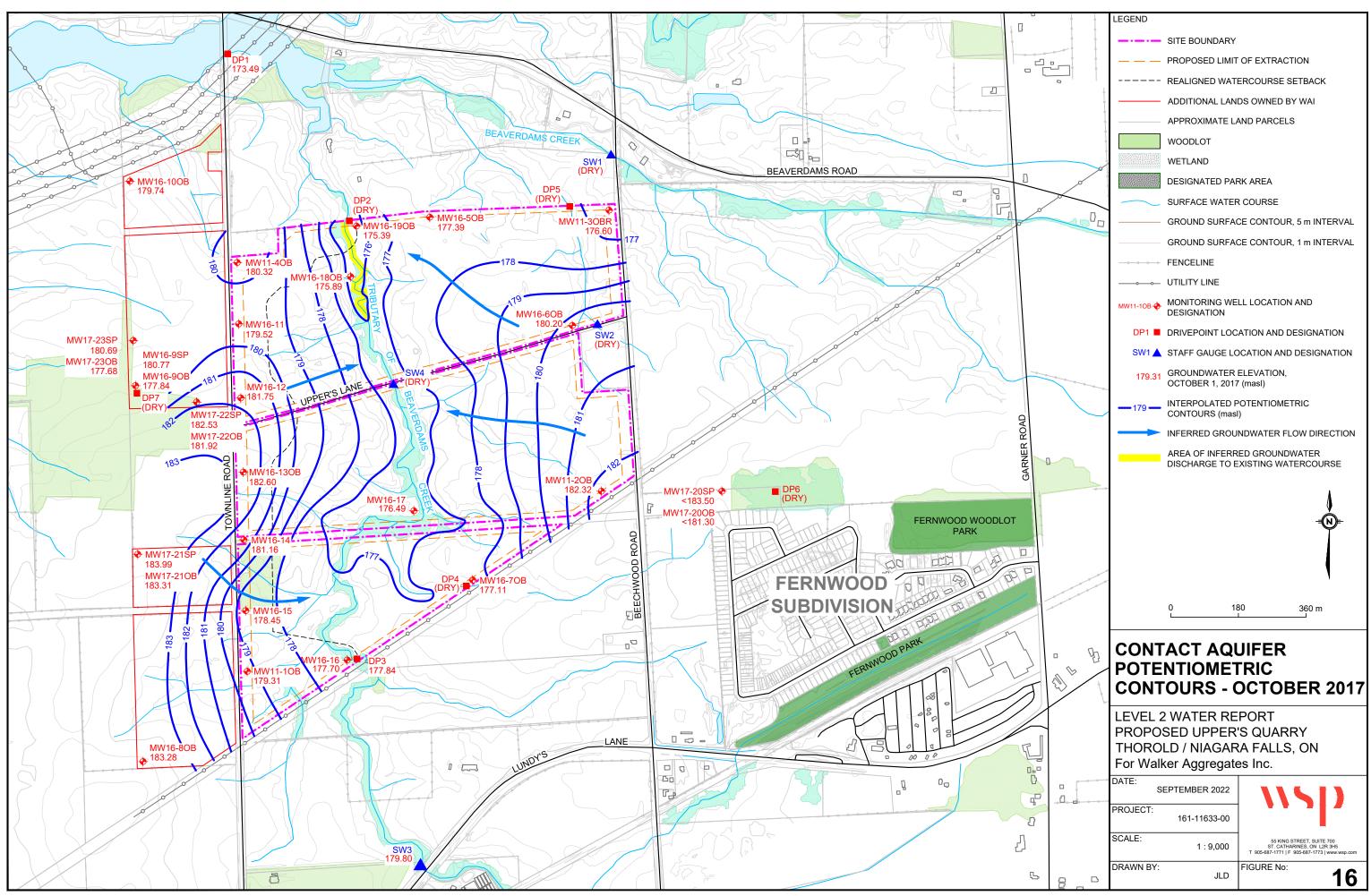
Leigh Davis, M.A.Sc., P.Eng. Project Engineer, Earth & Environment

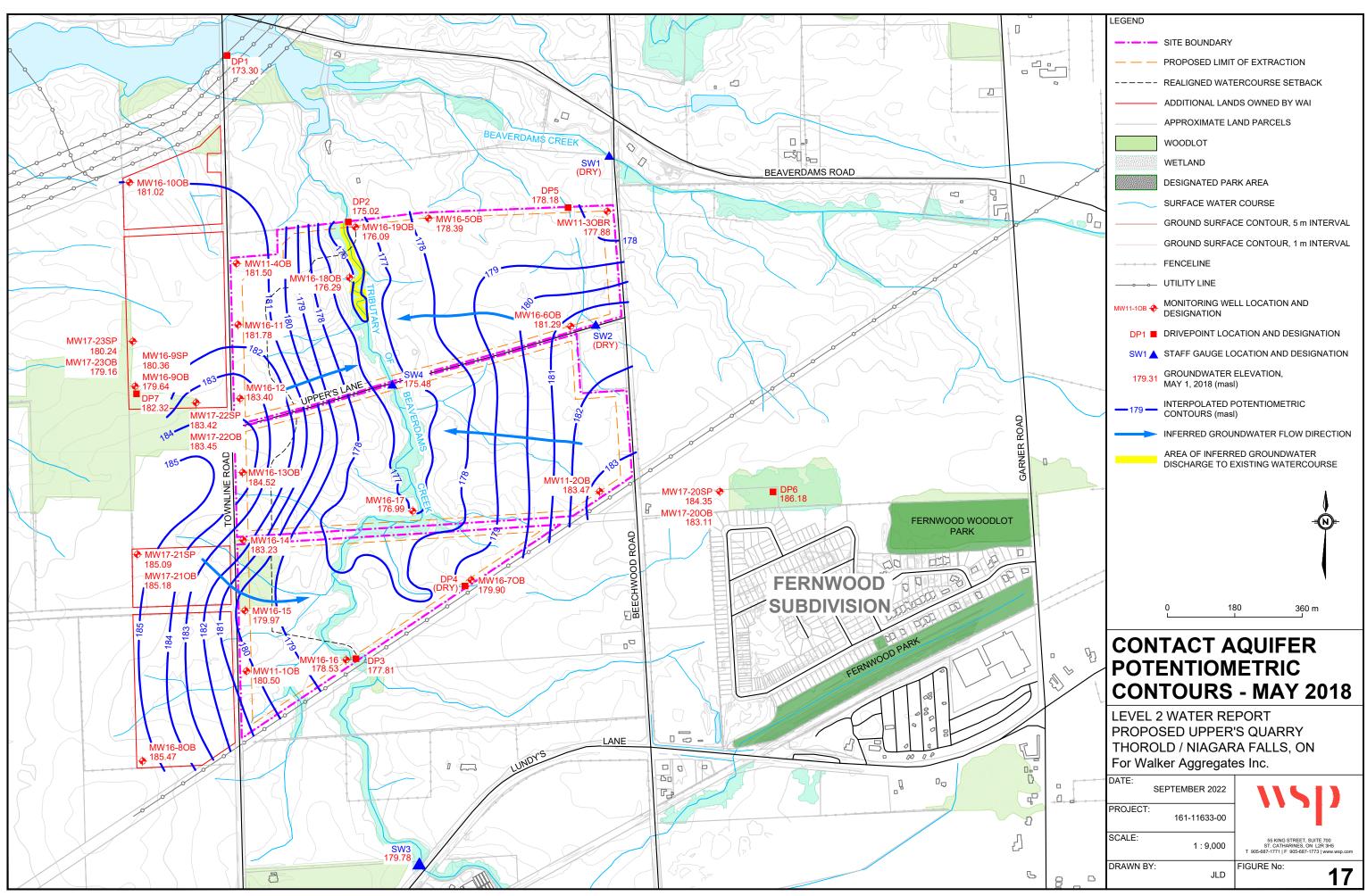
Kern Fitzpatrick

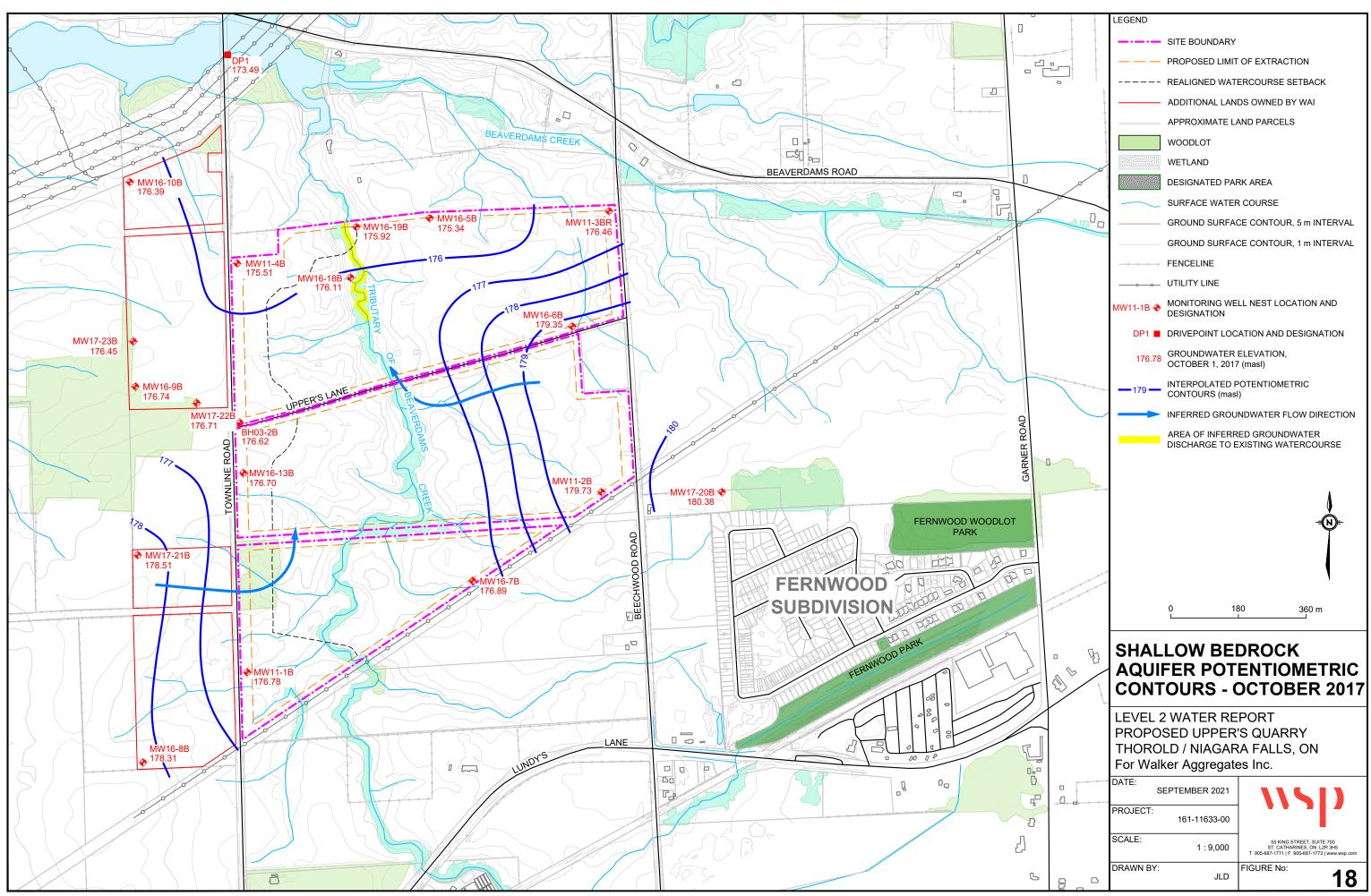
Kevin Fitzpatrick, P.Eng. Senior Project Engineer, Earth & Environment

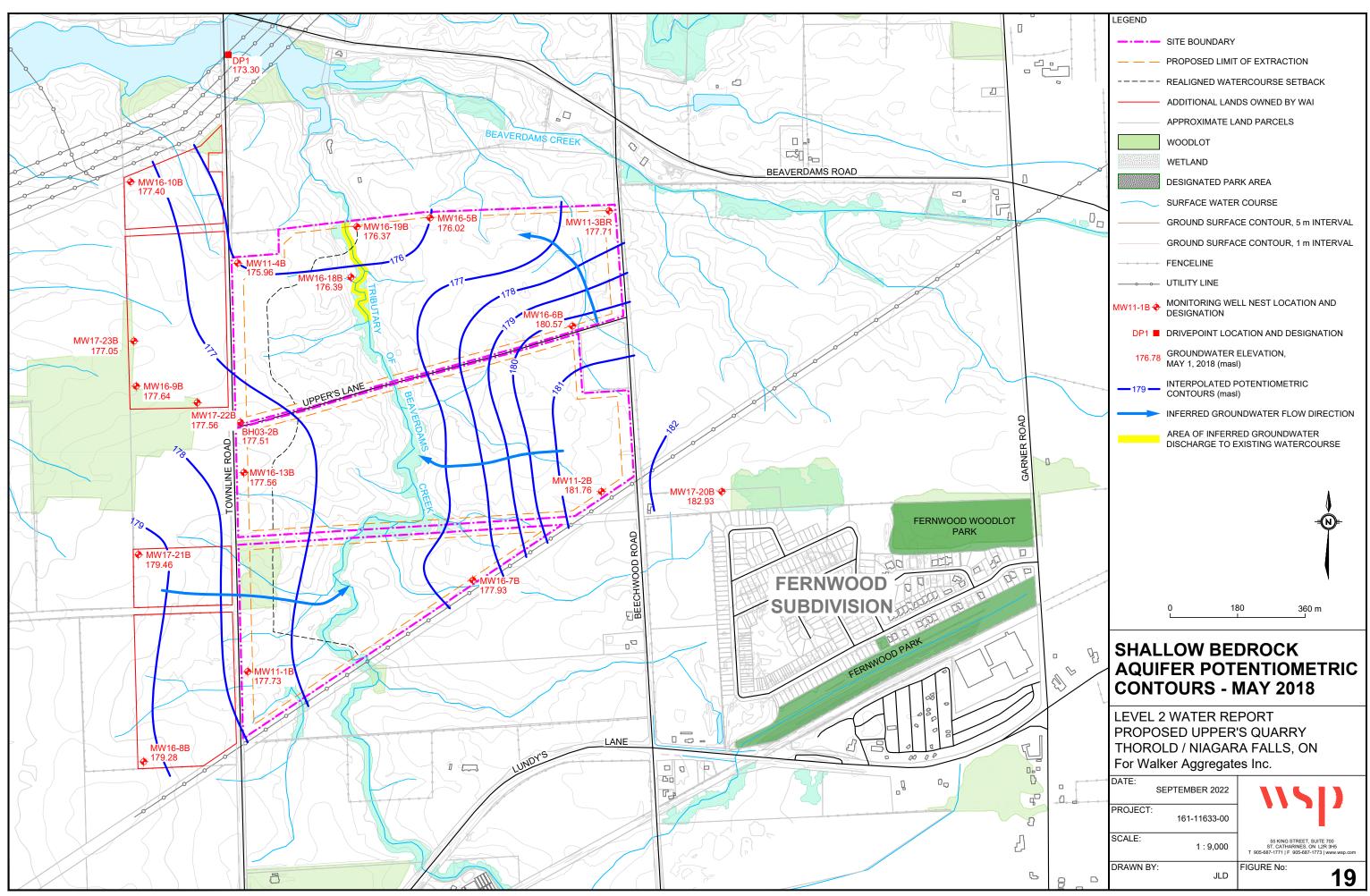
Attachments: Figure 8 – Conceptual Regional North-South Cross Section (Revised) Figures 16 through 21 – Potentiometric Contours (Revised) Appendix C-1 - Borehole Logs (Finalized) Table C-2 – Off-Site Well Details (Revised) Figure E-6 – Groundwater Hydrograph for Well Nest MW16-5 (Revised) Table G-1 – Surface Water Chemical Results (Revised) Figure H-1 – Model Domain Grid (Revised) Figure H-4 – Recharge Zones (Revised)

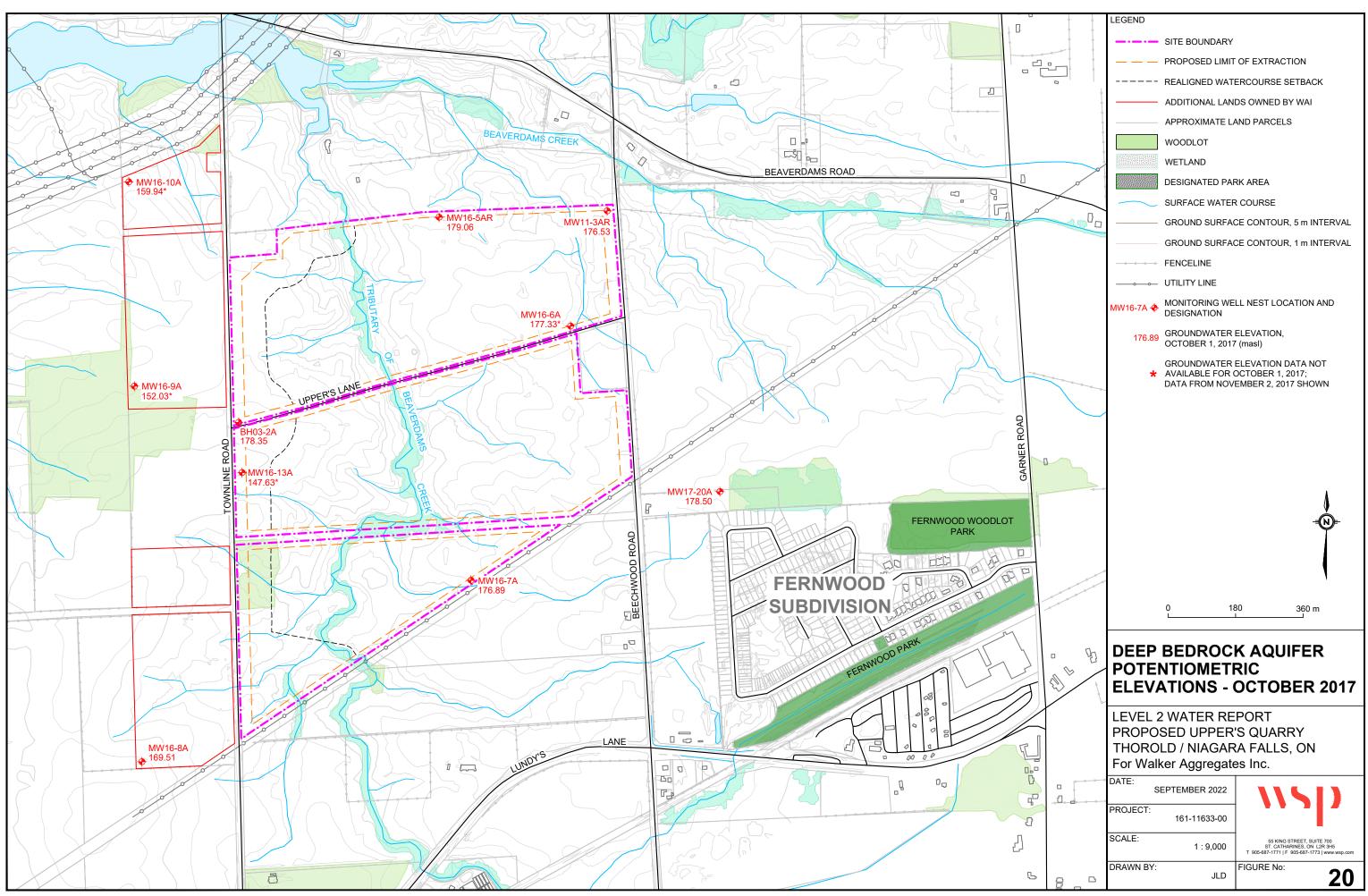


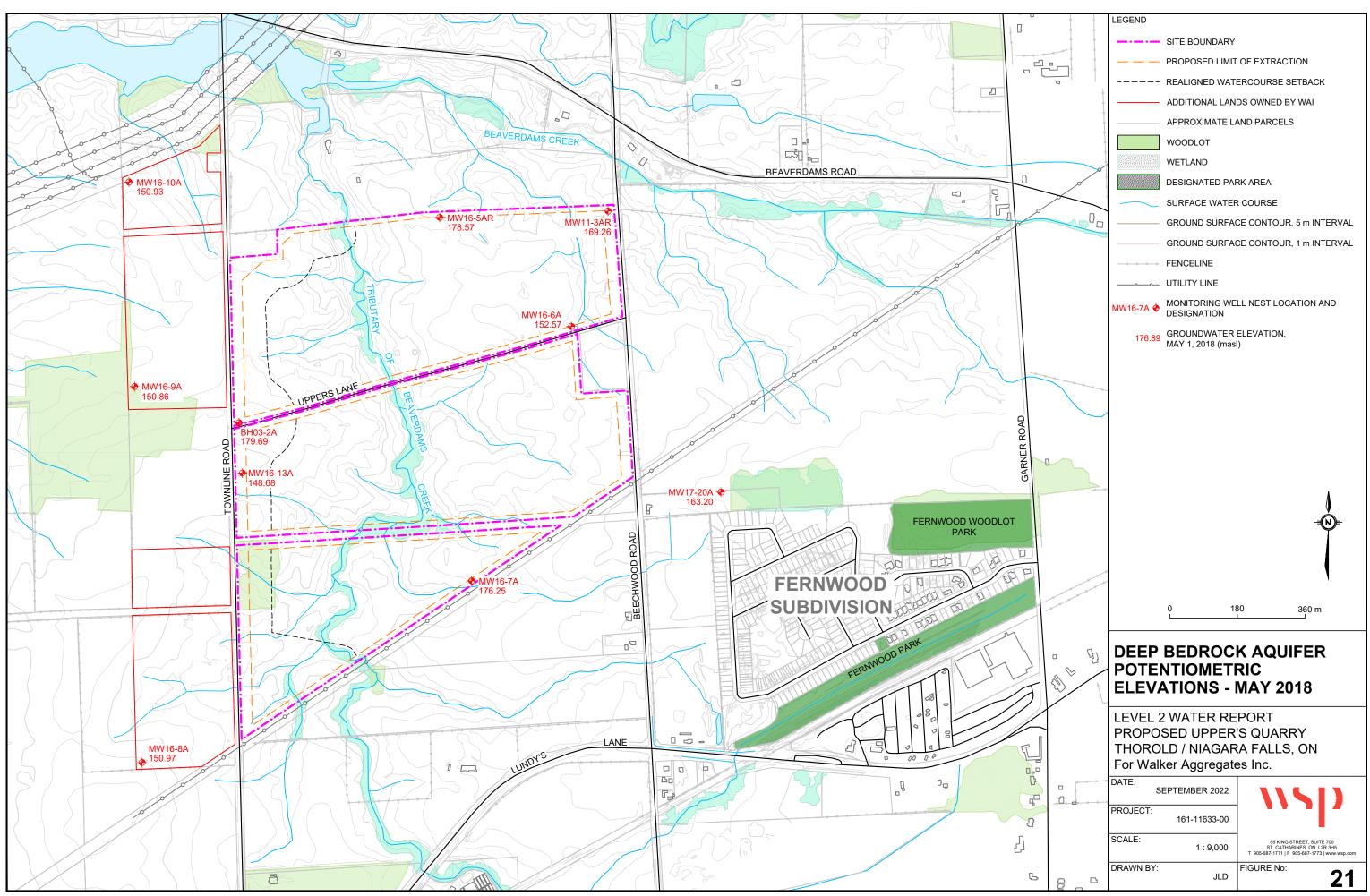












pro	ject	Proposed Uppers Quarry													project	no.	161-11633-00
		Walker Aggregates Inc.			ri	g type	CME	75						c	late sta		2016/11/08
loca	tion	Thorold / Niagara Falls, ON			n	nethod									superv	isor	SK
posi	tion	E: 648519 N: 4772919 (17T, Geo	detic)			coring	n/a								revie	wer	KJF
~		SUBSURFACE PROFILE		SA	MPLE		Penetrat (Blows /	ion Test 0.3m)	Values	_					ø		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dyni 10 Undraine O Un	amic Coni) 2 ad Shear confined cket Pane) Strength tromater	h (kPa) + Fiek	i Vane Vane	Wa Pi	ater Cor & Plas	u u	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
-0	104.3	CLAYEY SILT, reddish brown, dolostone	44			184	Ĩ				~	Ħ		Ť			Stratigraphy inferred from BH03-2
- 1		boulders at 3.4 m				- 183 -											borehole log
-2			KI.			- 103											Jagger Hims Limited in 2003.
ŀ			H.			182 -						2 Ì					
-3 -			Hł.			181 -						Fracture Frequency					
- 4	179.9	at 4.4m below grade				- 180						"					
- 5	4.4	ERAMOSA FORMATION, hard, fresh, brownish-grey to grey, medium grained				- 160											
-		dolostone with saccharoidal texture, with a petroliferous odour when broken. Thin				179 -											
-6		to medium horizontal beds with occasional 2 mm thick shale layers. Rare				178 -											
-7		stylolites and nodules of gypsum and other minerals. Approximately 3% vug				-											
ŀ.		content. Vugs 1-25 mm, to 1%, large ones at				177 -											
-8 -		6.2 m, 6.8 m, 7.5 m, 8.1 m and 8.4m. Some encrusted with dolomite, calcite, siderite and sphalerite.				176 -										¥ 🚽	
-9		sidente and sphalente.				175-											
- 10						-											
ŀ						174 -											
- 11						173-											
- 12						- 172 -											
- 13		Gypsum nodules at 12.4 m and 13.7 m, up to 100 mm, less than 1% by volume.				1/2-											
- "						171 -											
- 14						170-											
- 15		Vuggy zone, 14.7 m to 14.8 m, 2 mm to 50 mm, approximately 13% by volume.				-											
-		contract provide and the state of the state				169 -											
- 16 -						168 -											
- 17		Vuggy zone, 17.1 m to 17.6 m, 2 mm to				- 167 -											
- 18		45 mm, approximately 10% by volume.				-											
ŀ		Coarse grained layer, 18.6 m to 20.1				166 -										目	
- 19 -		m.				165 -											
- 20	164.2	GOAT ISLAND FORMATION, hard, grey,				- 164										<u> </u>	•
- -21		fine grained, fresh dolostone with occasional gypsum and chert nodules.	\bowtie			-											
ŀ		Weak petroliferous odour when broken. Rare fossil fragments, minor calcite and				163 -											
- 22		gypsum veins. Occasional to common stylolites and shale partings 2 mm thick.				162 -											
- 23		Fracture surfaces clean. Medium bedded	\bigotimes														
- 24			١ ا			161 -											
- 24		Occasional chert, gypsum and other nodules, 20.1 m to 26.5 m, 2-3% by				160 -											
- 25		volume.	\mathbb{N}			- 159 -											
- 26						-											
ŀ		(continued on next page)	Ň			158 -											
		(continued next page)									•		-				Sheet No. 1 of 2

LOG OF BOREHOLE BH03-2 Retrofit

LOG OF BOREHOLE BH03-2 Retrofit

153

152 -

15

150

149

148

147

146

145

144

143

142

141

140

139

138-

137 136

135

Elevation (m) 175.9

WELL 1 WATER LEVEL MONITORING

Depth (m) 8.5

Date Nov 10, 2016

wsp

Lab Data

and Comments

GRAIN SIZE DISTRIBUTION (5 (MIT)

SR SA SI

project no. | 161-11633-00 date started | 2016/11/08

supervisor SK reviewer | KJF

Well Details

Pandinas

립

Water Content (%) & Plasticity

WELL 2 WATER LEVEL MONITORING

Depth (m) 8.6

Date Nov 10, 2016

		Walker Aggregates Inc. Thorold / Niagara Falls, ON					g type ethod I	CME 75			
		E: 648519 N: 4772919 (17T, Geod	letic)			coring	n/a			
-		SUBSURFACE PROFILE			SA	MPLE		Penetration Tes (Blows / 0.3m)	t Values	_	
Depth Scale (m)	Elev	STRATIGRAPHY	ic Plot	Number	Type	SPT N-Value	tion Scale ASL)	X Dynamic Cor	2,0 3,0	40 (kPa)	-
-27	(m)	(continued)	Graphic	unN	τy	Core Recovery	Elevation (mASL	O Unconfined Pocket Pan	-	+ Field V	ane
- 27 - 28 - 29 - 30 - 21		Fosaliferous and stylotic layer, 26.5 m to 26.8 m, Rare chert and gypsum nodules 26.5 m to 31.5 m GOAT ISLAND FORMITION, hard, grey, fine grained, fresh dolostone with occasional gypsum wind chert nodules. Weak petroliferous odour when troken. Rare fosali fragments, minor calcite and gypsum veins. Occasional to common styloties and shale partings 2 mm thick. Fracture surfaces clean. Medium					157 - 156 155 - 154				

project | Proposed Uppers Quarry

bedded. (continued)

GASPORT FORMATION, hard, fresh, GASPURT FORMATION, hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone with saccharoidal texture. Nedium bedded with fossil fragments up to 6%. Occasional styloites. Rare gypsum nodules, less than 1% by volume.

...Dark grey fossiliferous dolomitic limestone from 36.2 m to 39.8 m.

41.2 41.2 Hossiliferous conglomeratic layer from 41.2 41.0 m to 41.2 m marks lower contact.

DECEW FORMATION, medium hard,

dark grey, fine grained. Fresh argillaceous dolostone with occasional shale partings 3 mm thick.

ROCHESTER FORMATION, very dark grey to black, dolomitic to calcareous shale. Increase in calcareous content

... Frequently splits horizontally along bedding planes. Conchoidal fractures.

...Fossiliferous layers below 49.7 m.

Borehole was dry and open upon

25 mm monitoring well installed. No. 10 screen installed.

END OF BOREHOLE

completion.

below 45.9 m.

... Frequent shale partings below 37.0 m, up to 10 mm thick.

- 31

- 32

- 33

- 34

- 35

- 36

- 37

- 38

- 39

- 40

- 41

- 42

- 43

- 44

- 45

- 46

- 47

- 49

134

Sheet No. 2 of 2

Elevation (m) 175.8

wsp

LOG OF BOREHOLE 11-3A/B Decom

pro	ject	Proposed Uppers Quarry														р	oject	no.	161-11633-00
c	ient	Walker Aggregates Inc.				ri	g type	CME	75							dat	e sta	rted	2016/10/25
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Rock	c corin	g						S	uperv	isor	SK
posi	tion						coring	HQ o	core, C	DD=9	6mm,	D=64	4mm				revie	wer	KJF
O Depth Scale (m)	Elev Depth (m)	SUBSURFACE PROFILE STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Type Type	MPLE SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dyr 1 Undrain 0 U 0 P	ation Test / 0.3m) namic Cone 0 2 ned Shear nconfined ocket Pane 0 8	e 0 3 Strength tromater	0 4 1 (kPa) + Fiek Lab 20 1	0 1 Vane Vane 30	P	ater Co & Pla L M 0 2	sticity		PID Readings	Well Details	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
-0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -1 11 -1 13 -4 -5 -6 -7 -8 -9 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1		END OF BOREHOLE Borehole was dry and open upon completion.																	Monitoring well overstilled to 30.7 m. PVC risers and screens removed.

LOG OF BOREHOLE 11-30B Decom

wsp

project no. | 161-11633-00

project | Proposed Uppers Quarry client | Walker Aggregates Inc. location | Thorold / Niagara Falls, ON

-0

rig type | CME 75 method

date started | 2016/10/25 supervisor | SK

position | reviewer | KJF coring | n/a SUBSURFACE PROFILE SAMPLE Lab Data and Comments enetration Test slows / 0.3m) \geq Elevation Scale (mASL)
 X Dynamic Cone

 10
 20
 30
 40

 Undrained Shear Strength (kPa)

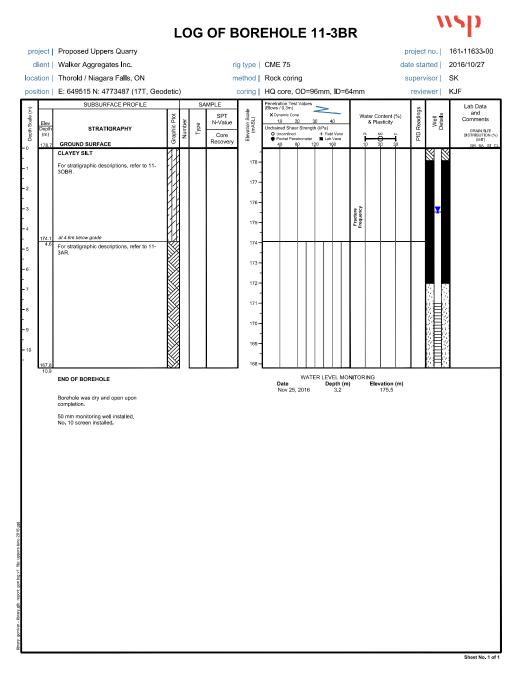
 O Uncordined
 + Field Vane

 ● Pocket Peartementer
 Lab Vane

 40
 80
 120
 160
 Readings Water Content (%) & Plasticity SPT Well N-Value Elev Depti (m) Type STRATIGRAPHY GRAIN SIZE DISTRIBUTION (5 (MIT) Core Recovery Depth PL MC LL 10 20 30 믭 GROUND SURFACE GR[°]SA[°]SI Granular bentonite PVC riser and screen pulled from borehole. Borehole backfilled with granular bentonite.

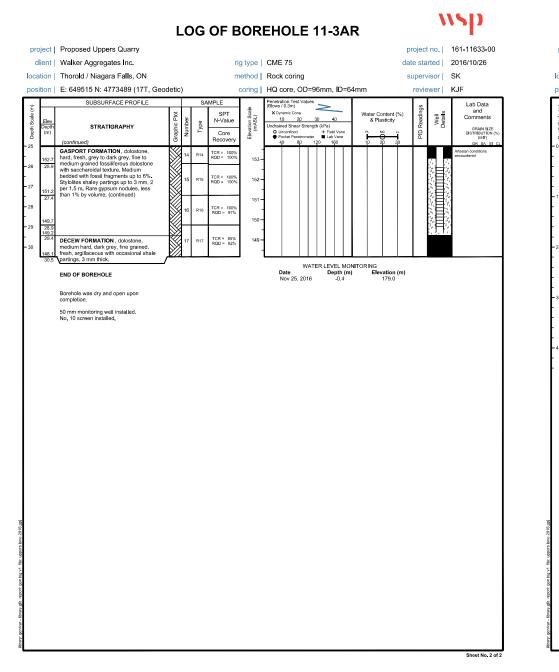
END OF BOREHOLE

Borehole was dry and open upon completion.



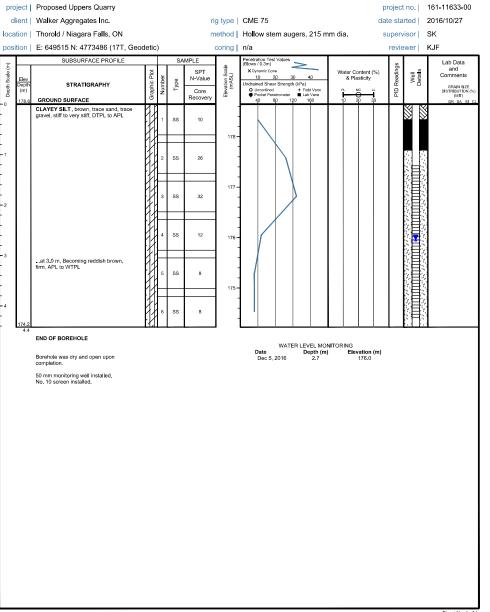
LOG OF BOREHOLE 11-3AR

			L	.C)G	OF B	OR	EHOLE	E 1	1-3	3 A	R							
pro	ject	Proposed Uppers Quarry												1	orojec	t no.	161-116	33-00	
c	ient	Walker Aggregates Inc.				riç	g type	CME 75						da	ate sta	arted	2016/10	/26	
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Rock coring							superv	visor	SK		
pos	tion	E: 649515 N: 4773489 (17T, Geod	detic)		c	coring	HQ core, O	0=96	imm,	D=6	4mm			revie	ewer	KJF		
Ê		SUBSURFACE PROFILE			SA	MPLE	e	Penetration Test Va (Blows / 0.3m)	lues	>					sf		Lab	Data	
Depth Scale (r	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dynamic Cone 1,0 2,0 Undrained Shear St O Unconfined Pocket Penetrol	neter	(kPa) + Fiek	i Vane Vane	PL	& Plast	u	PID Readings	Well	GR DISTR	nd ments AIN SIZE IBUTION (%) (MIT)	
-0	178.6	GROUND SURFACE CLAYEY SILT	йr	Н	-	Recovery	-	40 80	121) 1	30	ΰ	20	30	-		GF Artesian conc encountered	SA SI CL	
- -1		For stratigraphic descriptions, refer to 11- 30BR.					178 - - 177 -										encountered		
-2 - -3 -							177 - 176 - 175 -					Fracture Frequency							
- -5 -	174.0 4.6	at 4.6m below grade ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium to thin grained with saccharoidal texture, petroliferous odour when broken, thin to		1	R1	TCR = 100% RQD = 59%	174 - 173												
-7	6.1 171.0	medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites and gypsum nodules. Approximately 3% vug content.		2	R2	TCR = 100% RQD = 73%	- 172												
-8 - -9	7.6			3	R3	TCR = 100% RQD = 72%	171 - - 170 -												
- 10	9.1 168.0			4	R4	TCR = 100% RQD = 76%	169 -												
- 11 - - 12	169.6 11.0	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak		5	R5	TCR = 100% RQD = 97%	168 - - 167 -												
- - 13	12.2	petroliferous odour when broken. Rare fossil fragments, minor calcite and gypsum nodules. Occasional to common stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium		6	R6	TCR = 100% RQD = 95%	166 - - 165 -												
- 14 - - 15	13.6 163.4	bedded.		7	R7	TCR = 100% RQD = 100%	164 -												
- - 16 -	15.2			8	R8	TCR = 100% RQD = 100%	163												
- 17 - - 18	16.8 160.3			9	R9	TCR = 100% RQD = 100%													
- - 19	18.3 159.2 1 58.9	GASPORT FORMATION, dolostone,		10	R10	TCR = 98% RQD = 91%	160												
-20 - -21	19.7 157.3	hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone with saccharoidal texture. Medium bedded with fossil fragments up to 6%. Stylolites shaley partings up to 3 mm, 2		11	R11	TCR = 97% RQD = 90%	- 158												
- 22	21.3 155.8	per 1.5 m. Rare gypsum nodules, less than 1% by volume.		12	R12	TCR = 98% RQD = 98%	157 — - 156 —												
-23 - -24	22.8 154.2			13	R13	TCR = 97% RQD = 97%	- 155												
Ŀ	24.4 152.7		Ŵ	14	R14		154 -												
		(continued next page)															Shee	t No. 1 of 2	



LOG OF BOREHOLE 11-30BR

NSD

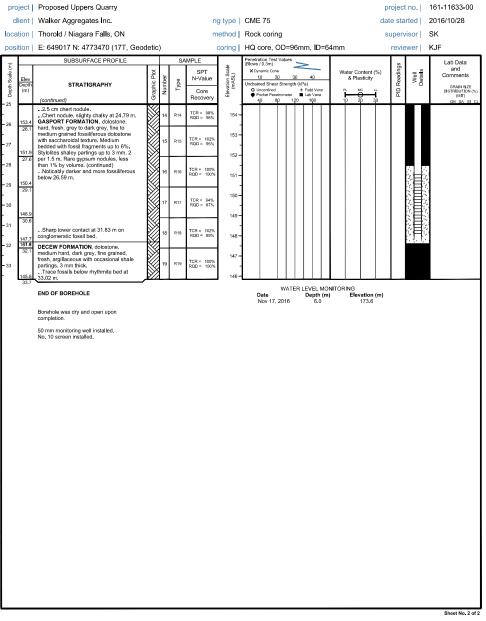


		Proposed Uppers Quarry Walker Aggregates Inc.				ri	g type	CME	75									no.	161-11633-00 2016/10/28
		Thorold / Niagara Falls, ON					nethod											isor	SK
		E: 649017 N: 4773470 (17T, Geo	datic	4			coring			-	6mm	ID=6	4mm					wer	KJF
posi	uon j	SUBSURFACE PROFILE	ueuc	'' T	SA	MPLE	coning [tion Tes (0.3m)		onnin,	10-0	1					weil	
(m) e		CODOCITINOE THOMALE	5		0,1	SPT	_ cale	X Dyr	namic Cor	θ.	\geq	_	w	ater C	ontent (%)	lings	- =	Lab Data and
Depth Scale	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value Core	Elevation Scale (mASL)	0 U		t <u>0 3</u> r Strengtl	0 4 n (kPa) + Fie) ■ Lab	40 d Vane		& Pla	isticity //C L	1. 1	PID Readings	Well Details	GRAIN SIZE DISTRIBUTION (%)
-0	179.5	GROUND SURFACE	Ō			Recovery	ш.	4		1: 0 1:	20 1	60 60			20 3	10	ш	× /1 - 18	(MIT) GR SA SI CL
-		CLAYEY SILT	M				179 -												
- 1		For stratigraphic details, refer to 16-5OB.	扪				-												
-2			ħł				178 -												
Ĺ			11				177-												
- 3			βł				-												
-			ľ1				176 -						ancy						
-4			fłł				- 175 -						Fracture						
-5	174.3	at 5.2m below grade	¥1				- 1/5												
-	5.2	ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium to	K	1	R1	TCR = 95% RQD = 10%	174 -												
-6	173.3 6.2	thin grained with saccharoidal texture, petroliferous odour when broken, thin to		Ц		RQD = 10%	-											_	
-7		medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites	$\langle \rangle \rangle$	2	R2	TCR = 100% RQD = 9%	173 -												
-	171.8	and gypsum nodules. Approximately 3% vug content.	\mathbb{N}			1020 - 330	172 -												
-8	7.7	Coarsely broken core recovery from 5.49 m to 6.10 m.	K			TCR = 87%	-												
-9		Trace vugs below 7.16 m as 2-3 mm blebs, some encrusted.		3	R3	TCR = 87% RQD = 63%	171 -												
- 9	170.3 9.2	Thin calcite or fracture surface at 7.39 m.	Ŵ	\mathbb{H}			170-												
- 10		Trace 4 cm gypsum nodules below 9.70 m.	K	4	R4	TCR = 98% RQD = 83%	-												
-	168.7	Trace sharp lower contact of change in colour and texture.					169 -												
- 11	11.8	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional	\mathbb{N}	5	R5	TCR = 100% RQD = 72%	- 168												
- 12	167.2	gypsum and chert nodules, weak petroliferous odour when broken. Rare	K			RQD = 72%	-												
-	12.3	fossil fragments, minor calcite and gypsum nodules. Occasional to common					167												
- 13		stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium	Ŵ	6	R6	TCR = 100% RQD = 94%	- 166 -												
- 14	165.6 13.9	bedded.	K	Н			-												
-		Chert as 5 cm to 10 cm nodules from		7	R7	TCR = 98% RQD = 85%	165 -												
- 15	164.1 15.4	14.47 m to 16.18 m, 2 to 3 % of core.	\otimes				164												
- 16	10.4		\mathbb{N}	8	R8	TCR = 98%	104 -												
-	162.7		K			RQD = 88%	163 -												
- 17	16.8					TCR = 98%	· · ·												
- 18	161.3		S	9	R9	TCR = 98% RQD = 98%	162 -												
-	18.2		K	Π			161 -												
- 19				10	R10	TCR = 97% RQD = 97%	-												
- 20	159.7 19.8		\otimes				160 -												
-			K	11	R11	TCR = 100% RQD = 100%	159-												
-21	158.1	Lower contact at 21.7 m at change is colour and increase in shale partings.	Ø			RQD = 100%	-												
	187.8 21.7	GASPORT FORMATION, dolostone,	\mathbb{R}				158 -												
- 22		hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone	Ŵ	12	R12	TCR = 100% RQD = 85%	- 157 -												
- 23	156.5 23.0	with saccharoidal texture. Medium bedded with fossil fragments up to 6%.	\otimes	+			-												
ŀ		Stylolites shaley partings up to 3 mm, 2 per 1.5 m. Rare gypsum nodules, less	K	13	R13	TCR = 100% RQD = 100%	156 -												
- 24	155.0	than 1% by volume. 2 cm very fine grained (graphite like)					155 -												
	153.5	shale layer. (continued next page)	Ň	14	R14			I											Sheet No. 1 of 2

LOG OF BOREHOLE 16-5A

LOG OF BOREHOLE 16-5A

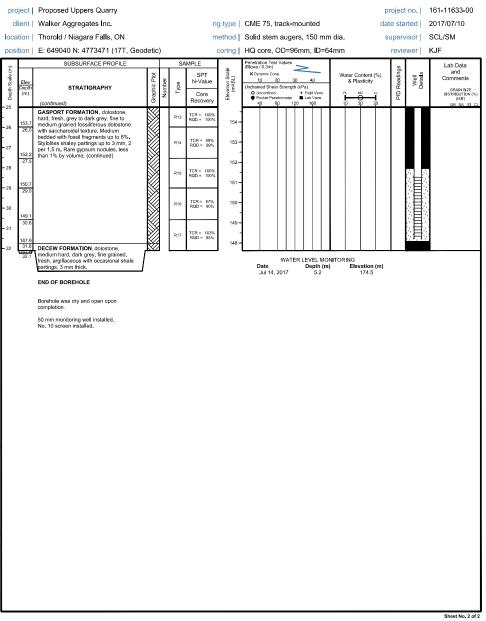
NSD

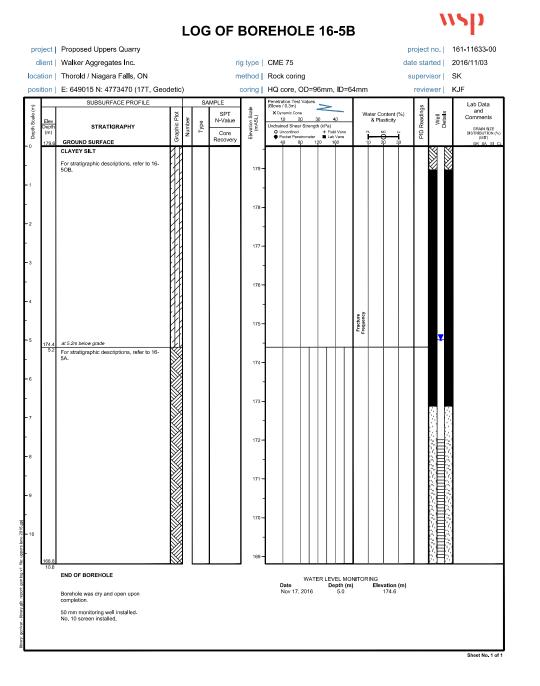


			L	0	G O	F B	OR	EH	OL	E 1	6-	5A	R						
pro	oject	Proposed Uppers Quarry														pr	oject	no.	161-11633-00
c	lient	Walker Aggregates Inc.				riç	g type	CME	75, tra	ack-n	nount	ted				dat	e star	ted	2017/07/10
loca	ation	Thorold / Niagara Falls, ON				m	ethod	Solid	stem	auge	rs, 15	50 mr	m dia			sı	upervi	isor	SCL/SM
pos	ition	E: 649040 N: 4773471 (17T, Geo	detic)			c	coring	HQ c	ore, C	D=9	6mm,	D=6	64mm	1			revie	wer	KJF
		SUBSURFACE PROFILE			SAMPL	LE		Penetral (Blows /	tion Test \ 0.3m)	/alues	_		Г				ω		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	A N	SPT I-Value Core	Elevation Scale (mASL)	X Dyn 1(Undraine O Un	amic Cone 0 20 ed Shear tconfined	3 Strength		40 d Vane	- "	ater Co & Pla	ontent (isticity	%)	PID Readings	Well	and Comments GRAIN SIZE
-0	179.7	GROUND SURFACE	ō	-	Re	ecovery	Ξ	♥ Po 4(ocket Panet 0 80	rometer 12	■ Lab 20 14	Vane 60	_	φ	10 3	0	۵.		(MIT) GR SA SI CL
- - 1		CLAYEY SILT For stratigraphic details, refer to 16-50B.					179 -												
-2							178 -												
-3			þł				177 -												
ŀ							176 -												
-4			[]]				-						• 5						
- 5			1H				175-						Fracture Frequency					—	
ŀ	173.6	at 6.1m below grade	11				174 -						<u> </u>						
-6 -	6.1	ERAMOSA FORMATION, brownish-grey	Ŕ				-			Т									
- 7		to grey dolostone, hard, fresh, medium to thin grained with saccharoidal texture, petroliferous odour when broken, thin to			R1 TC RQ	R = 84% D = 27%	173 -												
E.	172.0	medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites	\bigotimes	⊢	_		172 -												
-8		and gypsum nodules. Approximately 3% vug content.	\mathbb{N}		R2 TC	R = 92% D = 50%	-												
-9	170.5	5	\mathbb{K}		1.02	a) - 30%	171 -												
ŀ	9.2				TC	P = 100%	170 -												
- 10	168.9		\mathbb{X}		R3 RQ	R = 100% D = 96%	-												
- 11	108.9	GOAT ISLAND FORMATION, dolostone,	K				169 -												
ŀ		hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak			R4 TCF RQ	R = 100% 2D = 68%	168 -												
- 12	167.4 12.3	petroliferous odour when broken. Rare fossil fragments, minor calcite and guagement and calcite and	\bowtie	-	_		-												
- 13		gypsum nodules. Occasional to common stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium	\mathbb{K}		R5 TCF	R = 100% D = 92%	167 -												
ŀ	165.9	bedded.			N.	(D = 62.%	- 166												
- 14	13.8		\bigotimes		TCI	R = 100%	-												
- 15	164.3		\mathbb{N}		R6 RQ	R = 100% 2D = 95%	165 -												
ŀ	15.4		\mathbb{K}				164 -												
- 16					R7 TCF RQ	R = 100% D = 95%	-												
- 17	162.8 16.9	GASPORT FORMATION, dolostone,	X	⊢			163 -												
-		hard, fresh, grey to dark grey, fine to	\bigotimes		R8 TCF	R = 100% D = 98%	162 -												
- 18	161.3	medium grained fossiliferous dolostone with saccharoidal texture. Medium bedded with fossil fragments up to 6%.	\mathbb{N}	L			-												
- 19	18,4	Stylolites shaley partings up to 3 mm, 2 per 1.5 m. Rare gypsum nodules, less	\mathbb{K}		R9 TCF	R = 100% D = 100%	161 -												
0.00	159.8	than 1% by volume.	\bigotimes		RQ	D = 100%	- 160												
- 20	19.9		\bowtie				-												
-21			\otimes		R10 RQ	R = 98% D = 100%	159 -						1						
-	158.3 21.4		\mathbb{X}	F			- 158 -						1						
- 22			\bigotimes		R11 TCF	R = 100% D = 85%	-						1						
- 23	156.7 23.0		\mathbb{N}	┝			157 —												
-			\mathbb{N}		R12 TCF	R = 100% D = 100%	156 -												
- 24	155.2			L		. 100%	-												
	153.7	(continued next page)	\otimes		R13		155 -												Sheet No. 1 of 2

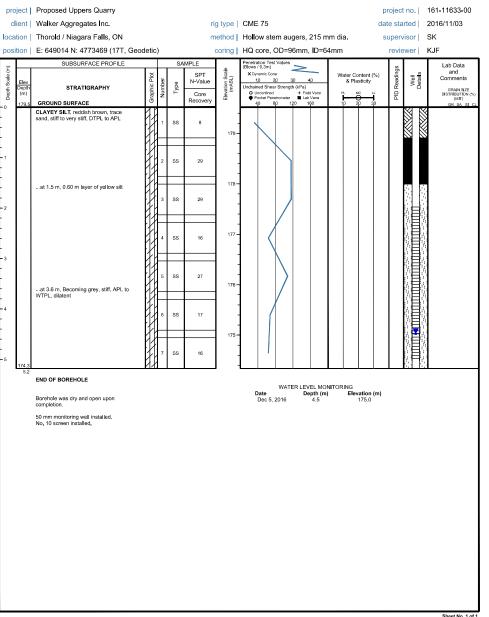
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LOG OF BOREHOLE 16-5AR





LOG OF BOREHOLE 16-50B

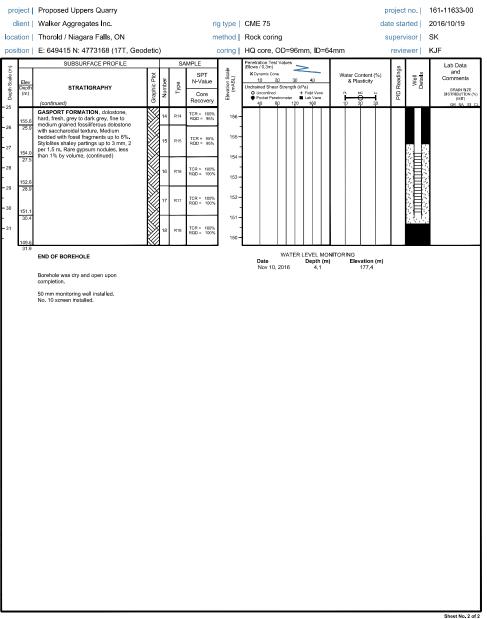


nro	iect I	Proposed Uppers Quarry											-				nr	niect	no.	161-11633-00
		Walker Aggregates Inc.				rie	g type	CME	75										rted	2016/10/19
		Thorold / Niagara Falls, ON					ethod			a									isor	SK
		E: 649415 N: 4773168 (17T, Geo	detic)			coring			-	:96r	nm.	ID=6	4mm					wer	KJF
		SUBSURFACE PROFILE		Í	SA	MPLE			, ation Test / 0.3m)											Lab Data
Depth Scale (m)	_		lot	-		SPT	Elevation Scale (mASL)	× Dy	namic Con I,0 2	0	30	- 40		w	ater Co	ontent (%)	Readings	Well Details	and Comments
pth Sc	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	N-Value Core	vation (mAS	Undrain	ned Shea	r Strei	nath (k	(Pa)		1	& Pia	sticity		D Rea	Det	GRAIN SIZE DISTRIBUTION (%) (MIT)
	181.5	GROUND SURFACE	Gra	z		Recovery	Ele		Inconfined locket Pene LO 8	etromet 0	er 120	+ Field ■ Lab \ 16	/ane i0			p 3	ρ	PID		(MIT) GR SA SI CL
-0		CLAYEY SILT	IJĬ				181 -												Š Š	
- 1		For stratigraphic descriptions, refer to 16- 6OB.	łł				-													
			ĥł				180 -													
-2			K				179-													
-3			ĥł				-							ture						
-			扪				178 -							Fracture Frequency						
- 4	177.1	at 4.4m below grade	Øł				- 177 -												Ţ	
- 5	4.4	ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium to	Ŵ			TCD - 78%	-													
		thin grained with saccharoidal texture, petroliferous odour when broken, thin to	K	1	R1	TCR = 78% RQD = 42%	176 -													
-6	175.4 6.1	medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites		-			175-													
-7		and gypsum nodules. Approximately 3% vug content.	\bigotimes	2	R2	TCR = 100% RQD = 45%														
	174.0 7.5		\mathbb{N}				174 -													
-8			K	3	R3	TCR = 94% RQD = 63%	173 -													
-9	172.4		$\langle \rangle \rangle$			1000 - 0010														
-	9.1		S			TOD 1000	172 -													
- 10	171.1 179.8		K	4	R4	TCR = 100% RQD = 63%	- 171 -	1												
- 11	10.7	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional	\mathbb{N}				1/1-													
		gypsum and chert nodules, weak petroliferous odour when broken. Rare	K	5	R5	TCR = 100% RQD = 89%	170 -													
- 12	169.3 12.2	fossil fragments, minor calcite and gypsum nodules. Occasional to common					-													
- - 13	12.2	stylites and shale partings 2 mm thick. Fracture surfaces clean, Medium	\mathbb{N}	6	R6	TCR = 100% RQD = 100%	169 -													
-	167.9 13.6	bedded.	K			10076	168 -													
- 14	13.0			-	R7	TCR = 98% RQD = 82%	-													
- 15	166.4		\bigotimes	Ĺ	10	RQD = 82%	167 -	1												
-	15.1		\mathbb{N}				166 -													
- 16			K	8	R8	TCR = 100% RQD = 100%	-													
- - 17	164.7 16.8			_			165 -													
			\otimes	9	R9	TCR = 100% RQD = 83%	164 -													
- 18	163.2		K			RQD - 65%	-													
- - 19	18.3			10	R10	TCR = 100% RQD = 100%	163 -													
- 19	161.8		\bigotimes	10	R1U	RQD = 100%	162 -													
- 20	19.7		\mathbb{N}				-													
-			K	11	R11	TCR = 100% RQD = 100%	161 -													
- 21	160.2 21.3		Ø				160 -													
- 22			Ň	12	R12	TCR = 100% RQD = 95%	-													
•	158.6		\mathbb{K}				159 -													
- 23	158.9 23.2	(continued on next page)	Ø			TCR = 98%	- 158 -	1												
- 24	157.1		Ŵ	13	R13	TCR = 98% RQD = 92%	.	1												
-	24.4 155.6		Ŵ	14	R14		157 -													
	.00.0	(continued next page)	<i>v//</i>	-						_	-									Sheet No. 1 of 2

LOG OF BORFHOLE 16-6A

LOG OF BOREHOLE 16-6A

NSD



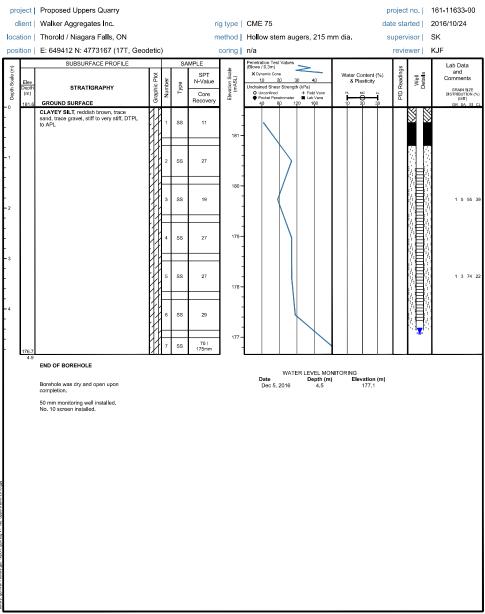
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					00		DOI				10		,					-
pro	ject	Proposed Uppers Quarry													рі	rojec	t no.	161-11633-00
c	ient	Walker Aggregates Inc.				ri	g type	CME	75						dat	e sta	irted	2016/10/24
loca	tion	Thorold / Niagara Falls, ON				m	nethod	Rock	coring)					SI	uper	/isor	SK
posi	tion	E: 649413 N: 4773167 (17T, Geod	letic	;)			coring	HQ co	ore. O	D=96	Smm.	D=6	4mm	ı		revie	ewer	KJF
		SUBSURFACE PROFILE		, T	SA	MPLE		Penetrati (Blows / 0								1	,	Lab Data
Depth Scale (m)			5			SPT	Elevation Scale (mASL)	X Dyna	imic Cone		\geq	_	, v	ater Content	(%)	PID Readings	_ =	and Comments
h Sca	Elev Depth	STRATIGRAPHY	PIC P	Number	Type	N-Value	ation 5 mASL	1,0 Undraine	d Shear	3(Strength	(kPa)	φ		& Plasticity		Rea	Well Details	
Dept	(m)	GROUND SURFACE	Graphic Plot	Ñ	+	Core Recovery	Eleva	O Unc Poc 40	confined ket Penetr	ometer 12	+ Fie) Lab	d Vane Vane		PL MC 10 20 3	30	딭		GRAIN SIZE DISTRIBUTION (%) (MIT)
0	181.5	CLAYEY SILT	Иľ			,	-	40	80	12	0 1				30			GR SA SI CL
		For stratigraphic descriptions, refer to 16-	N				181 -											
		60B.	121				101											
1			11				-											
			11															
			111	1			180 -											
2			11				-											
			Иł															
			11				179 -											
3			Ηł															
2			[]]															
			궴	1			178 -						ۍ ۳					
			M										Fracture Frequency					
4			Ρłł				-						ωĔ					
	177.1 4.4	at 4.4m below grade For stratigraphic descriptions, refer to 16-	惙				177 -							+				
		6A.	\bigotimes														T	
5			\mathbb{K}				-											
							176 -											
			\bigotimes				1/6-											
6			K				-											
			\otimes				175 -											
7			K															
																	目	
			Š				174 -										°≣°	
8			K														目	
•			\mathbb{Z}															
			\otimes				173 -											
			K														이름이	
9			\mathbb{Z}				-											
			\otimes				172 -										8 8 8	
			K															
10			Ø															
	170.0		\mathbb{N}				171 -										, E	
	170.9 10.6		177	4									-		L	L		
		END OF BOREHOLE						Da	ato	WATE	RLEV	EL MO		RING Elevation	(m)			
		Borehole was dry and open upon						No	ate ov 10, 2	016	De	4.7	'	176.8	(iii)			
		completion.																
		50 mm monitoring well installed. No. 10 screen installed.																

LOC OF BOREHOLE 16-6B

LOG OF BOREHOLE 16-60B

wsp



Sheet No. 1 of 1

wsp

pro	ject	Proposed Uppers Quarry														pr	oject	no.	16	1-11633-00	
c	ient	Walker Aggregates Inc.				ri	g type	CME	75							dat	e sta	rted	20	16/10/18	
loca	tion	Thorold / Niagara Falls, ON				m	nethod	Rock	< corir	ng						SL		isor	SK	(
posi	tion	E: 649147 N: 4772486 (17T, Geo	detic)			coring	HQ (core, (DD=9	6mm,	D=6	4mm				revie	ewer	KJ	F	
ê		SUBSURFACE PROFILE	_		SA	MPLE	da la	Penetra (Blows	ation Test / 0.3m)	Values	>						s			Lab Data	1
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dy 1 Undrain 0 U	namic Con I <u>0</u> 2 ned Shea Inconfined locket Pane I0 8	e 10 3 r Strengt stromster	h (kPa) + Fiel	40 Id Vane Vane 60	, I	ater Co & Pla	sticity ic i	L	PID Readings	Well Details		and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CI	,
-0	180,3	SILTY CLAY TO CLAYEY SILT	h				180 -												8	GR SA SI CI	1
-1		For stratigraphic details, refer to 16-7OB.	F/				-														
-			K1				179 -														
-2			X				178 -														
-3			Hł				-														
-			11				177 -														
- 4			Ĥ/				176 -						e ò								
- 5							-						Fracture Frequency								
-	174.3	at 6.0m below grade					175 -														
-6	6.0	ERAMOSA FORMATION, brownish-grey	\mathbb{K}				174 -														
- 7		to grey dolostone, hard, fresh, medium grained with saccharoidal texture, petroliferous odour when broken, thin to medium horizontal beds with occasional		1	R1	TCR = 88% RQD = 31%	-														
-8	172.7 7.6	2 mm thick shale layers. Rare styolites					173 -														
-		and gypsum nodules. Approximately 3% vug content.		2	R2	TCR = 95% RQD = 51%	172 -														
-9	171.1 9.2	Noticably porous and vuggy between 6.40 m and 9.45 m.					171 -														
- 10	5.2			3	R3	TCR = 102% RQD = 85%	-														
- 10	169.6					RQD = 85%	170 -														
- 11	10.7			4		TCR = 98%	- 169 -														
- 12	168.1			4	R4	TCR = 98% RQD = 46%	-														
-	12.2	Noticably porous and vuggy between 10.67 m and 14.02 m.					168 -														
- 13				5	R5	TCR = 100% RQD = 56%	167 -														
- 14	166.6 13.7						· ·														
-				6	R6	TCR = 98% RQD = 32%	166 -											7			
- 15	165.1 15.2						165 -														
- 16		0 em estelle unio et 46 4 m		7	R7	TCR = 98% RQD = 87%	-														
-	163.6 16.7	2 cm calcite vein at 16.1 m.					164 -														
- 17	10.7			8	R8	TCR = 100% RQD = 62%	163 -														
- 18	162.0					RQD = 62%	- 162 -														
- 19	18.3					TCR = 100%	- 102														
- 19	160.5	5 cm of dark shale at 19.7 m.	\otimes	9	R9	TCR = 100% RQD = 95%	161 -														
- 20	20:0	7.5 cm wide calcite filled vugs (corals) from 19.96 m to 22.76 m.					- 160 -														
- 21		GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional		10	R10	TCR = 100% RQD = 100%	- 100														
-	159.0 21.3	gypsum and chert nodules, weak petroliferous odour when broken. Rare	Ň	\vdash	_		159 -														
- 22		fossil fragments, minor calcite and gypsum veins. Occasional to common	\mathbb{K}	11	R11	TCR = 100% RQD = 100%	- 158 -	1													1
- 23	157.4	stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium bedded.																			1
	~2.0	Chert present from 21.31 m to 22.76 m.	Ň	12	R12		157 -						L								
- 24	155.9						156 -	1					L								
-	24.4 154.4		\mathbb{K}	13	R13																
		(continued next page)																		Sheet No. 1 of	2

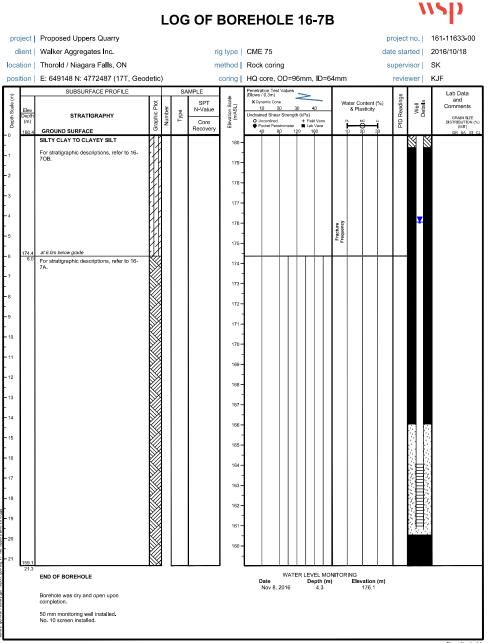
LOG OF BOREHOLE 16-7A

LOG OF BOREHOLE 16-7A

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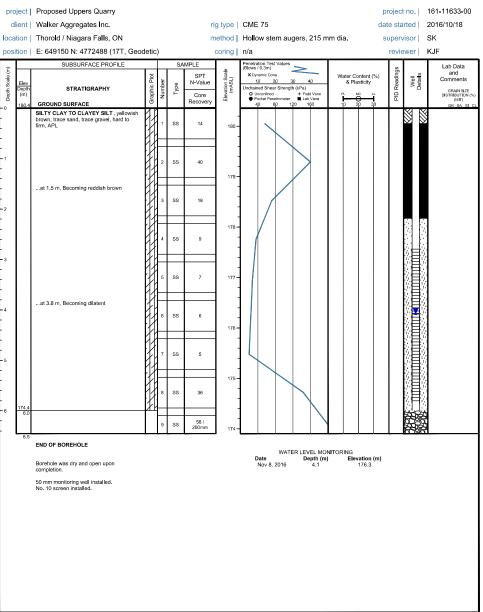
pro	ject	Proposed Uppers Quarry						project no. 161-11633-00
c	ient	Walker Aggregates Inc.				ri	g type	CME 75 date started 2016/10/18
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Rock coring SK
posi	tion	E: 649147 N: 4772486 (17T, Geo	detic)			coring	HQ core, OD=96mm, ID=64mm reviewer KJF
Ê		SUBSURFACE PROFILE			SA	MPLE	ø	Penetration Test Values S Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY (continued)	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	(Elkors) (0.3m) Lab Data X Opramic Cone 0 10 20 40 Water Content (%) X Plasticity 0 Lab Data 0 Lab Data
- 25		GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional	\mathbb{N}	13	R13	TCR = 100% RQD = 100%	155 -	
·26 ·27	154.4 25.9 152.8	gypsum and chert nodules, weak petroliferous odour when broken. Rare fossil fragments, minor calcite and gypsum veins. Occasional to common stylites and shale partings 2 mm thick.		14	R14	TCR = 100% RQD = 100%		
-28	27.5	Fracture surfaces clean Medium bedded (continued)		15	R15	TCR = 100% RQD = 100%	153 -	
- 29	151.4 150.9 29.4	Gradational contact.	ø	H			151 -	
- 30	149.8	GASPORT FORMATION, dolostone, hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone	Ŵ	16	R16	TCR = 97% RQD = 100%	- 150 -	
•31	30.5	with saccharoidal texture. Medium bedded with fossil fragments up to 6%. Occasional stylolites. Rare gypsum nodules, less than 1% by volume.		17	R17	TCR = 102% RQD = 102%	- 149 –	
· 32	31.9	1 cm "graphite" layer at 30.02 m, marker bed. Chalky chert nodule at 31.47 m.		18	R18	TCR = 100% RQD = 100%	- 148	
•34	146.8 33.5			19	R19	TCR = 100% RQD = 100%	147	
- 35	145.2 35.1					RQD = 100%	140 - 145 -	
- 36	143.7 36.6			20	R20	TCR = 100% RQD = 100%	- 144 —	
· 37 · 38	142.2			21	R21	TCR = 100% RQD = 86%	143 -	
- 39	38.1 141.0	Lower contact on conglomerate fossil bed.		22	R22	TCR = 100% RQD = 92%	142 - 141	
- 40	1 40.3 39.6	DECEW FORMATION, dolostone, medium hard, dark grey, fine grained, fresh, argillaceous with occasional shale partings, 3 mm thick.		23	R23	TCR = 100% RQD = 93%	141 -	
-41	139.2 41.1		Ø				- 139 -	
42	138.3 42.0 137.6	ROCHESTER FORMATION, shale, very dark grey to black, dolomitic to		24	R24	TCR = 100% RQD = 97%	- 138 -	
	42.7	calcareous shale.						WATER LEVEL MONITORING Date Depth (m) Elevation (m) Nov 8, 2016 14.5 165.8
		Borehole was dry and open upon completion. 50 mm monitoring well installed. No. 10 screen installed.						

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LOG OF BOREHOLE 16-70B

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Sheet No. 1 of 1

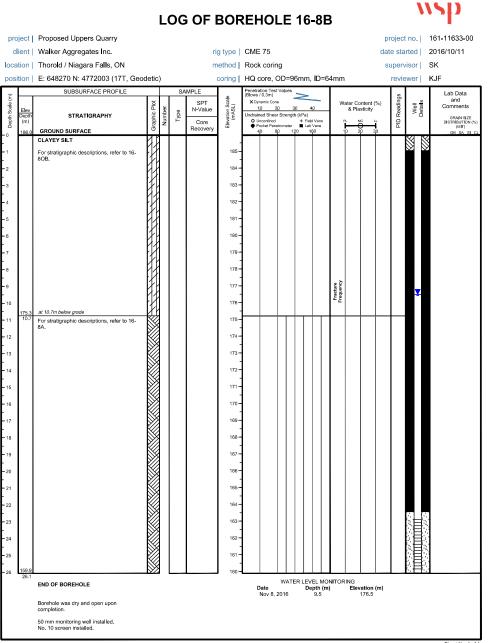
pro	ject	Proposed Uppers Quarry														pr	oject	no.	16	1-11633-00	
c	ient	Walker Aggregates Inc.				ri	g type	CME	75							dat	e sta	rted	201	16/10/04	
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Rock	c corir	g								risor	SK		
posi	tion	E: 648272 N: 4772003 (17T, Geod	letic)			coring				6mm,	ID=6	4mm				revie	wer	KJ	=	
(m)		SUBSURFACE PROFILE	_	_	SA	MPLE	ale		ation Test / 0.3m)		\geq						sbi			Lab Data and	
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	1 Undrain OU OP	namic Con <u>0</u> 2 ned Shea nconfined ocket Pene 0 8	0 3 Strengt	h (kPa) + Fiel	0 I Vane Vane	Wa P 1	ater Co & Plas	sticity	L	PID Readings	Well Details		GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL	
0	186.0	CLAYEY SILT	41					,	0 0	о I.	20 1	,0	H	0 2	5 3	0			3	GR SA SI CL	1
1		For stratigraphic descriptions, refer to 16- 80B.					185 -												>		
2			X				184														
3			[]]				183 -														
4			H				182 -														
5							181 -														
6							180 -														
7			KI.				179 -														
8							178-											V			
9			F)				177 -						ture ency								
10							176 -						Fracture Frequency								
11	175.3 10.7	at 10.7m below grade ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium to		-			- 175 -							_							
12	173.7	thin grained with saccharoidal texture, petroliferous odour when broken, thin to medium horizontal beds with occasional		15	R1	TCR = 60% RQD = 6%	- 174 -														
13	12.3	2 mm thick shale layers. Rare styolites and gypsum nodules. Approximately 3% vug content.		16	R2	TCR = 96% RQD = 68%	- 173 -														
14	172.3 13.7	rug concin.	X	17	R3	TCR = 100% RQD = 96%	- 172 -														
15	170.9 15.1		K			RQD = 96%	171 -														
16			K	18	R4	TCR = 100% RQD = 94%	170-														
17	169.3 16.7		K			TOD - 000	- 169 -														
18	167.7			19	R5	TCR = 92% RQD = 58%	- 168 -														
19	18.3			20	R6	TCR = 113% RQD = 50%	- 167 -														
20	166.3 19.7			-			- 166 -														
21	164.7			21	R7	TCR = 89% RQD = 39%	- 165 -														
22	21.3			22	R8	TCR = 109% RQD = 87%	- 164 -														
23	163.3 22.7		Ø				- 163 -														1
24				23	R9	TCR = 100% RQD = 70%	- 162 -														ĺ
25	161.6 24.4			\square		TCD - 90%	- 161														ĺ
	160.1	Pinkish white calcite filled vugs from 25.25 m for 5 cm and from 27.5 m to	Ž	24	R10	TCR = 88% RQD = 39%	160 -														1
26	25.9 158.5	27.81 m.	Ŵ	25	R11	TCR = 90% RQD = 90%	- 100														ĺ
	06.0	(continued next page)	<u>، ۲</u>																	Sheet No. 1 of 2	2

LOG OF BOREHOLE 16-8A

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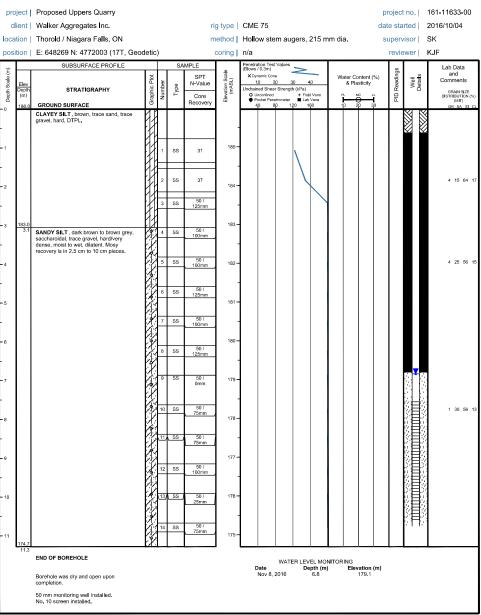
LOG OF BOREHOLE 16-8A

pro	oject	Proposed Uppers Quarry								proje	ct no.	161-11633-00
c	lient	Walker Aggregates Inc.				ri	g type	CME 75	d	late s	tarted	2016/10/04
loca	ation	Thorold / Niagara Falls, ON				m	ethod	Rock coring		supe	rvisor	SK
pos	ition	E: 648272 N: 4772003 (17T, Geo	detic)			coring	HQ core, OD=96mm, ID=6	4mm	rev	viewer	KJF
Ê		SUBSURFACE PROFILE	_		SA	MPLE	æ	Penetration Test Values (Blows / 0.3m)		s		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dynamic Cone 10 20 30 40 Undrained Shear Strength (kPa) Unconfined ← Field Vane ◆ Pocket Panetromater Lab Vane	Water Content (%) & Plasticity	PID Readings	Well	and Comments GRAIN SIZE DISTRIBUTION ((MIT) GR SA SI
27	158.5	(continued) 2 to 4 mm shaley partings from 28.01	×	25	R11	11000101)		40 80 120 160	10 20 30	-		GR SA SI
- 28	27.5 158.0 28.0	m to 30.78 m. GOAT ISLAND FORMATION, dolostone,		26	R12	TCR = 111% RQD = 111%	158 -					
29	157.1 28.9	hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak petroliferous odour when broken. Rare fossil fragments, minor calcite and		27	R13	TCR = 95% RQD = 95%	157 -					
30	155.5 30.5	gypsum nodules. Occasional to common stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium					156 -					
31	153.9	Calcite fossils from 30.18 m to 31.95 m.		28	R14	TCR = 100% RQD = 100%	155 - - 154 -					
33	32.1	Minor chert as 1 to 2 cm blebs from 32 m to 32.92 m.		29	R15	TCR = 100% RQD = 100%	- 153 -					
34	152.4 33.6			30	R16	TCR = 102% RQD = 102%	152 -					
35	150.9 35.1						151 -					
36	149.3 36.7			31	R17	TCR = 100% RQD = 100%	150 -					
37	147.8			32	R18	TCR = 100% RQD = 100%	149 - - 148 -					
39	38.2	2 cm chalky calcite bleb at 40.03 m.		33	R19	TCR = 97% RQD = 92%	140 -					
40	146.3 146.9 40.0	GASPORT FORMATION, dolostone,					146 -					
41	144.7 41.3	hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone with saccharoidal texture. Medium bedded with fossil fragments up to 6%		34	R20	TCR = 100% RQD = 100%	145 -					
42	143.3	Stylolites shaley partings up to 3 mm, 2 per 1.5 m. Rare gypsum nodules, less than 1% by volume.		35	R21	TCR = 100% RQD = 95%	144 -					
43	42.7	1 cm "Graphite like" marker bed at 40.54 m. 6 cm chalky calcite bleb at 43.66 m.		36	R22	TCR = 100% RQD = 100%	143 -					
44	141.8 44.2			37	R23	TCR = 98% RQD = 98%	142 - - 141 -					
46	140.2 45.8						- 140 -					
47	138.9 47.1			38	R24	TCR = 100% RQD = 100%	139 -					
48	137.7 48.3	Lower gasport contact at 48.29 m on conglomerate bed.		39	R25		138 -					
	137.4 48.6	medium hard, dark grey, fine grained, fresh, arenaceous. 1 cm calcite bleb at 48.46 m.						WATER LEVEL MO Date Depth (m) Nov 8, 2016 7.9				
		END OF BOREHOLE										
		Borehole was dry and open upon completion.										
		50 mm monitoring well installed. No. 10 screen installed.										



LOG OF BOREHOLE 16-80B

wsp



Sheet No. 1 of 1

pro	ject	Proposed Uppers Quarry														pr	oject	no.	161-11633-00	
c	ient	Walker Aggregates Inc.				ri	g type	CME	E 75							date	e star	rted	2016/11/18	
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Roc	k corir	ng						SU	ipervi	isor	SK	
posi	tion	E: 648258 N: 4773007 (17T, Geod	letic)			coring				6mm,	, I D=6	4mm	I			revie	wer	KJF	
Ê		SUBSURFACE PROFILE			SA	MPLE	e		ation Tes / 0.3m)		Ν						gs		Lab Data and	
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY GROUND SURFACE	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	Undrai O U ♥ F	namic Cor 1,0 2 ned Shea Jaconfined Pocket Pen 4,0 8	r Strengt stromater	h (kPa) + Fiel Lab	40 ki Vane Vane 60	W	& Pla	isticity	-	PID Readings	Well	GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL	
0	182.0	CLAYEY SILT	ht						1			1			Ĥ			3	GR SA SI CL	
1		For stratigraphic descriptions, refer to 16- 90B.					- 181 –											2		
2			17				180 -													
3							- 179 –													
4							178 -													
5							177 - - 176 -						Fracture Frequency					V		
			M				-						E e							
7	174.8 7.2	at 7.2m below grade ERAMOSA FORMATION, brownish-grey	k	1	R1	TCR = 100% RQD = 0%	175 -	-	-											
8	7.7	to grey dolostone, hard, fresh, medium to thin grained with saccharoidal texture, petroliferous odour when broken, thin to medium horizontal beds with occasional		2	R2	TCR = 98% RQD = 74%	174 -													
9	172.8 9.2	2 mm thick shale layers. Rare styolites and gypsum nodules. Approximately 3% vug content.	K	_			173 -													
10		ng content.	K	3	R3	TCR = 100% RQD = 82%	172 -													
11	171.2 10.8			_			- 171 -													
12	169.7			4	R4	TCR = 95% RQD = 44%	- 170 -													
13	12.3			5	R5	TCR = 100% RQD = 22%	- 169													
14	168.2 13.8			6	R6	TCR = 100% RQD = 89%	168 -													
15	166.6 15.4		Ø			NQD - 09%	167 -													
16			Ø	7	R7	TCR = 98% RQD = 89%	166 -													
17	165.1 16.9						165 -													
18	164.2 17.8 163.6	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional	Š	8	R8	TCR = 100% RQD = 81%	- 164													
19	18.4	gypsun and chert nodules, weak petroliferous odour when broken. Rare fossil fragments, minor calcite as 1.25 cm to 3.8 cm nodules. Occasional to		9	R9	TCR = 100% RQD = 100%	163 -													
20	162.0 20.0	common stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium bedded.	Ø	10	R10	TCR = 97% RQD = 97%	162 -													
21	160.5 21.5		Ŵ			KQD = 97%	161 -													
22	159.1	Three 1-3 cm nodules at 23.48 m to	Ŵ	11	R11	TCR = 100% RQD = 100%	160 -													
23 24	22.9	22,53 m.		12	R12	TCR = 100% RQD = 88%	159 - - 158 -													
	157.5 1 <u>24.5</u>		K	13	R13		-													
	100.0	for a floor of a cost of a cost	NY)					-	-				-						Sheet No. 1 of 2	

LOG OF BOREHOLE 16-9A

LOG OF BOREHOLE 16-9A

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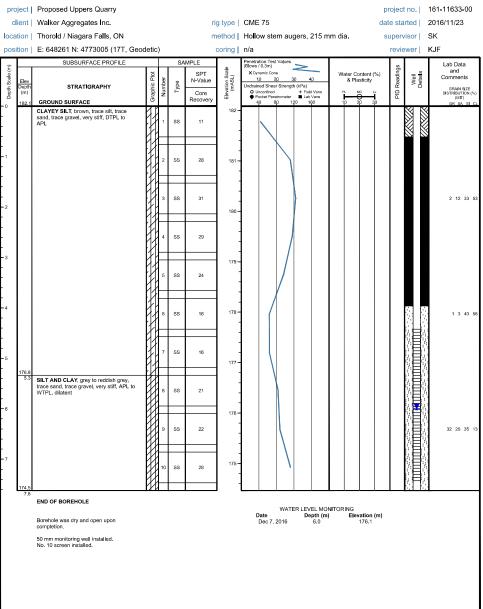
pro	ject	Proposed Uppers Quarry							1	project n	o.	161-11633-00
c	ient	Walker Aggregates Inc.				ri	g type	CME 75	da	ate starte	ed	2016/11/18
loca	tion	Thorold / Niagara Falls, ON				m	nethod	Rock coring	:	supervis	or	SK
posi	tion	E: 648258 N: 4773007 (17T, Geo	detic)			coring	HQ core, OD=96mm, ID=64	mm	review	er	KJF
(E)		SUBSURFACE PROFILE	_		SA	MPLE	٥	Penetration Test Values (Blows / 0.3m)		s		Lab Data
Depth Scale	Elev Depth (m)	STRATIGRAPHY (continued)	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dynamic Cone 10 20 30 40 Undrained Shear: Strength (kPa) O Unconfined + Fiold Vane Pocket Penetrometer 40 80 1220 160	Water Content (%) & Plasticity PL 102030	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
- 25		GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional		13	R13	TCR = 100% RQD = 100%	-					
- 26 - - 27	156.0 26.0	gypsum and chert nodules, weak petroliferous odour when broken. Rare fossil fragments, minor calcite as 1.25 cm to 3.8 cm nodules. Occasional to common stylites and shale partings 2		14	R14	TCR = 100% RQD = 100%	156 - 155 -					
- - 28 -	154.4 27.6	mm thick. Fracture surfaces clean. Medium bedded. (continued)		15	R15	TCR = 102% RQD = 102%	154 -					
- 29	153.0 159.0 29.3	GASPORT FORMATION, dolostone,		Η			153 -					
- 30 -	151.4 30.6	hard, fresh, grey to dark grey, fine to medium grained fossiliferous dolostone with saccharoidal texture. Medium bedded with fossil fragments up to 6%.		16	R16	TCR = 100% RQD = 100%	152 - - 151 -					
- 31 - - 32	149.8	Stylolites shaley partings up to 3 mm, 2 per 1.5 m. Rare gypsum nodules, less than 1% by volume. at 29.4 m, 1 cm "graphite" marker bed		17	R17	TCR = 100% RQD = 100%	151 -					
- - 33 -	32.2 148.3	is at 29.97 m.		18	R18	TCR = 100% RQD = 100%	149 -					
- 34 - - 35	33.7 146.8			19	R19	TCR = 100% RQD = 100%	148 - - 147 -					
- 35 - 36	35.2			20	R20	TCR = 100% RQD = 100%	147 -					
- 37 - 38	36.7			21	R21	TCR = 100% RQD = 100%	145 - - 144 -					
- 38 - 39	143.8 38.2			22	R22	TCR = 100% RQD = 100%	144					
- - 40 -	<u>149.9</u> 39.8	DECEW FORMATION, dolostone, medium hard, dark grey, fine grained, fresh, argillaceous with occasional shale partings, 3 mm thick.		23	R23	TCR = 100% RQD = 95%	142 -					
- 41	140.7 41.3	parango, a min anon	Ŵ				141 -					
		END OF BOREHOLE						WATER LEVEL MON Date Depth (m)	Elevation (m)			
		Borehole was dry and open upon completion.						Nov 25, 2016 5.3	176.7			
		50 mm monitoring well installed. No. 10 screen installed.										

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Proposed Uppers Quarry Valker Aggregates Inc. horold / Niagara Falls, ON :: 648259 N: 4773006 (17T, Geo SUBSURFACE PROFILE STRATIGRAPHY SROUND SURFACE LAYEY SILT	Graphic Plot		SA	m	ethod	CME 75 Rock corir HQ core, 0	-	imm, I D=	64mr	n	da	te sta	rted visor	161-11633-00 2016/11/22 SK KJF
horold / Niagara Falls, ON : 648259 N: 4773006 (17T, Geo SUBSURFACE PROFILE STRATIGRAPHY GROUND SURFACE	T		SA	m	ethod	Rock corir HQ core, (-	imm, I D=	64mr	n		uperv	visor	SK
: 648259 N: 4773006 (17T, Geo SUBSURFACE PROFILE STRATIGRAPHY GROUND SURFACE	T		SA			HQ core, 0	-	imm, I D=	64mr	n	s			
SUBSURFACE PROFILE STRATIGRAPHY GROUND SURFACE	T		SA		coring		DD=96	mm, I D=	64mr	n		revie	werl	KJF
STRATIGRAPHY GROUND SURFACE	phic Plot	5	SA	MPLE										
GROUND SURFACE	phic Plot	5			۵	Penetration Test (Blows / 0.3m)	Values	>				st		Lab Data
	6	Number	Type	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Con 1,0 2 Undrained Shea O Unconfined Pocket Pane	0 30 r Strength		-	Vater Cont & Plast	icity	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%)
LATET OLI	0 A P			Recovery	ш 182 —	40 E	0 121	160	+	10 20	30			(MIT) GR SA SI CL
or stratigraphic descriptions, refer to 16- DB.					- 181 — -									
					180 -									
					179 -									
					-									
					- 176 -				racture					
170 1 1	₽ł				-				<u>د ت</u>				Ť	
or stratigraphic descriptions, refer to 16-	k				175 -				+	+				
Α.					174 —									
					173 -									
					-									
					1/2-									
					171 -									
	\mathbb{K}				170 -									
					- 169									1
					-									1
	Ŵ				168 -									
	Ň				167 -									
					- 166 -									
					-									
					165 -									
							WATE	R LEVEL M		RING				
orehole was dry and open upon oppletion.						Date Nov 25,		Depth (6.3	m)	Elevat	t ion (m) '5.7			
0 mm monitoring well installed. o. 10 screen installed.														
	• ID OF BOREHOLE rehole was dry and open upon mpletion.	r stratigraphic descriptions, refer to 16-	7.2m below grade r stratigraphic descriptions, refer to 16- restingraphic descriptions, restingraphic description	<u>Z3m below grade</u> r stratigraphic descriptions, refer to 16- DOF POREHOLE rehole was dy and open upon mpretion.	Z3n below grade retrailingraphic descriptions, refer to 16- TO OF BOREHOLE Tehole was dry and open upon mignetion.	7.2m. below grade r stratigraphic descriptions, refer to 16- 1	7.2m. below grade r stratigraphic descriptions, refer to 16- 177- 176- 174- 174- 174- 174- 174- 174- 174- 174	Z2m below grade r stratigraphic descriptions, refer to 16.	Z.2n. helow grade rstratigraphic descriptions, refer to 16 177 No PORENCIE 174 No PORENCIE WATER LEVEL MONTORING Nov 25, 2016 WATER LEVEL MONTORING Nov 25, 2016 Depth (m) Elevation (m) 6.3 rehole was dry and open upon migneton. Trist of the set of the	22n helow grade r stratigraphic descriptions, refer to 16- .	Z3n below grade re tradigraphic descriptions, refer to 16 Image: Constraint of the second seco			

LOG OF BOREHOLE 16-90B

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Sheet No. 1 of 1

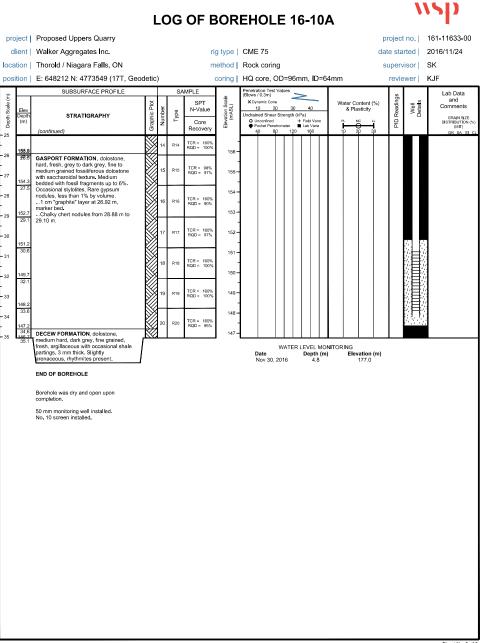
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wsp LOG OF BOREHOLE 16-9SP project | Proposed Uppers Quarry project no. | 161-11633-00 client | Walker Aggregates Inc. rig type | CME 75, track-mounted date started | 2017/07/26 location | Thorold / Niagara Falls, ON method | Hollow stem augers, 215 mm dia. supervisor SCL position | E: 648263 N: 4773003 (17T, Geodetic) reviewer | KJF coring | n/a SUBSURFACE PROFILE SAMPLE enetration Test Value Blows / 0.3m) Lab Data \leq Elevation Scale (mASL) Readings and Comments SPT X Dynamic Cone Water Content (%) & Plasticity Well Details 1,0 2,0 30 40 N-Value Elev Deptr (m) 10 20 30 -> Jndrained Shear Strength (kPa) 0 Uncerlined + Fiold Vane O Uncerlined + Fiold Vane ▲ Lab Vane 40 80 120 160 Type STRATIGRAPHY GRAIN SIZE DISTRIBUTION (% (MIT) Core Recovery Depth 립 182 GROUND SURFACE GR SA SI -0.0 CLAYEY SILT For stratigraphic descriptions, refer to 16-9OB. 182.0 0.5 181.5 1.0 181.0 180.5 - 2.0 180.0 - 2.5 179 END OF BOREHOLE Borehole was dry and open upon completion. WATER LEVEL MONITORING Depth (m) Elevation (m) 2017 1.1 181.1 Date Jul 28, 2017 50 mm monitoring well installed. No. 10 screen installed.

LOG OF BOREHOLE 16-10A

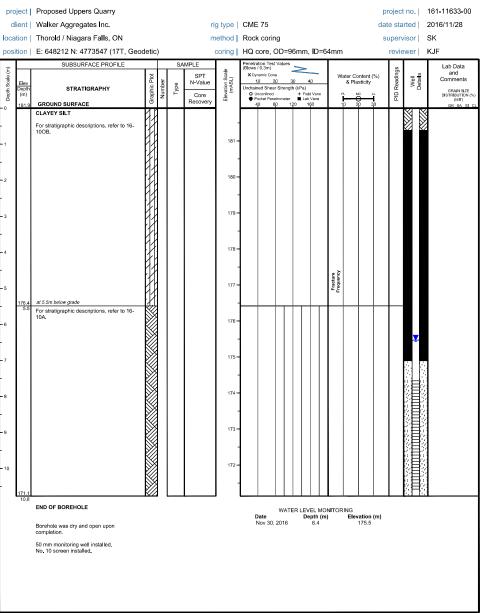
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			.00			ENOL		10-	107								
project	Proposed Uppers Quarry												pro	oject	no.	161-11633-00	
client	Walker Aggregates Inc.			ri	ig type	CME 75							date	e star	ted	2016/11/24	
ocation	Thorold / Niagara Falls, ON			m	nethod	Rock corir	ıg						su	pervi	isor	SK	
osition	E: 648212 N: 4773549 (17T, Geo	detic)			coring	HQ core, (DD=9	6mm,	D=6	4mm			r	evie	wer	KJF	
~	SUBSURFACE PROFILE		S/	AMPLE	T	Penetration Test (Blows / 0.3m)	Values	_								Lab Data	
Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number Type	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Con 10 2 Undrained Shea O Unconfined Pocket Pane	e 0 3 r Strengt	0 4(h (kPa) + Field ■ Lab \		,	ater Co & Pla	ջ պ.	»)	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) CB, CA, CI (C)	
181.8	GROUND SURFACE	0	_	Recovery	, u	40 E	0 1:	20 16	0	1	0 2	o 30		<u> </u>		GR SA SI CL	
	CLAYEY SILT For stratigraphic descriptions, refer to 16- 10OB.				- 181 –												
					180												
					179 -												
					178 -					Fracture Frequency					_		
176.3	at 5.5m below grade	ИЦ			177 -					"							
5.5	ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium grained with saccharoidal texture, slightly	ø	1 R1	TCR = 100% RQD = 38%	176 -												
174.2	vuggy, fossiliferous, petroliferous odour when broken, thin to medium horizontal beds with occasional 2 mm thick shale		2 R2	TCR = 100% RQD = 67%	175 -												
7.6	layers. Rare styolites and gypsum nodules.		3 R3	TCR = 100% RQD = 71%	174 -												
172.6 9.2			+		173 -												
) 171.1			4 R4	TCR = 98% RQD = 58%	172 - - 171 -												
1 10.7 2 169.5	Gradational core recovered as 5 cm to 10 cm pieces from 10.05 m to 13.82 m. Thin bedded from 10.36 m to 13.61 m.		5 R5	TCR = 100% RQD = 27%	171 - - 170 -												
12.3			6 R6	TCR = 100% RQD = 72%	169-	169 -											
168.0 13.8			7 R7	TCR = 100% RQD = 87%	168 - - 167 -												
5 166.5 15.3	Calcite filled parting at 15.60 m.		+		-												
7 165.6 16.2 165.0 16.8	1 cm chert nodule at 16.18 m. GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak	ø	8 R8	TCR = 100% RQD = 92%	- 165 -												
3 163.4	petroliferous odour when broken. Rare fossil fragments, minor calcite and gypsum veins. Occasional to common		9 R9	TCR = 97% RQD = 92%	164 -												
18.4	stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium bedded. 1 cm shale layer at 18.00 m.		10 R10	TCR = 100% RQD = 100%													
19.9	Chert nodules up to 7.62 cm wide, 4% of core from 19.76 m to 20.42 m.		11 R11	TCR = 100% RQD = 100%	- 162 - - 161 -												
160.4 21.4			12 R12	TCR = 100% RQD = 100%	- 160 -												
158.8 23.0			+		159 -												
157.3			13 R13	TCR = 100% RQD = 100%	- 1												
155.8	(continued next page)	\mathbb{N}	14 R14		157											Sheet No. 1 of 2	



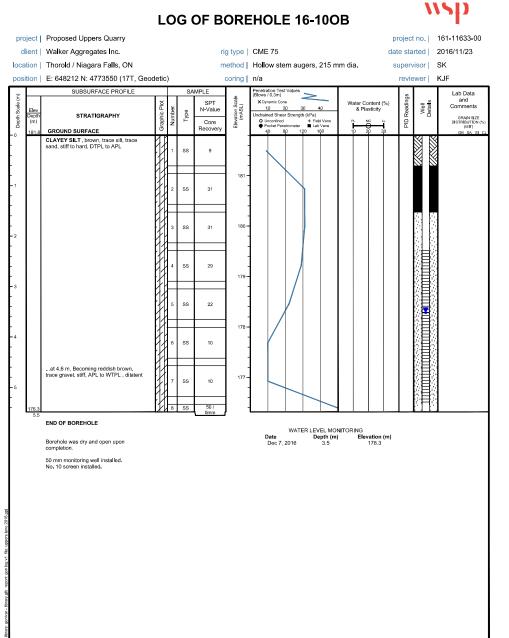
LOG OF BOREHOLE 16-10B

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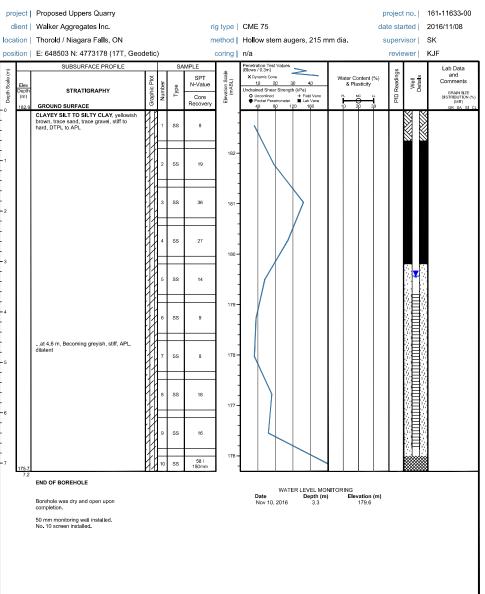
Sheet No. 2 of 2

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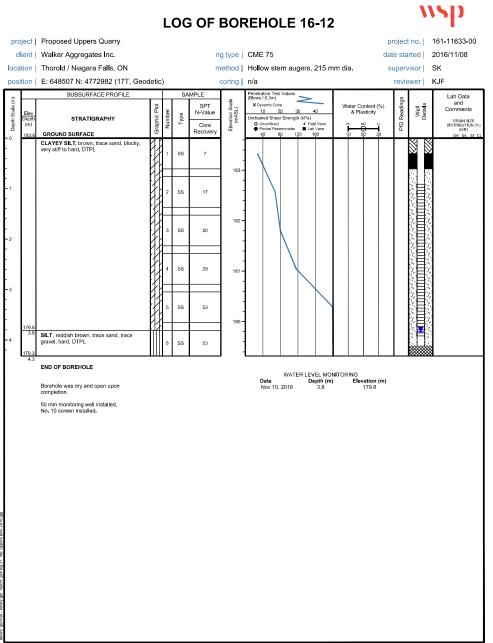
LOG OF BOREHOLE 16-11

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Sheet No. 1 of 1

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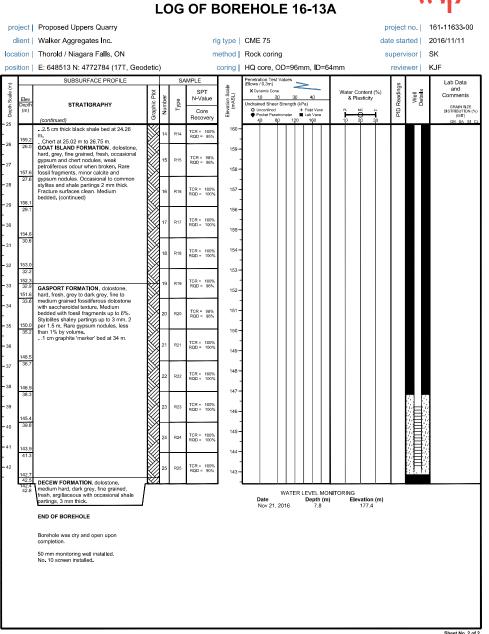


LOG OF BORFHOLE 16-13A

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			L	_(JG	OF E	SOR	EHOL		10-	1.3	A					
pro	ject	Proposed Uppers Quarry													projec	t no.	161-11633-00
c	ient	Walker Aggregates Inc.				ri	g type	CME 75						d	ate sta	arted	2016/11/11
loca	tion	Thorold / Niagara Falls, ON				m	ethod	Rock cori	ng						superv	visor	SK
posi	tion	E: 648513 N: 4772784 (17T, Geod	detic)			coring	HQ core,	OD=9	6mm	, ID= 6	4mm	I		revie	ewer	KJF
Ê		SUBSURFACE PROFILE			SA	MPLE	e	Penetration Tes (Blows / 0.3m)		>					s		Lab Data
Depth Scale (m)	Elev		Plot	er	æ	SPT N-Value	Elevation Scale (mASL)		10 C		40	w	ater Co & Pla	ntent (%) sticity	Readings	Well	and Comments
hepth S	Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	Core	evatic (m/	Undrained Shea O Unconfined Pocket Per	r Strengt	h (kPa) + Fie Lat	d Vane	.	n N	c u	PID R	- 0	GRAIN SIZE DISTRIBUTION (%)
-0	185.2	GROUND SURFACE	Ū			Recovery		40	0 1	20 1	160	<u> </u>	0 2	0 30	"		(MIT) GR SA SI CL
F		CLAYEY SILT For stratigraphic descriptions, refer to 16-	Hł				185 -										
-1		130B.	[#]				184 -										
-2			ľľ				-										
-			ĺł!				183 -										
-3			11				182 -					Fracture					
-4			ľł				-					Fred					
-	180.6 4.6	at 4.6m below grade ERAMOSA FORMATION, brownish-grey	Ø				181 -				<u> </u>						
-5		to grey dolostone, hard, fresh, medium to thin grained with saccharoidal texture,	\bigotimes	1	R1	TCR = 77% RQD = 27%	180 -										
-6	179.0	petroliferous odour when broken, thin to medium horizontal beds with occasional	\mathbb{N}			1020 - 2110	179-										
-	6.2	2 mm thick shale layers. Rare styolites and gypsum nodules. Approximately 3%	K			TCR = 100%	1/9-										
-7	177.5	vug content.	\mathbb{Z}	2	R2	TCR = 100% RQD = 90%	178 -										
-8	7.7		\otimes				-									.	
-			K	3	R3	TCR = 98% RQD = 90%	177 -										
-9	176.0 9.2						176 -										
- 10			Ø	4	R4	TCR = 100% RQD = 92%	475										
-	174.4		\mathbb{N}				175 -										
- 11	10.8	"Void" at 10.26 m to 10.36 m.	K	5	R5	TCR = 100% RQD = 75%	174 -										
- 12	172.9			Ĩ	R.S	RQD = 75%	470										
-	12.3		\mathbb{N}				173 -										
- 13			\mathbb{K}	6	R6	TCR = 98% RQD = 71%	172 -										
- 14	171.4 13.8	Grey muddy infill at 14.78 m for 10 cm.	K	Η			171 -										
-				7	R7	TCR = 100% RQD = 87%											
- 15	169.9 15.3	Eramosa as 10 cm to 15 cm pieces from 15.04 m to 19.81 m.	Ŵ				170 -										
- 16			K	8	R8	TCR = 90% RQD = 58%	- 169										
-	168.3		K			1100 - 0010	-										
- 17	16.9	Vuggy, up to 3 mm, 30 % of core from 17.01 m to 17.08 m.	\mathbb{Z}			TCR = 95% RQD = 69%	168 -										
- 18	166.8		Ň	9	R9	RQD = 69%	- 167 -								1		
-	18.4	Vuggy, up to 3 mm, 30 % of core from 18.49 m to 18.72 m.	K				-										
- 19		Calcite blebs up to 3 cm from 19.81 m	Ø	10	R10	TCR = 100% RQD = 86%	166 -										
- 20	165.3 19.9	to 20.14 m.	Ŵ	Η			165 -										
-			\mathbb{N}	11	R11	TCR = 95% RQD = 95%											
- 21	163.7		K				164 -								1		
- 22	21:6	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional	ø	12	R12	TCR = 100% RQD = 100%	- 163 -										
-	162.3	gypsum and chert nodules, weak petroliferous odour when broken. Rare	K			RQD = 100%	-								1		
- 23	22.9	fossil fragments, minor calcite and gypsum nodules. Occasional to common	Ŵ			TOP = 0PM	162 -								1		
- 24	160.7	stylites and shale partings 2 mm thick. Fracture surfaces clean. Medium bedded	Ŵ	13	R13	TCR = 98% RQD = 90%	- 161					L					
-	160.7 159.2	(continued on next page)	\mathbb{K}	14	R14												
		(continued next page)													•		Sheet No. 1 of 2

Sheet No. 1 of 1

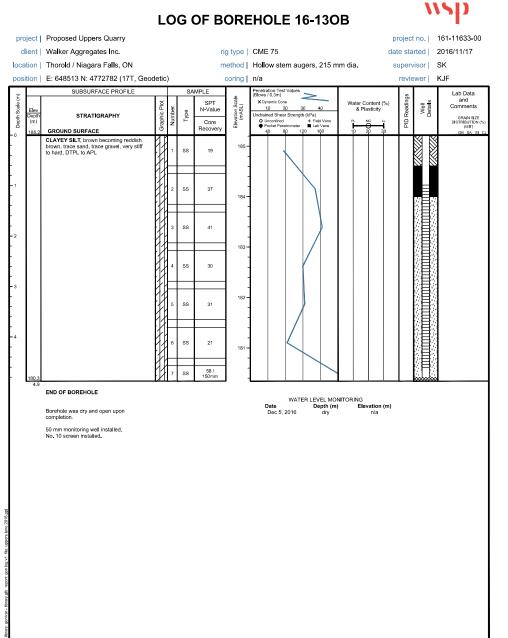


LOG OF BOREHOLE 16-13B

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		Proposed Uppers Quarry Walker Aggregates Inc.			I	rig type	CME 75									161-11633-00 2016/11/16
oca	tion	Thorold / Niagara Falls, ON				method	Rock corin	g						super		SK
oosi	tion	E: 648513 N: 4772783 (17T, Geo	detic))		coring	HQ core, (6mm,	ID=6	4mm			revi	ewer	KJF
Ē		SUBSURFACE PROFILE		-	SAMPLE	<u></u>	Penetration Test (Blows / 0.3m)		\geq	_				s6		Lab Data and
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dynamic Con 1,0 2 Undrained Shea O Unconfined Pocket Pane	0 3 Strengt	th (kPa) + Fiek ■ Lab	l0 d Vane Vane		ater Co & Plas	ntent (%) sticity	PID Readings	Well Details	GRAIN SIZE DISTRIBUTION (%) (MIT)
0	185.2	GROUND SURFACE CLAYEY SILT	иг	_	Recovery	185 -	40 8	0 1	20 1	60 	-	0 20	30			GR SA SI CL
1		For stratigraphic descriptions, refer to 16- 13OB.				184 -										
2						183 -										
2			[ł]			182 -					Fracture Frequency					
4	180.6	at 4.6m below grade				181 -					<u>ٿ</u>					
5	4.6	For stratigraphic descriptions, refer to 16- 13A.				- 180 -										
6						179 -										
7						178 -										
8 9						177 -										
10						176 - - 175 -									Y	
11						174-										
12						173 -										
13						172 -										
14 15						171 -										
16						170 - - 169 -										
17						168 -										
18			Ø			167 -										
19	165.3					166 -										
	19.9	END OF BOREHOLE		. –		_	Date Nov 21,		ER LEV De	EL MO pth (m 9,3	- NITOF)	Eleva	ation (m)			
		Borehole was dry and open upon completion.					1407 21,	2010		5,5						
		50 mm monitoring well installed. No. 10 screen installed.														

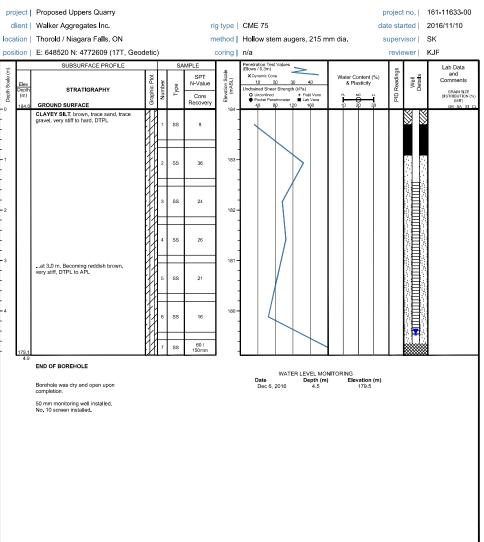
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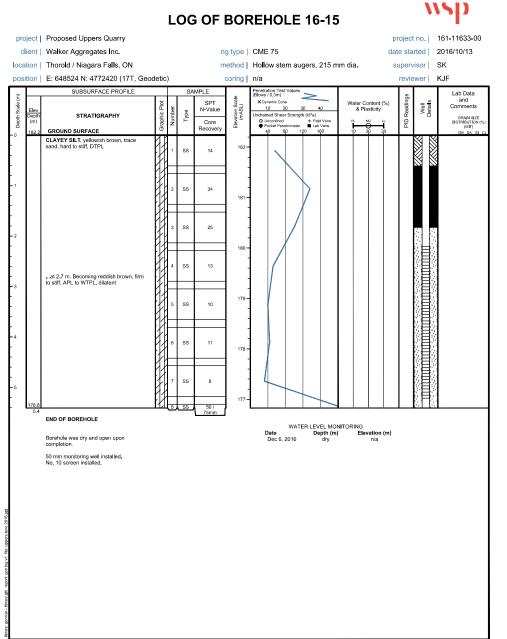
LOG OF BOREHOLE 16-14

-0

NSD

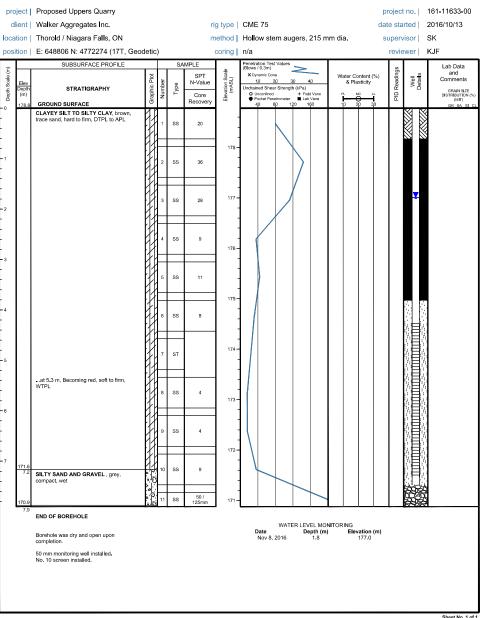


Sheet No. 1 of 1

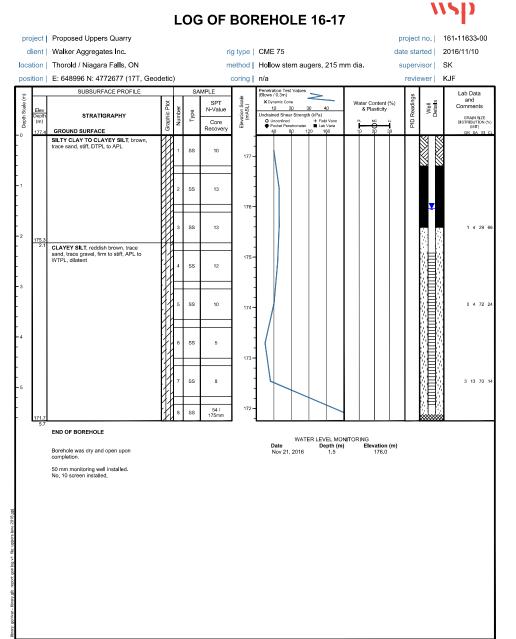


LOG OF BOREHOLE 16-16

wsp

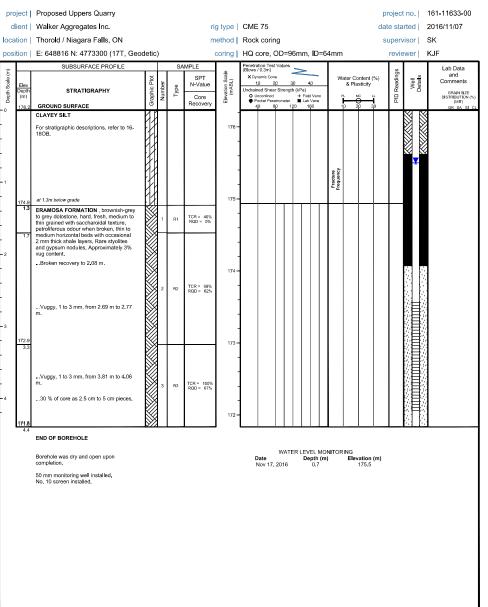


Sheet No. 1 of 1



LOG OF BOREHOLE 16-18B

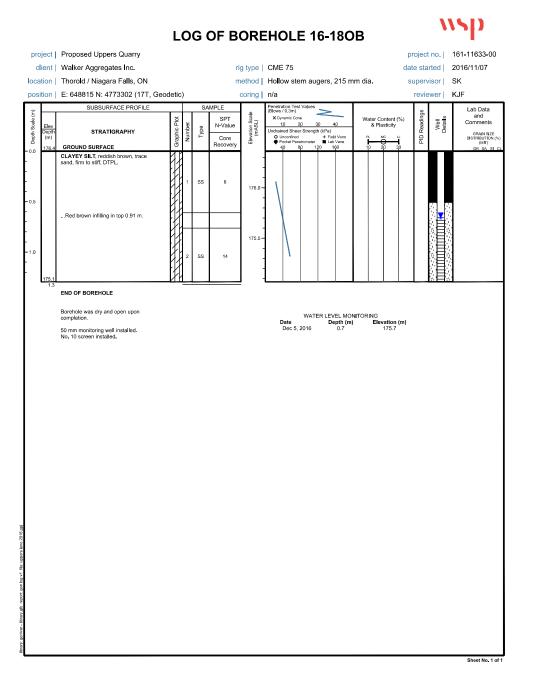
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Sheet No. 1 of 1

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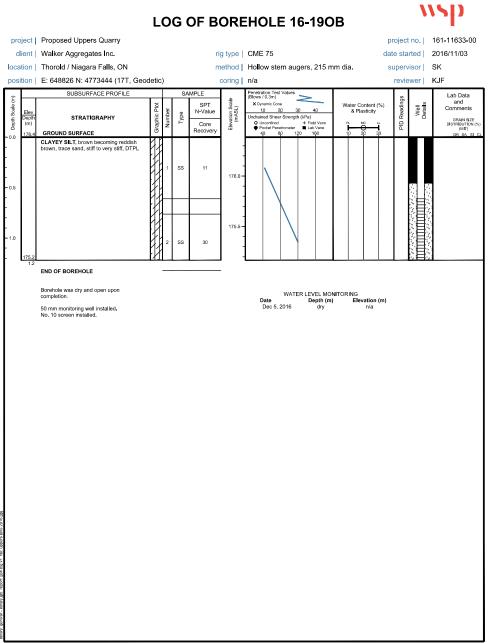
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LOG OF BOREHOLE 16-19B

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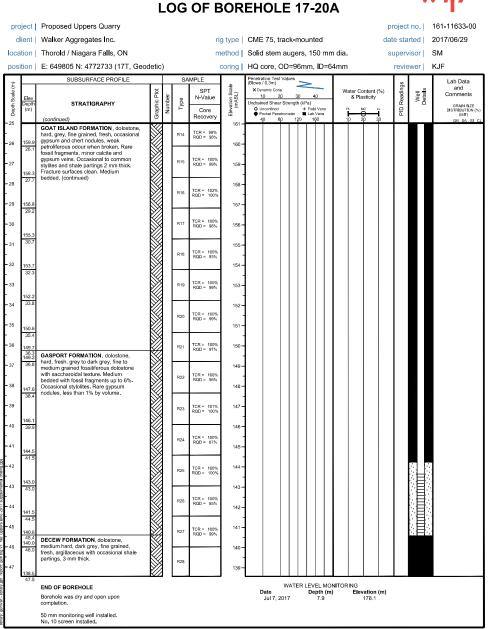
client W scation Tr sosition E:	roposed Uppers Quarry /alker Aggregates Inc. horold / Niagara Falls, ON : 648826 N: 4773443 (17T, Geoc SUBSURFACE PROFILE STRATIGRAPHY GROUND SURFACE LAYEY SILT v stratigraphic descriptions, refer to 16- IOB. 1.2m below grade LAWSA FORMATION, brownish-grey grey dolosione, hard, fresh, medium to uprimed with seachanoidal texture, no mithick shale layers. Rare styolites d gynsum nodules. Approximately 3%	Graphic Plot		m	g type nethod coring ecoring ecoring (Tsyme) intervention	Rock of HQ co Penetratio (Blows / 0 × Dynan 1,0	coring ore, OI on Test Vi 0.3m) mic Cone 20 d Shear S onfined ket Penetro	lues 30 renoth	+ Field Var		Water Co & Pla	da	ate sta supen	rted 2	161-11633-00 2016/11/04 SK KJF Lab Data and Comments OFAN SIZE DESTRACTION GR SA SI CL
Image: second	horold / Niagara Falls, ON : 648826 N: 4773443 (17T, Geod SUBSURFACE PROFILE STRATIGRAPHY :ROUND SURFACE LAYEY SILT or stratigraphic descriptions, refer to 16- IOB. 1.2m below grade RAMOSA FORMATION, brownish-gray gray dictoloties, hard (resh, medium to provinced with schalmeroid medium to trafferous ocour when broken, thin to elium horocrant beds with occessional mm thick shale layers. Rare styolites d orgous modules. Approximately 3%			MPLE SPT N-Value Core	ethod coring mysr) core gase coring mysr) coring coring mysr) coring coring cor	Rock of HQ co Penetratio (Blows / 0 × Dynan 10 Undrained • Poole	coring ore, OI on Test Vi 0.3m) mic Cone 20 d Shear S onfined ket Penetro	ilues 30 trength i	40 (kPa) + Field Varie ■ Lab Varie		Water Co & Pla	ontent (%) Isticity	supen revie	visor s	SK KJF Lab Data and Comments
Image: second	: 648826 N: 4773443 (17T, Geor SUBSURFACE PROFILE STRATIGRAPHY ROUND SURFACE LAYEY SILT or stratigraphic descriptions, refer to 16- IOB. 1.2m below grade RAMOSA FORMATION, brownish-gray arguined with seco-thravidal becaling and the seco-thravidal becaling and gradient with seco-thravidal becaling and a gradient with seco-thravidal becaling and the second second second and the second second second and the second second second and second second second second and the second second second second and the second second second second second the second second second second second second second and second second second second second second second second and second sec			MPLE SPT N-Value Core	Elevation Scale (mASL)	HQ CO Penetratio (Blows / 0 X Dynan 10 Undrained O Uncc	on Test Va D.3m) mic Cone 20 d Shear S onfined ket Panetro	ilues 30 trength i	40 (kPa) + Field Varie ■ Lab Varie		Water Co & Pla	ontent (%) Isticity	revie	ewer	KJF Lab Data and Comments
Image: constraint of the second sec	SUBSURFACE PROFILE STRATIGRAPHY ROUND SURFACE LAYEY SILT r stratigraphic descriptions, refer to 16- IOB. 1.2m below grade RAMOSA FORMATION, brownish-gray gray doclotone, hard, freash, medium to grayer doclotone, hard, freash, medium to grayer doclotone, hard, freash, medium to mm thick shale layers. Rare styolites di quysum nodules. Approximately 3%.			MPLE SPT N-Value Core	Elevation Scale (mASL)	Penetratio (Blows / 0 X Dynam 10 Undrained O Unco	on Test Va).3m) mic Cone 20 d Shear S onfined ket Panetro	ilues 30 trength i	40 (kPa) + Field Varie ■ Lab Varie		Water Co & Pla		1		Lab Data and Comments
176.4 G CL Fo 19 175.2 <i>at</i> 1.2 ER to per this this per this per this per this per this per this per this per this per this per this per this per this per this per this per this per this this this this this this this this	STRATIGRAPHY SROUND SURFACE LAYEY SILT or stratigraphic descriptions, refer to 16- IOB. 1.2m below grade RAMOSA FORMATION, brownish-grey grey foldoring hard, fresh, medium to tratificrous actour when broken, thin to elium horizontal beds with occessional mm thick shale layers. Rare stypilies di ognous modules. Approximately 3%.	Mumher		SPT N-Value Core	-	X Dynan 10 Undrained O Unco	mic Cone 20 d Shear S onfined ket Penetro	3,0 trength ((kPa) + Field Var Lab Varie	-	& Pla		PID Readings		Lab Data and Comments
176.4 G CL Fo 19 175.2 <i>at</i> 1.2 ER to per this this per this per this per this per this per this per this per this per this per this per this per this per this per this per this per this this this this this this this this	STRATIGRAPHY SROUND SURFACE LAYEY SILT or stratigraphic descriptions, refer to 16- IOB. 1.2m below grade RAMOSA FORMATION, brownish-grey grey foldoring hard, fresh, medium to tratificrous actour when broken, thin to elium horizontal beds with occessional mm thick shale layers. Rare stypilies di agusum ndduks. Approximately 3%.	Graphic Plot		SPT N-Value Core	-	X Dynan 10 Undrained O Unco	mic Cone 20 d Shear S onfined ket Penetro	3,0 trength ((kPa) + Field Var Lab Varie	-	& Pla		PID Readings	X Well Details	and Comments
176.4 G CL Fo 19 175.2 <i>at</i> 1.2 ER to per this this per this per this per this per this per this per this per this per this per this per this per this per this per this per this per this this this this this this this this	In the second se	Graphic P Mumber	Туре	Core	-	Undrained O Unco	d Shear S onfined ket Panetro	rength ((kPa) + Field Var Lab Varie		PL)	к ц	PID Rear	S Deta	
176.4 G CL Fo 19 175.2 <i>at</i> 1.2 ER to per this this per this per this per this per this per this per this per this per this per this per this per this per this per this per this per this this this this this this this this	LAYEY SILT r stratigraphic descriptions, refer to 16- I.2m below grade RAMOSA FORMATION, brownish-grey grey dolosione, hard, fresh, medium to trotificrous odour when broken, thin to elium horizontal beds with occesional mm thick shale layers. Rare styolites di ogusum ndoules. Approximately 3%	Grap		Core Recovery	-	O Uncc Pock 40	onfined ket Penetro 80	neter 120	+ Field Van Lab Vans 160		PL 0		G	84 R4	DISTRIBUTION (%) (MIT) GR SA SI CL
CL Fo 199 175.2 at 1.2 ER thin pel 1.7 2 m me 1.7 2 m	LAYEY SILT r stratigraphic descriptions, refer to 16- I.2m below grade RAMOSA FORMATION, brownish-grey grey dolosione, hard, fresh, medium to trotificrous odour when broken, thin to elium horizontal beds with occesional mm thick shale layers. Rare styolites di ogusum ndoules. Approximately 3%				- 176 -			120							GR SA SI CL
175.2 at 1.2 at 1.2 Eq to me 1.7 2 n me	r stratilgraphic descriptions, refer to 16- IOB. 1.2m below grade TAMOSA FORMATION , brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, in grained with saccharoldal texture, in grained with saccharoldal texture, though portorolated with occasional mm thick shale layers. Rare stypolites of upruse modules. Approximately 3%				- 176 -										
199 175.2 at 1.2 ER to this peter 1.7 2 m me 1.7 2 m	I.2m below grade TAMOSA FORMATION , brownish-grey gry dolostone, hard, fresh, medium to in grained with saccharodal texture, intofilences adout when broken, hinned intofilences adout when broken, hinned mm thick shale layers. Rare styolites d opusum nodules. Approximately 3%				176 -										
1.2 ER to y thii pel 1.7 2 m ani	RAMOSA FORMATION, brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, throliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites id gyosum nodules. Approximately 3%				-									\mathbb{X}	
1.2 ER to y thii pel 1.7 2 m ani	RAMOSA FORMATION, brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, throliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites id gyosum nodules. Approximately 3%														
1.2 ER to y thii pel 1.7 2 m ani	RAMOSA FORMATION, brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, throliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites id gyosum nodules. Approximately 3%										~				
1.2 ER to y thii pel 1.7 2 m ani	RAMOSA FORMATION, brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, throliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites id gyosum nodules. Approximately 3%				· ·					Fracture	dneu				
1.2 ER to y thii pel 1.7 2 m ani	RAMOSA FORMATION, brownish-grey grey dolostone, hard, fresh, medium to in grained with saccharoldal texture, throliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites id gyosum nodules. Approximately 3%				-					<u>ت</u>	2				
to s thii per 1.7 2 n ani	grey dolostone, hard, fresh, medium to in grained with saccharoidal texture, troliferous odour when broken, thin to edium horizontal beds with occasional mm thick shale layers. Rare styolites d gypsum nodules. Approximately 3%	\bowtie	\vdash		-			+		+		\vdash	_	_	
1.7 2 n an	edium horizontal beds with occasional mm thick shale layers. Rare styolites id gypsum nodules. Approximately 3%		R1	TCR = 88% RQD = 0%	175 -									ľ	
an	d gypsum nodules. Approximately 3%	\mathbb{N}		KQD = 0%	-										
vuş	a gypsum nooules. Approximately 570				1.										
	g content.	\bigotimes													
					-									<u> </u>	
	Vugs up to 5 mm at 1.82 m for 5 cm.				-										
	vugs up to 5 mm at 1.82 m tor 5 cm.	\bigotimes	R2	TCR = 95% RQD = 21%	174 -									61 K)	
		\mathbb{K}			-										
					.										
		×.												目	
V 173.2	Vugs up to 3 mm at 3 m for 2.5 cm.	\mathbb{K}			- I										
3.2					-									目	
N	Most pieces of core are 2.5 to 7.5 cm.	×.			173 -									日	
		\mathbb{K}			-									目	
			R3		-									目	
		×.												「目、	
170.0		\mathbb{K}												NE I	
172:2 4.2		\sim		I	1.								_	191-19	
EN	ND OF BOREHOLE														
Bo	prehole was dry and open upon					Dat		VATER	R LEVEL Depth			ation (m)			
COL	impletion.					No	ov 17, 20	16	1.3	,		175.1			
50 No	mm monitoring well installed. 5. 10 screen installed.														
															l



LOG OF BOREHOLE 17-20A

wsp

DIG	iect I	Proposed Uppers Quarry														D	olect	no.	161-11633-00
		Walker Aggregates Inc.				ri	g type	CMF	75 t	rack-r	nouni	ed						rted	2017/06/29
		Thorold / Niagara Falls, ON					nethod						n dia.					isor	SM
		E: 649805 N: 4772733 (17T, Geo	detic)				coring			-							1.1	wer	KJF
		SUBSURFACE PROFILE			SA	MPLE			ation Tes / 0.3m)		_								Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Number	Type	SPT N-Value Core Recovery	Elevation Scale (mASL)	X Dy Undrain O U	namic Cor I <u>0</u> ned Shea Inconfined locket Pen	e 10 3 r Strengt stromster	h (kPa) + Fiel	Vane	, I	& Pla	sticity		PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT)
-0	186.0	GROUND SURFACE CLAYEY SILT	И	-		libborory	186 -		ιο ε 	0 1	20 1	60		0 2	0 30)			GR SA SI CL Augered straight to bedrock
- - 1		For stratigraphic descriptions, refer to 17- 200B.					- 185												bedrock
- 2			H				184 -												
- 3							183 -						re ncy						
- 4							182 -						Fracture Frequency						
-5 - -6	180.9 5.1 179.7	at 5.1m below grade ERAMOSA FORMATION, brownish-grey to grey dolostone, hard, fresh, medium grained with saccharoidal texture,			२1	TCR = 65% RQD = 32%	181 - - 180 -												
- 7	6.3	petroliferous odour when broken, thin to medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites and gypsum nodules. Approximately 3%			72	TCR = 95% RQD = 29%	179-												
- 8	178.2 7.8	vug content.		$\left \right $	23	TCR = 97% RQD = 43%	178-											Ţ	
-9	176.7 9.3			Ľ	0	RQD = 43%	177 -												
- 10 - - 11	175.2				₹4	TCR = 100% RQD = 29%	176 -												
- 11 - - 12	173.6				₹5	TCR = 94% RQD = 55%	175 - - 174 -												
- - 13	12.4				₹6	TCR = 106% RQD = 40%	- 173-												
- - 14	172.0 14.0	at 13.7 m, grey clay seam to 13.9 m		┝			172 -												
- - 15 -	170.5			Ľ	27	TCR = 107% RQD = 29%	171 -												
- 16 -	15.5				₹8	TCR = 100% RQD = 43%	170 -												
- 17	17.0		\mathbb{N}	F			169 -												
- 18	167.5 18.5			Ľ	3 9	TCR = 100% RQD = 76%	168 -												
- 19 -	16.0			F	10	TCR = 100% RQD = 70%	167 -												
- 20 - - 21	20.0	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak		F	11	TCR = 100% RQD = 56%	166 - - 165 -												
- 22	164.4 21.6	petroliterous odour when broken. Rare fossil fragments, minor calcite and gypsum veins. Occasional to common stylites and shale partings 2 mm thick.		┢		TCP - 00**	165 - - 164 -												
- - 23	162.9 23.1	Fracture surfaces clean. Medium bedded.		F	12	TCR = 98% RQD = 98%	- 163 -												
- 24	161.4			F	113	TCR = 100% RQD = 100%	162 -												
	189:9	Inorthe under sector and	\mathbb{K}	F	14		1												Sheet No. 4 - 45
		(continued next page)																	Sheet No. 1 of 2



LOG OF BOREHOLE 17-20B

wsp

project no. | 161-11633-00

date started | 2017/07/06

project | Proposed Uppers Quarry client | Walker Aggregates Inc.

location | Thorold / Niagara Falls, ON

rig type | CME 75, track-mounted

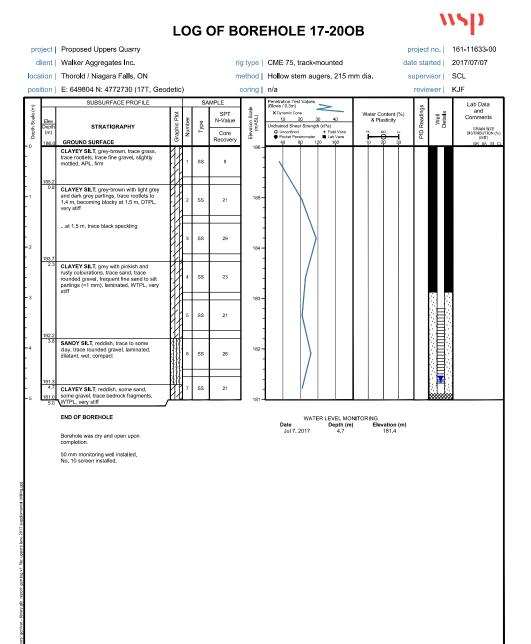
method | Solid stem augers, 150 mm dia.

supervisor | SM

0 Elwy Depth STRATIGRAPHY 0	ater Content (%) & Plasticity <u>c</u> OC <u>c</u> OC	Lab Data and Comments GRAN SIZE USTREATON (%) (%) GRI SA SI CL
0 1800 GROUND SURFACE 0 1000007 106 40 80 120 100 100 -1 For stratigraphic descriptions, refer to 17- 2008. 186- 180- 186- 186- 180	0 20 30	<u>98 SA SI CI</u>
-1 For stratigraphic descriptions, refer to 17- 185- -2 184- 184- -3 4 5.1m below grade 182- -4 5.1 For stratigraphic descriptions, refer to 17- 189- -4 180- 181- 182- -5 15.1 For stratigraphic descriptions, refer to 17- 180- -6 5.1 For stratigraphic descriptions, refer to 17- 180- -6 180- 190- 190- -7 190- 179- 179-	¥	
- 3 - 3 - 4 - 4 - 5 - 190.9 <i>at 5.1m below grade</i> - 6 - 7 - 7 - 7 - 190.9 <i>at 5.1m below grade</i> - 181- - 182- - 179- - 179- - 179- - 179- - 179- - 179-	¥	
180.5 af 5.1m below grade 181 5.1 For stratigraphic descriptions, refer to 17- 20A. 180 -6 180- 190 190 -7 179 179	¥	
- 6 180 - 180		
-9		
- 12 174-		
13		
-14		
		4
- 18		
	ING Elevation (m) 181.3	
Borehole was dry and open upon completion.	161.3	
50 mm monitoring well installed. No. 10 screen installed.		

Sheet No. 2 of 2

wsp



LOG OF BOREHOLE 17-20SP

NSD

Lab Data

and

Comments

GRAIN SIZE DISTRIBUTION (5 (MIT)

RSASI

project | Proposed Uppers Quarry project no. | 161-11633-00 client | Walker Aggregates Inc. rig type | CME 75, track-mounted date started | 2017/07/07 supervisor | SCL location | Thorold / Niagara Falls, ON method | Hollow stem augers, 215 mm dia. position | E: 649803 N: 4772728 (17T, Geodetic) coring | n/a reviewer | KJF SUBSURFACE PROFILE SAMPLE enetration Test Valu lows / 0.3m) \geq Elevation Scale (mASL) SPT X Dynamic Cone Water Content (%) Well 30 40 N-Value 1,0 2,0 & Plasticity Type ndrained Shear Strength (kPa) STRATIGRAPHY (m Core Unconfined + Field Vane
 Pocket Penetrometer Lab Vane
 40 80 120 160 8 Der For a Recovery GROUND SURFACE -0.0 CLAYEY SILT For stratigraphic descriptions, refer to 17-200B. 185.5 0.5 185.0 1.0 184.5 184.0 - 2.0

END OF BOREHOLE

183

Borehole was dry and open upon completion. 50 mm monitoring well installed. No. 10 screen installed.

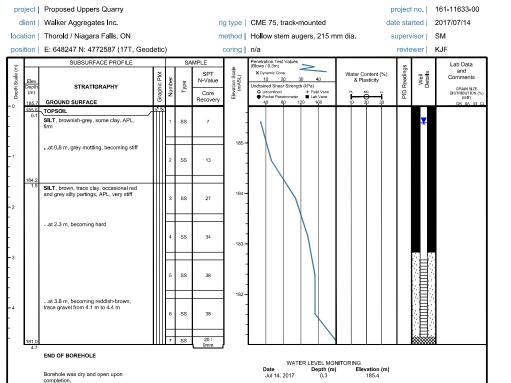
WATER LEVEL MONITORING Date Depth (m) 1.0 Elevation (m) Jul 7, 2017 184.9

Sheet No. 1 of 1

			L	_C)G	OF E	BOR	Ε	HOL	Е	17-	21	В				. 1	· 71
pro	ject	Proposed Uppers Quarry														project	no.	161-11633-00
с	lient	Walker Aggregates Inc.				ri	g type	С	CME 75, t	rack-	moun	ted			da	ate sta	rted	2017/07/18
loca	ition	Thorold / Niagara Falls, ON				m	nethod	н	lollow ste	m au	gers,	215 n	nm dia	a.		superv	visor	SM
pos	ition	E: 648250 N: 4772587 (17T, Geo	detic)			coring	н	IQ core, (DD=9	96mm	, I D=6	4mm			revie	ewer	KJF
Ê		SUBSURFACE PROFILE	T.		SA	MPLE	ae		enetration Test slows / 0.3m)		\geq	_				sbu		Lab Data and
Depth Scale (m)	Elev Depth	STRATIGRAPHY	Graphic Plot	ber	Type	SPT N-Value	Elevation Scale (mASL)	110	X Dynamic Con 10 2 ndrained Shea	0		40	Wa	ter Conte & Plastic	ent (%) sity	Readings	Well	Comments
Depth	(m)		Graph	Number	τ	Core Recoverv	Elevat (m		 Unconfined Pocket Pene 	tromater	+ Fie Lat	ki Vane Vane	Р	. MC	ц.	뎹		GRAIN SIZE DISTRIBUTION (%) (MIT)
- 0	185.7	GROUND SURFACE SILT	Ī			Hodovory	- 1	┢	40 8	0 -	20 1	60) 20	30			GR SA SI CL
-1		For stratigraphic descriptions, refer to 17-					185 -											
-2		210B.					184 -	-										
Ę							- 183 -											
- 3							-	-					Fracture Frequency					
-4							182 -						E eF					
ŀ,	181.1 4.6 4.8	at 4.6m below grade ERAMOSA FORMATION, brownish-grey	\mathbb{R}				181 -	┢	_		\mathbf{H}					-		
-5	7,0	to grey dolostone, hard, fresh, medium to thin grained with saccharoidal texture,			R1	TCR = 98% RQD = 30%	- 180 -	1										
-6	179.4	petroliferous odour when broken, thin to medium horizontal beds with occasional 2 mm thick shale layers. Rare styolites	- M				-	1										
-7	0.5	and gypsum nodules. Approximately 3% vug content.			R2	TCR = 109% RQD = 89%	179 -	1									Y	
-8	177.9 7.8						178-	-										
F°	1.0				R3	TCR = 107% RQD = 33%	- 177 -	1										
-9	176.4 9.3						- 1	-										
- 10	0.0				R4	TCR = 98% RQD = 10%	176 -	1										
-11	174.9 10.8					Nub = 10%	175 -	-										
F"	10,0				R5	TCR = 95% RQD = 29%	- 174 -	1										
- 12	173.3		\otimes			RQD = 29%	-	-										
- 13	12.4				R6	TCR = 102% RQD = 78%	173 -											
- 14	171.8		K			RQD = 78%	172 -	-										
- ^{''}	13.9				R7	TCR = 100% RQD = 63%	- 171 -											
- 15	170.3					RQD = 63%	-	-										
- 16	15.4				R8	TCR = 100% RQD = 51%	170 -											
- 17	168.7		K			RQD = 51%	169 -	-										
F"	17.0				R9	TCR = 100% RQD = 32%	168 -											
- 18	167.2		Ň		Re	RQD = 32%	-	-									÷Ц)	
- 19	18.5				R10	TCR = 105% RQD = 28%	167 -										目	j
- - 20	165.7		K		RIU	RQD = 28%	166 -	-									目.	
~ -	20.0					TCR = 100%	165	1									し目	
21	164.4		- 🕅		R11	TCR = 100% RQD = 35%	-	-										
- 21 - 21	21.3 164.1 21.6	GOAT ISLAND FORMATION, dolostone, hard, grey, fine grained, fresh, occasional gypsum and chert nodules, weak	<u> </u>	.			•	-		WAT		/EL MO		ING				
-		petroliferous odour when broken. Rare fossil fragments, minor calcite as 1.25							Date Jul 19, :	2017	D	epth (m 6.8)	Elevati 17	on (m) 3.9			
100		cm to 3.8 cm nodules. Occasional to common stylites and shale partings 2																
odou al		mm thick. Fracture surfaces clean. Medium bedded.																
Intelly 4		END OF BOREHOLE																
CIIVAL -		Borehole was dry and open upon completion.																
77 76 75		50 mm monitoring well installed. No. 10 screen installed.																
L		NO. TO SUPERI INSIAIRED.						_										Sheet No. 1 of 1

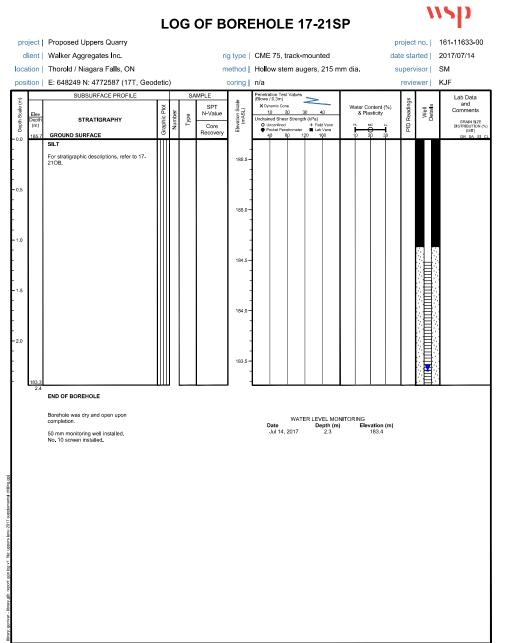
LOG OF BOREHOLE 17-210B

wsp



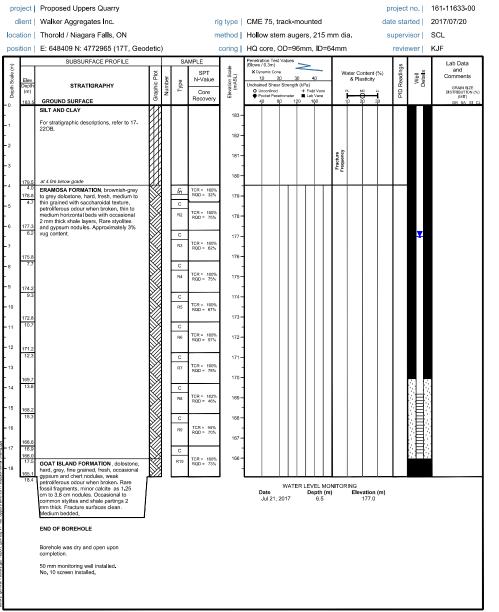
50 mm monitoring well installed. No. 10 screen installed.

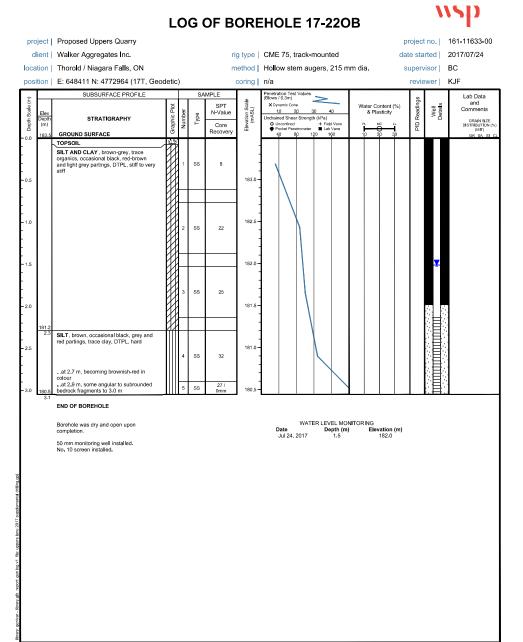
NSD



LOG OF BOREHOLE 17-22B

wsp





LOG OF BOREHOLE 17-22SP

NSD

project | Proposed Uppers Quarry project no. | 161-11633-00 client | Walker Aggregates Inc. rig type | CME 75, track-mounted date started | 2017/07/24 supervisor | BC location | Thorold / Niagara Falls, ON method | Hollow stem augers, 215 mm dia. position | E: 648412 N: 4772963 (17T, Geodetic) reviewer | KJF coring | n/a SUBSURFACE PROFILE SAMPLE enetration Test lows / 0.3m) Lab Data \geq Elevation Scale (mASL) and SPT X Dynamic Cone Water Content (%) Well Comments 30 40 N-Value 1,0 2,0 & Plasticity Type Judrained Shear Strength (kPa) O Unconfined + Field Vane ₱ Pocket Penetromster ■ Lab Vane 40 80 120 160 STRATIGRAPHY GRAIN SIZE DISTRIBUTION (5 (MIT) Core 8 For a Recovery GROUND SURFACE RSASI 183.5 SILT AND CLAY For stratigraphic descriptions, refer to 17-22OB. 183.0 182.5 182.0 END OF BOREHOLE Borehole was dry and open upon WATER LEVEL MONITORING Depth (m) Elevation (m) 2017 1.3 182.2 completion. Date Jul 24, 2017 50 mm monitoring well installed. No. 10 screen installed.

Sheet No. 1 of 1

(m

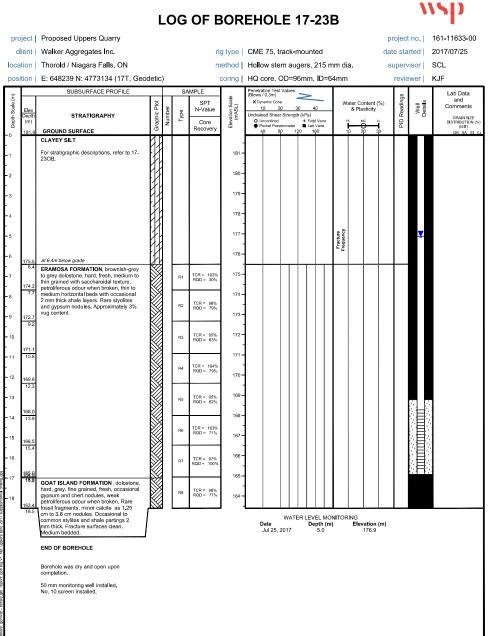
Der

-0.0

0.5

1.0

181



LOG OF BOREHOLE 17-23B

NSD

LOG OF BOREHOLE 17-230B project | Proposed Uppers Quarry project no. | 161-11633-00 client | Walker Aggregates Inc. rig type | CME 75, track-mounted date started | 2017/07/26 location | Thorold / Niagara Falls, ON method | Hollow stem augers, 215 mm dia. supervisor | SCL position | E: 648239 N: 4773132 (17T, Geodetic) reviewer | KJF coring | n/a SUBSURFACE PROFILE SAMPLE netration Test ows / 0.3m) Lab Data \geq Elevation Scale (mASL) and SPT X Dynamic Cone Water Content (%) Well Comments 40 N-Value 1,0 20 30 & Plasticity Type STRATIGRAPHY ndrained Shear Strength (kPa) GRAIN SIZE DISTRIBUTION ((MIT) (m Core Unconfined + Field Vane
 Pocket Penetrometer Lab Vane
 40 80 120 160 8 Der <u>⊢</u>____ Recover GROUND SURFACE RSASI - 0 TOPSOIL CLAYEY SILT, brown-grey, some rusty colouring, occasional grey partings, trace sand, trace rootlets, DTPL, firm SS 6 ...at 0.8 m, becoming very stiff 18 SS 18 CLAYEY SILT, brown-grey, trace grey and reddish partings, trace gravel, DTPL, very stiff SS 28 180 SS 29 179 ...at 3.0 m, becoming APL 88 10 ...at 3.5 m, presence of grey clay seams with rootlets to 4.9 m 178 SS 16 SS 15 177 ...at 5.3 m. becoming WTPL 13 CLAYEY SILT, red-grey, WTPL, stiff SS 176 at 6.1 m, some fine rounded to subangular gravel, trace fine sand laminations to 6.5 m 60 / 275mm SS END OF BOREHOLE WATER LEVEL MONITORING Depth (m) 3.6 Date Elevation (m) Borehole was dry and open upon Jul 26, 2017 178.3 completion. 50 mm monitoring well installed. No. 10 screen installed.

Sheet No. 1 of 1

wsp

LOG OF BOREHOLE 17-23SP

pr	oject	Proposed Uppers Quarry								р	roject	no.	161-11633-00
c	lient	Walker Aggregates Inc.			ri	ig type	CME 75, tr	ack-mounte	d	da	te star	rted	2017/07/26
loca	ation	Thorold / Niagara Falls, ON			n	nethod	Hollow ste	m augers, 2	15 mm dia.	s	upervi	isor	SCL
pos	ition	E: 648239 N: 4773130 (17T, Geo	detic)			coring	n/a				revie	wer	KJF
Ē		SUBSURFACE PROFILE		. 5	AMPLE		Penetration Test (Blows / 0.3m)	Values 📏			s		Lab Data
Depth Scale (m)	Elev Depth (m)	STRATIGRAPHY	Graphic Plot	Type	SPT N-Value Core	Elevation Scale (mASL)	X Dynamic Cone 10 2) Undrained Shear O Unconfined Pocket Pane	9 0 30 40 Strength (kPa) + Field V trometer Lab Va	/ane PL M	sticity	PID Readings	Well Details	and Comments GRAIN SIZE DISTRIBUTION (%) (MIT)
- 0.0	181.9	GROUND SURFACE CLAYEY SILT	и r	_	Recovery	· .	40 8	0 120 160	ine 10 2	5 30			GR SA SI CL
- - - 0.5		For stratigraphic descriptions, refer to 17- 230B.				- - 181.5 -							
- - - 1.0						181.0-							
- - 1.5 - -						- 180.5 -							
- 2.0 - - - 2.5						180.0 - - - - - - - - - - - - - - - - - - -							
ľ	179.2 2.7		КИ			J ·						M. F	
		END OF BOREHOLE											
nemtal dri ling, gpj		Borehole was dry and open upon completion. 50 mm monitoring well installed. No. 10 screen installed.					Date Jul 26, 2	Dept	L MONITORING th (m) Elev .2	ation (m) 180.7			
rary, genivar - Ibrary, gb. report: gen log v1. file: uppers lane. 2017. supplementa													

Table C-2 Off-Site Well Details

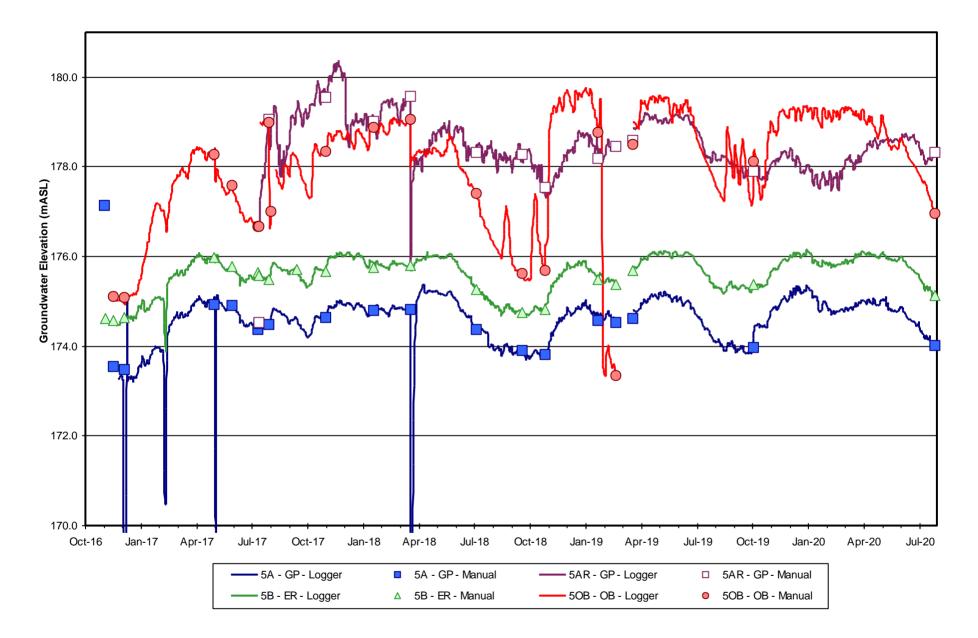
		UTM Co	ordinates	Monitor	Ground	Bedrock			S	stratigraphic	Contact Su	mmary (mas	sl)		14		Dete
Well ID	Site Name	Easting	Northing	Installation	Elevation	Elevation	Bedrock Subcrop	Guelph	Lockport Eramosa	Lockport Goat Island	Lockport Gasport	DeCew	Rochester	Irondequoit	vv	ater Level	Data
		m	m	Date	m	asl		Formation	Member	Member	Member	Formation	Formation	Formation	Date	masl	Formation
BH6	Abitibi Co-Gen Plant	646640	4774257	2006	176.52	163.12	(unspecified)	-	-	-	-	-	-	-	11-May-06	167.42	Overburden
BH14	Abitibi Co-Gen Plant	646579	4774238	2006	179.60	162.40	(unspecified)	-	-	-	-	-	-	-	09-May-06	164.46	Overburden
BH19	Abitibi Co-Gen Plant	646580	4774177	2006	178.13	163.93	(unspecified)	-	-	-	-	-	-	-	04-May-06	171.43	Overburden
MW1-I	Cytec Canada Inc. Welland Plant Site	648684	4768944	1984	181.07	165.83	Guelph Formation	-	-	-	-	-	-	-	18-Sep-84	176.31	Guelph Fm
MW2-I	Cytec Canada Inc. Welland Plant Site	650424	4768922	1984	180.16	162.35	Guelph Formation	-	-	-	-	-	-	-	18-Sep-84	175.88	Guelph Fm
MW3-I	Cytec Canada Inc. Welland Plant Site	649594	4768316	1984	178.56	160.02	Guelph Formation	-	-	-	-	-	-	-	18-Sep-84	175.61	Guelph Fm
MW4-I	Cytec Canada Inc. Welland Plant Site	649261	4767243	1984	176.62	156.38	Guelph Formation	-	-	-	-	-	-	-	18-Sep-84	174.42	Guelph Fm
MW5-I	Cytec Canada Inc. Welland Plant Site	650344	4767373	1984	175.95	155.93	Guelph Formation	-	-	-	-	-	-	-	18-Sep-84	174.11	Guelph Fm
OW12	Mountain Road Landfill Site	653331	4778385	1985	175.29	169.90	Lockport Gasport Member	-	-	-	-	-	-	-	12-Apr-16	172.73	Gasport Mb
OW54(23)	Mountain Road Landfill Site	652517	4777526	2012	195.42	195.42	Lockport Goat Island Member	-	-	-	174.82	169.12	-	-	14-Oct-16	178.42	Overburden
CMT3	Mountain Road Landfill Site	652741	4777578	2007	202.00	178.60	Lockport Gasport Member	-	-	-	-	168.70	167.60	-	14-Oct-16	182.2	Gasport Mb
CMT5	Mountain Road Landfill Site	652386	4778554	2007	174.30	170.60	Lockport Gasport Member	-	-	-	-	165.60	164.30	-	14-Oct-16	168.9	Gasport Mb
CRA-11D-09	Niagara Recycling Centre	652979	4773755	2009	193.60	183.24	Lockport Eramosa Member	-	-	-	-	-	-	-	10-Oct-14	184.90	Eramosa Mb
IW6	Niagara Recycling Centre	652985	4773843	2006	193.16	182.36	(unspecified)	-	-	-	-	-	-	-	10-Oct-14	184.21	(bedrock)
OW13D	Niagara Recycling Centre	652871	4773896	2003	193.20	182.20	(unspecified)	-	-	-	-	-	-	-	10-Oct-14	184.53	(bedrock)
MW10 (NF-30)	Niagara Tunnel Project	656361	4777364	1991	181.06	164.59	Lockport Gasport Member	-	-	-	-	157.61	155.21	136.96			
MW14	Niagara Tunnel Project	656540	4769926	2005	184.04	154.17	Lockport Eramosa Member	-	-	-	-	118.08	115.42	97.54	23-Oct-13	169.80	Eramosa Mb
NF-28	Niagara Tunnel Project	655800	4773685	1991	185.06	169.36	Lockport Goat Island Member	-	-	-	163.06	151.89	149.14	131.49			
BadenPowell (BH31)	NPCA Monitoring Well	652903	4767379	2014	176.63	150.13	Salina Formation	-	-	-	-	-	-	-			
YoungMatthews (BH11)	NPCA Monitoring Well	649479	4763858	2014	181.92	155.82	Guelph Formation	-	-	-	-	-	-	-			
BH03-1	Rolling Meadows	647685	4772408	2003	182.50	176.50	Lockport Eramosa Member	-	-	161.00	149.80	-	-	-			
BH03-3	Rolling Meadows	648112	4771708	2003	186.50	175.90	Guelph Formation	-	173.60	154.80	143.60	134.00	131.10	-			
BH03-4	Rolling Meadows	647569	4771341	2003	183.00	172.70	Guelph Formation	-	170.70	152.90	141.60	132.00	-	-			
4-1	Walker Brothers Quarry	647829	4776539	1976	180.09	168.96	(unspecified)	-	-	-	-	-	-	-	03-Aug-17	169.08	Lockport
19-1R2	Walker Brothers Quarry	649320	4777011	2015	183.90	177.10	Lockport (undifferentiated)	-	-	-	-	169.00	166.40	-	07-Sep-17	172.70	Rochester Fm
40-1r	Walker Brothers Quarry	649322	4776674	2016	184.30	177.60	Lockport Gasport Member	-	-	-	-	167.10	165.60	146.90	07-Sep-17	160.01	Irondequoit Fm
51-l	Walker Brothers Quarry	650399	4776396	1988	184.70	178.90	Lockport (undifferentiated)	-	-	-	-	165.30	163.90	-	07-Sep-17	180.58	Lockport
55-I	Walker Brothers Quarry	648943	4775340	1990	177.87	170.67	Lockport Goat Island Member	-	-	-	162.77	156.27	154.27	-	07-Sep-17	170.31	Lockport

Notes: • Elevations provided in metres above sea level (masl)

Table C-2 Off-Site Well Details

		UTM Co	ordinates	Monitor	Ground	Bedrock			S	tratigraphic	Contact Su	mmary (mas	sl)		14		Dete
Well ID	Site Name	Easting	Northing	Installation Date	Elevation	Elevation	Bedrock Subcrop	Guelph Formation	Lockport Eramosa	Lockport Goat Island	Lockport Gasport	DeCew Formation	Rochester Formation	Irondequoit Formation		ater Level	
		m	m			asl		1 officiation	Member	Member	Member				Date	masl	Formation
C-2	(Bolton, 1957)	656099	4775820	1949	181.14	166.63	Lockport Goat Island Member	-	-	-	164.81	158.07	154.63	137.37			
D-1	(Bolton, 1957)	655977	4775611	1949	180.53	169.01	Lockport Goat Island Member	-	-	-	164.74	158.04	155.27	137.56			
D-3	(Bolton, 1957)	655740	4775042	1949	184.43	168.13	Lockport Goat Island Member	-	-	-	163.01	155.66	153.16	135.64			
E-2	(Bolton, 1957)	655715	4773202	1949	185.93	166.48	Lockport Eramosa Member	-	-	164.13	159.17	146.09	143.26	126.31			
E-8	(Bolton, 1957)	656949	4770385	1949	167.18	165.08	Guelph Formation	-	146.73	138.84	128.90	123.50	120.94	102.17			
E-18	(Bolton, 1957)	655761	4774468	1950	194.52	172.91	Lockport Goat Island Member	-	-	-	162.15	156.76	153.89	136.18			
E-19	(Bolton, 1957)	656470	4770645	1950	163.80	152.83	Guelph Formation	-	143.74	141.61	131.22	124.60	122.35	104.55			
E-29	(Bolton, 1957)	655737	4771671	1951	195.86	174.92	Guelph Formation	-	159.04	156.39	141.12	135.67	132.77	115.06			
E-32	(Bolton, 1957)	655726	4772390	1951	193.94	172.61	Guelph Formation	-	167.06	162.52	146.70	141.43	137.40	120.18			
F-1	(Bolton, 1957)	658038	4777687	1950	175.05	173.19	Lockport Goat Island Member	-	-	-	164.53	154.44	150.66	134.02			
F-2	(Bolton, 1957)	657176	4777077	1950	178.92	168.46	Lockport Goat Island Member	-	-	-	159.65	152.92	150.82	132.65			
K-1	(Bolton, 1957)	656169	4776923	1950	179.92	165.05	Lockport Goat Island Member	-	-	-	161.91	154.44	151.61	134.02			
N-14	(Bolton, 1957)	657241	4770090	1951	182.76	162.34	Guelph Formation	-	151.46	141.06	127.16	119.27	116.62	97.96			
O-1	(Bolton, 1957)	658218	4770205	1949	174.35	166.70	Guelph Formation	-	138.38	134.29	124.27	117.47	114.91	96.26			
F013366	Oil, Gas and Salt Resources Library	641918	4768816	1947	183.30	154.04	(unspecified)	-	-	-	-	-	-	-			
F013943	Oil, Gas and Salt Resources Library	652452	4772579	1950	194.95	182.45	Guelph Formation	-	-	-	-	-	141.91	125.15			
F014098	Oil, Gas and Salt Resources Library	647220	4764979	1953	179.11	147.41	Guelph Formation	-	-	-	-	-	78.83	59.01			
F014123	Oil, Gas and Salt Resources Library	644275	4764547	1946	183.79	155.75	Salina Formation	131.37	-	-	-	-	72.85	58.22			
N002812	Oil, Gas and Salt Resources Library	652892	4770040	1908	179.83	166.13	(unspecified)	-	-	-	-	-	-	107.89			
N002815	Oil, Gas and Salt Resources Library	646765	4776643		158.10	145.29	(unspecified)	-	-	-	-	-	-	-			
T007932	Oil, Gas and Salt Resources Library	655602	4776811	1992	182.22	165.34	Lockport Gasport Member	-	-	-	-	-	152.51	135.11			
T010011	Oil, Gas and Salt Resources Library	650379	4766538	1926	174.96	145.82	Guelph Formation	-	-	-	-	-	-	145.86			
T012327	Oil, Gas and Salt Resources Library	650359	4766843		174.98	149.10	Guelph Formation	-	-	-	-	-	96.36	78.07			
T012542	Oil, Gas and Salt Resources Library	646587	4775276	2017	179.00	171.60	Lockport Goat Island Member	-	-		162.90	-	153.00	-			

Notes: • Elevations provided in metres above sea level (masl)

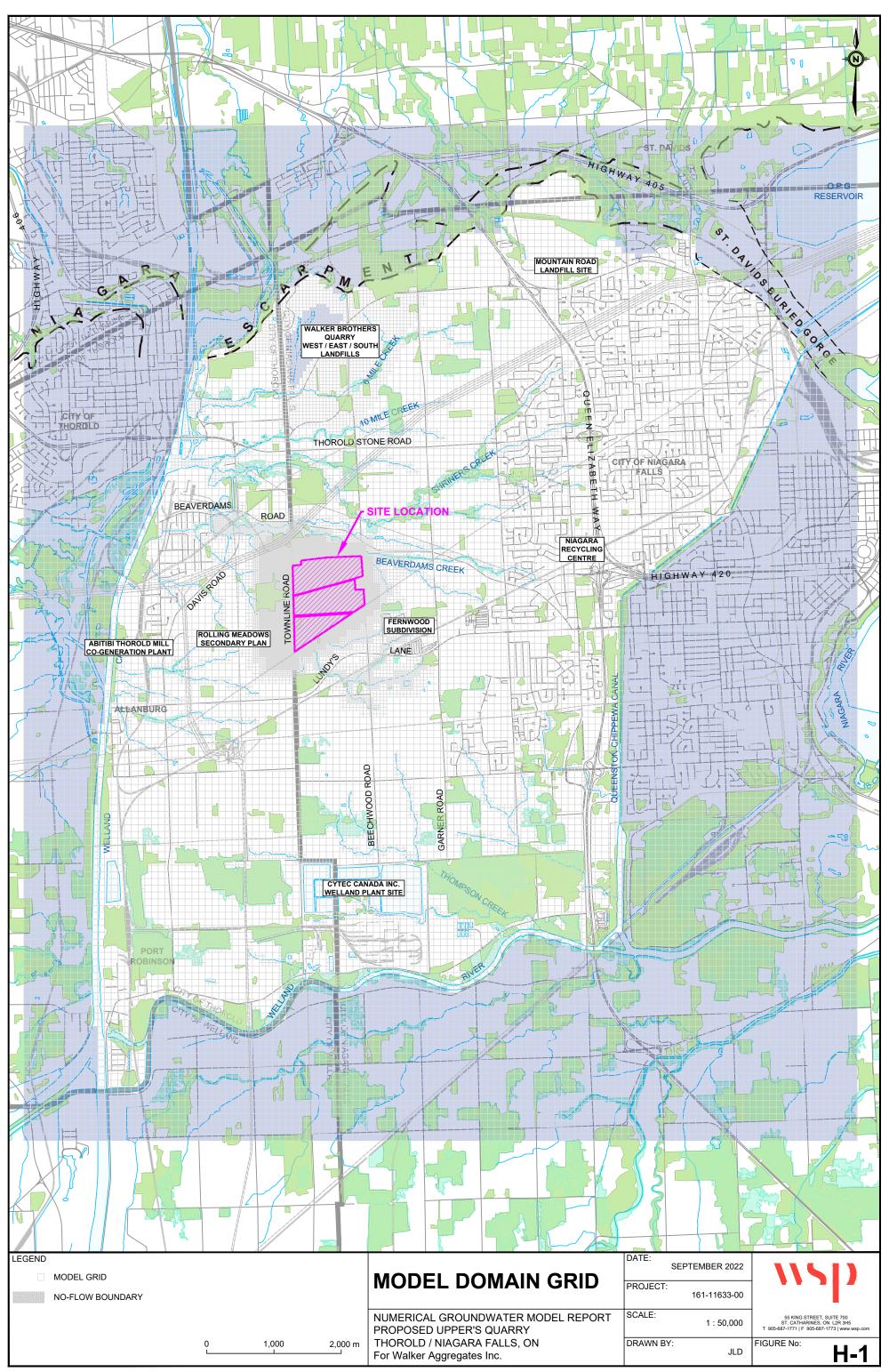


			Field	1				Ge	eneral C	hemistry						Major lor	าร		
Station	Date	рН	EC	т	DO	рН	EC	TDS	тѕѕ	Hardness	Turbidity	Total Oil &	Chloride	Sulphate	Alkalinity	Calcium	Magnesium	Sodium	Potassium
Station	Units PWQO	S U 6.5 - 8.5	µS/cm nc	°C nc	(a)	S U 6.5 - 8.5	µS/cm nc	nc	nc	nc	(b)	Grease (c)	nc	nc	(d)	nc	nc	nc	nc
SW1	7-Dec-16	8.3	960	4.1	3.3	8.09	870	518	5	340	4.6	<0.5	93	120	200	76	26	57	3.3
-	1-May-17	7.5	327	9.9	13.5	7.77	330	178	61	120	130	<0.5	26	31	91	31	11	23	3.1
	19-Mar-18	7.9	796	1.1	13.9	8.00	780	235	16	270	43	0.5	100	67	160	57	21	56	3.3
SW2	7-Dec-16	8.6	480	4.3	2.7	8.06	460	270	7	160	18	<0.5	37	44	120	39	11	33	2.4
	1-May-17	7.4	210	10.5	13	7.62	200	168	77	81	84	<0.5	8.5	<5.0	82	23	8	11	2
	19-Mar-18	8.5	239	1.1	13.4	7.84	250	120	250	95	170	0.7	23	25	59	28	10	9.4	4.1
SW3	7-Dec-16	8.2	820	5.1	3.6	7.99	810	454	9	300	13	<0.5	81	120	160	73	18	50	4
	1-May-17	7.7	341	12.3	12.3	7.76	360	262	67	130	130	<0.5	27	37	100	34	10	20	4
	21-Mar-18	7.7	1,213	0.1	11.7	7.98	1100	450	18	290	14	1.8	160	97	160	72	21	100	5
SW4	7-Dec-16	8.4	920	4.2	4.4	8.00	880	494	17	320	9.1	<0.5	97	140	160	72	21	59	3.6
	1-May-17	7.8	292	9.8	11.1	7.68	280	232	76	96	180	<0.5	23	25	78	27	8	18	3.7
	19-Mar-18	8.3	699	0.1	13	7.99	750	410	17	220	21	2.6	110	73	130	54	15	62	5.1
DP1	7-Dec-16	8.3	1,750	4.5	3.1	8.15	1400	758	98	240	26	<0.5	250	95	170	67	18	220	3.3
	1-May-17	7.7	374	12.4	12.5	7.79	330	352	830	77	690	<0.5	33	24	87	33	17	32	5.3
	21-Mar-18	7.6	1,024	0	11.6	8.10	850	440	29	260	31	<0.5	110	89	160	65	22	67	4.4
DP2	7-Dec-16	8.1	1,130	3.8	3.4	7.60	1100	676	13	410	14	<0.5	110	150	240	94	31	67	4.3
	1-May-17	7.7	281	9.6	12.7	7.71	280	232	120	96	180	<0.5	25	24	78	27	8.5	19	4.2
	19-Mar-18	8.0	676	0.6	13	7.98	690	185	79	210	32	1.6	95	69	120	55	18	56	6.3
DP3	7-Dec-16	8.2	870	4.9	3.8	8.07	850	486	3	290	6.5	<0.5	88	130	160	71	19	57	4
	1-May-17	7.6	344	12.1	12.2	7.75	350	270	77	120	160	<0.5	32	32	91	33	9.9	25	4
	19-Mar-18	7.8	797	2.4	13.2	8.05	830	275	17	230	15	0.8	120	82	140	62	16	71	5.1
DP4	5-Dec-16 (1)																		
	19-Mar-18	7.9	222	1.3	13.9	7.83	230	45	24	92	74	2.4	14	31	60	21	7.3	8.3	3.1
DP5	22-Mar-18 (2)																		

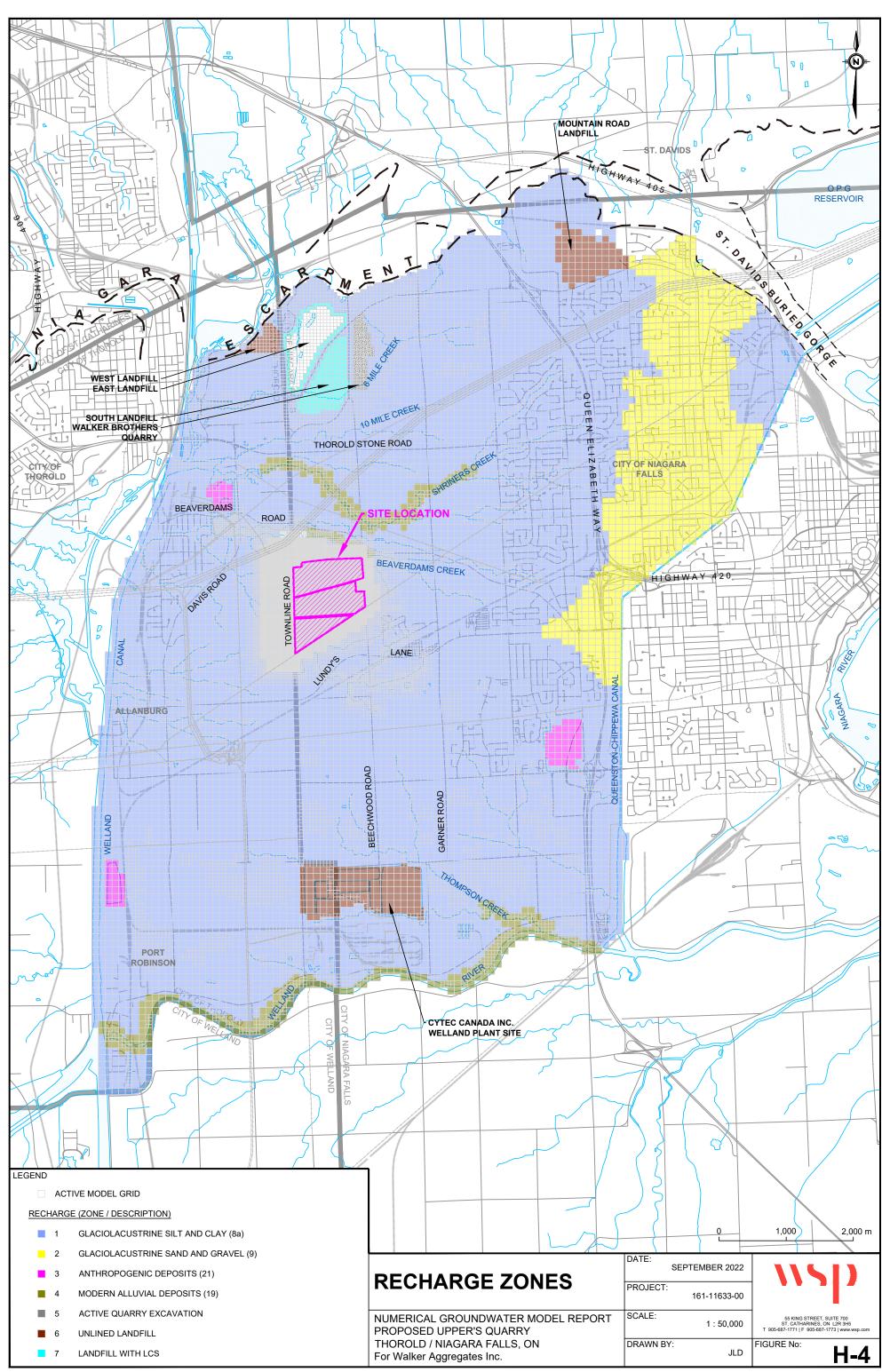
				N	utrients and	Organic Indi	cators					Tot	tal Metals			
Station	Date Units	Nitrate	Nitrite	TKN	Ammonia	Un-ionized Ammonia	Total Phosphorus	тос	Phenols	Aluminum (dissolved)	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium
-	PWQO	nc	nc	nc	nc	0.02 (e)	0.03 (f)	nc	0.001	0.075	(0.02)	0.1	nc	0.011	(0.2)	0.0002
SW1	7-Dec-16	0.46	<0.01	0.37	<0.05	<0.001	0.061	5.7	<0.001	<0.005	<0.0005	<0.001	0.035	<0.0005	0.051	<0.0001
	1-May-17	1.5	0.016	0.5	<0.05	<0.001	0.16	7.8	<0.001	0.016	<0.0005	0.0015	0.037	<0.0005	0.039	<0.0001
	19-Mar-18	0.56	<0.01	0.3	0.081	<0.001	0.12		<0.001	0.008	<0.0005	<0.001	0.035	<0.0005	0.026	<0.0001
SW2	7-Dec-16	0.27	0.023	0.85	<0.05	<0.0024	0.075	13	<0.001	0.017	<0.0005	<0.001	0.014	<0.0005	0.017	<0.0001
	1-May-17	1.3	0.017	0.69	<0.05	<0.001	0.2	13	<0.001	0.029	<0.0005	0.0013	0.03	<0.0005	0.029	<0.0001
	19-Mar-18	0.66	<0.01	0.37	<0.05	<0.001	0.37		<0.001	0.031	<0.0005	0.0029	0.08	0.00053	0.012	<0.0001
SW3	7-Dec-16	0.74	0.018	0.36	<0.05	<0.001	0.048	7	<0.001	<0.005	<0.0005	<0.001	0.032	<0.0005	0.035	<0.0001
	1-May-17	0.3	<0.01	0.67	<0.05	<0.001	0.2	11	<0.001	0.017	<0.0005	0.0015	0.041	<0.0005	0.032	<0.0001
	21-Mar-18	0.19	<0.01	1	0.15	<0.001	0.16		<0.001	0.007	<0.0005	<0.001	0.032	<0.0005	0.022	<0.0001
SW4	7-Dec-16	0.34	<0.01	0.4	<0.05	<0.0015	0.032	7.6	<0.001	<0.005	<0.0005	<0.001	0.024	<0.0005	0.028	<0.0001
	1-May-17	0.6	0.013	0.66	<0.05	<0.001	0.25	9.9	<0.001	0.019	<0.0005	0.0011	0.037	<0.0005	0.024	<0.0001
	19-Mar-18	0.36	<0.01	0.52	0.067	0.0011	0.076		<0.001	0.008	<0.0005	<0.001	0.026	<0.0005	0.014	<0.0001
DP1	7-Dec-16	0.28	<0.01	0.31	<0.05	<0.001	0.075	5.2	<0.001	0.008	<0.0005	0.0012	0.051	<0.0005	0.029	<0.0001
	1-May-17	1.44	<0.05	0.46	<0.05	<0.001	0.58	10	<0.001	0.02	<0.0005	0.0054	0.12	0.0009	0.037	0.00025
	21-Mar-18	0.12	<0.01	0.37	0.088	<0.001	0.08		<0.001	0.009	<0.0005	<0.001	0.032	<0.0005	0.028	<0.0001
DP2	7-Dec-16	<0.1	<0.01	0.72	0.11	0.0015	0.12	13	<0.001	0.005	<0.0005	0.0013	0.034	<0.0005	0.024	<0.0001
	1-May-17	0.26	<0.01	0.68	<0.05	<0.001	0.28	10	0.0014	0.021	<0.0005	0.0019	0.045	<0.0005	0.026	<0.0001
	19-Mar-18	0.39	<0.01	0.51	0.05	<0.001	0.18		<0.001	0.009	<0.0005	0.0031	0.094	0.00055	0.016	0.00037
DP3	7-Dec-16	0.42	<0.01	0.43	<0.05	<0.001	0.034	7.3	<0.001	0.005	<0.0005	<0.001	0.024	<0.0005	0.029	<0.0001
	1-May-17	0.33	0.011	0.6	<0.05	<0.001	0.2	11	<0.001	0.02	<0.0005	0.0017	0.044	<0.0005	0.029	<0.0001
	19-Mar-18	0.35	<0.01	0.49	0.059	<0.001	0.073			0.007	<0.0005	<0.001	0.028	<0.0005	0.016	<0.0001
DP4	5-Dec-16 (1)															
	19-Mar-18	<0.1	<0.01	0.33	<0.05	<0.001	0.16		<0.001	0.024	<0.0005	<0.001	0.029	<0.0005	0.01	<0.0001
DP5	22-Mar-18 (2)															

						Total	Metals			
Station	Date	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel
	PWQO	0.0089	0.0009	0.005	0.3	0.025	nc	0.0002	(0.04)	0.025
SW1	7-Dec-16	<0.005	<0.0005	0.0015	0.22	<0.0005	0.032	<0.0001	0.0007	0.0015
	1-May-17	0.0056	0.0017	0.0065	5	0.0031	0.065	<0.0001	0.00083	0.0055
	19-Mar-18	<0.005	0.00074	0.0033	2.3	0.001	0.053	<0.0001	0.00071	0.0027
SW2	7-Dec-16	<0.005	<0.0005	0.0045	0.66	0.00054	0.012	<0.0001	<0.0005	0.0016
	1-May-17	<0.005	0.0014	0.0062	4.2	0.0028	0.059	<0.0001	<0.0005	0.0048
	19-Mar-18	0.013	0.005	0.013	15	0.0075	0.22	<0.0001	0.00053	0.014
SW3	7-Dec-16	<0.005	<0.0005	0.003	0.53	0.0006	0.072	<0.0001	0.00097	0.0018
	1-May-17	0.0054	0.0017	0.008	5	0.003	0.082	<0.0001	0.00083	0.0058
	21-Mar-18	<0.005	<0.0005	0.0041	0.82	0.00069	0.082		0.0012	0.0021
SW4	7-Dec-16	<0.005	<0.0005	0.0024	0.62	<0.0005	0.05	<0.0001	0.00075	0.002
	1-May-17	<0.005	0.0013	0.0063	3	0.0034	0.088	<0.0001	<0.0005	0.0041
	19-Mar-18	<0.005	0.00053	0.0064	1.2	0.00069	0.054	<0.0001	0.0011	0.0027
DP1	7-Dec-16	<0.005	0.00084	0.0033	1.9	0.0016	0.065	<0.0001	0.001	0.0028
	1-May-17	0.024	0.0097	0.022	25	0.012	0.35	<0.0001	0.0015	0.028
	21-Mar-18	<0.005	0.00066	0.0038	2	0.00097	0.082	<0.0001	0.00087	0.003
DP2	7-Dec-16	<0.005	0.0011	0.0018	1.3	<0.0005	2.3	<0.0001	0.00082	0.0051
	1-May-17	0.0075	0.0025	0.0089	7.2	0.0044	0.12	<0.0001	0.00078	0.0078
	19-Mar-18	0.015	0.0061	0.018	15	0.012	0.61	<0.0001	0.0014	0.017
DP3	7-Dec-16	<0.005	<0.0005	0.0015	0.34	<0.0005	0.076	<0.0001	0.00068	0.0027
	1-May-17	0.0066	0.0022	0.0078	6.4	0.0033	0.1	<0.0001	0.00078	0.007
	19-Mar-18	<0.005	0.00057	0.0062	1.1	0.00071	0.061	<0.0001	0.0011	0.0028
DP4	5-Dec-16 (1)									
	19-Mar-18	<0.005	0.00096	0.0035	3.7	0.0018	0.03	<0.0001	<0.0005	0.004
DP5	22-Mar-18 (2)									

		Total Metals							
Station	Date	Selenium	Silver	Strontium	Tungsten	Uranium	Vanadium	Zinc	Zirconium
	PWQO	0.1	0.0001	nc	(0.03)	(0.005)	(0.006)	0.03	(0.004)
SW1	7-Dec-16	<0.002	<0.0001	0.49	<0.001	0.0021	0.00091	<0.005	<0.001
	1-May-17	<0.002	<0.0001	0.18	<0.001	0.00058	0.0077	0.023	<0.001
	19-Mar-18	<0.002	<0.0001	0.35	<0.001	0.0016	0.0036	0.0099	<0.001
SW2	7-Dec-16	<0.002	<0.0001	0.12	<0.001	0.00025	0.0017	0.0055	<0.001
	1-May-17	<0.002	<0.0001	0.09	<0.001	0.00016	0.0069	0.019	<0.001
	19-Mar-18	<0.002	<0.0001	0.19	<0.001	0.00047	0.018	0.051	0.0012
SW3	7-Dec-16	<0.002	<0.0001	0.47	<0.001	0.0009	0.001	0.0085	<0.001
	1-May-17	<0.002	<0.0001	0.21	<0.001	0.00054	0.0076	0.026	<0.001
	21-Mar-18	<0.002	<0.0001	0.51	<0.001	0.0013	0.0016	0.0081	<0.001
SW4	7-Dec-16	<0.002	<0.0001	0.42	<0.001	0.00075	0.0012	<0.005	<0.001
	1-May-17	<0.002	<0.0001	0.15	<0.001	0.00037	0.0053	0.02	<0.001
	19-Mar-18	<0.002	<0.0001	0.31	<0.001	0.00089	0.0019	0.0077	<0.001
DP1	7-Dec-16	<0.002	<0.0001	0.38	<0.001	0.0012	0.0029	0.01	<0.001
	1-May-17	<0.002	0.00012	0.17	<0.001	0.00092	0.031	0.094	0.0017
	21-Mar-18	<0.002	<0.0001	0.41	<0.001	0.0013	0.0029	0.0083	<0.001
DP2	7-Dec-16	<0.002	<0.0001	0.42	<0.001	0.00093	0.0013	0.0059	<0.001
	1-May-17	<0.002	<0.0001	0.15	<0.001	0.0005	0.01	0.032	<0.001
	19-Mar-18	<0.002	<0.0001	0.31	<0.001	0.0014	0.017	0.085	0.0012
DP3	7-Dec-16	<0.002	<0.0001	0.42	<0.001	0.0008	0.00089	<0.005	<0.001
	1-May-17	<0.002	<0.0001	0.2	<0.001	0.00043	0.0092	0.028	0.001
	19-Mar-18	<0.002	<0.0001	0.36	<0.001	0.00099	0.0018	0.006	<0.001
DP4	5-Dec-16 (1)								
	19-Mar-18	<0.002	<0.0001	0.096	<0.001	0.00032	0.0061	0.019	<0.001
DP5	22-Mar-18 (2)								



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