Appendix F

Existing Conditions Reports

Appendix F-1a

Geology & Hydrogeology Existing Conditions Report

DRAFT

REPORT

Geology and Hydrogeology Existing Conditions Report - Draft

Walker South Landfill Phase 2 Environmental Assessment

Submitted to:

Walker Environmental Group

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1 INTRODUCTION

This report provides an overview of the existing geology and hydrogeology conditions within the study areas for the South Landfill Phase 2 Environmental Assessment (EA). The Minister of the Environment, Conservation and Parks (Minister) Approved Terms of Reference (ToR) for the EA included a preliminary description of the existing environmental conditions and made a commitment to expand upon this description during the EA.

Walker Environmental Group (Walker) initiated a Comprehensive EA under the Ontario EA Act seeking approval to expand the capacity of its existing South Landfill located at the Walker Resource Management Campus (Campus) in Niagara Falls. The South Landfill is an essential component of Walker's Campus since it began operating in 2009 under Environmental Compliance Approval (ECA) No. 008-78RKAM, as amended, and provides safe, reliable, and affordable disposal capacity for solid, non-hazardous waste from residential and industrial, commercial, and institutional (IC&I) sources to its customer base within the City of Niagara Falls, the Regional Municipality of Niagara, and the Province of Ontario. The South Landfill's total approved disposal capacity is 17.7 million m^3 and is expected to reach maximum capacity by 2029 to 2031.

The proposed Phase 2 of the South Landfill would extend its approved capacity by approximately 18 to 20 million m^3 over a 20-year period, ensuring Walker can continue to provide essential residual waste disposal services to its existing customer base. Walker is proposing to locate the additional disposal capacity (Phase 2) to the east of the existing South Landfill within the area currently occupied by Walker's Southeast Quarry. The proposal would maintain the existing landfill service area, as well as the annual volume of solid, non-hazardous waste from the sources currently accepted.

The EA Act requires that proponents describe the environment that may potentially be affected or may reasonably be expected to be affected, directly or indirectly, by the Alternative Methods of Carrying Out the Undertaking (Alternative Methods) proposed as part of an EA. The description of the existing environmental conditions will provide the baseline for the assessment of potential effects for the proposed Undertaking, which will be conducted during the EA. This report focuses on characterizing the existing conditions within the study areas for the South Landfill Phase 2 EA for geology and hydrogeology.

2 STUDY AREAS

From a geology and hydrogeology perspective, the characterization of existing conditions within the following study areas are appropriate to this EA:

- Site Study Area (SSA), encompassing lands (81.30 ha) owned and operated by Walker that include the current Southeast Quarry extraction limit, and encompasses the proposed limit of fill and buffer area, which aligns with the proposed Waste Disposal Site Limit Boundary;
- Local Study Area (LSA), including all lands within a one (1) km radius to the east, south, and southwest of the Walker Campus, which includes the SSA, and bounded by the Welland Canal and the Niagara Escarpment to the north and northwest of the Campus; and
- Regional Study Area (RSA), including all lands bounded by the Welland River to the south, the Welland Canal to the west, the Niagara Escarpment and specifically the Lockport and Rochester Formation bedrock subcrops to the north, and the Queenston-Chippewa Hydro Canal to the east.

The current extent of influence from the Campus, including the SSA, on the geology and hydrogeology setting are contained within the LSA. Characterization of the SSA and LSA completed as part of this study provides baseline conditions for evaluating the predicted effects of the proposed South Landfill Phase 2 on groundwater flow and quality. The RSA provides a generalized characterization of geology and hydrogeology conditions beyond the influence of the Campus, but within the active domain of the numerical model used for predictive modelling to support the Alternative Methods evaluation.

The geology and hydrogeology study areas are illustrated on **Figure 2-1**.

3 METHODOLOGY

Available secondary sources of information were collected and reviewed to characterize geologic and hydrogeologic existing conditions within the study areas. The following sources of secondary information were collected and reviewed:

- Annual Compliance Monitoring reports for the Walker South Landfill, East Landfill, West Landfill and Southeast Quarry situated within the Campus.
- Published maps and reports from the Ontario Geological Survey.
- Available site-specific hydrogeology, geology and geotechnical reports from within the study reas.
- Niagara Peninsula Conservation Authority (NPCA) published source protection and watershed reports, databases and mapping.
- Provincial Water Quality Monitoring Network (PWQMN) data. There are no PWQMN groundwater stations within the RSA.
- Ministry of the Environment, Conservation and Parks (MECP) Water Well Record database.
- Environment Canada and local weather station climate data.

The existing secondary information was supplemented through a field investigation to address data gaps. The field investigation included a drilling and testing program, a baseline groundwater monitoring program, and a residential water well use inventory. The field investigations are summarized below, while the methodologies are provided in **Appendix A**.

The drilling program was conducted to improve the understanding of the local geology and hydrogeology, particularly to the east and northeast of the SSA. The investigation included:

- Borehole drilling at seven (7) locations to the base of the Irondequoit Formation or the Rochester Formation, depending on location, and detailed core logging.
- Hydraulic conductivity testing (packer testing) in the open borehole (packer testing).
- Downhole geophysical logging in the deep borehole at four (4) locations closest to the SSA.
- Installation of twenty-nine (29) monitoring wells in target bedrock zones at the seven (7) well nest locations.
- Hydraulic conductivity testing in the installed monitoring wells.

Baseline groundwater monitoring, incorporating the newly installed and select existing monitoring wells, was undertaken in 2025 and 2026. The monitoring wells included in the baseline program were equipped with dataloggers to measure and record water levels, and they were sampled over four events to determine the seasonal variations in groundwater quality. Two domestic water wells located northeast of the SSA were also instrumented with dataloggers to provide additional groundwater level data. The baseline groundwater elevation and groundwater quality data will supplement the existing database from the Campus wells.

An inventory of private/domestic and public water wells was completed based on the MECP Water Well Record database (data currently available up to August 2025) to identify well records located within or adjacent to the LSA. A water use survey was completed for the wells situated on parcels of land that are not municipally serviced and/or not owned by Walker.

Background data from the secondary sources of information and data collected from the supplemental field investigation were compiled, reviewed and used to characterize the geology and hydrogeologic existing conditions within the study areas. Data from the supplemental field investigation and monitoring, as well as historic data from the years of investigations and monitoring at the Campus, were used to assess the baseline groundwater flow regime and water quality in key bedrock units, and to evaluate the potential for impacts to off-site groundwater users and receptors. The baseline hydrogeological assessment was completed following guidance provided in Ontario Regulation (O. Reg.) 232/98.

4 CHARACTERIZATION OF THE EXISTING ENVIRONMENT

4.1 Physiography and Topography

The study areas are situated within the Haldimand Clay Plain physiographic region, extending from the Niagara Escarpment in the north to Lake Erie in the South (Chapman & Putnam, 1984). This physiographic region is characterized by low topographic relief and poorly drained soils. During the last glaciation, the area was inundated by glacial Lake Warren and resulted in the deposition of massive stratified clay and silt over the underlying bedrock. The clay and silt deposits thicken from north to south in the RSA. The SSA is situated just south of the Niagara Escarpment, where the overburden deposits are thinner.

Ground surface within the RSA generally slopes gently southward from the Niagara Escarpment towards the Welland River, with low topographic relief. Topography within the RSA is locally influenced by the Niagara Escarpment to the north, the Welland Canal system to the west, and local drainage courses. Within the LSA, topographic relief is influenced by the various operations on the Walker Campus, and 10 Mile Creek to the southeast and south of the Campus.

4.2 Water Budget

To estimate the water budget, temperature and precipitation data from the Welland-Pelham climatological station (operated by Environment Canada) were used. The 30-year climate normal for the period between 1991 and 2020 is summarized in **Table 1**.

As shown in the **Table 1**, the 30-year climate normal (1991-2020) for total annual precipitation for the LSA is 967.0 mm. Using the Thornthwaite Mather methodology, the estimated annual evapotranspiration is 637.5 mm, yielding an average water surplus of 329.5 mm/year available for surface water runoff and recharge to the groundwater system.

Table 1: Welland-Pelham Climate Station 30-Year Climate Normal (1991 – 2020)

Month	Mean Temperature (°C)	I	E (mm)	Daylight Factor	E Adj. (mm)	Total Precipitation (mm)	WHC (mm)	Surplus (mm)	Deficit (mm)
January	-4.1	0.0	0.0	0.8	0.0	81.6	200.0	81.6	0.0
February	-3.8	0.0	0.0	0.8	0.0	52.8	200.0	52.8	0.0
March	0.7	0.1	2.1	1.0	2.1	70.3	200.0	68.2	0.0
April	7.1	1.7	29.8	1.1	33.4	83.1	200.0	49.7	0.0
May	13.7	4.6	63.3	1.3	80.4	81.0	200.0	0.6	0.0
June	19.0	7.5	92.2	1.3	118.0	85.7	167.7	0.0	0.0
July	21.5	9.0	106.2	1.3	138.1	84.0	113.7	0.0	0.0
August	20.7	8.5	101.7	1.2	122.0	78.7	70.3	0.0	0.0
September	17.0	6.3	81.1	1.0	84.4	96.0	82.0	0.0	0.0
October	10.6	3.1	47.2	1.0	44.8	88.5	125.6	0.0	0.0
November	4.5	0.9	17.7	0.8	14.3	83.7	195.0	0.0	0.0
December	-0.7	0.0	0.0	0.8	0.0	81.6	200.0	76.6	0.0
Totals	**8.9**				**637.5**	**967.0**		**329.5**	**0.0**
			Net Water Surplus			**329.5**	**mm**		

Notes: Calculations based on Thornthwaite Mather method
I – denotes heat index
E – denotes evapotranspiration
WHC – denotes water holding capacity
A value of 200 mm was used for the WHC of the soils (clay loam soil moderately deep-rooted crops)

Similar analyses were completed for previous 30-year climate normals after 1961 for comparison. The latest climate normals for mean annual temperature and total precipitation are essentially the same as the 1961 – 1990 climate normals of 8.9°C and 953.1 mm, respectively. It is also noted that mean annual temperature and total precipitation amounts marginally varied for these climate normal time periods with no discernible trend. Periods of abnormal conditions have been observed periodically over these timeframes, which has an effect on groundwater elevations and discharge. For example, a period of notably lower than normal total precipitation was recently observed between August and December 2024.

4.3 Geology

The geology near the Niagara Escarpment and within the RSA is well documented in the technical literature. Within the LSA, boreholes have been drilled within and around the Campus at over 80 different locations to confirm subsurface and geologic conditions. The existing monitoring well locations within the LSA, including those being added as part of the EA investigation, are shown on **Figure 4-1**.

4.3.1 Overburden

The RSA surficial geology is presented on **Figure 4-2**. Within the RSA the overburden largely consists of a relatively thick layer of poorly draining glaciolacustrine clayey silt to silty clay with a discontinuous lower basal till unit overlying the dolostone bedrock. East of the Campus, much of the City of Niagara Falls urban area is underlain by sand and gravel overburden of glaciolacustrine origin. More recent alluvial deposits are present along the local watercourses including the Shriners Creek, Beaverdams Creek and Welland River to the south of the Campus. Areas of modern fill / spoil (i.e., anthropogenic deposits) related to the numerous large-scale historical excavations are present along the modern (and historic) Welland Canal, Queenston-Chippewa Power

Canal, Mountain Road Landfill Site to the northeast and Walker Campus operations. The natural overburden thickness generally increases to the south, away from the Escarpment.

Within the LSA, a relatively thin layer of glaciolacustrine clayey silt covers the area and is locally underlain by a glacial silt till. Overburden is absent in most of the SSA as it has been stripped as part of the current quarry operation. Natural overburden is also absent across most of the Campus as a result of past and current operations. Overburden thickness in the SSA prior to stripping, and in areas that have not been stripped, generally ranged from 5 m to 9 m. Beyond the Campus area, the overburden thickness within the LSA generally ranges from 2 m to 10 m.

4.3.2 Bedrock

4.3.2.1 Regional Setting

The RSA is underlain by Ordovician and Silurian age shale, sandstone, limestone and dolostone, as shown on **Figure 4-3**. The Niagara Escarpment is the dominant bedrock feature in the area, with many bedrock outcrops along the escarpment brow where the overburden is thinnest. The Paleozoic aged bedrock is the subject of on-going research by the OGS; but for this study, the naming convention follows that of the Paleozoic bedrock Map 2344 (Liberty, Feenstra, & Telford, 1976) as it has been in long-term use at the existing Walker facilities. The naming convention for bedrock stratigraphic units in this report are defined from youngest to oldest in **Table 2**.

Overall, the bedrock surface in the RSA generally dips from the escarpment (approximately 176 masl in the vicinity of the Campus) to the south (approximately 155 masl near the Welland River). The Lockport, DeCew, and Rochester Formations are truncated by the Niagara Escarpment along the north boundary of the RSA and LSA.

4.3.2.2 Local Setting

The SSA encompasses the area currently occupied by Walker's Southeast Quarry, in which the limit of fill will be situated. Similarly, the South Landfill and other operations at the Walker Campus are constructed within historic quarries. These quarries excavated the dolostone of the Goat Island and Gasport Members of the Lockport Formation, exposing the DeCew Formation argillaceous dolostone and in some areas the top of the Rochester Formation shale. Geological profiles across the SSA and Walker Campus are provided in **Figures 4-4 to 4-6**. The cross-section locations are shown on **Figure 4-1** and are based on geological boreholes advanced across the Campus. Borehole logs, including those advanced as part of the EA drilling program, are presented in **Appendix B.** Documentation of the geophysical logging as part of the EA drilling program is provided in **Appendix C**.

The Rochester shale is considered a natural barrier separating groundwater movement between the upper Lockport dolostone unit and the underlying Irondequoit limestone and Reynales dolostone units. Nonetheless, the underlying Irondequoit limestone is included as part of the local setting to assess potential effects on groundwater flow and quality beneath the Rochester shale.

Table 2: Bedrock Stratigraphic Units

Group (Age)	**Formation / Member**	**Description**
Salina Formation (Upper Silurian Age)		The Salina Formation consists of argillaceous dolostone and shale and abundant gypsum nodules. This formation subcrops at the very south of the RSA near the Welland River. It is generally not considered a drinking water source due to water quality and quantity issues.
Lockport Group (Middle Silurian age)	**Guelph Formation**	The Guelph Formation is a hard, fresh, brownish-grey, vuggy, medium grained reefal dolostone with saccharoidal texture. The Guelph Formation has a gradational lower contact with the underlying Eramosa member and subcrops in the southern portion of the RSA. It is the primary bedrock aquifer for drinking water where it subcrops south in the RSA. The Guelph Formation is absent in the LSA.
	Lockport Formation -	
	Eramosa Member	The Eramosa member is a hard, fresh, brownish-grey medium grained dolostone with saccharoidal texture and a petroliferous odour when broken. It is thin to medium bedded and often blocky in appearance with occasional shale layers and rare stylolites. The Eramosa member is absent in the LSA and subcrops within the central portion of the RSA. Published values in the literature suggest that the full unit thickness may be up to 10 m; however, thicknesses of 20 m have been observed in some studies. The Eramosa member is the primary bedrock aquifer for drinking water where it subcrops.
	Goat Island Member	The Goat Island member is a hard, fresh, grey to brown, fine-grained dolostone with a weak petroliferous odour when broken and can be up to 8 m thick locally to the south in the RSA. It is medium bedded and has occasional white chert and gypsum nodules. It is much harder than the underlying shales and sandstones and forms the cap rock of the Niagara Escarpment. The Goat Island member is present within the LSA and is the primary bedrock aquifer where it subcrops. The lower contact with the Gasport member is typically gradational.
	Gasport Member	The Gasport member is a hard to medium hard, fresh, grey to dark grey fine to medium grained fossiliferous dolostone with a saccharoidal texture and can locally be up to 14 m thick, although it is normally significantly thinner. The Gasport members is present within the LSA and is not particularly noted as a drinking water source.

Group (Age)	**Formation / Member**	**Description**
Clinton Group (Middle Silurian age)	**DeCew Formation**	The DeCew Formation is a medium hard, dark grey, fine-grained, fresh argillaceous dolostone with occasional shale partings and can locally be up to 4 m thick. This unit is normally not suitable as a drinking water source due to groundwater quality issues.
	Rochester Formation	The Rochester Formation is a dark grey, dolomitic to calcareous shale, which frequently splits along bedding planes and can be up to 14 m thick. On the Niagara Peninsula, the Rochester shale is associated with the presence of naturally occurring hydrogen sulphide gas, and is considered a barrier to groundwater flow. This unit is not suitable as a drinking water source due to the poor quality of the groundwater.
	Irondequoit Formation	The limestone, dolostone and sandstone formations of the lower Clinton Group can collectively be up to 12 m in thickness. These units are generally not used as a drinking water source within the RSA and LSA owing to their depth below the Rochester shale.
	Reynales Formation	
	Thorold Formation	
Cataract Group (Lower Silurian Age)	**Grimsby Formation**	The red and grey sandstone and shale formations that form the Cataract Group can be over 30 m thick in some areas. The Cataract Group is rarely used as a drinking water source due to the depth of formation and typically poor water quality.
	Cabot Head (Power Glen) Formation	
	Whirlpool Formation	
Queenston Formation (Upper Ordovician age)		The red shales of the Queenston Formation are the oldest and thickest bedrock in the RSA and form the base of the Niagara Escarpment. This formation is considered a poor source of drinking water owing to both quantity and quality issues.

Lockport Formation

The Lockport Formation dolostone, consisting of the Goat Island and Gasport Members, is the uppermost bedrock unit in the LSA and has been quarried historically at the Campus. The Goat Island and underlying Gasport Members have a generally similar appearance and composition, and therefore, have not been differentiated in many of the historical geologic borehole logs.

Within the LSA, the Goat Island Member dolostone is grey to brown, fine to medium grained, medium bedded, with occasional white chert and gypsum nodules. The Gasport Member dolostone is grey to dark grey, fine to medium grained, thick to massively bedded, fossiliferous with occasional shale stylolites. The Lockport Formation dolostone in both members is relatively porous due to the presence of natural fractures, vugs (small solution voids), larger cavities, and occasional fossiliferous zones. The upper portion of the Lockport Formation dolostone typically exhibits weathering and a higher degree of fracturing. Studies indicate two main sets of vertical jointing in the bedrock. The primary joint set has a bearing of 14 degrees west of north, while the secondary joint set has a mean bearing of 42 degrees east of north (Gartner Lee Limited, 2006).

Adjacent to the SSA, the Lockport Formation ranges in thickness from approximately 4 m in the north to 14 m to the south. The Goat Island Member is present in the very southern portion of the SSA (3.3 m and 6.5 m thick at boreholes 46 and 75, respectively) but thins to the north and is absent at the remaining boreholes adjacent to the SSA. The Gasport Member adjacent to the SSA ranges in thickness from approximately 11 m in the south to 4 m in the north. Within the LSA, the Lockport Formation dolostone thickness ranges from about 2 m to 15 m. The Lockport Formation is thinnest in the north along the Niagara Escarpment (2.4 m thick at boreholes 49 and 76) generally becoming thicker toward the south.

DeCew Formation

The underlying DeCew Formation dolostone is a dark grey, massively bedded argillaceous (shaley) dolostone that tends to become increasingly shaley with depth. The shaley content results in the bedrock being easily weathered with lower rock quality. The DeCew Formation thickness is irregular which complicates its identification in drill cores. Across the SSA and LSA, the DeCew Formation shaley dolostone ranges from approximately 0.5 m to 5 m thick.

Most of the DeCew Formation was extracted within the former West and East Quarries, while extraction of the DeCew as part of the quarry operations was limited within the former South and current Southeast Quarries. It is understood that the remainder of the DeCew shaley dolostone was removed in the South Landfill Phase 1 (former South Quarry) during landfill construction.

Rochester Formation

The Rochester Formation underlies the DeCew Formation and is a dark grey, very fine grained dolomitic to calcareous shale. The bedrock is thinly bedded and frequently splits along bedding planes. Beds of limestone to dolostone rich (calcareous) shale, commonly 1 to 4 cm thick, and often with fossil and/or carbonate fragments, are present within the unit. The calcareous beds, often referred to as fossiliferous zones, are generally rare in the upper 4 m to 8 m of the Rochester shale.

Previously, the Rochester Formation had been fully penetrated at 6 locations across the Campus (boreholes 26, 39, 40, 61, 64 and 67). As part of the field investigation drilling program for the EA the Rochester Formation was fully penetrated at an additional 7 locations (boreholes 75 to 81), particularly to the east of the SSA. Within the SSA, the Rochester Formation shale bedrock unit ranges from 16.5 m to 18 m thick. Across the LSA, the Rochester Formation shale bedrock unit ranges from 14 m to 18 m thick.

A zone of frequent calcareous and fossiliferous beds, approximately 1 m thick and present at a depth of about 5 m to 8 m within the Rochester Formation had previously been identified in boreholes west (West Landfill) and southwest of the SSA (Gartner Lee Limited, 2006). This fossiliferous zone was also encountered in the 7 boreholes drilled as part of the EA field investigation program at depths from approximately 4.5 m to 8.7 m in the unit, and at thicknesses from 0.8 m to 1.5 m. As this fossiliferous zone has been identified in boreholes west, south and east of the SSA, it is inferred to be laterally extensive across the LSA. As noted above, calcareous or fossiliferous beds were rarely encountered above this laterally extensive fossiliferous zone.

The calcareous and fossiliferous beds, including the laterally extensive fossiliferous zone, are not considered hydraulically significant (Gartner Lee Limited, 2006). The fossil and/or carbonate fragments were deposited within a matrix of the fine grained sediments, not as separate exclusive layers, creating zones and lenses that are imbedded and isolated within the massive shale bedrock as demonstrated in the photograph below from BH75.

Where the Rochester Formation shale is exposed at the base of the former quarries, the upper portion of the bedrock is inferred to have experienced some increased weathering and fracturing due to natural exposure and quarrying activities.

Irondequoit Formation

The Irondequoit Formation consists of light grey to pinkish brown grey, medium to coarse grained crystalline dolomitic limestone. The unit is medium to thickly bedded. Across the SSA and LSA, the Irondequoit Formation ranges from 2 m to 2.5 m thick.

4.3.2.3 Bedrock Hydraulic Conductivity Characteristics

A total of fifty-nine (59) Lugeon packer tests and twenty-nine (29) single-well response tests were completed at the seven (7) newly installed monitoring well nests as part of this study to confirm and augment existing hydraulic conductivity data for the various bedrock units previously compiled by others. When combined with historical testing done previously by others, over 140 hydraulic tests have been completed within the LSA. The test methodology, results and analyses for the previous and current studies are provided in **Appendix D**. A summary of the results is provided in **Table 3**.

A comparison of the test results for packer test intervals which overlap with slug test intervals shows a good agreement between test methods (i.e., results are generally within an order of magnitude). A number of observations can be made based on the results presented in **Table 3**:

- Hydraulic conductivity ranges from tests completed as part of the current study are in general agreement with the historical results presented previously as part of the South Landfill EA. The exceptions are the Goat Island Member results where the historical range varies more widely in comparison to the results from the current study, while the historical value determined for the Irondequoit Formation is notably higher than the range determined from the current study. The historic value for the Irondequoit Formation from the previous South Landfill EA was determined based on tests at two boreholes immediately adjacent to the Escarpment, which likely contributed to the higher hydraulic conductivity results.

Table 3: Summary of Hydraulic Conductivity in Stratigraphic Units

Stratigraphic Unit	Hydraulic Conductivity (m/s)					
	Packer Test Range		Slug Test Range		Geometric Mean	Published Range *
	Minimum	Maximum	Minimum	Maximum		
Lockport Fm. – Goat Island Mb.	$1x10^{-5}$	$2x10^{-5}$	$7x10^{-7}$	$9x10^{-4}$	$2x10^{-5}$	$1x10^{-9}$ – $6x10^{-6}$ (1)
Lockport Fm. – Gasport Mb.	$<1x10^{-8}$	$2x10^{-5}$	$4x10^{-10}$	$1x10^{-4}$	$1x10^{-6}$	
Rochester Fm. – Upper	$4x10^{-8}$	$2x10^{-5}$	$7x10^{-11}$	$1x10^{-5}$	$5x10^{-7}$	$1x10^{-13}$ – $2x10^{-9}$ (2)
Rochester Fm. – Middle	$<1x10^{-8}$	$3x10^{-6}$	$4x10^{-12}$	$1x10^{-5}$	$2x10^{-7}$	
Rochester Fm. – Lower	$<1x10^{-8}$	$3x10^{-6}$	$<1x10^{-8}$	$1x10^{-7}$	$2x10^{-7}$	
Irondequoit Fm.	$<1x10^{-8}$	$6x10^{-7}$	$8x10^{-12}$	$3x10^{-5}$	$1x10^{-7}$	$1x10^{-9}$ – $6x10^{-6}$ (1)

Notes: * From (Domenico & Schwartz, 1990).
(1) Sound limestone and dolomite
(2) Shale

- The Goat Island and Gasport Members of the Lockport Formation are the most conductive bedrock units within the LSA, in comparison to the underlying bedrock units which, on average, have hydraulic conductivities which are two orders of magnitude lower.
- Localized high conductivity zones are inferred to exist within the Lockport and Rochester Formations that exceed published ranges for sound limestone / dolostone and shale, which is inferred to be an indication of the predominance of secondary porosity (i.e., bedding planes and fracturing) within the bedrock matrix.
- Hydraulic conductivity values in the upper and middle portions of the Rochester Shale varies over six orders of magnitude, which is consistent with varying recovery times following historical sampling events at existing monitoring wells screened within the Rochester Formation, which can take up to four years to recover following purging at some locations.
- The hydraulic conductivity range for the middle Rochester Formation, which is associated with the previously noted laterally extensive fossiliferous zone, does not differ from the ranges for the upper and lower portions of the formation. Even tests completed specifically across the identified fossiliferous zone provided hydraulic conductivity values similar to those above and below the zone. Given that the hydraulic conductivity ranges for the upper, middle and lower Rochester Formation are substantially similar, and that the fossiliferous zone is isolated within the Rochester Formation, the fossiliferous zone is not hydraulically significant across the LSA. These results are consistent with those reported previously (Gartner Lee Limited, 2006).

Previous testing and analyses completed for the South Landfill Phase 1, suggested that the lower portion of the Lockport dolostone, and the shallow Rochester shale showed some evidence of increased hydraulic conductivity immediately adjacent to the quarry operations (Gartner Lee Limited, 2006). Specifically, the Rochester shale immediately below the East Landfill appeared to have increased permeability. The increased hydraulic conductivity may potentially be related to removal of the overlying materials, and the historical blasting and pumping activities as part of the quarry operations.

4.4 Hydrogeology

The groundwater setting in the RSA is described in the Niagara Peninsula Source Protection Area Updated Assessment Report (NPCA, 2013) as summarized in the **Table 4.**

Table 4: Regional Study Area Groundwater Setting

Hydrogeologic Unit		Description
Overburden	**Upper Aquitard**	Fine-textured glaciolacustrine clay and silt overburden deposits.
	Contact-Zone Aquifer	Discontinuous basal till layer that underlies the glaciolacustrine clay and silt and overlies the upper weathered bedrock. The contact aquifer is not continuous across the RSA and generally does not occur along the Niagara Escarpment, within the northeastern portion of the LSA near the Campus, or below local watercourse meander valleys and was therefore not a focus of the current study. This aquifer is considered to vary between confined and unconfined depending on the thickness of the overlying aquitard.
Bedrock	**Shallow Bedrock Aquifer**	Shallow bedrock consisting of the Guelph Formation dolostone and the Eramosa member dolostone within the southern portion of the RSA, and the Goat Island member dolostone within the LSA and northern portion of the RSA. This aquifer is continuous across the study area and varies between semi-confined to confined depending on the thickness of the overlying aquitard.
	Deep Bedrock Aquifer	Consists of the Goat Island and Gasport dolostone members of the Lockport Formation. This aquifer is confined and typically has a lower hydraulic conductivity compared to the shallow bedrock aquifer to the south in the RSA. There is interpreted to be no confining layer between the shallow and deep bedrock aquifers.
	Lower Aquitard	DeCew Formation argillaceous dolostone and Rochester Formation shale bedrock units.

Within the LSA, the Goat Island Member associated with the shallow bedrock aquifer is locally thin to occasionally absent; and thus, the shallow and deep bedrock aquifers are considered to function as a single aquifer, referred to as the dolostone bedrock aquifer. Though the Irondequoit Formation limestone is often included as part of the lower aquitard (Novakowski & Lapcevic, 1988), it is also considered to be a semi-pervious aquifer.

In summary, the groundwater setting within the LSA consists of the upper overburden aquitard, the Lockport Formation dolostone bedrock aquifer, the lower aquitard associated with the DeCew and Rochester Formations, and the underlying Irondequoit Formation semi-pervious aquifer.

The groundwater monitoring wells within the SSA and LSA are shown on **Figure 4-1**. The geologic units in which the monitoring wells are completed along with well construction are provided in **Appendix B**. Groundwater elevations are provided in **Tables E-1 to E-3**, **Appendix E**, for monitoring wells, sub-liner and GWCS stations, and residential wells. Graphs showing groundwater elevation changes over time since 2000 for select monitoring locations are also provided in **Appendix E**.

4.4.1 Source Water Protection

As described in the Niagara Peninsula Source Protection Area Updated Assessment Report, (NPCA, 2013) Significant Groundwater Recharge Areas (SGRAs) are defined as areas that have a recharge of more than 1.15 times the average recharge in the Niagara Peninsula Source Protection Area (NPSP Area). Based on the results of the assessment undertaken by the NPCA, the SSA is not located within a SGRA. A small area north of the SSA, associated with the Niagara Escarpment, is designated as a SGRA. Otherwise, there are no other areas with SGRA designations within the LSA and RSA.

The NPSP Area Updated Assessment Report delineated Highly Vulnerable Aquifers (HVAs) based mainly on vulnerability mapping completed previously by NPCA, which combined two vulnerability assessment methods: (i) intrinsic susceptibility index (GwISI) and (ii) aquifer vulnerability index (AVI). High susceptibility areas occur mainly where soil layers overlying an aquifer are thin (less than 5 m over bedrock) or consist of highly permeable overburden. Once delineated, the HVAs were assigned a vulnerability score of 6.

Based on the results of the vulnerability assessment undertaken for the NPSP, the SSA and the Walker Campus is located within an HVA. The HVA designation likely relies on the presence of bedrock outcropping or thin (i.e., <5 m) overlying deposits, and increased groundwater vulnerability related to aggregate operations.

MECP's Table of Drinking Water Threats (TDWT) establishes if a given activity/circumstance is a low, moderate, or significant drinking water threat, depending on the vulnerability score of the HVA in which it is located. For an HVA vulnerability score of 6, the establishment and operation of a waste disposal site greater than 10 hectares for solid, non-hazardous waste from residential and industrial, commercial, and institutional (IC&I) sources is considered a low drinking water quality threat. The exception is for vinyl chloride or other dense-non-aqueous-phase-liquids (DNAPL) that could degrade to vinyl chloride, which is considered a moderate potential chemical drinking water threat for a landfill greater than 10 hectares (NPCA, 2013). It is noted, however, that the SSA is not designated as an SGRA.

There are no municipal well fields in operation, and as such, no well-head protection areas (WHPAs) within Niagara Region. Therefore, the SSA is not situated within a WHPA.

4.4.2 Existing Anthropogenic Influences

The South Landfill, as well as the East and West Landfills, were developed within exhausted quarries. Within the former East Quarry, a trench was constructed along the north-south axis of the former quarry floor to provide gravity drainage of water away from the operations to the Old Welland Canal. Upon completion of the Quarry, an engineered perforated collection pipe was installed within the trench, with granular backfill material, to facilitate continued groundwater collection from the original quarry floor below the East Landfill liner. A solid drainage pipe was also installed in the trench to facilitate drainage of surface water from the adjacent South Quarry (current South Landfill Phase 1) and future (at the time) Southeast Quarry. The perforated pipe is referred to as the Groundwater Collection System (GWCS), which along with the solid drainage pipe, is collectively referred to as the WEG Drainage System (WDS).

Under baseline (pre-developed) conditions, bedrock groundwater in the vicinity of the Campus flowed generally north towards the Niagara Escarpment. The permitted development at the Campus has altered the potentiometric surfaces for the dolostone bedrock aquifer and shale bedrock aquitard such that surrounding water levels have declined relative to pre-development conditions. The groundwater drawdown cone around the former and current quarries is estimated to extend about 500 m beyond the east / southeast excavation limits, and marginally beyond 500 m to the south of the Campus. The estimated extent of the drawdown in 2025 was inferred to have remained unchanged since 2015, suggesting that conditions may be stable.

A conceptual representation of the local groundwater setting across the Campus is presented on **Figure 4-7**. It is noted that the figure is not to scale. Around the perimeter of the East and South Landfills, which are sealed by clay sidewalls and liners, groundwater movement is in a downward direction, along the buried vertical quarry faces, and into the weathered shale floor. The groundwater then mixes with water from the shallow Rochester shale before being collected by the perforated pipe in the GWCS. The groundwater then flows northward through the GWCS pipe to a collection chamber from where it may be discharged to the leachate collection system or used on-site under appropriate conditions based on water quality monitoring results.

The South and East Landfills are designed and constructed to contain and isolate the leachate from the natural environment. Within each landfill cell, an engineered clay liner was continuously constructed to achieve this isolation. A leachate collection system was constructed on top of the engineered clay liner, directly below the waste, to collect the leachate. The collected leachate is pumped from the waste cells through a force main to two engineered holding lagoons where the leachate is partially treated prior to discharge into the sanitary sewer. Leachate collection reduces potential leachate mounding within each landfill cell, thereby minimizing the potential for the downward migration of leachate through the engineered clay liner. The Closed West Landfill operates on a different design, where pumping from a network of leachate wells is undertaken on an on-going basis to minimize leachate mounding within the waste fill. The leachate from the Closed West Landfill is also directed to the on-Site lagoons.

The design of the South and East Landfills and presence of the GWCS maintains groundwater flow patterns similar to the conditions at the former quarries prior to landfilling, which is a natural sink or drawdown effect in the dolostone bedrock aquifer and shale bedrock aquitard. This creates a continuous inward groundwater gradient (i.e., hydraulic trap) surrounding the South and East Landfills and the Southeast Quarry, whereby groundwater within the dolostone aquifer and shale aquitard below the Campus does not flow off-site.

4.4.3 Upper Overburden Aquitard

Within the RSA and LSA, the glaciolacustrine clay and silt overburden deposits act as an aquitard and are not a significant source of potable water owing to its low permeability and poor yields.

The water table in the clayey silt overburden within the LSA is predominantly situated above the potentiometric surface of the underlying Lockport dolostone aquifer, as depicted on **Figure 4-7**, and groundwater movement in the overburden is generally downward to the underlying dolostone aquifer. In the areas immediately adjacent to the landfills and quarries, the overburden water table is perched due to the low permeability of the soils relative to the underlying dolostone bedrock. The low permeability of the overburden soils acts as a confining layer to control the downward movement of groundwater recharge from precipitation to the underlying bedrock units.

4.4.4 Lockport Dolostone Bedrock Aquifer

The Goat Island and Gasport Member dolostone of the Lockport Formation are treated as a single bedrock aquifer in the LSA, though the Goat Island Member dolostone is typically more fractured and permeable.

The Goat Island Member of the Lockport Formation is the most permeable bedrock unit within the LSA, with measured hydraulic conductivity ranging between 7×10^{-7} m/s and 9×10^{-4} m/s, with a geometric mean of 2×10^{-5}

m/s. The hydraulic conductivity of the underlying Gasport Member is more variable but is overall about an order of magnitude less permeable, with estimated hydraulic conductivity ranging between $4x10^{-10}$ m/s and $1x10^{-4}$ m/s, with a geometric mean of $2x10^{-6}$ m/s. The geometric mean for the combined Lockport aquifer is $2x10^{-6}$ m/s.

Within the RSA, the potentiometric surface in the dolostone bedrock aquifer appears to be a subtle reflection of bedrock surface topography, as a local potentiometric high is mapped at the north end of the City of Niagara Falls urban area to the east of the Campus beyond the LSA in the Niagara Peninsula Source Protection Area Updated Assessment Report (NPCA, 2013). A smaller localized potentiometric high also occurs southeast of the Campus outside the LSA. Groundwater is inferred to flow radially away from these localized highs toward the Niagara Escarpment to the north, Welland Canal to the west, Welland River to the south, or Queenston-Chippewa Power Canal to the east.

The potentiometric surfaces in the Lockport dolostone aquifer within the LSA in June 2025, September 2025, December 2025 and March 2026 are presented on **Figure 4-8** to **Figure 4-11**, respectively, representing different seasonal conditions. Groundwater elevations are provided in **Table E-1**, **Appendix E**.

Lockport dolostone is present adjacent to the south, east, and north sides of the SSA, but has largely been extracted to the west. **Figures 4-8** to **4-11** show the inward groundwater flow direction within the dolostone bedrock aquifer around the South Landfill, East Landfill and current Southeast Quarry, which is consistent with the flow regimes observed in previous years. Though potentiometric levels in the dolostone bedrock aquifer monitoring wells fluctuate in response to seasonal and climatic conditions, the groundwater flow directions within the bedrock aquifer remain similar in all seasons, as demonstrated in **Figures 4-8** to **4-11**.

At the SSA, groundwater discharge occurs along the north, east and south quarry faces. Groundwater discharge and surface water runoff in the SSA drains to the quarry sump, from where it is discharged through the solid drainage pipe to the Old Welland Canal as part of the WDS. Around the perimeter of the South Landfill and East Landfill, which are sealed by clay sidewalls, groundwater movement is in a downward direction, along the buried vertical quarry faces, and into the weathered shale floor. The groundwater then moves beneath the South Landfill and East Landfill clay liners and mixes with water from the shallow Rochester shale before draining to the GWCS.

In summary, within the LSA, groundwater in the Lockport dolostone aquifer flows inward toward the SSA (current Southeast Quarry), South Landfill and East Landfill due to the drawdown effect of the GWCS and quarry. At the SSA, groundwater discharges slowly into the quarry through the north, east and south rock faces and drains to the quarry sump. Around the perimeter of the South Landfill and East Landfill, which are sealed by clay sidewalls, groundwater moves downward along the buried vertical quarry faces and into the weathered shale floor. The groundwater then moves beneath the South Landfill and East Landfill clay liners and mixes with water from the shallow Rochester shale before draining to the GWCS.

4.4.5 Lower Aquitard

The DeCew / Rochester Formations form a lower aquitard that acts as a natural flow barrier separating groundwater flow within the Lockport dolostone bedrock aquifer from flow within the lower Irondequoit limestone unit (Novakowski & Lapcevic, 1988).

The Rochester Formation has the most variable hydraulic conductivity within the LSA, ranging over seven orders of magnitude. The estimated hydraulic conductivity ranges between $4x10^{-12}$ m/s and $1x10^{-5}$ m/s, with a geometric mean of $5x10^{-7}$ m/s, $2x10^{-7}$ m/s and $2x10^{-7}$ m/s, for the upper, middle and lower portions of the formation, respectively. Overall, the geometric mean hydraulic conductivity of the Rochester Formation is notably lower than the geometric mean of the overlying Lockport Formation units. It was previously inferred that variability in hydraulic conductivity within the Rochester Formation is related to natural heterogeneity within the shale bedrock, where localized variations in lithology, bedding planes and fracture density can have a significant influence.

It was also noted previously and confirmed with the current study results that there is no correlation between the fossiliferous zone and higher hydraulic conductivity, and that the fossiliferous zone is not considered to be hydraulically significant.

Within the RSA outside of the Campus, groundwater movement within the shale lower aquitard is inferred to be primarily vertical, driven by vertical hydraulic gradients; however, minimal groundwater flux occurs due to the low hydraulic conductivity of the shale bedrock. The hydraulic conductivity of the native Rochester Formation is inferred to be highly anisotropic (directional) along horizontal bedding planes, restricting downward flux of groundwater. While there are no measurements of vertical hydraulic conductivity within the LSA, the vertical values are expected to be substantially (at least 10 times or more) lower than the horizontal values.

Within the LSA, and particularly near the Campus, the upper portion of the Rochester shale is inferred to have increased weathering and horizontal jointing along beds due to natural exposure and quarry operations. Groundwater movement in the upper portion of the shale aquitard near the Campus is primarily horizontal due to the bedded nature of the shale, with only minor downward vertical leakage across the relatively low permeability shale beds. Notable downward flow is only expected to occur immediately adjacent to the Niagara Escarpment, where weathering processes are inferred to have caused natural vertical fracturing (Gartner Lee Limited, 2006).

The June 2025, September 2025, December 2025 and March 2026 potentiometric surfaces in the Rochester shale aquitard within the LSA are presented on **Figure 4-12** to **Figure 4-15**. The groundwater flow directions in the shale aquitard are consistent throughout the seasons, and similar to historic patterns. **Figures 4-12** to **4-15** show that horizontal groundwater flow in the shale bedrock within the LSA is radially inward towards the sump within the SSA (Southeast Quarry), South Landfill and the GWCS below the East Landfill liner.

Lower potentiometric heads are observed in the Rochester shale (and DeCew shaley dolostone) relative to the overlying Lockport dolostone at many monitoring locations. The differences in potentiometric heads are attributed to the low hydraulic conductivity of the lower Lockport Formation (Gasport Member), which maintains higher water levels in the Lockport dolostone, along with lateral drainage of the DeCew shaley dolostone and upper Rochester shale to the existing quarry excavations and the Niagara Escarpment. The exposed bedrock faces at these locations allow the deeper groundwater system to drain, lowering the potentiometric heads in those formations.

In summary, within the LSA, groundwater in the lower aquitard associated with the DeCew and Rochester Formations flows inward toward the SSA (current Southeast Quarry), South Landfill and East Landfill due to the drawdown effect of the GWCS and quarry. At the SSA, groundwater in the lower aquitard moves through the weathered shale floor to the quarry sump from where it is discharged through the solid drainage pipe to the Old Welland Canal as part of the WDS. Around the perimeter of the South Landfill and East Landfill, which are lined by clay, groundwater moves through the weathered shale floor beneath the South Landfill and East Landfill clay liners and drains to the GWCS.

4.4.6 Irondequoit Aquifer

Groundwater pressures in the Irondequoit Formation limestone are measured at a number of locations across the Campus and adjacent to the SSA. The groundwater potentiometric head in the Irondequoit limestone is lower than the overlying Rochester shale piezometric surface; as such, a downward hydraulic gradient exists between these two units. The piezometric surface within the Irondequoit Formation is relatively flat across the LSA, except in the western part of the Campus where gradients are influenced by the Welland Canal and the flow direction is subject to seasonal variability.

A section of the Old Welland Canal immediately adjacent to the west side of the Campus is drained annually for the winter season (typically from about late December through mid-March) by the St. Lawrence Seaway Authority. Water levels in the Canal overflow channel during shipping season are typically around 159 masl and around 147 masl during drained conditions in the winter (Gartner Lee Limited, 2006). During this period, groundwater levels at monitoring wells screened within the Irondequoit limestone typically decrease.

Using the available historic water level data for the Irondequoit Formation, the following seasonal trends were identified:

- Prior to drainage of the Canal, west to southwest flow directions are typically observed in December, considered to be naturally occurring as the result of high water surplus (the potential source is recharge through the weathered bedrock along the brow of the escarpment northeast of the Campus).
- During drained conditions, west to southwest flow directions are typically observed from January to early March, interpreted to be the result of induced inward gradients toward the Canal.
- During refilling of the Canal, east to southeast flow directions are typically observed from late March through June, interpreted to be the result of induced outward gradients away from the Canal.
- During periods of low water surplus (September), northwest groundwater flow directions are typically observed, interpreted to be the ambient horizontal hydraulic gradient within the Irondequoit limestone.

The June 2025, September 2025, December 2025 and March 2026 groundwater potentiometric levels measured in the Irondequoit limestone are presented on **Figure 4-16** to **Figure 4-19**. The June 2025 potentiometric levels (**Figure 4-16**) suggest overall flow to the southwest; though gradients between monitoring wells 26-1R and 67-1 (closest to the Canal) and 39-1 are eastward which is consistent with refilling of the Canal. The September 2025 potentiometric surface indicates flow to the northwest, as shown on **Figure 4-17,** which is interpreted to be representative of ambient flow conditions within the Irondequoit formation during dry conditions. The December 2025 and March 2026 potentiometric levels (**Figures 4-18 and 4-19**) indicate a west to southwest inferred flow direction, consistent with naturally occurring high water surplus conditions (December) and induced gradients toward the Canal during drained conditions (March). Groundwater elevations in the Irondequoit monitoring wells at locations 75 and 77 are inferred to be still stabilizing after installation and have not reached static conditions.

The mean hydraulic conductivity of the Irondequoit Formation is similar to that of the overlying Rochester Formation, and localized values can also vary significantly. The estimated hydraulic conductivity ranges between $8x10^{-12}$ m/s and $3x10^{-5}$ m/s, with a geometric mean of $1x10^{-7}$ m/s. These hydraulic conductivity values confirm that the Irondequoit Formation, particularly away from the Escarpment, functions more as an aquitard than an aquifer within the LSA.

In summary, groundwater in the Irondequoit aquifer in the LSA typically flows west to southwest or west to northwest; but the flow direction is seasonally influenced by the draining and filling of the Welland Canal. The groundwater potentiometric head in the Irondequoit aquifer is lower than the overlying lower aquitard piezometric surface; as such, a downward hydraulic gradient exists between these two units.

4.4.7 Groundwater Trends with Time and Vertical Hydraulic Gradients

Most overburden, dolostone and shale monitoring wells across the LSA show groundwater elevation fluctuations or trends related to seasonal effects, sampling, and/or quarry operations. Away from the Campus operation influences, groundwater elevations are typically highest in early spring and lowest in late summer/ early autumn. Monitoring wells closer to the landfills and active quarry, however, generally show minor seasonal variations due to the continued dewatering effects of the GWCS and active quarry. This is most notable in the Lockport dolostone wells, as demonstrated in the newly installed monitoring well nests. Seasonal fluctuations in Lockport wells at nests 77 and 78 closest to the Southeast Quarry were between 0.41 m and 0.66 m, while seasonal fluctuations in Lockport wells at nests 79, 80 and 81 furthest from the quarry ranged from 1.3 m to 1.5 m. As noted previously, groundwater elevations changes in the Irondequoit limestone wells, particularly in the western portion of the LSA, are influenced by the seasonal draining and filling of the Old Welland Canal basin west of the Campus.

As observed in the hydrographs in **Appendix E**, drawdown effects related to the former South and current Southeast quarrying activities are observed in a number of Lockport dolostone and Rochester shale monitoring wells north, east and south of the Campus. At well nests 48, 49, 50, 51, 52 and 56 in the vicinity of the SSA, the water level declines align with the start of quarrying activities in the Southeast Quarry, while water level declines at other wells nests such as 46, 47, 53, 54 and 55 begin earlier in response to the former South Quarry operations. The Lockport dolostone and Rochester shale groundwater elevations at these well nests, however, have stabilized in recent years. As the Southeast Quarry continues its extraction activities toward the northeast, the Lockport dolostone and Rochester shale groundwater elevations toward the northeast may still decline marginally.

Most monitoring wells screened within the Rochester shale exhibit slow recovery due to the low hydraulic conductivity of the shale bedrock. Historic water levels have shown that the recovery to static conditions in some shale wells can take at least two years, and in some cases up to four years following installation and/or sampling. Consequently, groundwater elevations measured in some of the Rochester shale wells are not included in the assessment and potentiometric contouring until static or near-static conditions have been reached.

Neutral to downward hydraulic gradients are typically observed between the Lockport dolostone and Rochester shale monitoring wells across the LSA. At some locations, particularly near the perimeter of the former South Quarry, the Lockport dolostone potentiometric heads declined before the potentiometric heads in the Rochester shale, resulting in upward hydraulic gradients for a number of years. The original neutral to downward vertical hydraulic gradients at these locations were restored over time as the groundwater elevation in the Rochester shale wells declined due to dewatering.

The groundwater potentiometric head in the Irondequoit limestone is typically lower than the overlying Rochester shale piezometric surface; as such, a downward hydraulic gradient exists between these two units. The hydraulic conductivity of the native Rochester Formation, however, is inferred to be highly anisotropic (directional) along horizontal bedding planes, restricting downward flux of groundwater. While there are no measurements of vertical hydraulic conductivity within the LSA, the vertical values are expected to be substantially (at least 10 times or more) lower than the horizontal values.

4.4.8 GWCS Hydraulic Influence

As previously described in **Section 4.4.2**, the presence of the GWCS maintains a continuous inward gradient surrounding the South and East Landfills and the Southeast Quarry, whereby groundwater within the dolostone aquifer and shale aquitard below the Campus does not flow off-site.

In early January 2005, the WEG Drainage System (WDS) consisting of the solid surface water drainage pipe and the GWCS, was lowered about 4 m to improve drainage of stormwater from the former South Quarry (Gartner Lee Limited, 2006). A drop in water level was observed in several Rochester shale monitoring wells adjacent to the south, southeast and west of the East Landfill, and in the MM-series wells completed below the landfill. The hydraulic response, particularly, in the MM-series wells can be seen in the hydrographs in **Appendix E**.

The water level response suggests a strong hydraulic connection within the shallow Rochester shale between the GWCS and the MM-series wells, as well as other monitoring wells at the perimeter of the East Landfill. Though water level responses to the lowered GWCS in 2005 were not necessarily measured in shallow Rochester shale monitoring wells around the perimeter of the South Landfill and Southeast Quarry, inward hydraulic gradients between these locations and the GWCS have consistently between observed over the years. This has been demonstrated through the historic groundwater flow regimes in the Lockport dolostone and Rochester shale bedrock.

The directions of groundwater flow in the Lockport dolostone aquifer and Rochester shale aquitard during the baseline groundwater monitoring period are consistent with historic patterns. The inward gradient is present around the Campus in both potentiometric surfaces within the Lockport dolostone and the Rochester shale, as depicted on **Figures 4-8 through 4-15**. The potentiometric data confirms that the hydraulic influence of the GWCS extends to the perimeter of the SSA. The inward gradients are also conceptually shown in **Figure 4-7**.

Around the perimeter of the East and South Landfills, which are sealed by clay sidewalls, groundwater movement in the Lockport aquifer is in a downward direction, along the buried vertical quarry faces, and into the weathered shale floor. The groundwater then flows beneath the existing landfill clay liners and mixes with water from the shallow Rochester shale before draining to the GWCS.

Owing to the horizontally-bedded nature of the shale and shaley dolostone units of the formation, groundwater movement within the Rochester shale is primarily horizontal, with only minor downward vertical leakage expected across the low hydraulically conductive shale beds. Notable downward flow is only expected to occur immediately adjacent to the Niagara Escarpment, where weathering processes have caused the bedrock to fracture naturally.

4.4.9 Groundwater Use

There are no municipal well fields in operation within the LSA and RSA, as all of the urban serviced areas are supplied via surface water intake. As such, there are no well-head protection areas (WHPAs) within the LSA. Three MECP Permit-to-Take-Water (PTTW) for groundwater takings exist within the RSA, including water takings for dewatering of the existing Southeast Quarry, operation of a groundwater containment system at Niagara Region’s Mountain Road Landfill Site east of the LSA, and for irrigation of the Niagara Falls Golf Club within the southern portion of the RSA. It is noted that no PTTWs were found for the dewatering operations along the Welland Canal at the Thorold Stone Road tunnel southwest of the LSA and Townline Road / Main Street Tunnels in Welland southwest of the RSA or dewatering associated with the Queenston-Chippewa Power Canal along the eastern portion of the RSA. It is acknowledged in the Niagara Peninsula Source Protection Area Updated Assessment Report (NPCA, 2013) that these dewatering operations also have an impact on the regional potentiometric surface, although the exact extent of the impact is currently not well documented.

According to the Niagara Region Master Servicing Plan (2016), a significant number of parcels within the LSA are connected to the municipal water supply, particularly along Garner Road east of the SSA. A large proportion of the un-serviced lands are either (i) owned by Walker, (ii) vacant with no associated street address, or (iii) within the hydro corridor right-of-way to the southeast of the SSA or the Niagara Escarpment Parks and Open Spaces System to the west of the SSA.

Addresses of the remaining parcels with the potential for private water well use are shown on **Figure 4-20**. Previous water well surveys have been completed as part of the existing quarry licencing, and a number of residential wells within and adjacent to the LSA are currently included in the annual monitoring program as shown on the figure.

4.4.9.1 MECP Water Well Record Search

A search of the MECP Water Well Record database (data currently available up to August 2025) was undertaken to identify well records located within or adjacent to the LSA. The results of the search are shown on **Figure 4-20** and summarized in **Table F-1, Appendix F**.

A total of 97 water well records plot within the search area. Of these well records, 36 are reported as domestic supply, 11 are reported as livestock / irrigation, 3 are reported as municipal supply (associated with the Thorold Public Works facility west of the East Landfill), 3 are reported as industrial / commercial, 25 are reported as monitoring wells / test holes and 14 have no reported use. Five (5) recent well records submitted since 2024 are related to aquifer test well installation to the east of Garner Road.

A total of 61 wells are reportedly screened within bedrock, 7 within the overburden and 29 with unknown screen depths. Fresh water was reported in 38 wells, sulphur / mineralized water was reported in 13 wells while the water type at the remaining wells was not specified in the water well record. The recommended pumping rates vary significantly, ranging between 2 Imperial gallons per minute (Igpm) and 17 Igpm, with a median value of 5 Igpm (23 L/min).

4.4.9.2 Water Well Survey

A residential water well survey of unserviced parcels was undertaken in summer 2025 in accordance with MECP technical guidance (MECP, 2008). The survey responses are summarized in **Table F-2**, **Appendix F**, and depicted graphically on **Figure 4-20**. A summary of the 2025 survey is provided below:

- Attempts were made to deliver surveys to fourteen (14) parcels with a municipal address that were identified within the survey area shown on **Figure 4-20**. This total does not include other lands owned by Walker.
- The door-to-door surveys were conducted in July 2025. At least two attempts at contact were made: once during daytime hours, and a follow-up attempt during evening or weekend hours, where no response was received during the first attempt. If no contact had been established by the second attempt, a pre-stamped return envelope and survey package was left in the mailbox.
- Of the fourteen (14) properties, a total of nine (9) property owners responded either verbally in person during the door-to-door survey or mailed a completed survey package later. Five (5) surveys were not completed owing to no response from the property owner.
- Of the nine (9) property owners who responded to the survey either in person or by mail, three (3) identified a well as their only water source, while 6 (six) identified having a well and a cistern as their

source of water. Overall, four (4) of the respondents indicated that their well is either their sole water source or used for domestic purposes. These properties include:

  - 3393 Thorold Townline Road (Walker Residential Well 8);
  - 9332 Thorold Stone Road (Walker Residential Well 3);
  - 10056 Thorold Stone Road (Walker Residential Well 7); and
  - 8865 Mountain Road (Walker Residential Well 14).

- Five (5) of the respondents indicated that the cistern is the only source for domestic water, and the well was either no longer in use or used only for lawn / garden watering.

In summary, a significant number of parcels within the LSA are connected to the municipal water supply, and a large proportion of the un-serviced lands are either (i) owned by Walker, (ii) vacant with no associated street address, or (iii) within the hydro corridor right-of-way to the southeast of the SSA or the Niagara Escarpment Parks and Open Spaces System to the west of the SSA. A total of 97 MECP water well records plot within the LSA, of which 36 are reported as domestic supply, while the remainder are for use as livestock / irrigation, industrial / commercial, or monitoring wells / test holes.

Based on the residential water well survey, there are four (4) residents within the LSA that use their well as the sole water source for domestic purposes. Each of these residences are included in Walker's current residential well monitoring program for the Southeast Quarry, and the closest wells are approximately 500 m south and northeast of the SSA, respectively.

4.5 Groundwater Quality

The natural groundwater quality within the LSA is presented and discussed in terms of the following water bearing geological formations: Lockport Dolostone (aquifer), Rochester shale (aquitard), and Irondequoit limestone (aquifer).

A baseline groundwater sampling program, incorporating the newly installed and select existing monitoring wells, was undertaken in June, September and December 2025, and March 2026. The monitoring wells included in the groundwater sampling program are shown on **Table 5**. It is noted that some of the newly installed monitoring wells (76-2, 77-1 and 77-3) were only sampled once due to slow recovery yielding insufficient water, consistent with monitoring wells in the current East and South Landfill monitoring programs. The baseline groundwater sampling program included the following monitoring wells, which have been categorized according to their locations as either near the perimeter of the SSA, South Landfill Phase 1, and East Landfill, or removed from the perimeter toward the periphery of the LSA. The monitoring well locations are shown on **Figure 4-2**.

Groundwater samples collected as part of the baseline program were analyzed for the suite of parameters listed in O. Reg. 232/98. Groundwater chemistry for select existing monitoring wells, collected as part of ongoing annual compliance programs, were also included in the baseline chemistry for assessment. The inorganic groundwater quality results are provided in **Table G-1**, while organic chemistry results are provided in **Table G-2**, **Appendix G**. Historic groundwater quality data from 2009 to March 2025 are also included in the tables. It is noted that various historic groundwater monitoring programs did not include the full suite of O. Reg. 232/98 parameters, such as biological oxygen demand (BOD) and, in some cases, chemical oxygen demand (COD), arsenic and mercury.

Table 5: Baseline Groundwater Monitoring Locations

Perimeter Monitoring Wells	
Lockport Dolostone (Bedrock Aquifer)	17-2, 17-3, 19-3R, 40-2R, 46-2, 46-3R, 47-2R, 47-3R, 48-2, 67-4, 75-4, 75-5, 77-5, 78-4, 78-5
Rochester Shale (Lower Aquitard)	15-1, 17-1R, 19-1R2, 46-1R, 47-1R, 48-1, 67-3, 75-2, 75-3, 77-2, 77-3, 77-4, 78-2, 78-3
Irondequoit Limestone (Aquifer)	39-1, 40-1R, 67-1, 75-1, 77-1, 78-1
Periphery Monitoring Wells	
Lockport Dolostone (Bedrock Aquifer)	49-2, 51-2, 55-3, 79-3, 79-4, 80-3, 81-3
Rochester Shale (Lower Aquitard)	23-1R, 24-1, 49-1, 51-1, 55-1, 56-1, 76-2, 76-3, 76-4, 79-1, 79-2, 80-1, 80-2, 81-1, 81-2
Irondequoit Limestone (Aquifer)	76-1

A statistical summary of the groundwater quality results by hydrogeologic unit from the perimeter monitoring wells and periphery monitoring wells are summarized for the baseline EA period (2025/2026) in **Table 6** and **Table 7**, respectively. A statistical summary of the historic (2009 to March 2025) groundwater quality results from the perimeter and periphery monitoring wells are provided in **Table 8** and **Table 9**, respectively.

In addition to groundwater quality around the perimeter of the SSA, South Landfill Phase 1 and East Landfill, and to the periphery of the LSA, groundwater quality in the shallow Rochester shale below the East Landfill as collected from the MM-series wells and the GWCS is presented in **Table G-3**, **Appendix G**.

The September 2025 groundwater quality at the Site is illustrated on the trilinear diagrams in **Figures 4-21 through 4-24**. The figures represent groundwater quality in the Lockport dolostone, Rochester shale, Irondequoit limestone, and the MM-series wells/GWCS, respectively. The anion chemical results are presented on the triangular graph in the lower right, and the cation chemical results are presented on the triangular graph in the lower left. The anion and cation results are combined on the diamond shaped graph in the centre. Water with similar chemical signatures will plot together on the trilinear plot.

Fields representing typical precipitation (also referred to as meteoric) water quality; natural Lockport dolostone, DeCew dolostone, and Rochester shale water quality; West Landfill leachate quality; and historic and more recent East Landfill leachate quality are presented on the trilinear diagram for reference purposes. The typical groundwater and leachate fields were developed based on historic data from the various compliance monitoring programs at the Campus.

Table 6: Baseline EA Perimeter Monitoring Well Summary

Parameter	ODWQS	Lockport Dolostone					Rochester Shale					Irondequoit Limestone				
		No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg
General																
pH (SU)	6.5 - 8.5	42	0	6.93	7.97	7.62	36	0	5.59	8.22	7.40	14	0	6.73	8.49	7.39
E C (µS/cm)		42	0	780	>100000	8464	36	0	1300	210000	49450	14	0	6500	>100000	39829
Alkalinity	30 - 500	42	0	120	520	373	36	0	8.7	470	233	14	0	42	440	286
T D S	500	42	0	390	108000	8082	36	0	835	310000	54233	14	0	4190	82500	28296
Major Ions																
Chloride	250	42	0	18	61000	4120	36	0	28	180000	31876	14	0	990	59000	15714
Sulphate	500	42	0	48	1900	712	36	0	310	2500	1124	14	0	650	2000	1182
Calcium		42	0	92	9600	829	36	0	110	25000	4282	14	0	230	6800	2421
Magnesium		42	0	24	3500	362	36	0	69	9000	1620	14	0	68	1700	674
Sodium	200	42	0	16	23000	1681	36	0	44	62000	11523	14	0	800	19000	6336
Potassium		42	0	0.83	360	32	36	0	3.8	960	194	14	0	8.7	320	115
Other																
Nitrate	10 *	42	28	<0.1	2.73	0.32	36	34	<0.1	0.16	0.21	14	13	<0.1	0.27	0.13
Nitrite	1 *	36	33	<0.01	0.014	0.007	35	31	<0.01	0.092	0.025	14	12	<0.01	0.078	0.020
T K N		36	0	0.13	14	2.25	35	0	0.23	96	21.1	14	0	3.4	28	10.9
Ammonia		42	4	<0.05	28	2.19	36	0	0.17	80	19.1	14	0	3	26	9.92
Total Phosphorus		36	1	<0.004	1.80	0.237	35	0	0.005	2.9	0.44	14	0	0.022	7.4	1.34
B O D		41	26	<2	69	6.07	34	14	<2	690	76.9	11	1	3	75	48.3
D O C	5	42	0	0.76	12	2.59	36	0	0.99	57	11.7	14	0	1.6	59	11.1
C O D		40	12	<4	970	68	33	2	<4	3400	450	14	0	19	850	241
Phenols		42	16	<0.001	0.890	0.058	36	4	<0.001	2	0.341	14	3	<0.001	3.2	0.316
Arsenic	0.01 *	34	24	<0.001	0.004	0.002	32	19	<0.005	0.041	0.025	14	13	<0.001	0.0012	0.003
Barium	1 *	42	0	0.019	0.16	0.049	36	3	0.02	0.35	0.111	14	0	0.033	0.53	0.135
Boron	5 *	42	0	0.043	4.5	0.78	36	0	0.14	5.6	2.26	14	0	0.15	2	1.14
Cadmium	0.005 *	36	34	<0.00009	0.00032	0.00010	35	35	<0.00009	<0.009	0.00065	14	14	<0.00009	<0.0009	0.00055
Chromium	0.05 *	36	36	<0.005	<0.05	0.0051	35	35	<0.005	<0.5	0.0363	14	14	<0.005	<0.05	0.0136
Copper	1	36	28	<0.0009	0.0031	0.0012	35	35	<0.0009	<0.09	0.0065	14	13	<0.009	0.002	0.0026
Iron	0.3	42	9	<0.1	3.6	0.81	36	19	<0.1	25	2.76	14	8	<0.1	3.7	0.84
Lead	0.01 *	36	24	<0.0005	0.0024	0.0006	35	35	<0.0005	<0.05	0.0035	14	14	<0.0005	<0.005	0.0014
Manganese	0.05	36	2	<0.002	0.43	0.093	35	0	0.020	4.7	0.690	14	0	0.021	4.4	1.014
Mercury	0.001 *	41	41	<0.0001	<0.0001	5.0E-05	34	34	<0.0001	<0.0015	1.1E-04	14	14	<0.0001	<0.0001	5.0E-05
Zinc	5	36	32	<0.005	0.15	0.014	35	32	<0.005	0.22	0.045	14	14	-0.05	-0.005	0.014

Notes: Values in milligrams per litre (mg/L) unless otherwise noted

ODWQS - Ontario Drinking Water Quality Standards (MECP, June 2003 and updates)

ND - non detect

Table 7: Baseline EA Periphery Monitoring Well Summary

Parameter	ODWQS	Lockport Dolostone					Rochester Shale					Irondequoit Limestone				
		No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg
General																
pH (SU)	6.5 - 8.5	25	0	7.42	8.15	7.71	38	0	6.54	8.06	7.66	4	0	7.35	7.55	7.44
E C (µS/cm)		25	0	1200	11000	2564	38	0	670	>100000	30523	4	0	3300	5000	4125
Alkalinity	30 - 500	25	0	190	500	390	38	0	71	420	237	4	0	240	250	248
T D S	500	25	0	775	6040	1709	38	0	395	126000	27663	4	0	2970	3790	3430
Major Ions																
Chloride	250	25	0	13	3000	356	38	0	4.6	79000	13988	4	0	260	690	475
Sulphate	500	25	0	180	1100	472	38	0	62	2800	1435	4	0	1400	1500	1475
Calcium		25	0	74	650	184	38	0	71	8800	1856	4	0	610	700	665
Magnesium		25	0	66	230	118	38	0	41	4000	797	4	0	70	110	91
Sodium	200	25	0	33	1600	188	38	0	13	26000	5624	4	0	120	340	228
Potassium		25	0	1.6	38	9.3	38	0	2.9	440	117	4	0	7.2	13	11
Other																
Nitrate	10 *	25	21	<0.1	3.01	0.25	38	36	<0.1	2.42	0.18	4	4	<0.1	<0.1	0.05
Nitrite	1 *	25	20	<0.01	0.084	0.011	38	28	<0.01	0.122	0.020	4	4	<0.01	<0.01	0.005
T K N		25	2	<0.1	2.9	0.78	38	0	0.11	46	12.6	4	0	0.69	1.3	0.98
Ammonia		25	2	<0.05	2.6	0.65	38	2	<0.05	40	11.5	4	0	0.54	0.98	0.82
Total Phosphorus		25	0	0.016	2.70	0.537	38	0	0.006	3.8	0.28	4	0	0.006	0.038	0.022
B O D		25	17	<2	35	5.0	38	12	<2	150	28.7	4	3	<2	3	1.5
D O C	5	25	0	0.86	5.2	1.97	38	0	0.46	63	5.61	4	0	0.8	0.98	0.91
C O D		24	11	<4	52	10	38	8	<4	1200	251	4	2	<4	13	5
Phenols		25	10	<0.001	1.000	0.090	38	6	<0.001	2	0.483	4	0	0.015	0.17	0.100
Arsenic	0.01 *	24	3	<0.001	0.029	0.006	38	18	<0.001	0.035	0.007	4	2	<0.001	0.0041	0.002
Barium	1 *	25	0	0.015	0.14	0.058	38	0	0.0066	0.55	0.109	4	0	0.025	0.034	0.030
Boron	5 *	25	0	0.032	1.7	0.42	38	0	0.070	5.7	2.85	4	0	0.18	0.31	0.25
Cadmium	0.005 *	25	25	<0.00009	<0.00045	0.00005	38	38	<0.00009	<0.0009	0.00015	4	4	<0.00009	<0.00009	0.00005
Chromium	0.05 *	25	25	<0.005	<0.025	0.0029	38	38	<0.005	<0.05	0.0085	4	4	<0.005	<0.005	0.0025
Copper	1	25	24	<0.0009	0.0015	0.0006	38	38	<0.0009	<0.009	0.0015	4	4	<0.0009	<0.0009	0.0005
Iron	0.3	25	2	<0.1	1.3	0.53	38	25	<0.1	1.2	0.25	4	0	0.14	0.88	0.51
Lead	0.01 *	25	24	<0.0005	0.0013	0.0003	38	38	<0.0005	<0.005	0.0008	4	4	<0.0005	<0.0005	0.0003
Manganese	0.05	25	1	<0.002	0.6	0.077	38	0	<0.002	1	0.232	4	0	0.14	0.18	0.165
Mercury	0.001 *	25	25	<0.0001	<0.0001	5.0E-05	38	38	<0.0001	<0.0001	5.0E-05	4	4	<0.0001	<0.0001	5.0E-05
Zinc	5	25	21	<0.005	0.017	0.004	38	38	<0.005	0.0088	0.008	4	4	<0.005	<0.005	0.003

Notes: Values in milligrams per litre (mg/L) unless otherwise noted

ODWQS - Ontario Drinking Water Quality Standards (MECP, June 2003 and updates)

ND - non detect

Table 8: Historic Perimeter Monitoring Well Summary

Parameter	ODWQS	Lockport Dolostone					Rochester Shale					Irondequoit Limestone				
		No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg
General																
pH (S U)	6.5 - 8.5	328	0	6.79	8.19	7.65	106	0	5.42	8.1	7.40	45	0	6.8	8.17	7.28
E C (µS/cm)		327	0	611	97000	12493	106	0	4	425000	67801	45	0	5200	83000	43204
Alkalinity	30 - 500	328	0	170	640	401	106	0	7	450	242	45	0	190	450	317
T D S	500	328	0	397	84700	9300	106	0	880	310000	55641	45	0	3520	64200	29979
Major Ions																
Chloride	250	328	0	13	47000	4566	106	0	110	174000	31670	45	0	1000	34000	16338
Sulphate	500	328	0	33	1800	771	106	0	280	2400	1486	45	0	560	2080	1568
Calcium		328	0	91	8000	893	106	0	98	36400	4471	45	0	240	4900	2373
Magnesium		328	0	17	2800	393	106	0	48	16500	1884	45	0	68	1800	886
Sodium	200	328	0	16	19000	1759	106	0	150	92300	13206	45	0	950	12000	6828
Potassium		328	0	0.83	280	32	106	0	19	1910	236	45	0	27	270	145
Other																
Nitrate	10 *	328	156	<0.05	3.32	0.33	106	97	<0.1	51.2	0.71	45	43	<0.1	0.4	0.14
Nitrite	1 *	196	179	<0.01	0.14	0.036	86	72	<0.01	0.5	0.065	45	34	<0.05	0.049	0.031
T K N		196	4	<0.5	26	2.84	86	0	1.39	110	23.6	45	0	2	26	14.4
Ammonia		316	49	<0.05	23	2.30	103	0	1.23	79	21.1	45	0	1.4	22	13.0
Total Phosphorus		196	85	<0.004	0.65	0.028	86	25	<0.01	35	0.59	45	13	<0.01	6.8	0.63
D O C	5	328	0	0.8	39.7	3.58	98	5	<0.5	49	4.16	45	1	0.9	110	7.65
C O D		303	26	<4	108000.0	453	74	2	0.7	11600	1196	45	1	30	3350	477
Phenols		196	155	<0.001	0.11	0.004	86	27	<0.001	0.29	0.033	45	18	<0.001	0.17	0.014
Arsenic	0.01 *	171	137	<0.001	0.17	0.031	46	35	<0.005	2	0.224	45	32	<0.005	0.28	0.124
Barium	1 *	328	30	<0.1	0.21	0.045	106	42	<0.1	0.5	0.151	45	17	<0.1	0.33	0.148
Boron	5 *	328	1	<0.01	5.00	0.70	106	1	0.37	190	8.55	45	0	0.47	12	4.63
Cadmium	0.005 *	196	184	<0.00009	0.00041	0.0002	86	85	<0.00009	0.001	0.0017	45	45	<0.00009	<0.02	0.0234
Chromium	0.05 *	196	158	<0.005	0.010	0.010	86	82	<0.005	0.25	0.041	26	25	<0.005	0.047	0.026
Copper	1	196	98	<0.0009	0.047	0.004	86	71	<0.0045	0.16	0.023	45	41	<0.0009	0.04	0.016
Iron	0.3	328	151	<0.1	11.7	0.84	106	79	<0.1	31	2.44	45	44	<0.1	2	0.72
Lead	0.01 *	196	193	<0.0005	0.0018	0.0016	86	83	<0.0005	0.27	0.0185	45	45	<0.0005	<0.2	0.0119
Manganese	0.05	196	9	<0.01	4.600	0.235	86	19	<0.1	5	0.670	45	7	0.1	1.1	0.470
Mercury	0.001 *	171	170	<0.0001	0.00021	0.0001	46	45	<0.0001	0.0003	0.0001	45	44	<0.0001	0.0002	0.0012
Zinc	5	196	154	<0.005	0.03	0.018	86	84	<0.005	0.022	0.140	45	45	<0.005	<2	0.119

Notes: Values in milligrams per litre (mg/L) unless otherwise noted

ODWQS - Ontario Drinking Water Quality Standards (MECP, June 2003 and updates)

ND - non detect

Table 9: Historic Periphery Monitoring Well Summary

Parameter	ODWQS	Lockport Dolostone					Rochester Shale					Irondequoit Limestone				
		No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg	No.	No. ND	Min	Max	Avg
General																
pH (S U)	6.5 - 8.5	24	0	7.5	8.07	7.80	35	0	5.38	8.16	7.17					
E C (µS/cm)		24	0	1200	3500	1992	33	0	4	446000	69528					
Alkalinity	30 - 500	24	0	325	490	394	35	0	4.4	480	229					
T D S	500	24	0	755	2740	1440	35	0	2530	312000	81343					
Major Ions																
Chloride	250	24	0	38	430	189	35	0	89	169000	46830					
Sulphate	500	24	0	130	1000	456	35	0	300	2310	1083					
Calcium		24	0	72	380	186	35	0	150	38800	7733					
Magnesium		24	0	46	160	106	35	0	60	11400	2805					
Sodium	200	24	0	35	240	123	35	0	247	97800	20314					
Potassium		24	0	2	19	9	35	0	27	1150	301					
Other																
Nitrate	10 *	24	10	<0.1	2.04	0.39	35	19	<0.1	8.46	1.09					
Nitrite	1 *	24	22	<0.01	0.017	0.021	35	24	<0.01	0.28	0.067					
T K N		24	1	<0.1	1.5	0.62	35	0	0.29	93	27.0					
Ammonia		24	4	<0.01	1.2	0.39	35	0	0.14	81	23.8					
Total Phosphorus		24	6	<0.001	2.15	0.574	35	10	<0.004	2.1	0.19					
D O C	5	24	0	1.1	11.1	3.85	35	0	0.7	90.4	5.69					
C O D		0	0	0	0											
Phenols		24	18	<0.001	0.02	0.003	35	15	<0.001	0.042	0.013					
Arsenic	0.01 *	0	0	0	0											
Barium	1 *	24	3	<0.01	0.11	0.052	35	14	<0.1	0.39	0.157					
Boron	5 *	24	0	0.053	0.67	0.38	35	0	0.9	4.6	2.34					
Cadmium	0.005 *	24	23	<0.00009	0.00024	0.0001	35	35	<0.00009	<0.01	0.0016					
Chromium	0.05 *	24	21	<0.005	0.006	0.002	35	33	<0.005	0.006	0.046					
Copper	1	24	15	<0.0009	0.0044	0.0010	35	31	<0.0009	0.0091	0.0237					
Iron	0.3	24	12	<0.03	0.6	0.19	35	17	<0.1	33	6.65					
Lead	0.01 *	24	24	<0.0005	<0.001	0.0003	35	35	<0.0005	<0.1	0.0130					
Manganese	0.05	24	2	<0.01	0.100	0.033	35	7	<0.1	6	1.36					
Mercury	0.001 *	0	0	0	0											
Zinc	5	24	16	<0.005	0.026	0.007	35	35	<0.005	<1	0.053					

Notes: Values in milligrams per litre (mg/L) unless otherwise noted

ODWQS - Ontario Drinking Water Quality Standards (MECP, June 2003 and updates)

ND - non detect

4.5.1 Lockport Dolostone Bedrock Aquifer

Groundwater quality within the Lockport dolostone is influenced by the infiltration of precipitation through the overlying overburden, which results in less saline and less mineralized groundwater than in the deeper, more isolated bedrock units. The natural groundwater quality in the Lockport dolostone ranges from potable to non-potable, with increasing mineralization and, therefore, decreasing potability, with increasing depth. The Ontario Drinking Water Quality Standards (MECP, 2003 and updates) (ODWQS) aesthetic objectives for TDS and hardness are naturally exceeded at the monitoring wells screened in this formation. The ODWQS are also often naturally exceeded with respect to chloride, sodium, sulphate, iron, and manganese concentrations.

As shown in **Table 6** and **Table 8**, average concentrations in the perimeter monitoring wells during the baseline EA period were similar to those from the historic period. Also, the average concentrations in the periphery monitoring wells during the baseline EA period were generally within the range of the historic results, as shown in **Table 7** and **Table 9**. The exceptions were the conductivity, TDS, chloride and iron concentrations at the periphery wells during the baseline EA period, which were elevated compared to the historic range. The higher parameter concentrations are related to the addition of periphery monitoring well 79-3, which was installed as part of the EA program and exhibited elevated concentrations during the initial sampling events. Concentrations of these parameters at monitoring well 79-3 declined through 2025 such that they were similar to the other Lockport dolostone periphery well concentration ranges in March 2026.

The Lockport groundwater is generally more mineralized in the perimeter monitoring wells than in the periphery wells, as observed in **Table 6** and **Table 7**. A main contributor to this difference is monitoring well 47-2R, which is installed at the base of the Lockport dolostone in the transition zone into the DeCew shaley dolostone, and is influenced from upwelling of the more mineralized groundwater from the shaley dolostone unit. Aside from 47-2R, more mineralized groundwater is also observed at 78-4, screened near the base of the Lockport dolostone near the eastern perimeter of the Southeast Quarry. As previously reported, an increase in mineralization around the perimeter of the landfills and quarry is likely attributed to the higher hydraulic conductivity of the lower Lockport (and possibly the DeCew) due to increased fracturing from quarry operations such as blasting (Gartner Lee Limited, 2006). The increased fracturing would create a greater hydraulic connection between the Lockport dolostone and underlying DeCew shaley dolostone, allowing mixing of the two bedrock groundwater types.

As shown on **Figure 4-21**, the Lockport dolostone perimeter and periphery monitoring wells generally plot within the Lockport dolostone field or towards the meteoric water field. Monitoring wells that are completed at shallower depths with the Lockport formation (i.e., 78-5) generally plot closer to the typical meteoric water field on the diamond graph while monitoring wells completed deeper within the Lockport formation (i.e., 78-4) generally plot within the Lockport Dolostone field on the diamond graph.

During the baseline EA monitoring period, benzene and toluene were detected at perimeter well 47-2R, which is consistent with historic results and likely related to the upwelling of shale influenced groundwater which is naturally petroliferous. Trace detections of benzene and toluene were also detected at newly installed well 75-5 in June 2025 and 75-4 in June and September 2025, and toluene at 78-3 and 81-3 in June, and 79-3 in June and Sept 2025. These results, however, were not repeated in subsequent samples and may be artifacts of the drilling and well installation activities.

4.5.2 Lower Aquitard

The DeCew and Rochester bedrock units are not suitable as a drinking water source due to the poor quality of the groundwater, and low yields owing to low intrinsic permeabilities in the shale bedrock.

Due to its shale content, groundwater quality in the DeCew dolostone is similar to the quality in the Rochester shale but is less mineralized than the Rochester shale brine. The groundwater in the DeCew dolostone is generally considered to be non-potable due to the presence of naturally elevated concentrations of inorganic compounds.

The Rochester shale was formed in a saline marine depositional environment, which resulted in naturally saline and highly mineralized groundwater within this formation. The Rochester shale groundwater is considered a brine and is more mineralized than modern seawater. The salinity generally increases with both depth within the formation and distance from the Niagara Escarpment. Natural fractures in the shale near the Niagara Escarpment cause mixing with groundwater from overlying units, which decreases the salinity. Trace concentrations of BTEX parameters (benzene, toluene, ethylbenzene and xylenes) have historically been detected in the Rochester shale groundwater at the site, as the Rochester shale is naturally petroliferous (Novakowski & Lapcevic, 1988).

ODWQS aesthetic objectives for TDS, hardness, chloride, sodium, sulphate, organic nitrogen, iron, and manganese are naturally exceeded at the monitoring wells screened in this formation. The ODWQS are also naturally exceeded with respect to nitrate, dissolved organic carbon (DOC), arsenic, boron, chromium and lead concentrations on isolated occasions.

As shown in **Table 6** and **Table 8**, the average concentrations in the Rochester shale perimeter monitoring wells during the baseline EA period were similar to those from the historic period. Also, the average concentrations in the periphery monitoring wells during the baseline EA period were generally within the range of the historic results, as shown in **Table 7** and **Table 9**.

The Rochester shale groundwater quality in the perimeter monitoring wells is generally similar to that in the periphery wells; though differences in mineralization are observed. These differences are related to the presence of “brine” versus “dilute brine” Rochester shale groundwater quality. The “brine” groundwater type (typically associate with TDS concentrations greater than 35,000 mg/L) is observed in the deeper Rochester shale, further removed from the Escarpment. Approximately half of the periphery monitoring well locations are close to the Escarpment and exhibit Rochester shale groundwater quality associated with a dilute brine, while the majority of the perimeter well locations exhibit a brine groundwater quality signature.

As shown on **Figure 4-22**, the Rochester shale perimeter and periphery monitoring wells generally plot close together within the Rochester shale field. The exceptions are groundwater quality at perimeter well 77-4, and periphery wells 76-4, 81-2 and 23-1R which plot toward or within the meteoric water field. Each of these monitoring wells are located closer to the Niagara Escarpment and are expected to receive more infiltration owing to the natural fracturing closer to the Escarpment. The wells that plot closest to the edge of the trilinear diamond within the natural Rochester field generally exhibit “brine” type groundwater quality.

As noted above, concentrations of BTEX parameters (benzene, toluene, ethylbenzene and xylenes) have historically been detected in the Rochester shale groundwater within the LSA and RSA. During the baseline EA monitoring period, benzene and toluene were detected at perimeter and periphery monitoring wells 17-1R, 47-1R, 75-2, 75-3, 76-2, 76-3, 76-4, 77-2, 77-3, 77-4, 78-2, 78-3, 79-1, 79-2, 80-1, and 80-2, while toluene was detected at 81-1 in June 2025. These results are consistent with historic data and are consistent with the naturally petroliferous nature of the Rochester shale groundwater.

4.5.3 Irondequoit Aquifer

Groundwater in the Irondequoit Formation limestone is not suitable as a drinking water source due to the poor quality of the groundwater. The natural groundwater quality in the Irondequoit aquifer is less mineralized than the quality in the overlying Rochester shale; but is typically considered non-potable owing to its high mineralization. Also, groundwater in this unit is considered to be naturally petroliferous (Novakowski & Lapcevic, 1988).

The ODWQS aesthetic objectives for TDS, chloride, sodium, sulphate, organic nitrogen and manganese are naturally exceeded at the monitoring wells screened in this formation. The ODWQS are also naturally exceeded with respect to arsenic, boron and iron on isolated occasions. As shown in **Table 6** and **Table 8**, the average concentrations in the perimeter monitoring wells in the Irondequoit limestone during the baseline EA period were generally similar or lower than those during the historic period. It is noted that the baseline EA dataset for the Irondequoit limestone perimeter monitoring wells is limited compared to the historic range. Also, the only periphery monitoring well, 76-1, does not have any historic data.

In the Irondequoit limestone periphery monitoring wells, the average concentrations of TDS, chloride, sulphate, sodium, iron and manganese naturally exceeded the ODWQS as shown in **Table 7**. There are no historic Irondequoit limestone periphery monitoring wells included in the dataset shown in **Table 9**.

As shown on **Figure 4-23**, the Irondequoit limestone perimeter and periphery monitoring wells plot generally close together within the Rochester shale field. The exception is water quality at periphery well 76-1, near the Escarpment, which plots in the Lockport dolostone field. This is expected given its location near the Escarpment.

During the baseline EA monitoring period, trace detections of benzene at 40-1R (June 2025), and 67-1 (March 2025), as well as benzene and toluene at 75-1 and 77-1 were observed. As noted above, groundwater in the Irondequoit limestone is considered to be naturally petroliferous (Novakowski & Lapcevic, 1988).

4.5.4 Groundwater Quality Below the East Landfill and within the GWCS

Four liner monitoring stations, identified as MM1, MM2, MM3 and MM4, were installed within the footprint of the East Landfill. The liner monitoring stations provide water level and quality information below the liner (MM#-1 and MM#-2 monitors), and leachate level and quality information in the granular blanket above the landfill liner (MM#-3 monitors). The deep sub-liner monitoring wells MM1-1, MM2-1 and MM3-1 are completed about 7 to 10 m into the Rochester shale, below the old quarry floor, while MM1-2, MM2-2, MM3-2 and MM4-2 are installed in the shallow shale immediately below the clay liner.

The GWCS collects groundwater from beneath the East Landfill and South Landfill Phase 1, as well as from the Rochester shale below the current Southeast Quarry, as noted previously. Manhole locations MHC2a and MHC2g are sampled as part of the ongoing annual monitoring programs to provide water quality information in the GWCS.

The sub-liner monitoring stations and GWCS manhole locations are shown on **Figure 4-2**. Water quality data for the sub-liner monitors and the GWCS manholes from 2009 to 2026 are presented in **Table G-3**, **Appendix G**.

The water quality signatures for MHC2a and MHC2g and sub-liner monitors are presented in **Figure 4-24.** Water quality within the GWCS is typical of a mixture of Lockport, DeCew and Rochester shale groundwater with minor mixing of meteoric or surface water infiltrating through the open quarry floor. The ionic signatures for the sub-liner monitors plot within the Rochester shale field, as expected. Leachate quality influences are not observed in the GWCS and sub-liner monitors below the East Landfill.

5 CONCLUSIONS

The SSA and LSA are situated just south of the Niagara Escarpment in an area characterized by low topographic relief and poorly drained soils. A relatively thin layer of lacustrine clayey silt covers the area and is underlain by a glacial silt till. The overburden thickness generally increases to the south within the LSA and RSA, away from the Escarpment. Beneath the overburden are various bedrock units.

The Lockport Formation dolostone is the uppermost bedrock unit in the Study Areas and has been quarried historically at the Campus. The unit thickness ranges from about 3 m to 15 m and is relatively porous due to the presence of natural fractures, vugs, larger cavities, and occasional fossiliferous zones. The underlying DeCew dolostone is an argillaceous (shaley) dolostone that is up to 4 m thick and tends to become increasingly shaley with depth. The Rochester Formation underlies the DeCew dolostone and consists of thin to medium bedded shale and thin beds of dolomitic shale with occasional isolated thin beds of dolostone. The Rochester shale bedrock ranges from 14 m to 17 m thick. These bedrock units extend regionally to the south but are limited to the north of the Site by the Niagara Escarpment.

The bedrock units below the Rochester Formation, including the Irondequoit Formation limestone, and the deeper bedrock formations of the Clinton and Cataract Groups are not exposed through the historic or current quarry operations at the Campus.

The groundwater setting within the LSA consists of the upper overburden aquitard, the Lockport Formation dolostone bedrock aquifer, the lower aquitard associated with the DeCew and Rochester Formations, and the underlying Irondequoit Formation semi-pervious aquifer. The Rochester shale is considered a natural barrier separating groundwater movement between the upper Lockport dolostone unit and the underlying Irondequoit limestone and Reynales dolostone units.

The design of the South and East Landfills and presence of the GWCS maintains groundwater flow patterns similar to the conditions at the former quarries prior to landfilling, which is a natural sink or drawdown effect in the dolostone bedrock aquifer and shale bedrock aquitard. This creates a continuous inward gradient (i.e., hydraulic trap) surrounding the South and East Landfills and the Southeast Quarry, whereby groundwater within the dolostone aquifer and shale aquitard below the Campus does not flow off-site.

Within the RSA and LSA, the glaciolacustrine clay and silt overburden deposits act as an aquitard and are not a significant source of potable water owing to its low permeability and poor yields.

Within the LSA, groundwater in the Lockport dolostone aquifer and lower aquitard associated with the DeCew and Rochester shale flows inward toward the SSA (current Southeast Quarry), South Landfill and East Landfill due to the drawdown effect of the GWCS and quarry. At the SSA, groundwater discharges slowly into the quarry through the north, east and south rock faces toward the quarry sump. Around the perimeter of the South Landfill and East Landfill, which are sealed by clay sidewalls, groundwater moves downward along the buried vertical quarry faces and into the weathered shale floor. The groundwater then moves beneath the South Landfill and East Landfill clay liners and mixes with the shallow shale groundwater before draining to the GWCS. The water level response within the shallow Rochester shale suggests a strong hydraulic influence from the GWCS that maintains a continuous inward gradient whereby groundwater within the dolostone aquifer and shale aquitard below the Campus does not flow off-site.

Groundwater in the Irondequoit aquifer in the LSA typically flows west to southwest or west to northwest; but the flow direction is seasonally influenced by the draining and filling of the Welland Canal. The groundwater potentiometric head in the Irondequoit aquifer is lower than the overlying lower aquitard piezometric surface; as such, a downward hydraulic gradient exists between these two units.

A significant number of parcels within the LSA are connected to the municipal water supply, and a large proportion of the un-serviced lands are either (i) owned by Walker, (ii) vacant with no associated street address, or (iii) within the hydro corridor right-of-way to the southeast of the SSA or the Niagara Escarpment Parks and Open Spaces System to the west of the SSA. A total of 97 MECP water well records plot within the LSA, of which 36 are reported as domestic supply, while the remainder are for use as livestock / irrigation, industrial / commercial, or monitoring wells / test holes. Based on the residential water well survey, there are four (4) residents within the LSA that use their well as the sole water source for domestic purposes. Each of these residences are included in Walker's current residential well monitoring program for the Southeast Quarry, and the closest wells are approximately 500 m south and northeast of the SSA, respectively.

Groundwater quality within the Lockport dolostone is influenced by the infiltration of precipitation through the overlying overburden, which results in less saline and less mineralized groundwater than in the deeper, more isolated bedrock units. The natural groundwater quality in the Lockport dolostone ranges from potable to non-potable, with increasing mineralization and, therefore, decreasing potability, with increasing depth.

The Rochester shale was formed in a saline marine depositional environment, which resulted in naturally saline and highly mineralized groundwater within this formation. The Rochester shale groundwater is considered a brine, which is more mineralized than modern seawater, to dilute brine. The salinity generally increases with both depth within the formation and distance from the Niagara Escarpment. Natural fractures in the shale near the Niagara Escarpment cause mixing with groundwater from overlying units, which decreases the salinity. Trace concentrations of BTEX parameters (benzene, toluene, ethylbenzene and xylenes) have historically been detected in the Rochester shale groundwater at the site, as the Rochester shale is naturally petroliferous.

Groundwater in the Irondequoit Formation limestone is not suitable as a drinking water source due to the poor quality of the groundwater. The natural groundwater quality in the Irondequoit aquifer is less mineralized than the quality in the overlying Rochester shale; but is typically considered non-potable owing to its high mineralization. Groundwater in this unit is also considered to be naturally petroliferous.

Water quality in the GWCS and sub-liner monitors below the East Landfill do not exhibit any leachate influences. Water quality within the GWCS is typical of a mixture of Lockport, DeCew and Rochester shale groundwater with minor mixing of meteoric or surface water infiltrating through the open quarry floor. Groundwater quality in the sub-liner monitors is consistent with that of the Rochester shale, as expected.

6 REFERENCES

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Signature Page

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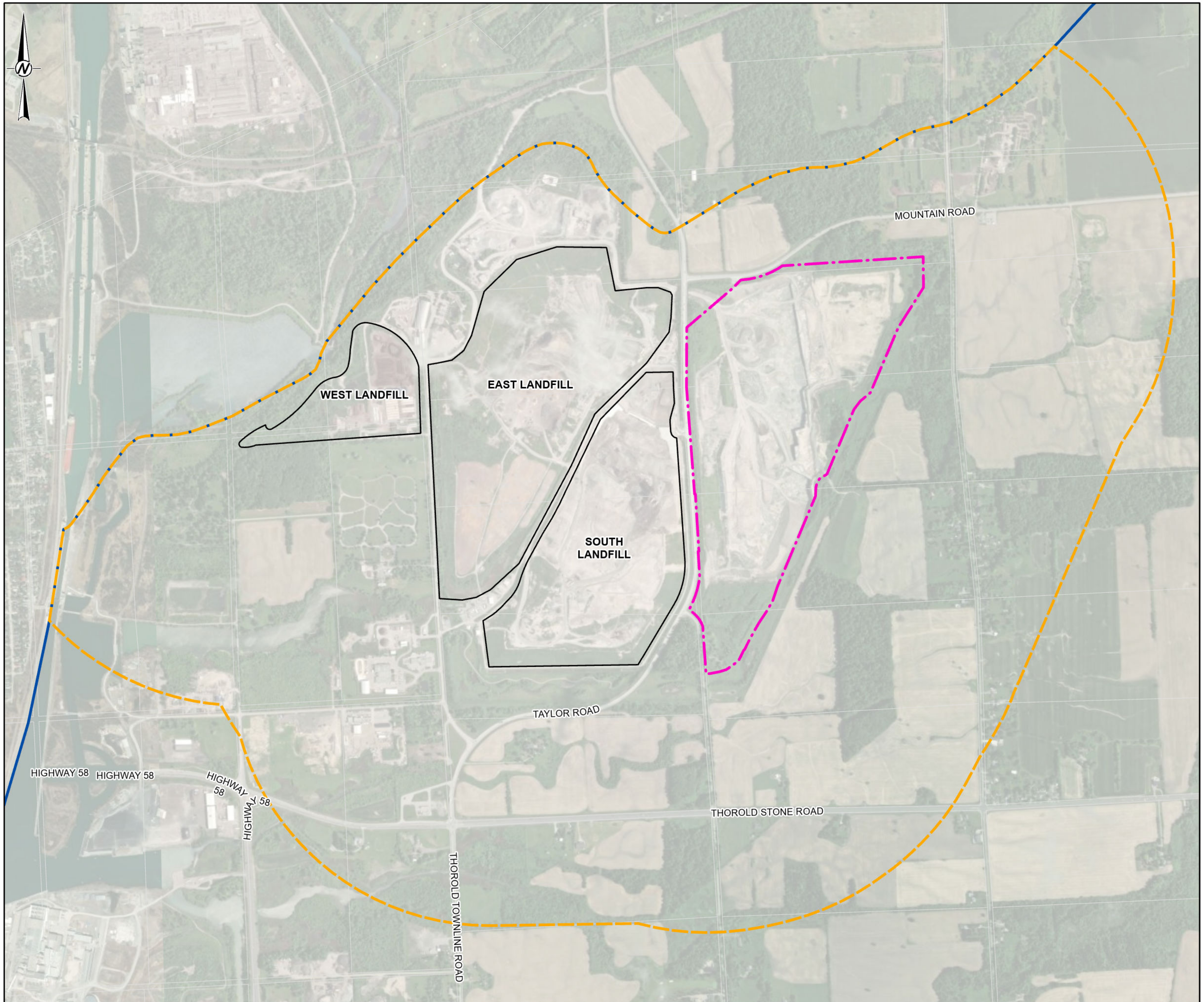
FIGURES



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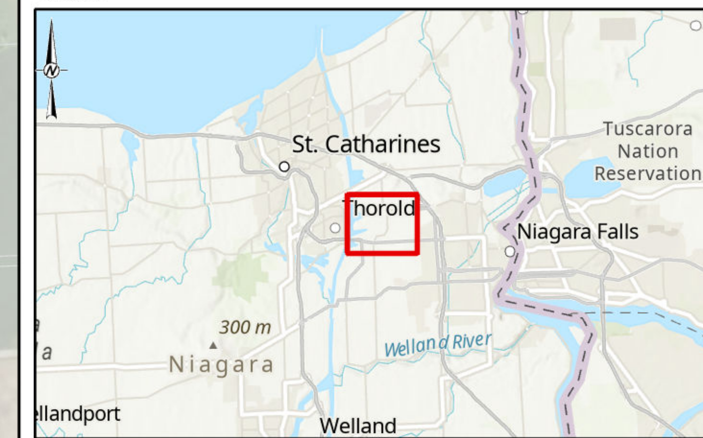

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LEGEND

- PROPOSED LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- PROPOSED REGIONAL STUDY AREA (RSA)
- SITE STUDY AREA (SSA)
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:15,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
GEOLOGY AND HYDROGEOLOGY STUDY AREA

CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	2-1

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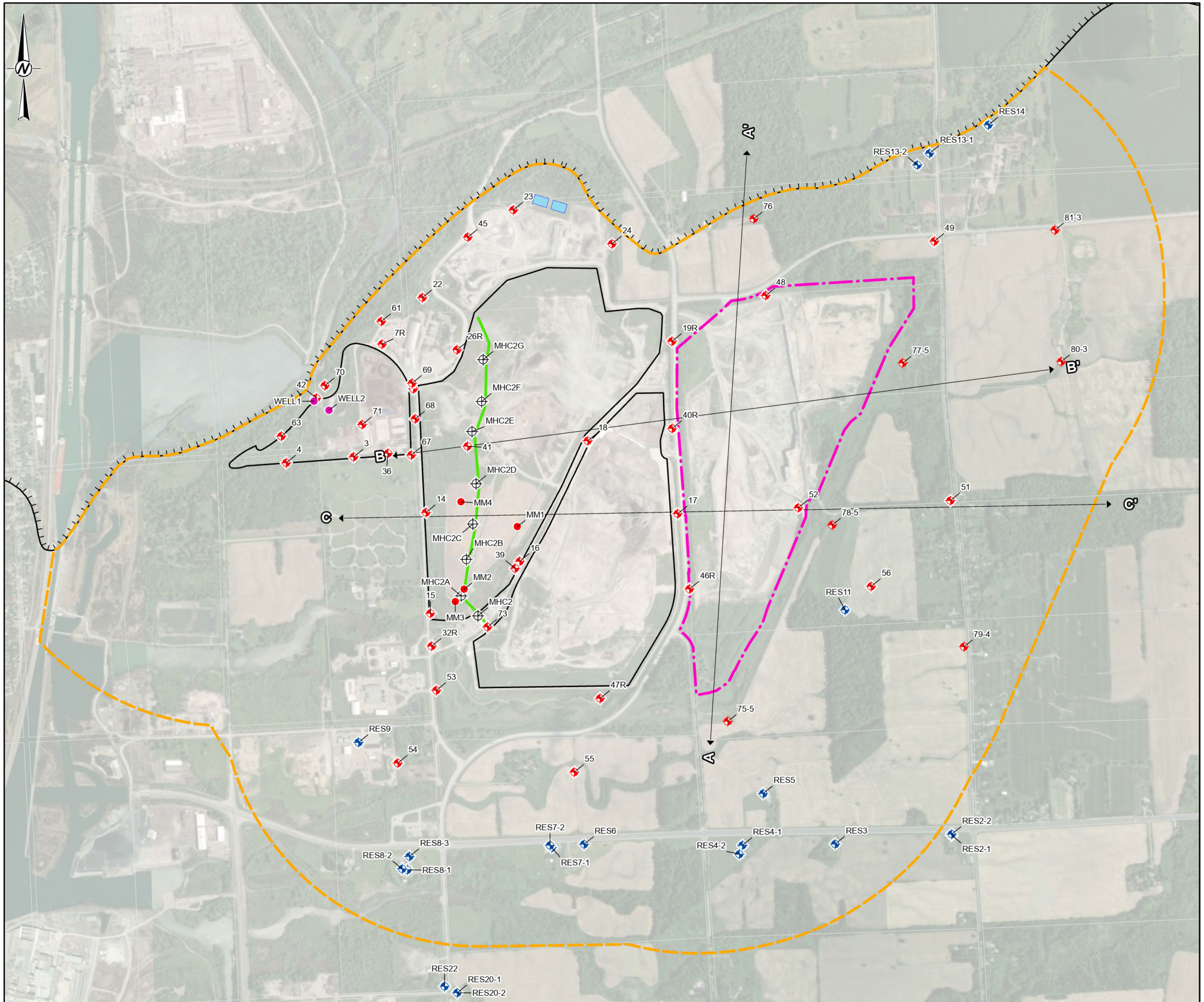

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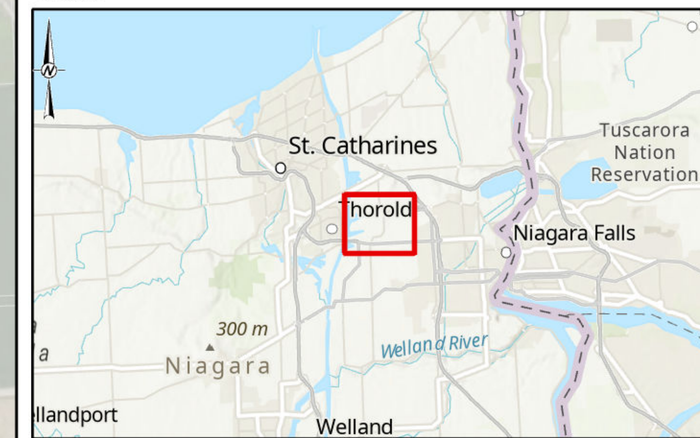

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LEGEND

- MONITORING WELL NEST
- MANHOLE
- RESIDENTIAL SUPPLY WELL
- EAST LANDFILL LINER WELL NEST
- WEST LANDFILL LEACHATE PUMPING WELL
- APPROXIMATE LOCKPORT SCARP
- CROSS SECTIONS
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- PROPOSED LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- SITE STUDY AREA (SSA)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:15,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
LOCAL STUDY AREA

CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-1

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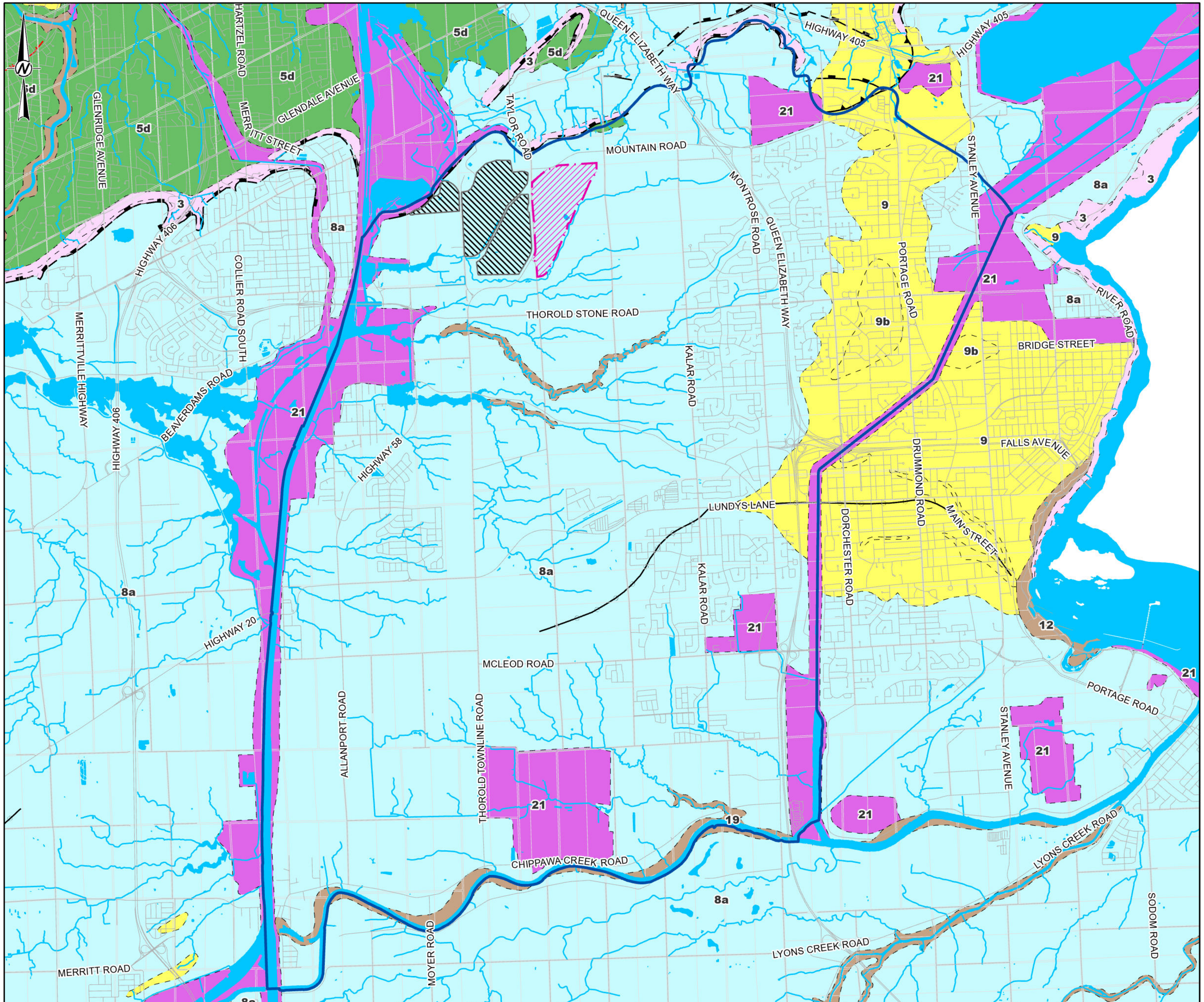

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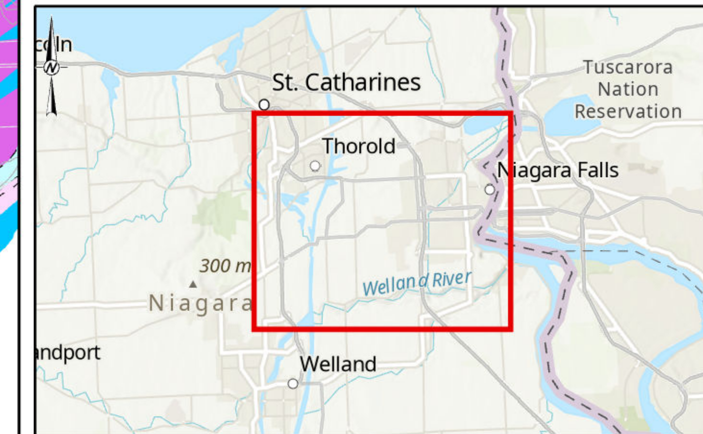

SCALE: 1:500,000

LEGEND

- PROPOSED REGIONAL STUDY AREA (RSA)
- SITE STUDY AREA (SSA)
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

SURFICIAL GEOLOGY (OGS, 2003)

- BEDROCK ESCARPMENT
- ICE-CONTACT SLOPE
- MORAINE, MINOR
- SHORE BLUFF OR SCARP
- GEOLOGIC CONTACT, APPROXIMATE / ASSUMED
- 3: PALEOZOIC BEDROCK
- 5D: GLACIOLACUSTRINE-DERIVED SILTY TO CLAYEY TILL
- 8A: MASSIVE-WELL LAMINATED
- 9: COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 9B: LITTORAL-FORESHORE DEPOSITS
- 12: OLDER ALLUVIAL DEPOSITS
- 19: MODERN ALLUVIAL DEPOSITS
- 21: ANTHROPOGENIC DEPOSITS

DRAFT

0 500 1,000 2,000

1:55,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
SURFICIAL GEOLOGY

CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-2

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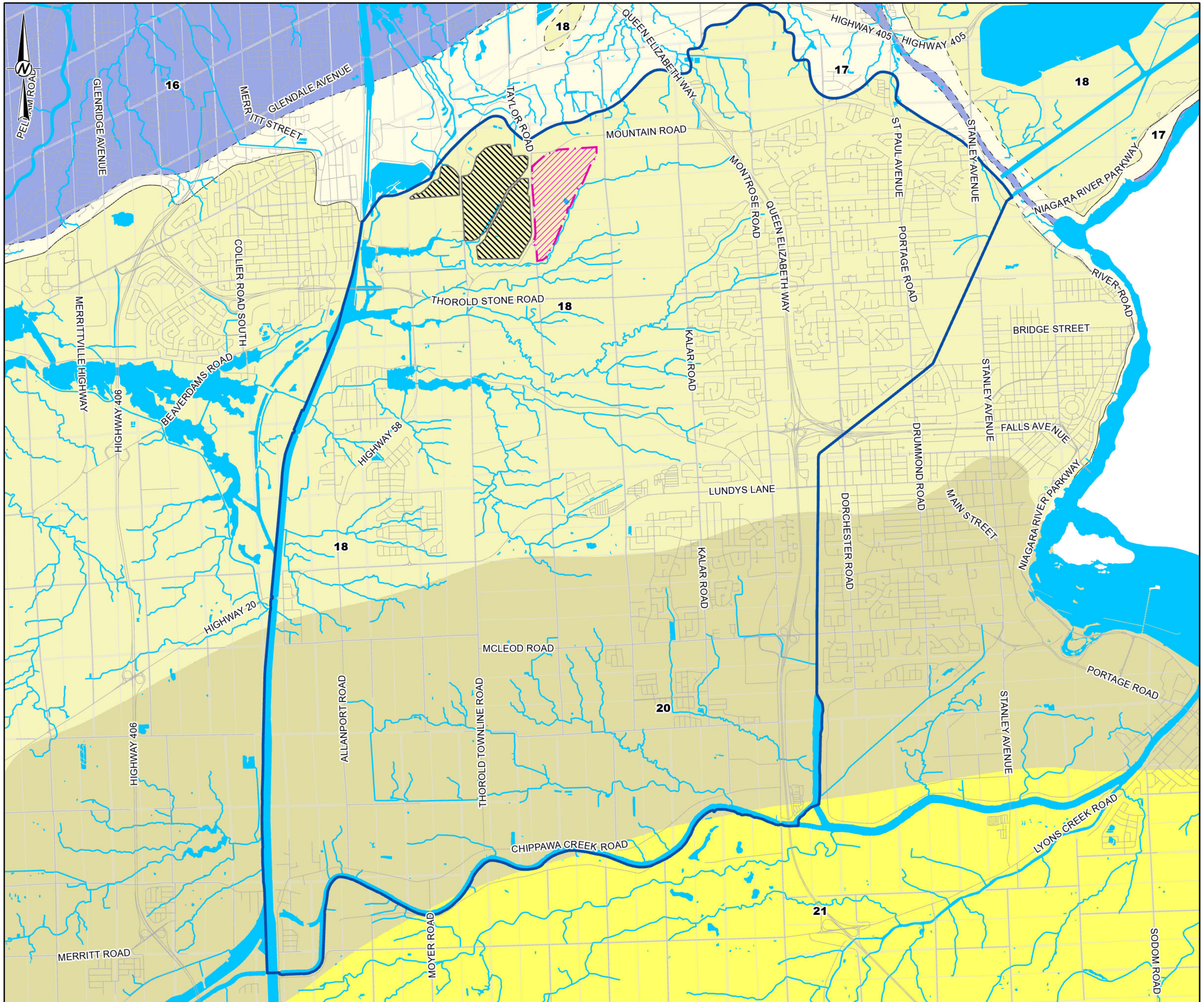

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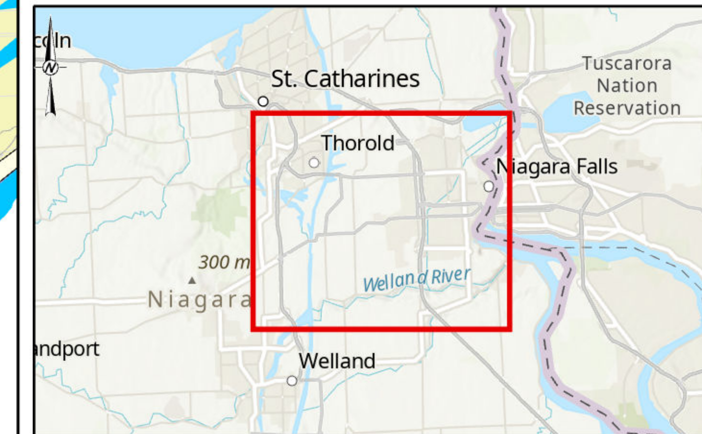

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LEGEND

PROPOSED REGIONAL STUDY AREA (RSA)

SITE STUDY AREA (SSA)

WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

PALEOZOIC BEDROCK GEOLOGY (OGS, 2007)

CONTACT, APPROXIMATE

CONTACT, INTERPRETED

CONTACT, OBSERVED

UPPER SILURIAN

21: SALINA FORMATION: ARGILLACEOUS DOLOSTONE, GYPSUM SALT (AT DEPTH)

20: GUELPH FORMATION: DOLOSTONE: SUCROSIC, FOSSILIFEROUS, LOCALLY BIOHERMAL

LOWER SILURIAN

18: LOCKPORT FORMATION: DOLOSTONE, LIMESTONE, ARGILLACEOUS DOLOSTONE; LOCALLY CHERTY; INCLUDES BITUMINOUS (ERAMOSA MEMBER)

17: CLINTON AND CATARACT GROUPS: SHALE, SANDSTONE, DOLOSTONE, LIMESTONE UNITS

UPPER ORDOVICIAN

16: QUEENSTON FORMATION: SHALE, SILTSTONE, MINOR LIMESTONE AND SANDSTONE

DRAFT

0 500 1,000 2,000

1:55,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
PALEOZOIC BEDROCK GEOLOGY

CONSULTANT

wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-3

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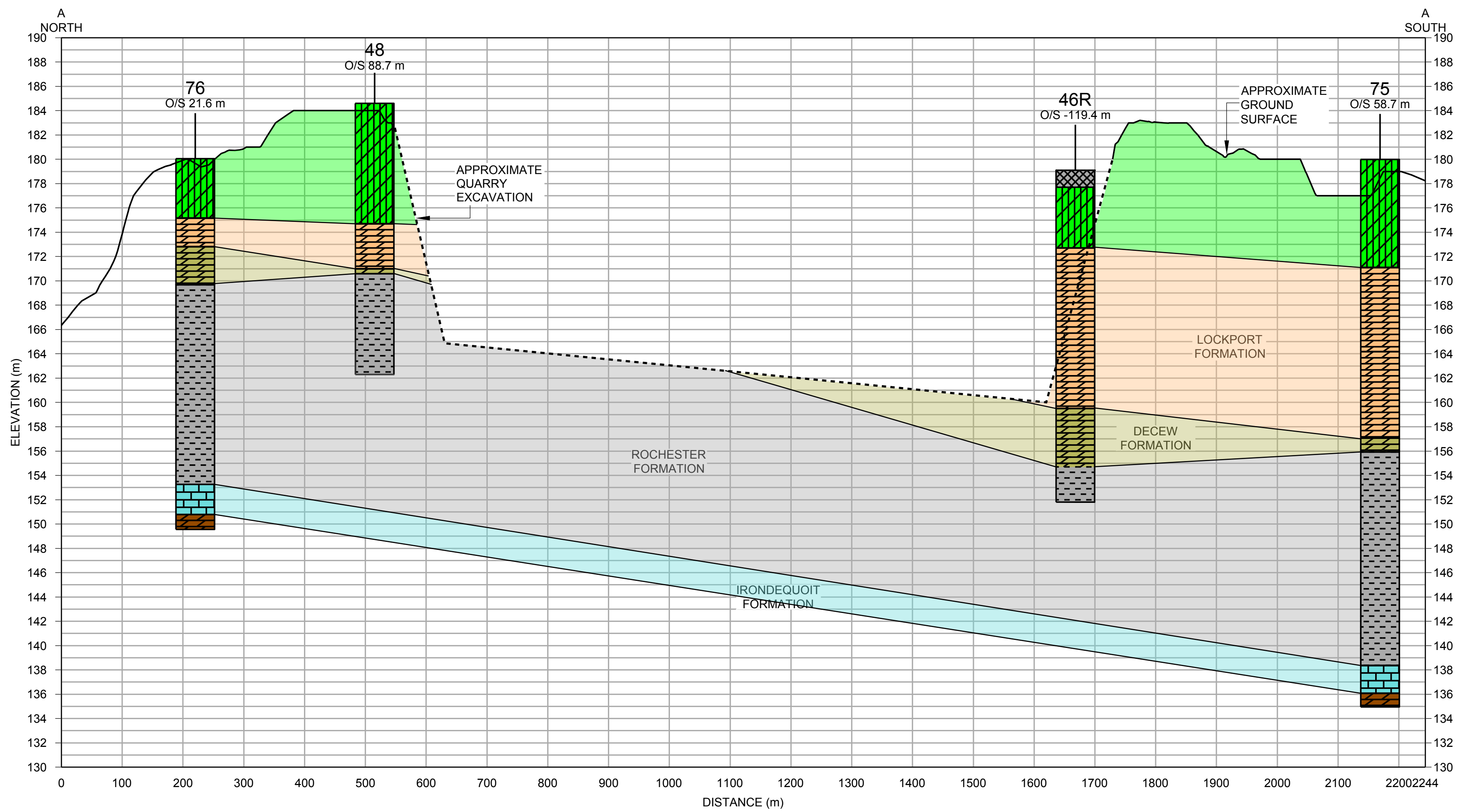

LEGEND

APPROXIMATE GROUND SURFACE

STRATIGRAPHY

- FILL
- OVERBURDEN
- LOCKPORT DOLOSTONE
- DECEW DOLOSTONE
- ROCHESTER SHALE
- IRONDEQUOIT LIMESTONE
- REYNALES DOLOSTONE

INSTALLATION DETAILS

BH — BOREHOLE ID
O/S -0.5 m — OFFSET FROM CROSS-SECTION LINE
+ EAST OF CROSS-SECTION LINE
- WEST OF CROSS-SECTION LINE
BOREHOLE STRATA SYMBOL

NOTE(S)

1. REFER TO FIGURE 4-1 FOR CROSS-SECTION LOCATIONS.

REFERENCE(S)

1. EXISTING GROUND BASED ON UAV DSM SURVEY BY WALKER ON JUNE 12, 2025.

DRAFT

0 10 20
1:500 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY
EXISTING CONDITIONS REPORT

CONSULTANT

YYYY-MM-DD	2026-05-07
DESIGNED	CL
PREPARED	AP
REVIEWED	CL
APPROVED	CL

TITLE
GEOLOGIC CROSS-SECTION A-A'

PROJECT NO.	CONTROL	REV.	FIGURE
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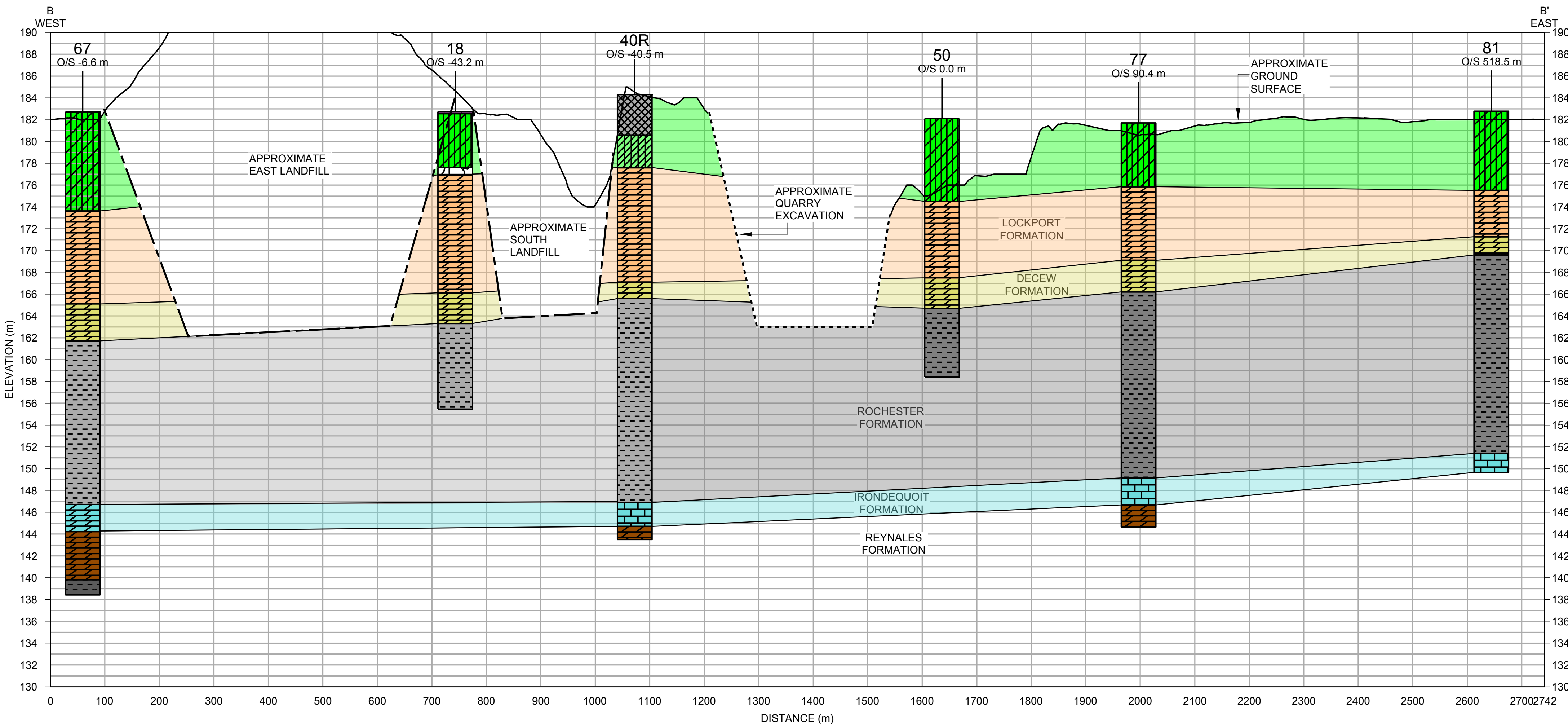

LEGEND

APPROXIMATE GROUND SURFACE

STRATIGRAPHY

- FILL
- OVERBURDEN
- LOCKPORT DOLOSTONE
- DECEW DOLOSTONE
- ROCHESTER SHALE
- IRONDEQUOIT LIMESTONE
- REYNALES DOLOSTONE
- NEAHGA SHALE

INSTALLATION DETAILS

OFFSET FROM CROSS-SECTION LINE
+ EAST OF CROSS-SECTION LINE
- WEST OF CROSS-SECTION LINE

BH
O/S -0.5 m

BOREHOLE ID

BOREHOLE STRATA SYMBOL

NOTE(S)

1. REFER TO FIGURE 4-1 FOR CROSS-SECTION LOCATIONS.

REFERENCE(S)

1. EXISTING GROUND BASED ON UAV DSM SURVEY BY WALKER ON JUNE 12, 2025.

DRAFT

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0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
WALKER ENVIRONMENTAL GROUP

CONSULTANT
wsp

YYYY-MM-DD	2026-05-07
DESIGNED	CL
PREPARED	AP
REVIEWED	CL
APPROVED	CL

PROJECT
GEOLOGY AND HYDROGEOLOGY
EXISTING CONDITIONS REPORT

TITLE
GEOLOGIC CROSS-SECTION B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-5

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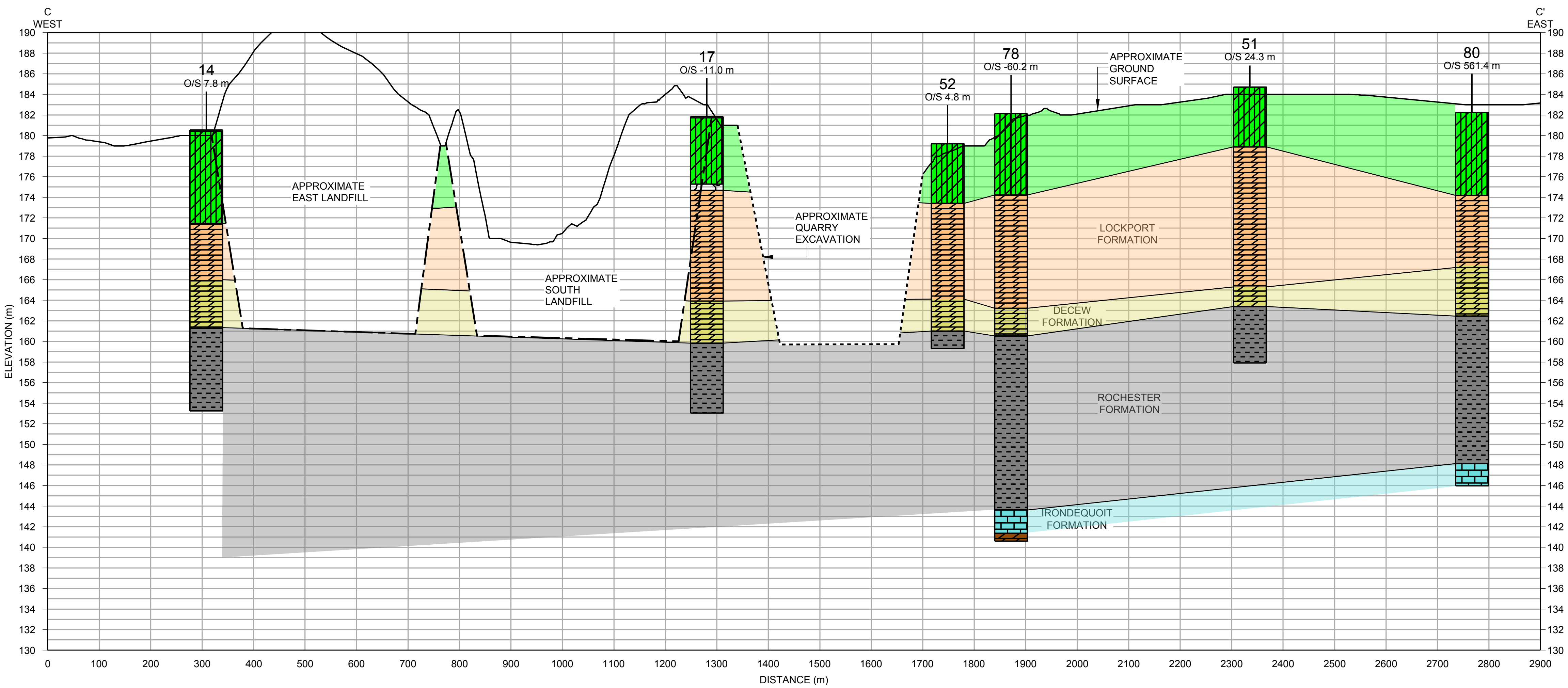


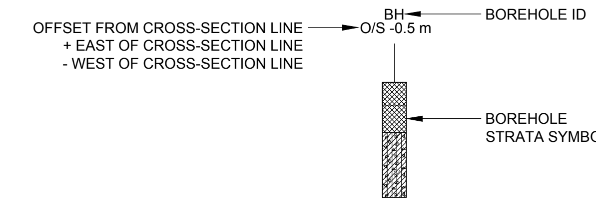
LEGEND

APPROXIMATE GROUND SURFACE

SOIL STRATIGRAPHY

- FILL
- OVERBURDEN
- LOCKPORT DOLOSTONE
- DECEW DOLOSTONE
- ROCHESTER SHALE
- IRONDEQUOIT LIMESTONE
- REYNALES DOLOSTONE

INSTALLATION DETAILS



NOTE(S)

1. REFER TO FIGURE 4-1 FOR CROSS-SECTION LOCATIONS.

REFERENCE(S)

1. EXISTING GROUND BASED ON UAV DSM SURVEY BY WALKER ON JUNE 12, 2025.

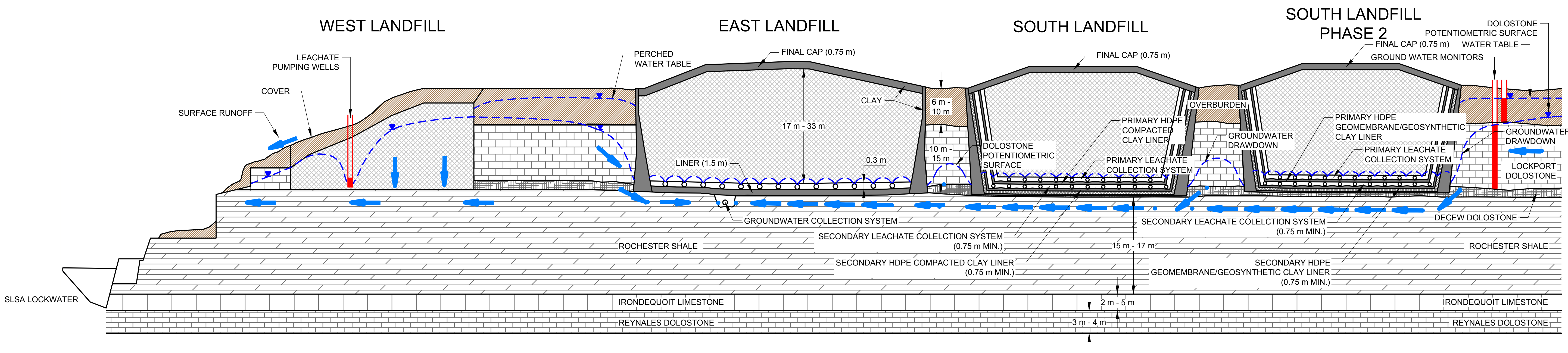
DRAFT

0 10 20
1:500 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT	WALKER ENVIRONMENTAL GROUP
PROJECT	GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT
CONSULTANT	WSP
YYYY-MM-DD	2026-05-07
DESIGNED	CL
PREPARED	AP
REVIEWED	CL
APPROVED	CL
TITLE	GEOLOGIC CROSS-SECTION C-C'
PROJECT NO.	CA0065457.5367
CONTROL	0001
REV.	A
FIGURE	4-6

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



CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY
EXISTING CONDITIONS REPORT

TITLE
CONCEPTUAL CROSS SECTION

CONSULTANT

wsp

YYYY-MM-DD	2026-06-12
DESIGNED	
PREPARED	FC/MK
REVIEWED	FSB
APPROVED	CL

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-7

Path: \\corp.pbwan.net\CA\CAMIS300\CTX_Data\SM\Clients\Walker_Industries\Southeast_Quarry\99_PROJ\CA0065457_5367_Phase2_EA\40_PROD\0001_Existing_Conditions_Report\ | File Name: CA0065457_5367-0001-HS-0004.dwg | Last Edited By: gid_mkeenan Date: 2026-06-12 Time:4:24:45 PM | Printed By: gid_mkeenan Date: 2026-06-12 Time:4:25:16 PM

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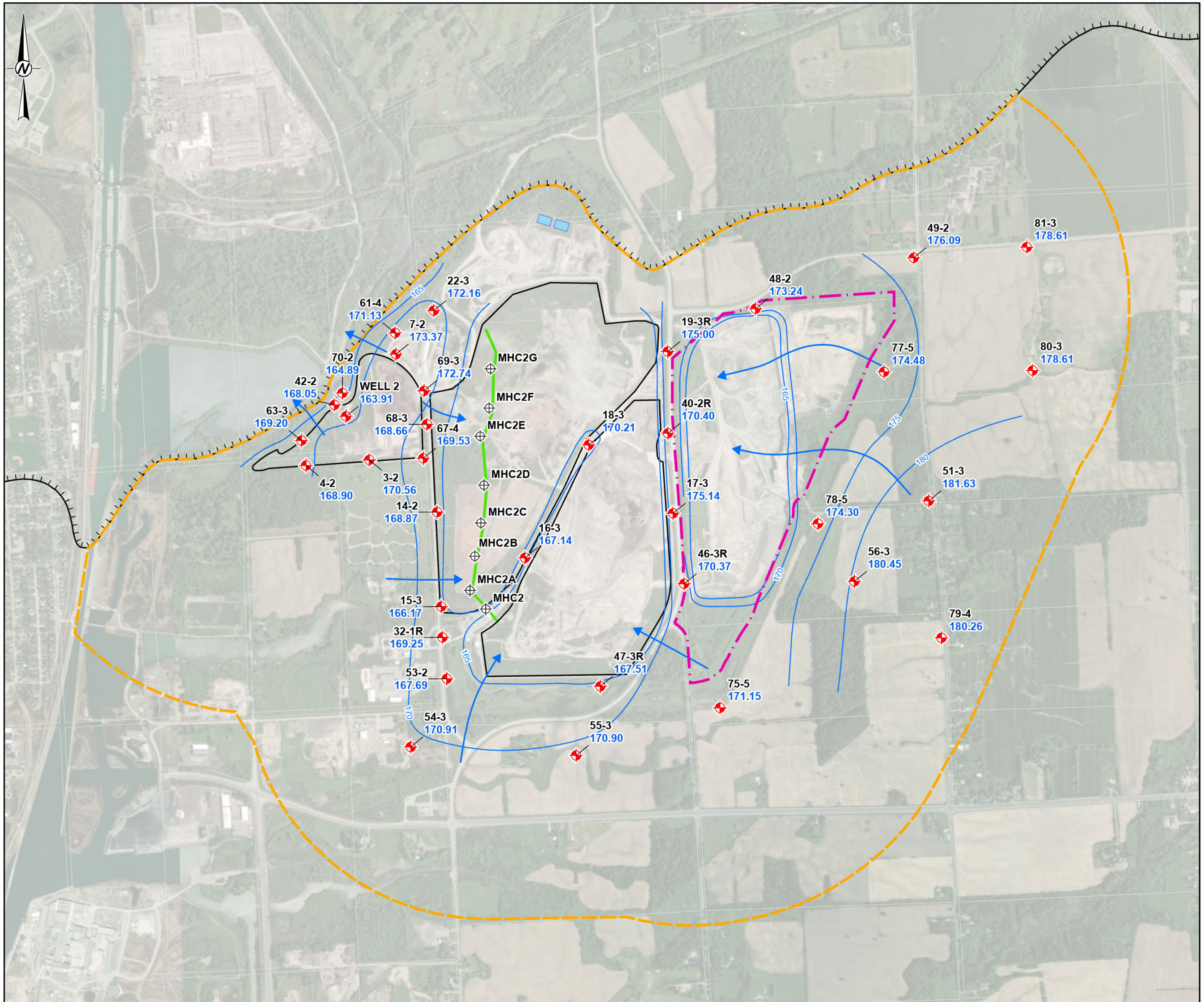
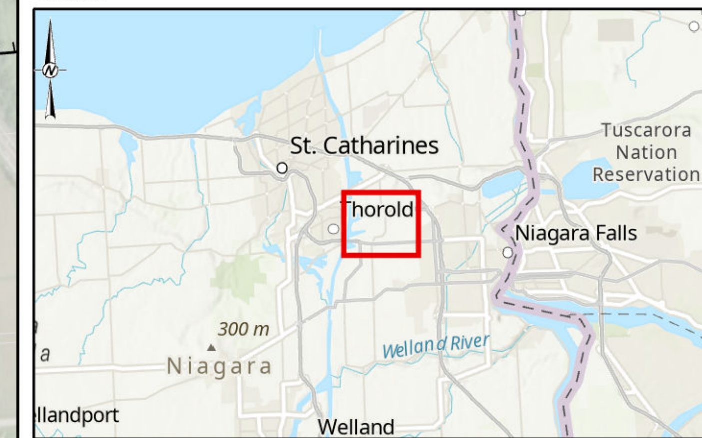
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B





SCALE: 1:500,000

LEGEND

- MANHOLE LOCATION
- MONITORING WELL NEST
- (176.09) POTENTIOMETRIC ELEVATION, JUNE 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWATER FLOW IN LOCKPORT DOLOSTONE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
LOCKPORT DOLOSTONE POTENTIOMETRIC SURFACE - JUNE 2025

CONSULTANT

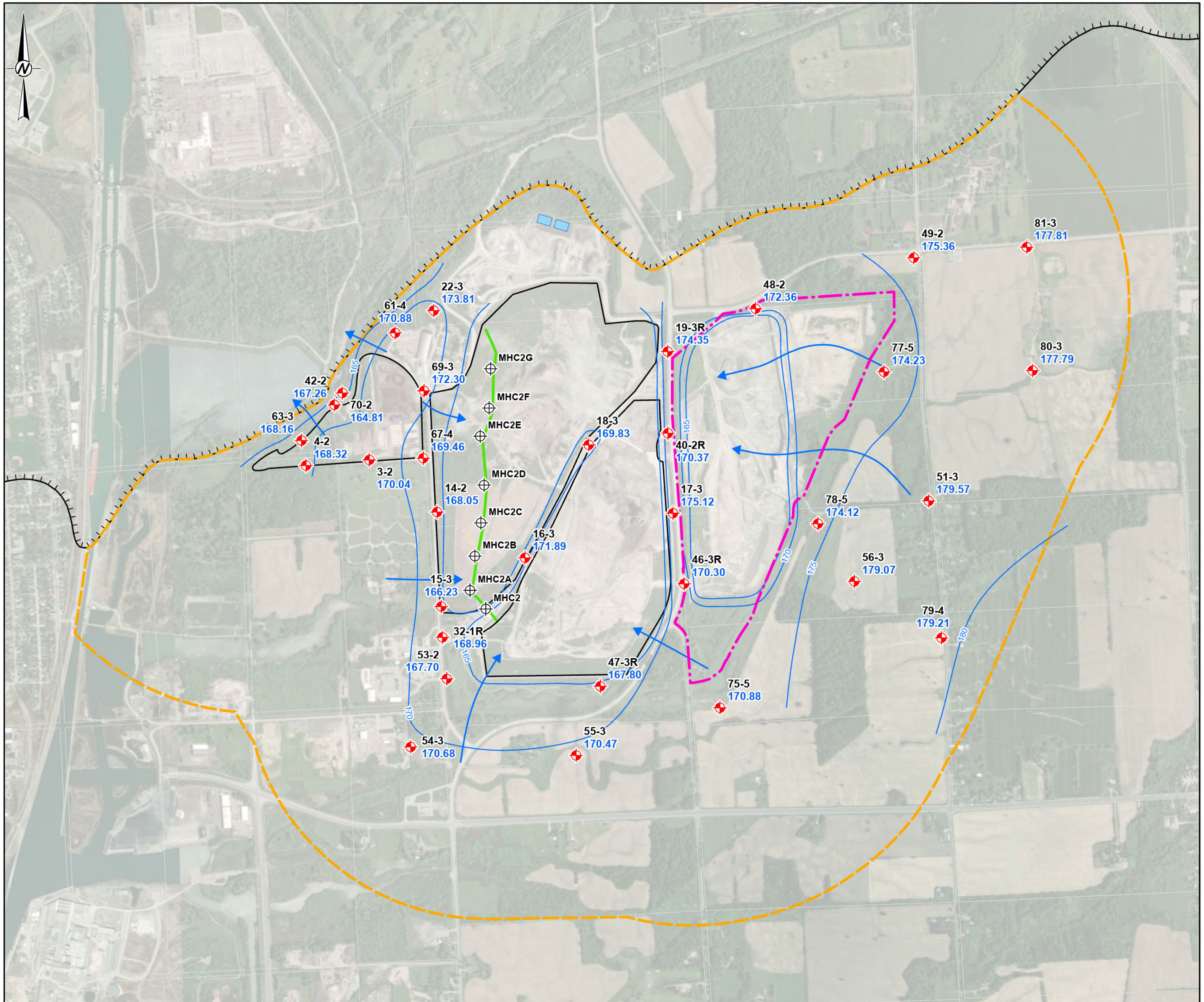
wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-8

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

PATH: S:\Clients\Walker_Industries\Southeast_Quarry\99_PROJ\CA0065457_5367_Phase2_EA\40_PROD\0001_Existing_Conditions_Report\CA0065457_5367-0001-HS-0000\CA0065457_5367-0001-HS-0000.aprx PRINTED ON: AT: 11:04:19 AM



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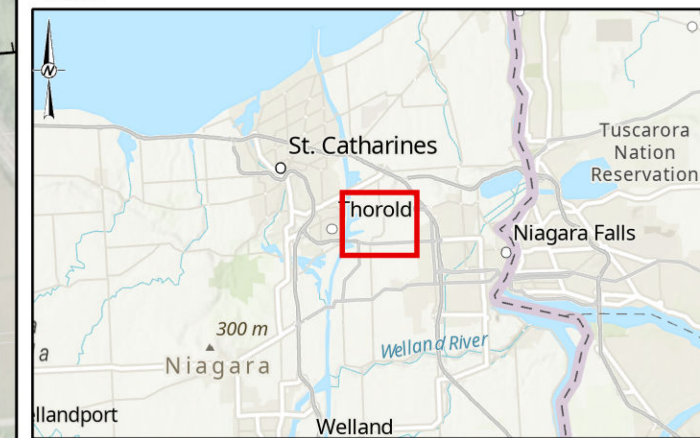


SCALE: 1:500,000

LEGEND

- MANHOLE LOCATION
- MONITORING WELL NEST
- (176.09) POTENTIOMETRIC ELEVATION, SEPTEMBER 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWATER FLOW IN LOCKPORT DOLOSTONE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600
1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

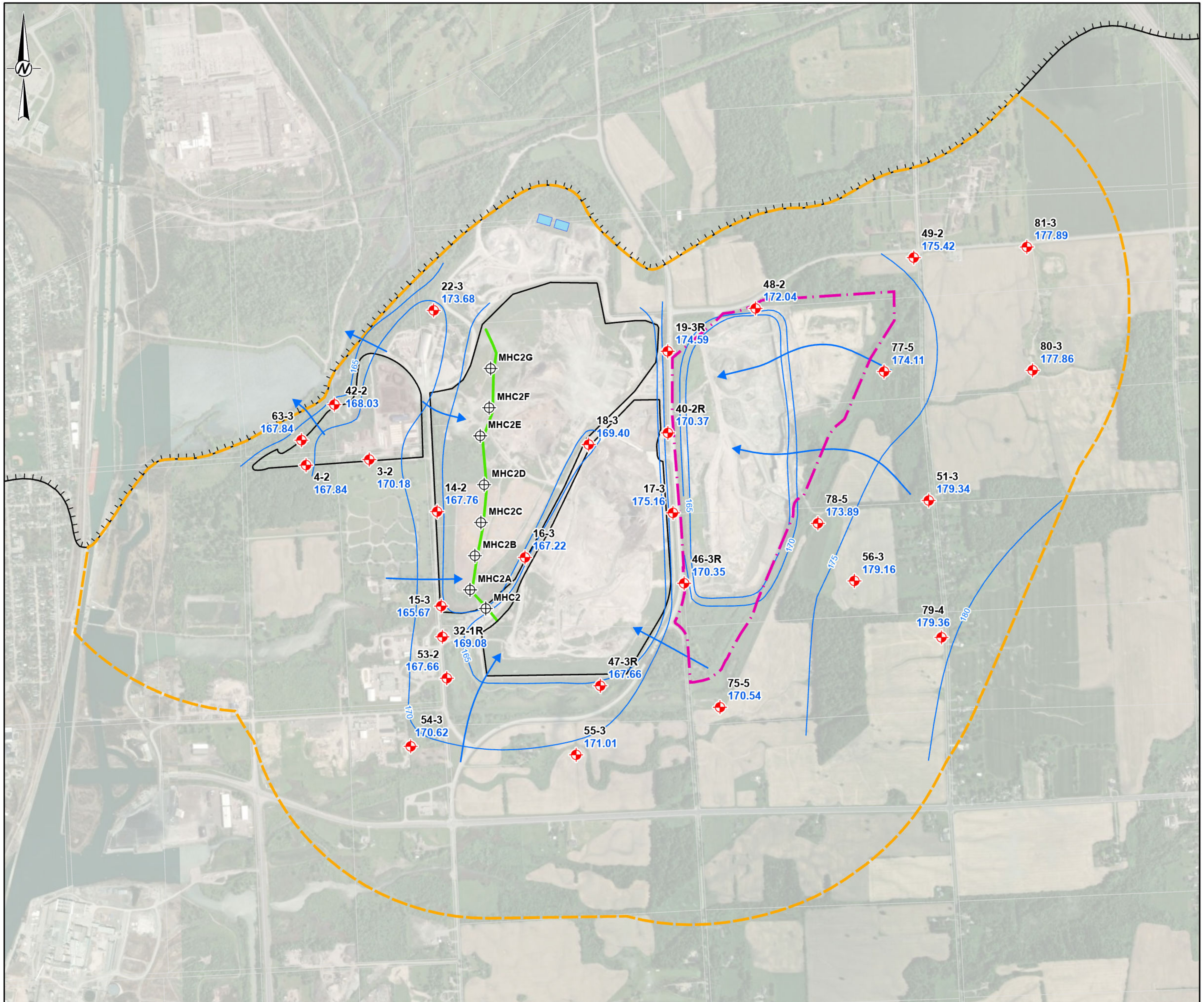
TITLE
LOCKPORT DOLOSTONE POTENTIOMETRIC SURFACE - SEPTEMBER 2025

CONSULTANT
wsp

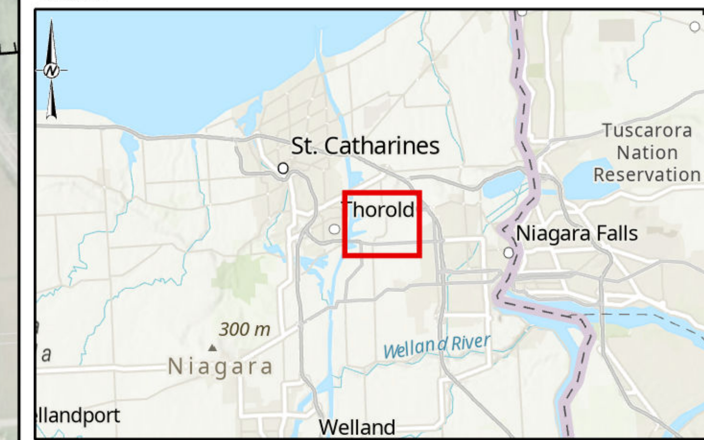
YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-9

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



KEY MAP



SCALE: 1:500,000

LEGEND

- MANHOLE LOCATION
- MONITORING WELL NEST
- (176.09) POTENTIOMETRIC ELEVATION, DECEMBER 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN LOCKPORT DOLOSTONE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
LOCKPORT DOLOSTONE POTENTIOMETRIC SURFACE - DECEMBER 2025

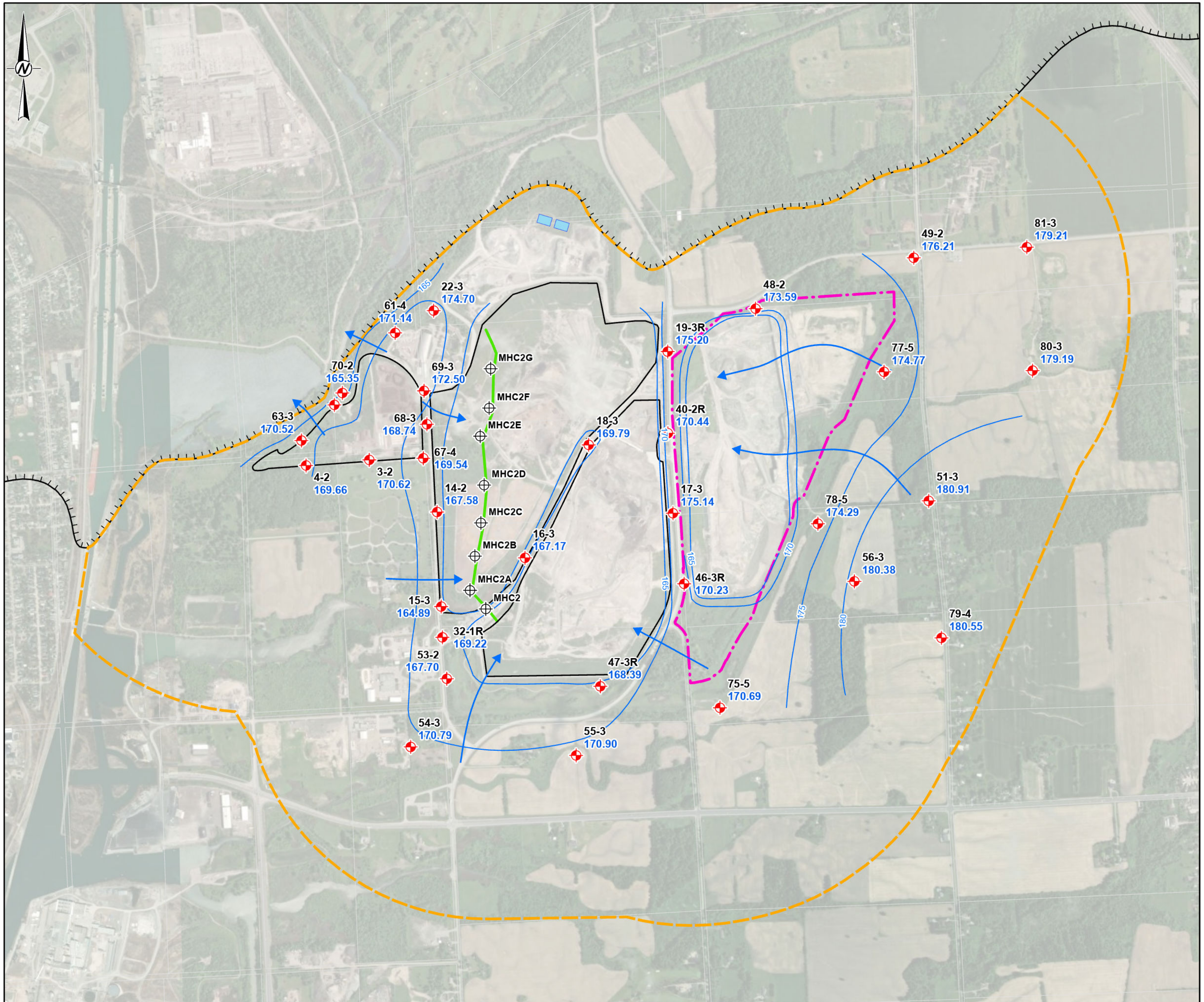
CONSULTANT

wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-10

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



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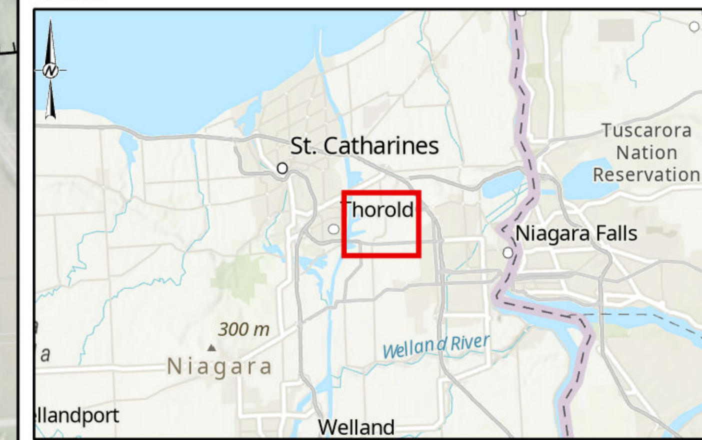

SCALE: 1:500,000

LEGEND

- MANHOLE LOCATION
- MONITORING WELL NEST
- (176.09) POTENTIOMETRIC ELEVATION, MARCH 2026 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN LOCKPORT DOLOSTONE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

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3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

WALKER ENVIRONMENTAL GROUP

PROJECT

GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE

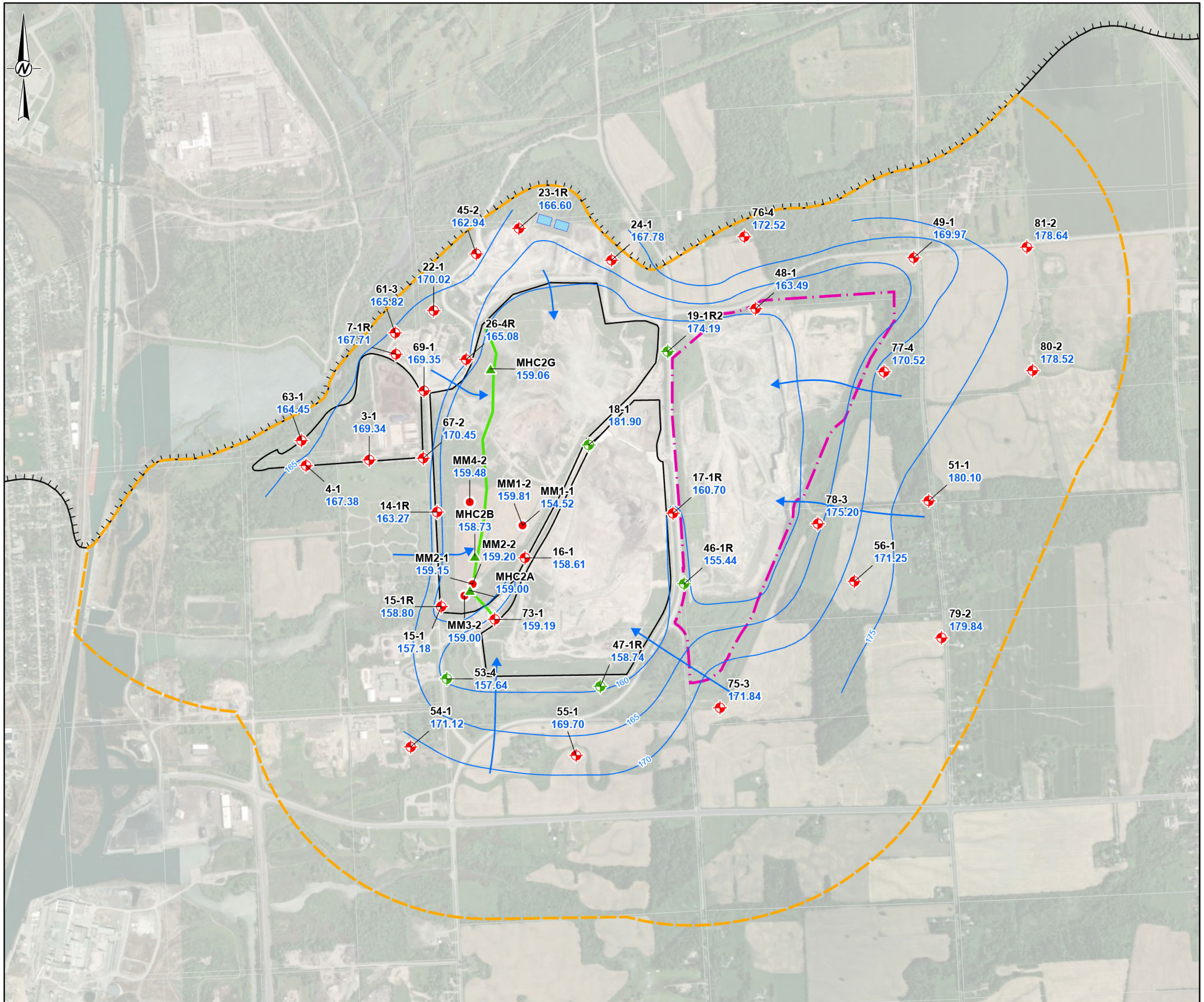
LOCKPORT DOLOSTONE POTENTIOMETRIC SURFACE - MARCH 2026

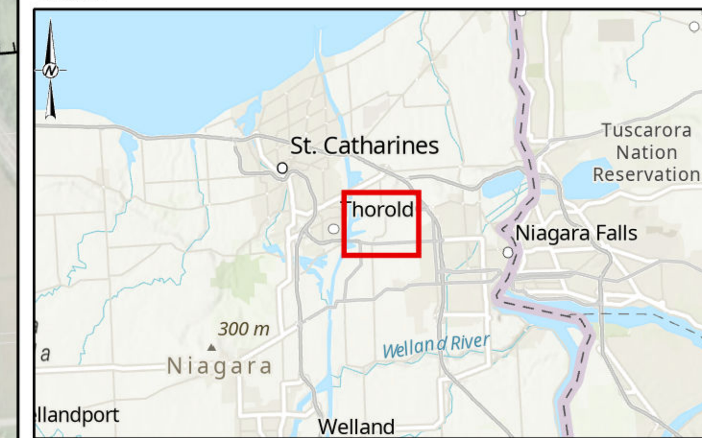
CONSULTANT	YYYY-MM-DD	2026-06-12
wsp	DESIGNED	----
	PREPARED	JM
	REVIEWED	----
	APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-11

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

25mm





SCALE: 1:500,000

LEGEND

- MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- MONITORING POINT LOCATION AND DESIGNATION
- SOUTH LANDFILL ECA DESIGNATED SLOW RECOVERY WELLS (SR) - MONITORING WELL MAY BE RECOVERING TO STATIC WATER LEVEL FOLLOWING SAMPLING EVENT
- LANDFILL LINER MONITORING LOCATION AND DESIGNATION
- GWCS MANHOLE LOCATION AND DESIGNATION
- (163.49) POTENTIOMETRIC ELEVATION, JUNE 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN ROCHESTER SHALE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600
1:16,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
ROCHESTER SHALE POTENTIOMETRIC SURFACE – JUNE 2025

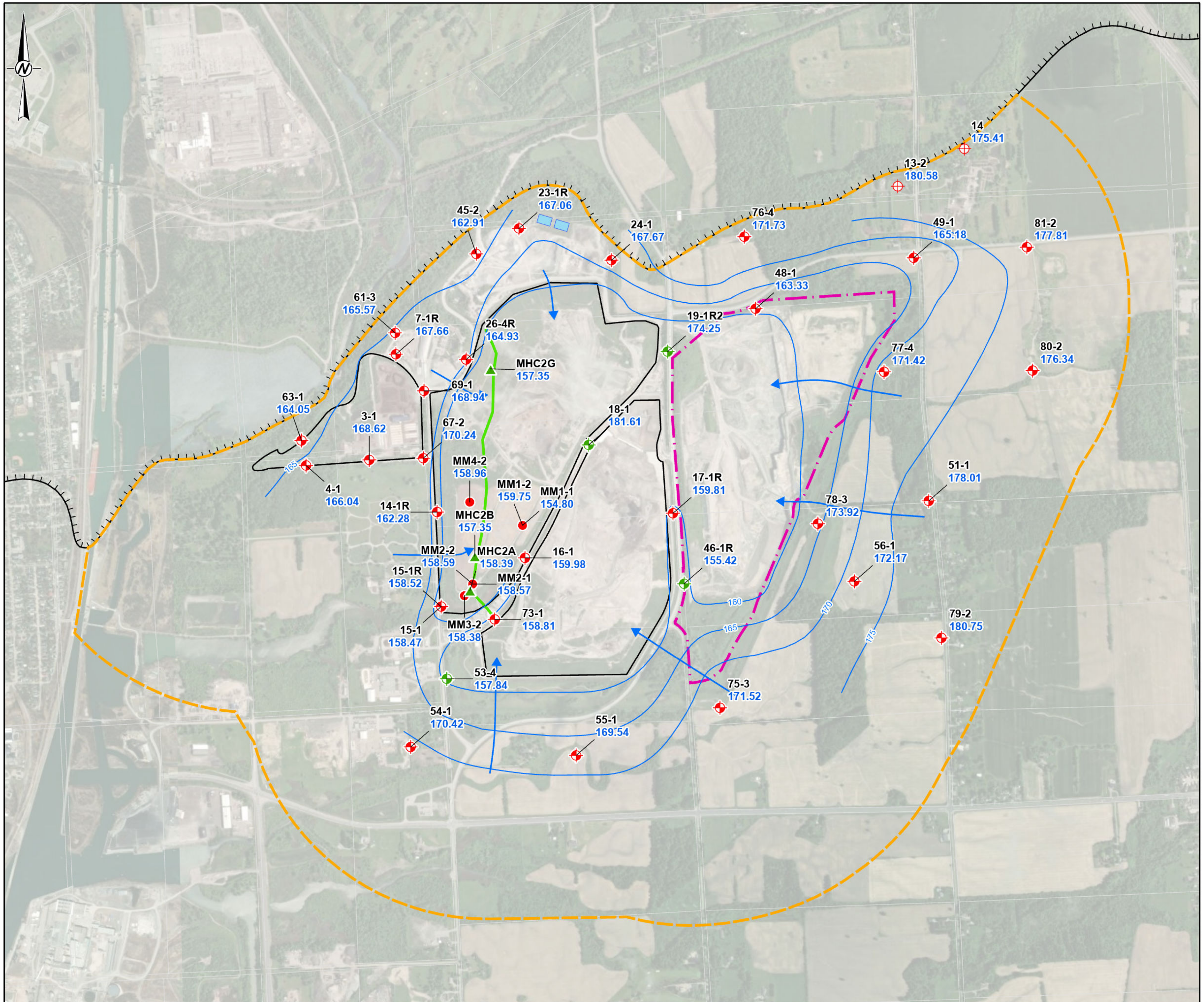
CONSULTANT: wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

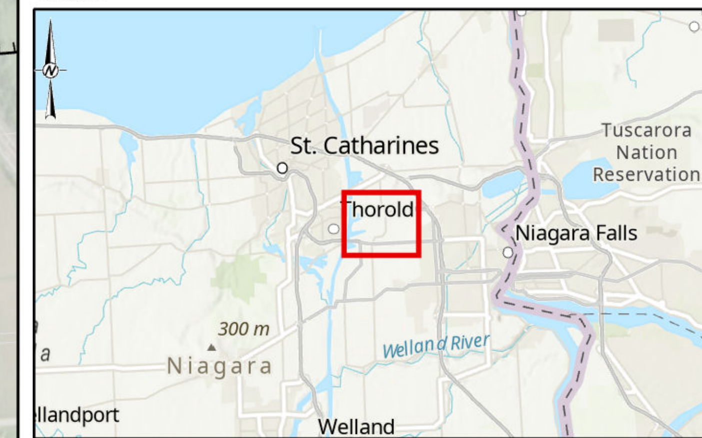
PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-12

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

PATH: S:\Clients\Walker_Industries\Southeast_Quarry\99_PROJ\CA0065457_5367_Phase2_EA\40_PROD\0001_Existing_Conditions_Report\CA0065457_5367-0001-HS-0000\CA0065457_5367-0001-HS-0000.aprx PRINTED ON: AT: 1:00:25 PM



KEY MAP



SCALE: 1:500,000

LEGEND

- MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- MONITORING POINT LOCATION AND DESIGNATION
- SOUTH LANDFILL ECA DESIGNATED SLOW RECOVERY WELLS (SR) - MONITORING WELL MAY BE RECOVERING TO STATIC WATER LEVEL FOLLOWING SAMPLING EVENT
- LANDFILL LINER MONITORING LOCATION AND DESIGNATION
- GWCS MANHOLE LOCATION AND DESIGNATION
- (163.49) POTENTIOMETRIC ELEVATION, SEPTEMBER 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN ROCHESTER SHALE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
ROCHESTER SHALE POTENTIOMETRIC SURFACE – SEPTEMBER 2025

CONSULTANT

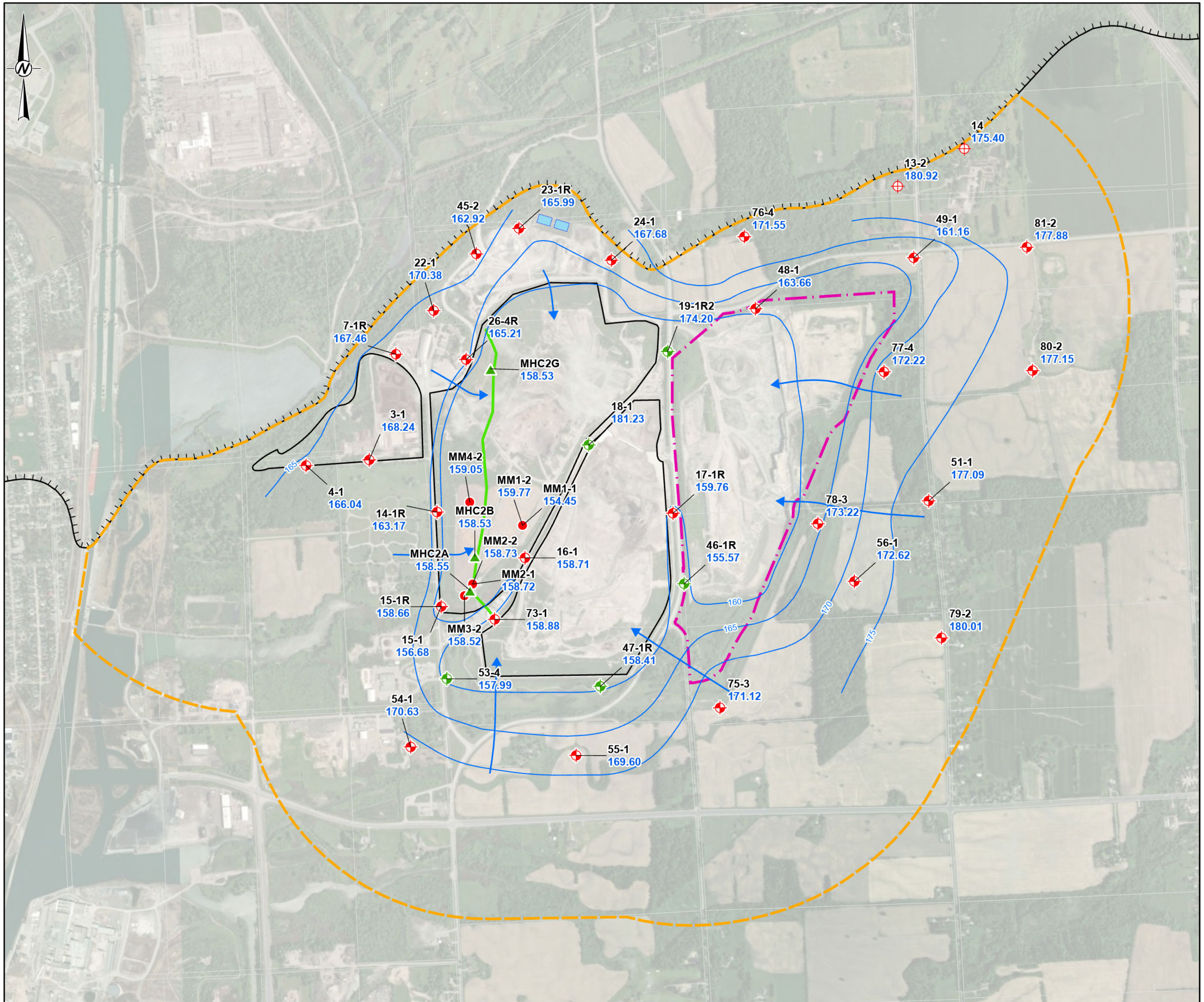
wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-13

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

25mm



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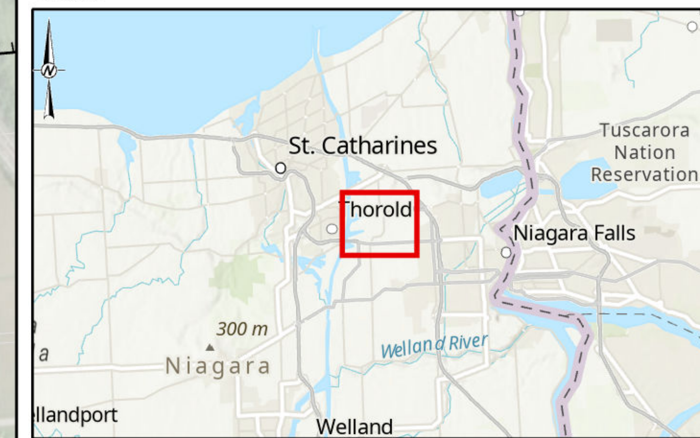

SCALE: 1:500,000

LEGEND

- MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- MONITORING POINT LOCATION AND DESIGNATION
- SOUTH LANDFILL ECA DESIGNATED SLOW RECOVERY WELLS (SR) - MONITORING WELL MAY BE RECOVERING TO STATIC WATER LEVEL FOLLOWING SAMPLING EVENT
- LANDFILL LINER MONITORING LOCATION AND DESIGNATION
- GWCS MANHOLE LOCATION AND DESIGNATION
- (163.49) POTENTIOMETRIC ELEVATION, DECEMBER 2025 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN ROCHESTER SHALE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- INFERRED DIRECTION OF HORIZONTAL GROUNDWATER FLOW IN ROCHESTER SHALE
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

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2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
ROCHESTER SHALE POTENTIOMETRIC SURFACE – DECEMBER 2025

CONSULTANT

wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-14

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

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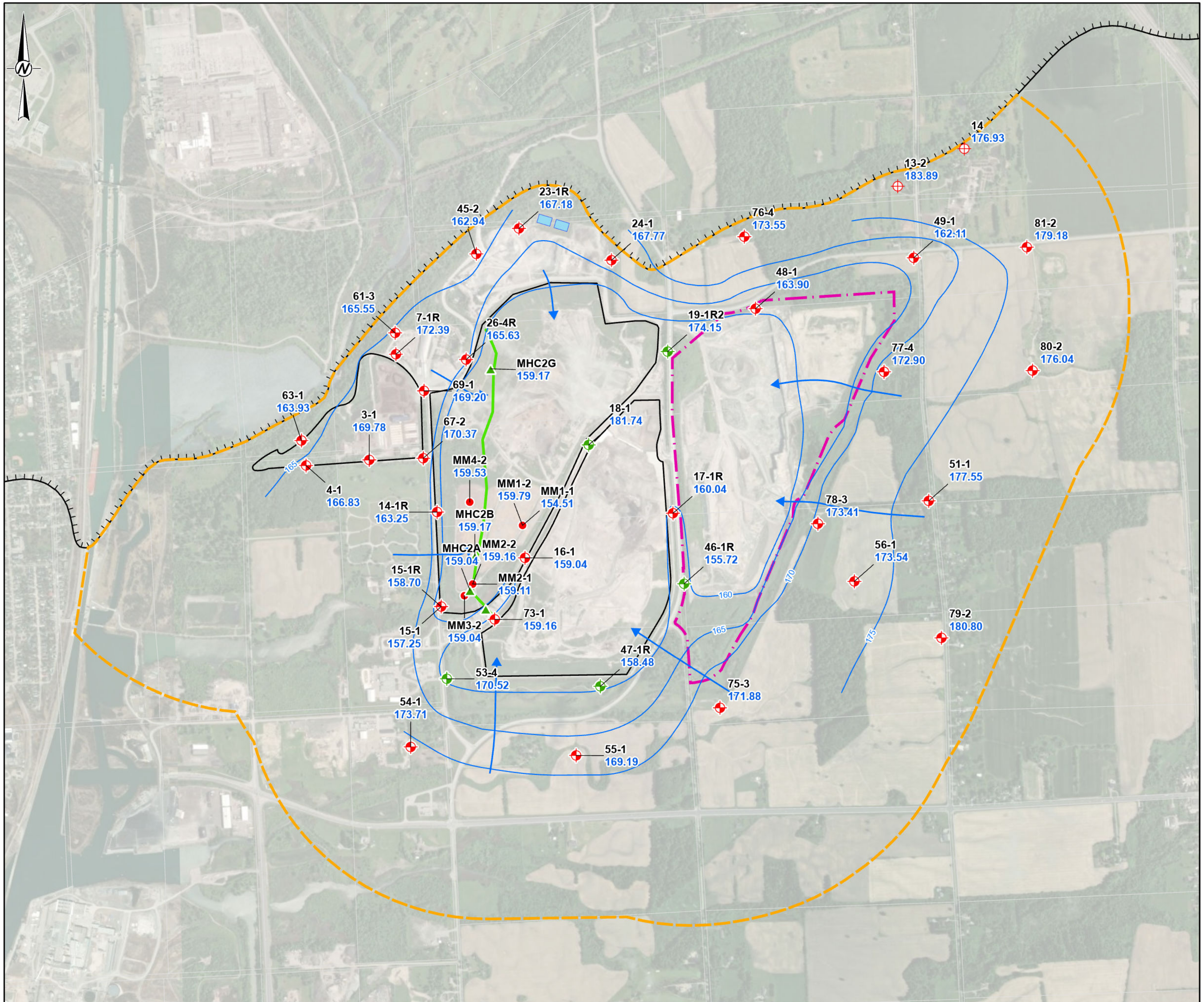

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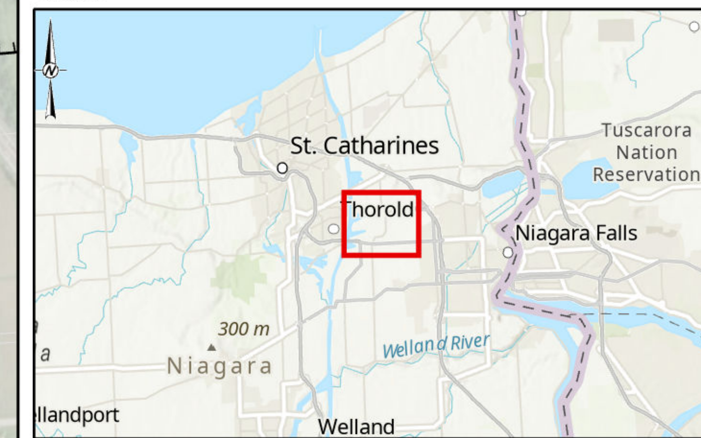


SCALE: 1:500,000

LEGEND

- MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- MONITORING POINT LOCATION AND DESIGNATION
- SOUTH LANDFILL ECA DESIGNATED SLOW RECOVERY WELLS (SR) - MONITORING WELL MAY BE RECOVERING TO STATIC WATER LEVEL FOLLOWING SAMPLING EVENT
- LANDFILL LINER MONITORING LOCATION AND DESIGNATION
- GWCS MANHOLE LOCATION AND DESIGNATION
- (163.49) POTENTIOMETRIC ELEVATION, MARCH 2026 (MASL)
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF GROUNDWAER FLOW IN ROCHESTER SHALE
- INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

WALKER ENVIRONMENTAL GROUP

PROJECT

GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE

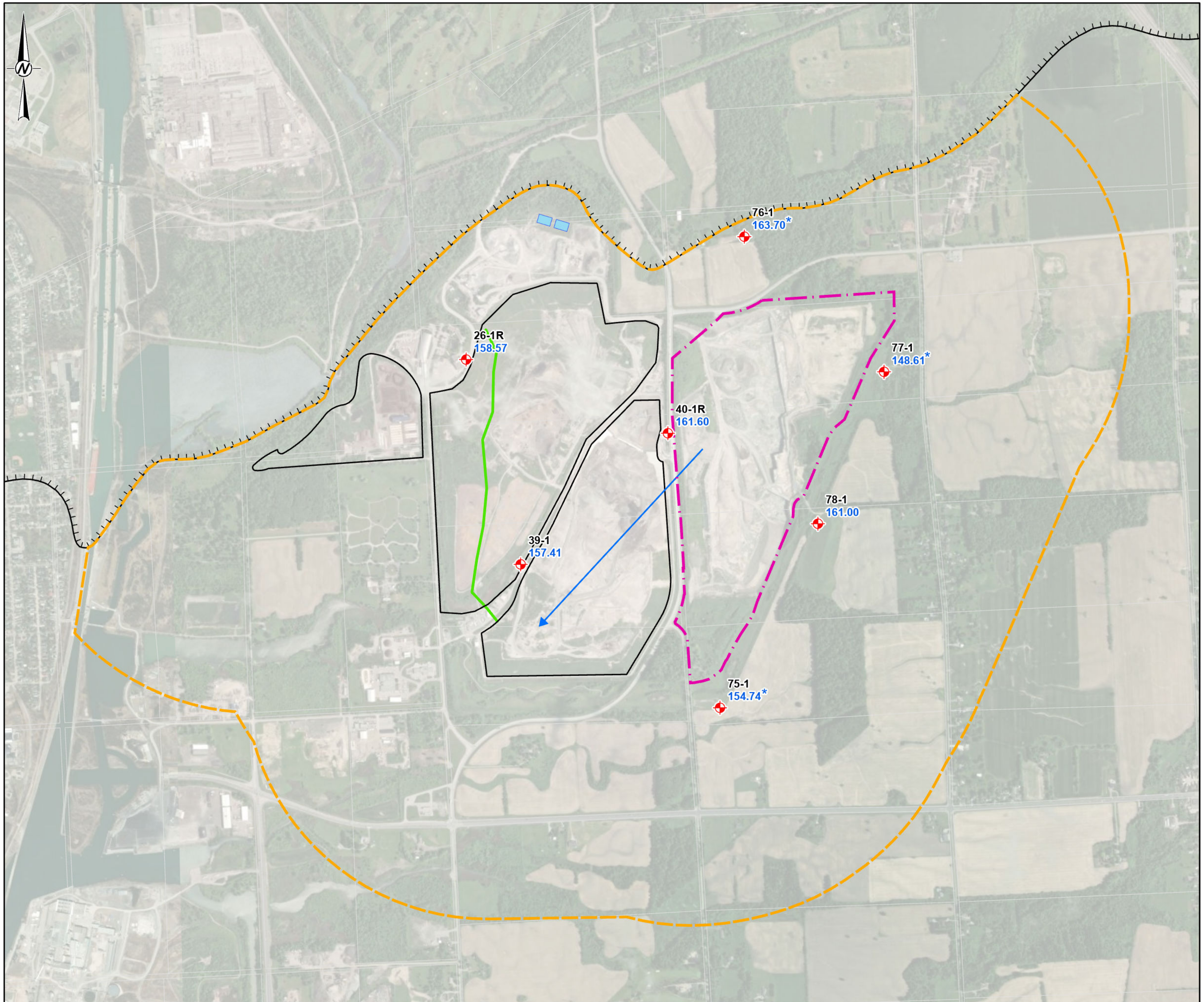
ROCHESTER SHALE POTENTIOMETRIC SURFACE – MARCH 2026

CONSULTANT

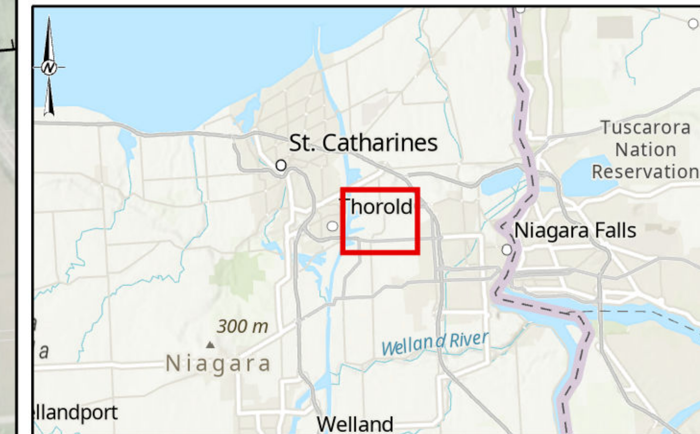
wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-15



KEY MAP



SCALE: 1:500,000

LEGEND

- MONITORING POINT LOCATION AND DESIGNATION
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF HORIZONTAL GROUNDWAER FLOW IN IRONDEQUOIT LIMESTONE
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)
- * GROUNDWATER LEVEL HAS NOT REACHED STATIC CONDITIONS FOLLOWING WELL INSTALLATION AND DEVELOPMENT

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

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3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

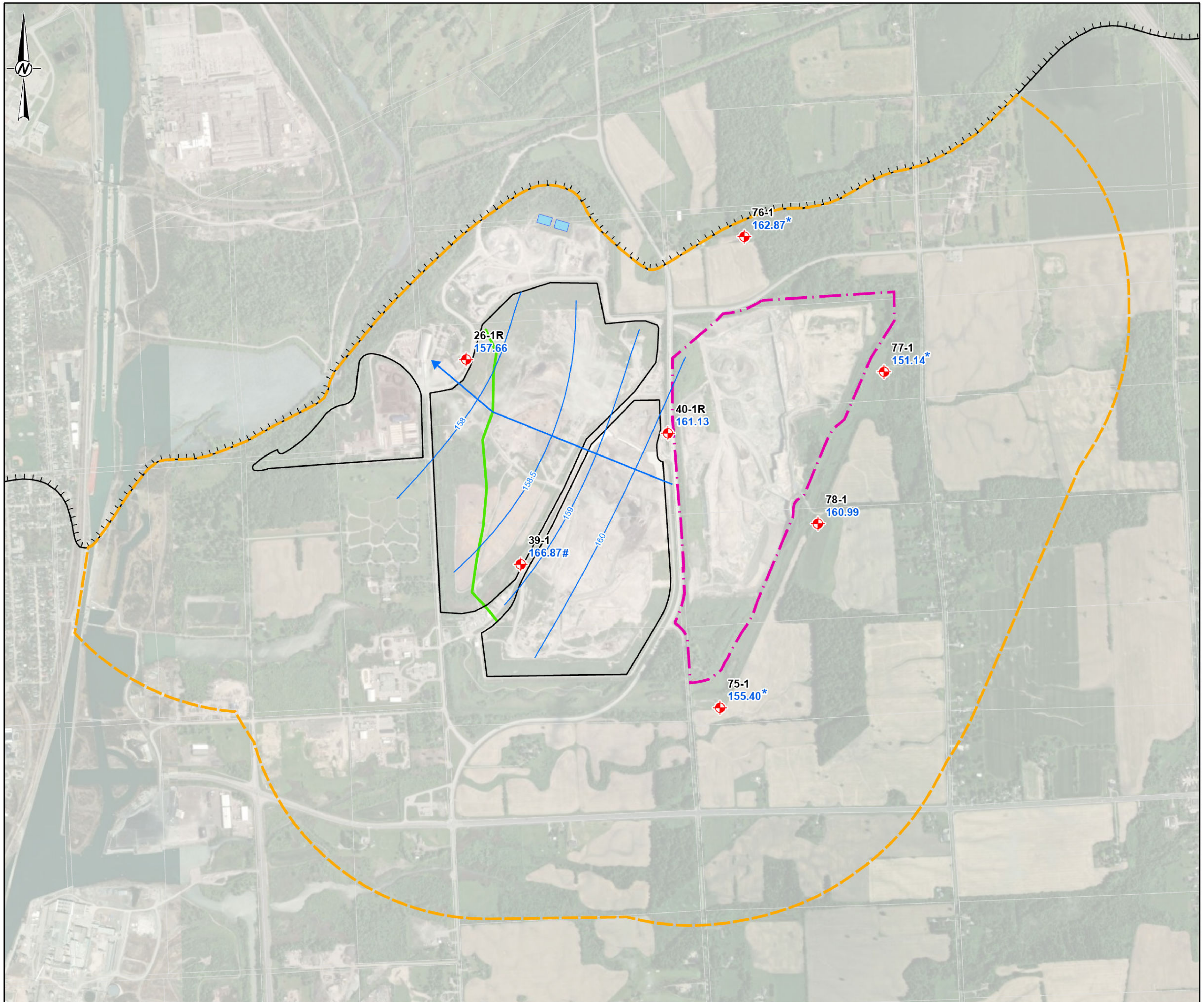
PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
IRONDEQUOIT LIMESTONE POTENTIOMETRIC LEVELS – JUNE 2025

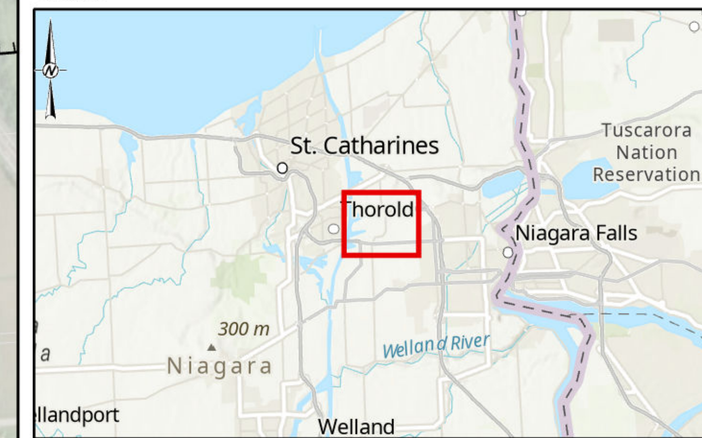
CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-16



KEY MAP



SCALE: 1:500,000

LEGEND

- MONITORING POINT LOCATION AND DESIGNATION
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF HORIZONTAL GROUNDWAER FLOW IN IRONDEQUOIT LIMESTONE
- 157 INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)
- * GROUNDWATER LEVEL HAS NOT REACHED STATIC CONDITIONS FOLLOWING WELL INSTALLATION AND DEVELOPMENT
- # POTENTIOMETRIC ELEVATION INFERRED TO BE ANOMALOUS

DRAFT

0 150 300 600
1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

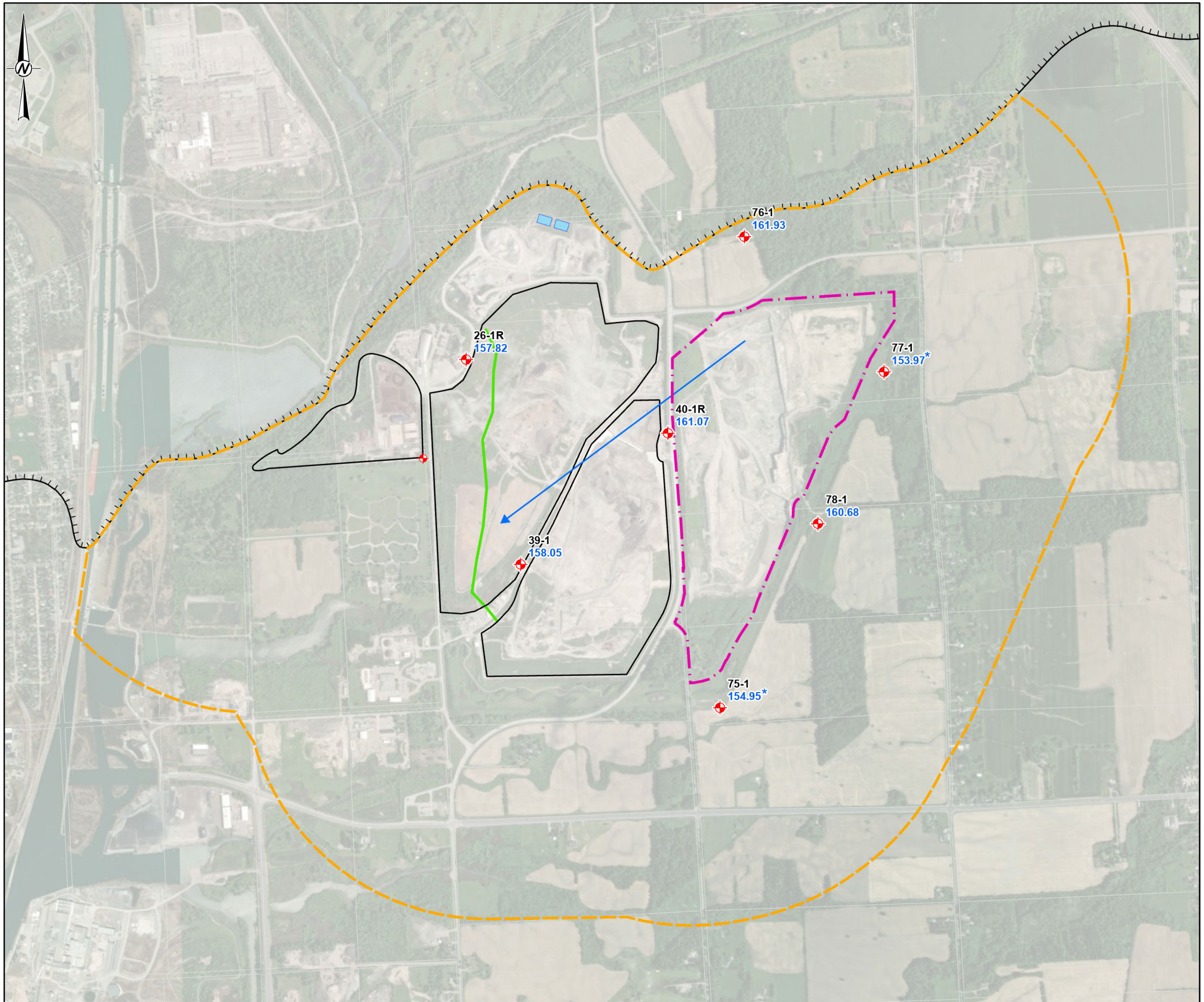
PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
IRONDEQUOIT LIMESTONE POTENTIOMETRIC LEVELS – SEPTEMBER 2025

CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-17



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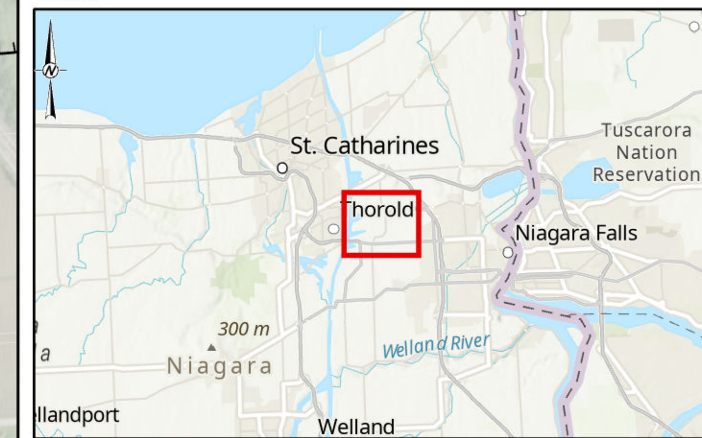


SCALE: 1:500,000

LEGEND

- MONITORING POINT LOCATION AND DESIGNATION
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF HORIZONTAL GROUNDWAER FLOW IN IRONDEQUOIT LIMESTONE
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- LANDFILL LEACHATE LAGOONS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)
- * GROUNDWATER LEVEL HAS NOT REACHED STATIC CONDITIONS FOLLOWING WELL INSTALLATION AND DEVELOPMENT

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

WALKER ENVIRONMENTAL GROUP

PROJECT

GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE

IRONDEQUOIT LIMESTONE POTENTIOMETRIC LEVELS – DECEMBER 2025

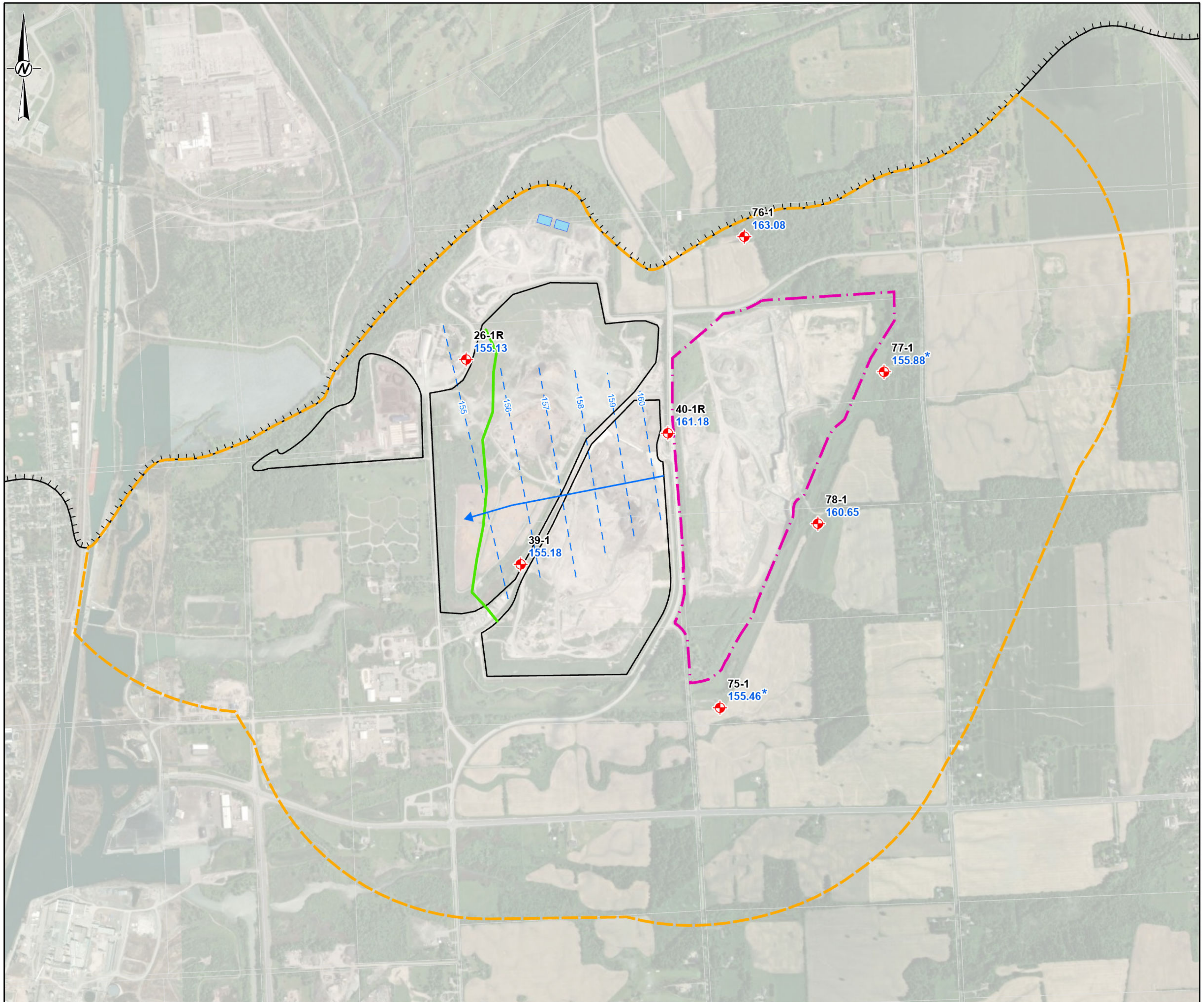
CONSULTANT

wsp

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-18

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



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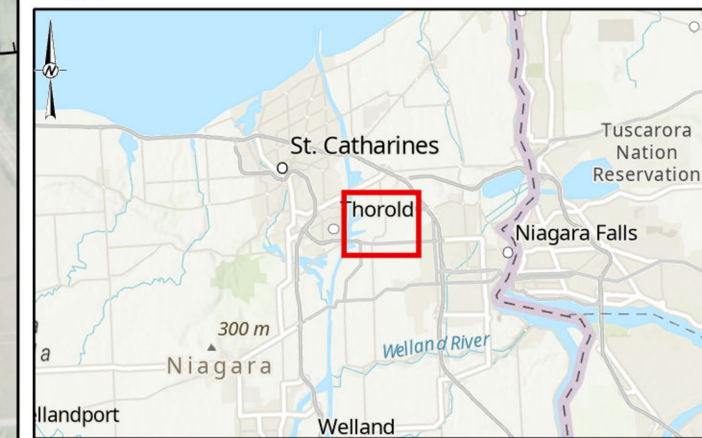


SCALE: 1:500,000

LEGEND

- MONITORING POINT LOCATION AND DESIGNATION
- APPROXIMATE LOCKPORT SCARP
- GROUNDWATER COLLECTION SYSTEM (GWCS)
- INFERRED DIRECTION OF HORIZONTAL GROUNDWAER FLOW IN IRONDEQUOIT LIMESTONE
- 157 INFERRED POTENTIOMETRIC CONTOUR (MASL)
- SITE STUDY AREA (SSA)
- LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)
- LANDFILL LEACHATE LAGOONS
- * GROUNDWATER LEVEL HAS NOT REACHED STATIC CONDITIONS FOLLOWING WELL INSTALLATION AND DEVELOPMENT

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

WALKER ENVIRONMENTAL GROUP

PROJECT

GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE

IRONDEQUOIT LIMESTONE POTENTIOMETRIC LEVELS – MARCH 2026

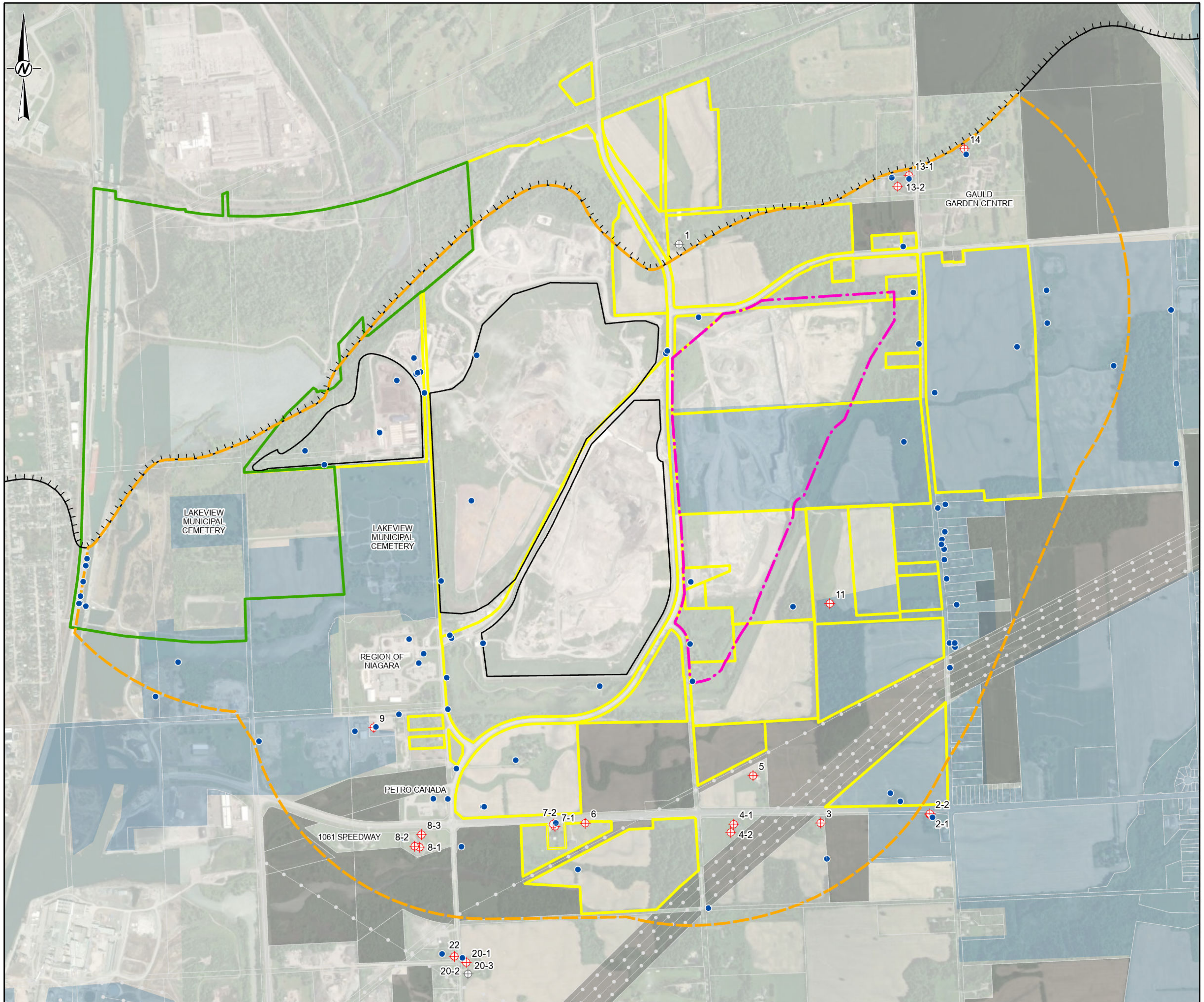
CONSULTANT

wsp

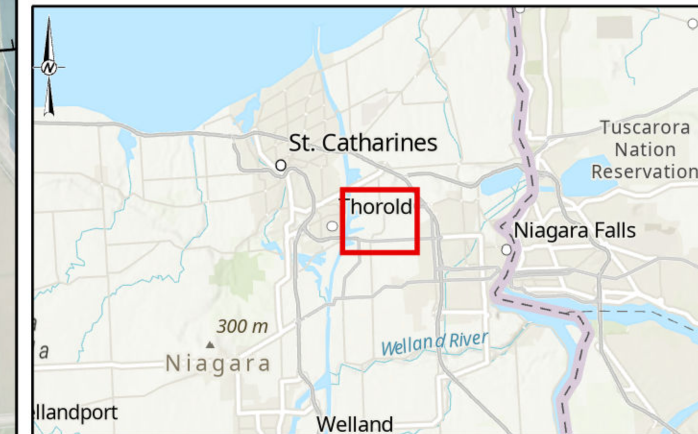
YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-19

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



KEY MAP



SCALE: 1:500,000

LEGEND

- MECP WATER WELL RECORD
- MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- HISTORICALLY MONITORED RESIDENTIAL WELL LOCATION AND DESIGNATION
- PROPOSED LOCAL STUDY AREA (LSA) (1KM CAMPUS BUFFER)
- APPROXIMATE LOCKPORT SCARP
- HYDRO CORRIDOR
- APPROXIMATE EXISTING WATER SYSTEM (MASTER SERVICING PLAN, NIAGARA REGION, 2016)
- APPROXIMATE NIAGARA ESCARPMENT PARKS AND OPEN SPACE SYSTEM
- SITE STUDY AREA (SSA)
- VACANT PARCEL WITH NO ASSOCIATED STREET ADDRESS
- WALKER OWNED LANDS
- WALKER RESOURCE MANAGEMENT CAMPUS (EAST, SOUTH AND WEST LANDFILLS)

DRAFT

0 150 300 600

1:16,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: ESRI, CGIAR, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY, NEW YORK STATE, VANTOR
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
GEOLOGY AND HYDROGEOLOGY EXISTING CONDITIONS REPORT

TITLE
WATER WELL SURVEY

CONSULTANT

YYYY-MM-DD	2026-06-12
DESIGNED	----
PREPARED	JM
REVIEWED	----
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0001	A	4-20

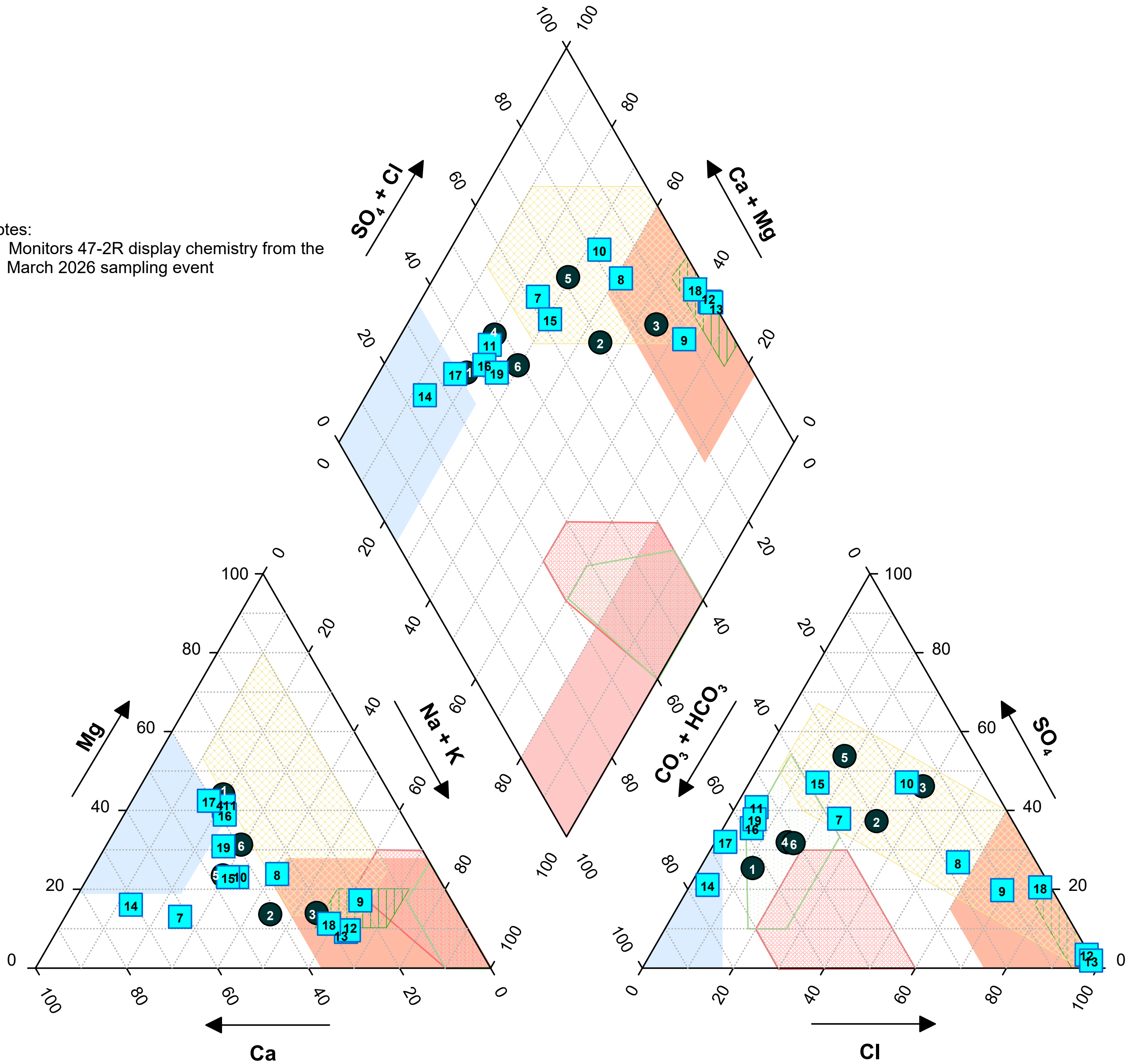
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Figure 4-21 Lockport Wells Trilinear Diagram

September 2025

Notes:
* Monitors 47-2R display chemistry from the March 2026 sampling event



LEGEND

Perimeter Wells
Periphery Wells

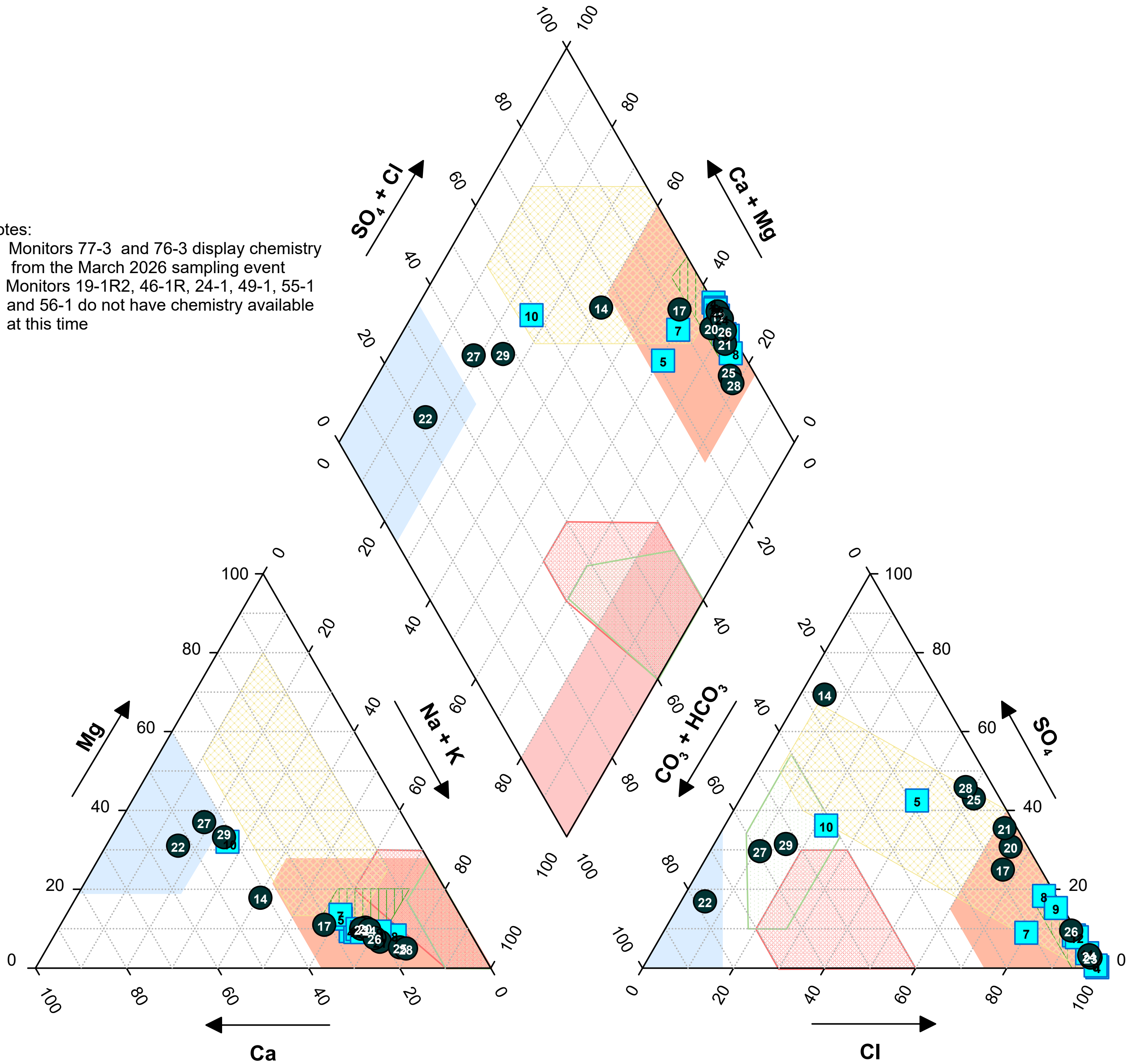
Typical Meteoric Water
Lockport Dolostone
DeCew Dolostone
Upgradient Rochester Shale
Historic East Landfill Leachate Field (Pre-1999)
East Landfill Leachate Field (1999-Present)
West Landfill Leachate Field (JHL, 2005)

1	49-2	11	47-3R
2	51-2	12	47-2R**
3	79-3	13	47-2R
4	81-3	14	48-2
5	55-3	15	75-4
6	79-4	16	75-5
7	17-2	17	77-5
8	19-3R	18	78-4
9	46-2	19	78-5
10	46-3R		

Figure 4-22 Rochester Wells Trilinear Diagram

September 2025

Notes:
* Monitors 77-3 and 76-3 display chemistry from the March 2026 sampling event
** Monitors 19-1R2, 46-1R, 24-1, 49-1, 55-1 and 56-1 do not have chemistry available at this time



LEGEND

Perimeter Wells — Periphery Wells

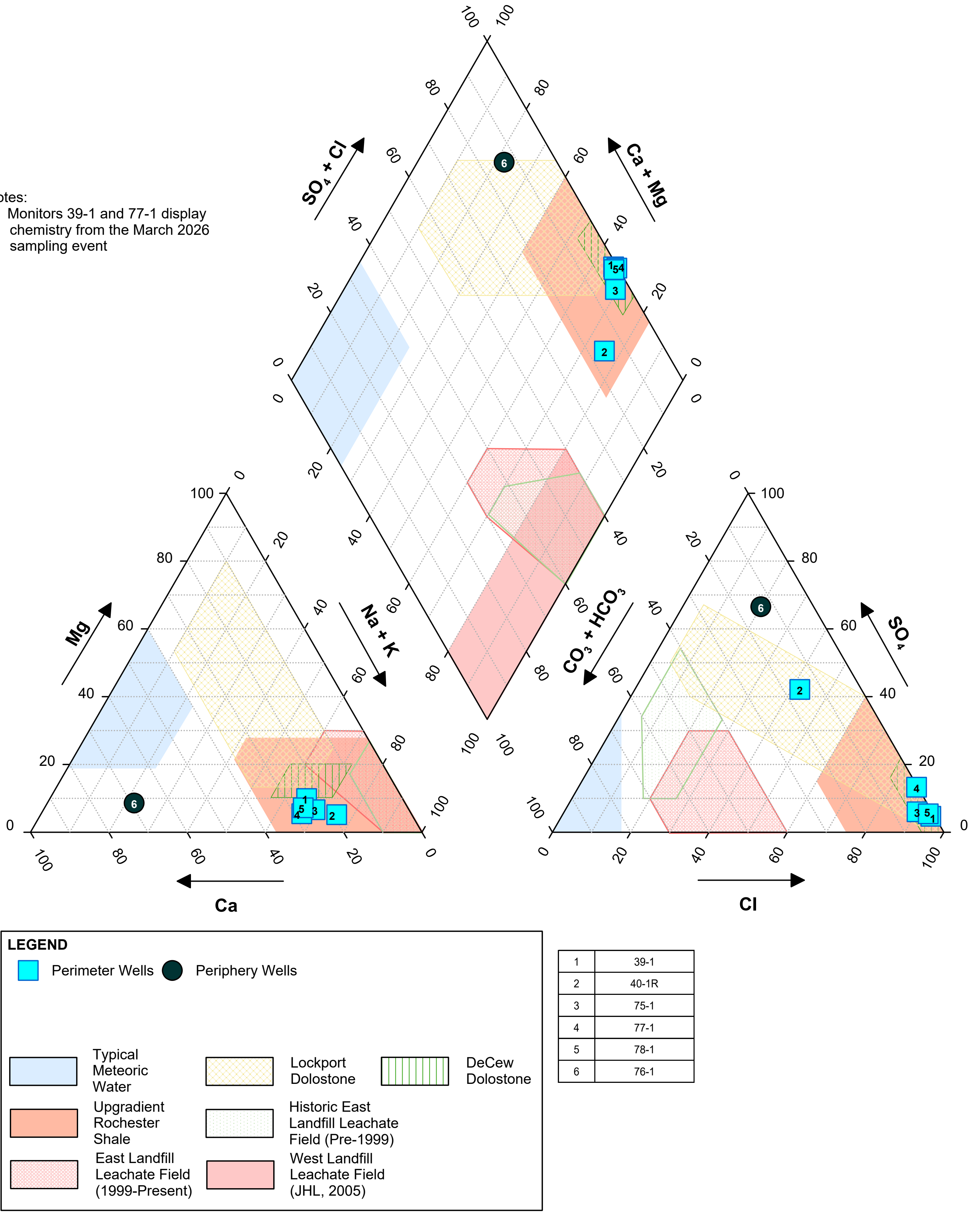
- Typical Meteoric Water
- Lockport Dolostone
- DeCew Dolostone
- Upgradient Rochester Shale
- Historic East Landfill Leachate Field (Pre-1999)
- East Landfill Leachate Field (1999-Present)
- West Landfill Leachate Field (JHL, 2005)

1	17-1R	11	78-2	21	76-3*
2	19-1R2**	12	78-3	22	76-4
3	46-1R**	13	17-1R	23	79-1
4	47-1R	14	23-1R	24	79-2
5	48-1	15	24-1**	25	80-1
6	75-2	16	49-1**	26	80-2
7	75-3	17	51-1	27	80-3
8	77-2	18	55-1**	28	81-1
9	77-3*	19	56-1**	29	81-2
10	77-4	20	76-2		

Figure 4-23 Irondequoit Wells Trilinear Diagram

September 2025

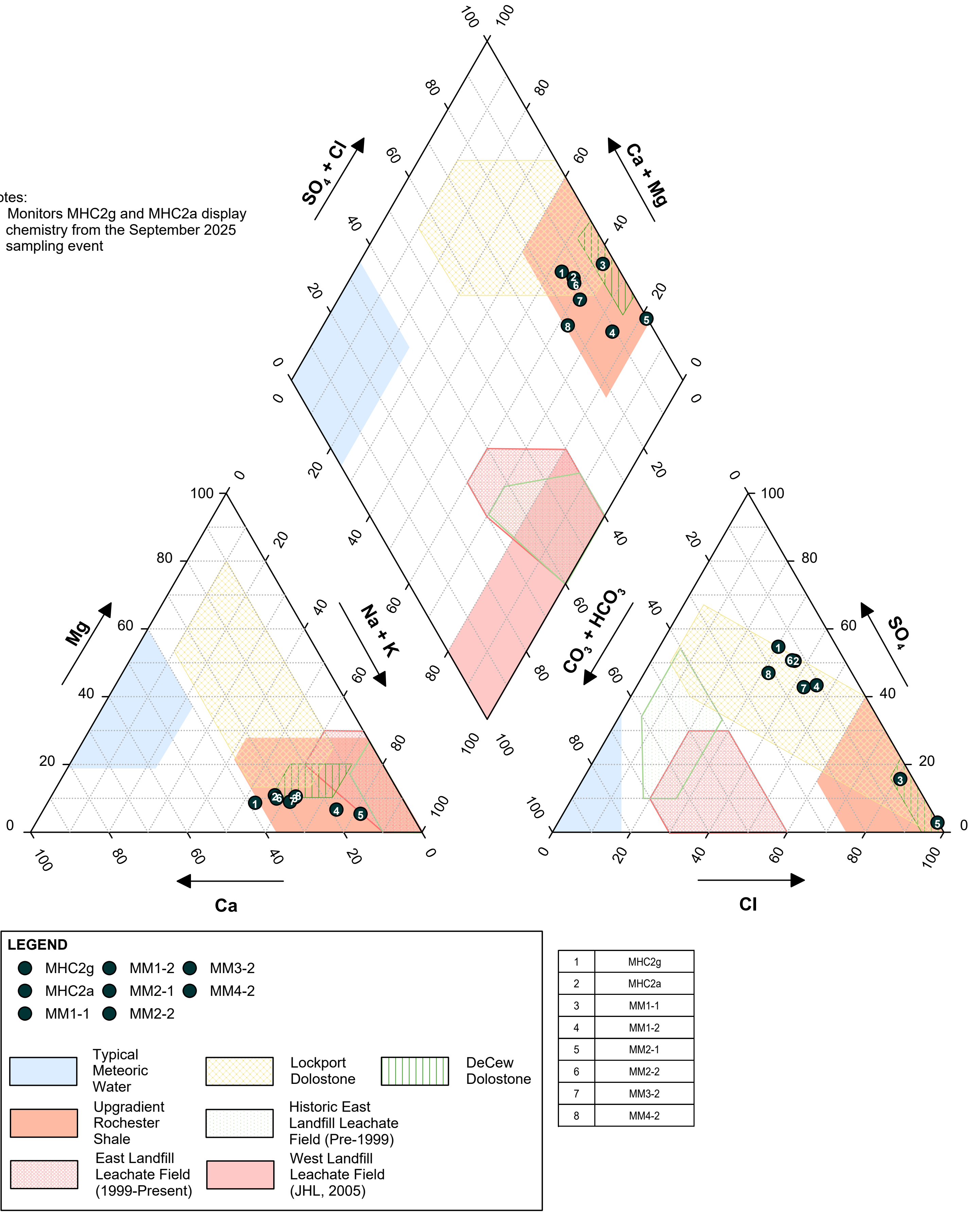
Notes:
* Monitors 39-1 and 77-1 display chemistry from the March 2026 sampling event



1	39-1
2	40-1R
3	75-1
4	77-1
5	78-1
6	76-1

Figure 4-24 Groundwater Collection System Trilinear Diagram June and September 2025

Notes:
* Monitors MHC2g and MHC2a display chemistry from the September 2025 sampling event



1	MHC2g
2	MHC2a
3	MM1-1
4	MM1-2
5	MM2-1
6	MM2-2
7	MM3-2
8	MM4-2