

Appendix I-2

**Surface Water Detailed Impact Assessment
Report**



DRAFT REPORT

Surface Water Resources Detailed Impact Assessment

Walker South Landfill Phase 2 Environmental Assessment

Submitted to:

Walker Environmental Group

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Table of Contents

- 1 INTRODUCTION 1**
 - 1.1 Description of the Preferred Landfill Configuration Option 2
 - 1.2 Description of the Preferred Leachate Management Option 2
 - 1.3 Facility Characteristic Report for the Preferred Method 3
- 2 STUDY AREA 3**
- 3 METHODOLOGY 5**
 - 3.1 Assessment Approach and Confirmation of Effects 5
 - 3.2 Additional Investigations 6
- 4 DESCRIPTION OF THE ENVIRONMENT POTENTIALLY AFFECTED 6**
 - 4.1 Existing Conditions 6
 - 4.1.1 Drainage Patterns and Catchment Areas 6
 - 4.1.2 Desktop Surface Water Flow and Quality 6
 - 4.1.3 Historical Water Quality and Flow Results 7
 - 4.1.4 Field Investigations 7
 - 4.2 “Future” Existing Conditions (Do Nothing Option) 9
- 5 SURFACE WATER RESOURCES NET EFFECTS 10**
 - 5.1 Potential Effects on Surface Water Quality 10
 - 5.1.1 Potential Effects 10
 - 5.1.2 Proposed Mitigation and Compensation Measures 11
 - 5.1.3 Net Effects 12
 - 5.2 Potential Effects on Surface Water Quantity 12
 - 5.2.1 Potential Effects 12
 - 5.2.2 Proposed Mitigation and Compensation Measures 13
 - 5.2.3 Net Effects 14
- 6 CUMULATIVE IMPACT ANALYSIS 16**
- 7 CLIMATE CHANGE CONSIDERATIONS 17**

7.1	Potential Effects of the Undertaking on Climate Change.....	17
7.1.1	Mitigation.....	17
7.2	Potential Effects of Climate Change on the Undertaking.....	17
7.2.1	Adaptation.....	18
8	ENVIRONMENTAL MONITORING.....	18
8.1	Environmental Effects Monitoring.....	18
8.2	Development of an Environmental Management Plan.....	20
9	COMMITMENTS.....	20
10	SURFACE WATER APPROVALS REQUIRED FOR THE UNDERTAKING.....	20
11	REFERENCES.....	21

TABLES

Table 3-1: Considerations for Indicators.....	5
Table 3-2: General Assumptions for Evaluation of Surface Water Resources Criteria.....	5
Table 5-1: Surface Water Resources Potential Environmental Effects, Proposed Impact Management Measures, and Net Effects.....	15
Table 8-1: Surface Water Proposed Monitoring Requirements.....	19

FIGURES

Figure 2-1: Surface Water Resources Study Area.....	4
Figure 4-1: Surface Water Monitoring Stations.....	8

APPENDICES

Appendix A

Hydrological modelling and Stormwater Management System Design Report

1 INTRODUCTION

This report documents the Surface Water Resources impact assessment of the Preferred Method for the Environmental Assessment (EA) to develop the next phase of the existing South Landfill (i.e., South Landfill Phase 2) located at the Walker Resource Management Campus (Campus). The proposed South Landfill Phase 2 will add approximately 19.8 million cubic metres (m³) of landfill capacity over a 20-year period.

In the preceding Alternative Methods phase of the EA, net effects analyses as well as a comparative evaluation of three Alternative Landfill Configuration Options and two Leachate Management Options were carried out in order to identify a Preferred Landfill Footprint and a Preferred Leachate Management Option. The three Alternative Landfill Configuration Options and two Leachate Management Options presented in the Alternative Methods phase were developed to a conceptual level of design and documented in a Conceptual Design Report (CDR). The potential environmental effects, preliminary impact management measures to address the potential adverse environmental effects, and the remaining net effects following the application of the impact management measures were identified for all three Alternative Landfill Configuration Options and both Leachate Management Options. The Preferred Landfill Configuration Option was determined to be Option A (*Same Height and Slopes as Current South Landfill Phase 1*¹) and the Preferred Leachate Management Option was determined to be Option A (*Continued and Expanded Use of the Municipal Wastewater Treatment System*), hereafter collectively referred to as the Preferred Method.

At the detailed impact assessment phase, additional details are developed for the Preferred Method from a design and operations perspective, as documented in a Facilities Characteristics Report (FCR), so that potential environmental effects, preliminary impact management and compensation measures, and resultant net effects described at the Alternative Methods stage can be reviewed and more accurately defined, as required, along with enhancement opportunities and approval requirements. Specifically, the following can be accomplished:

- Potential environmental effects can be identified with more certainty.
- More site-specific impact management measures can be developed for application.
- Additional mitigation and impact management measures can be identified, as required.
- Net environmental effects can be identified with more certainty.
- Appropriate monitoring requirements can be clearly defined.
- Specific approval/permitting requirements for the proposed undertaking can be identified.

Climate change mitigation and adaptation measures are also reviewed as part of the detailed site design established for the Preferred Method. In addition, during the impact assessment stage of the South Landfill Phase 2 EA, Walker has committed to completing an assessment of the cumulative effects of the proposed undertaking and other non-Walker projects and activities that are existing, planned/approved or reasonably foreseeable within the Study Area.

¹ Following consultation on the comparative evaluation of the alternative methods, the Preferred Landfill Configuration Option was refined based on public, stakeholder and Government Review Team (GRT) comments and feedback received. Specifically, the proposed maximum height was decreased to reduce visual impact, the proposed Limit of Fill was adjusted in several areas to avoid sensitive natural features and to accommodate necessary infrastructure within the buffer, and slopes were adjusted to maximize compatibility with an agricultural end use, all of which resulted in a slightly reduced waste capacity.

The discipline-specific work plans developed during the Terms of Reference (ToR) outlined how impacts associated with the Preferred Method would be assessed. The results of these assessments are documented in 13 stand-alone Detailed Impact Assessment Reports:

- Geology and Hydrogeology
- Surface Water Resources
- Noise and Vibration
- Air Quality
- Terrestrial and Aquatic Environment
- Land Use
- Agriculture
- Transportation
- Social Environment
- Economic Environment
- Built Heritage and Cultural Heritage Landscapes
- Archaeology
- Visual

1.1 Description of the Preferred Landfill Configuration Option

Landfill Configuration Option A was originally selected as preferred due to its long-term benefits, including the largest waste capacity, longest operational lifespan, and associated economic and employment advantages. Following its selection, the design of Landfill Configuration Option A was refined in response to feedback received during consultation to reduce its visual impact and improve compatibility with a future agricultural end use. Furthermore, the Limit of Fill boundaries were adjusted to avoid natural features and to accommodate necessary infrastructure within the buffer. These refinements included a reduction in peak elevation to 211 metres above mean sea level (masl) at the top of waste (TOW; 211.75 masl at the top of cap), and adjustments to slope gradients, now designed to a maximum steepness of 3:1 (horizontal:vertical) for below-ground slopes and between 16:1 and 3.5:1 for above-ground slopes, improving the area compatible with an agricultural end use. These changes bring Option A closer in form to the Options B and C while preserving its advantage of a higher overall waste capacity. The refined Option A design would provide approximately 19.8 million m³ of expanded landfill capacity and include 44 hectares (ha) of land compatible with an agricultural end use.

From the surface water resources perspective, these adjustments are expected to result in minor changes to hydrologic response of runoff that may require minor adjustments to the design of stormwater management components, but as such these would not result in material differences in potential effects.

1.2 Description of the Preferred Leachate Management Option

Leachate Management Option A builds upon the pre-existing leachate management system and approach while including the necessary expansion of the system capacity as South Landfill Phase 2 is expected to generate a approximately 131,000 m³ of additional leachate per year at the time of closure (2050) and approximately 147,000 m³ of additional leachate per year in 2070 when considering climate change. The expansion of the leachate

management system would include a leachate sump, including a pump station equipped with the needed metering equipment and controls for monitoring and contingency purposes, a forcemain to transport the leachate from the pump station to the lagoon area, and lagoon upgrades consisting of 2 additional lagoons, if required (located adjacent the existing two lagoons), for pretreatment and eventual discharge.

Once pretreated at the on-site lagoons, leachate will be conveyed via an existing force/gravity main to the Niagara-on-the-Lake (NOTL) sanitary sewer system for final treatment at the Region of Niagara's Port Weller Wastewater Treatment Plant. The need to upgrade the private sewer that connects to the Niagara-on-the-Lake sanitary sewer system has been identified and will be considered in the assessment.

1.3 Facility Characteristic Report for the Preferred Method

The Facility Characteristics Report (FCR) presents preliminary design and operations information for the Preferred Method and provides information on all main aspects of landfill design and operations including:

- Site layout design, including existing and proposed Site characteristics;
- stormwater management;
- leachate management;
- landfill gas management; and,
- landfill development sequence and daily operations.

The FCR also provides estimates of parameters relevant to the detailed impact assessment, including estimates of leachate generation, landfill liner performance, landfill gas generation, and traffic levels associated with waste and construction materials haulage.

2 STUDY AREA

From a Surface Water Resources perspective, the characterization of impacts within the following study areas are appropriate to this EA:

- Site Study Area (SSA): The SSA is consistent across all technical disciplines and encompasses a total of 81.30 ha of land owned and operated by Walker. The SSA includes the current quarry extraction limit, and encompasses the proposed limit of fill, the buffer area, and aligns with the proposed Waste Disposal Site Limit Boundary. While the SSA captures the core area of the proposed landfill development, certain ancillary features related to the landfill are proposed to be located outside the SSA. These features will be addressed within the broader Local Study Area.
- Local Study Area (LSA): It includes all lands within a 1.2 km radius of the Walker campus boundaries, as shown on **Figure 2-1**. The surface water existing conditions LSA was designed to capture the local effects of the Project on surface water environment that may extend beyond the SSA with the understanding that the spatial extent of this LSA is intended to account for the local area where effects of the Project are likely to be measurable.
- Regional Study Area (RSA): It includes watershed areas (as defined on a subwatershed scale in accordance with Niagara Peninsula Conservation Authority (NPCA) designation) of each waterbody that is crossed by the Project footprint, as shown on **Figure 2-1**.

The Surface Water Resources study areas are illustrated in **Figure 2-1**.

3 METHODOLOGY

3.1 Assessment Approach and Confirmation of Effects

The assessment of impacts associated with the Preferred Method was undertaken through a series of steps that were based, in part, on a number of previously prepared reports (Surface Water Resources Existing Conditions Report, and Surface Water Resources Comparative Evaluation Technical Memorandum).

In order to characterize the Surface Water Resources existing conditions within the study areas, available secondary sources of information were collected and reviewed. The existing secondary information was supplemented through a detailed field monitoring program to address the data gaps. The field investigation included monitoring of flows, water levels, and surface water quality. The approach and methodologies are summarized in **Section 4** and detailed in the Surface Water Resources Existing Condition Report. Hydrological assessment and preliminary stormwater management system design was also completed to assess the impact assessment on receiving and surrounding watercourses.

Evaluation Criteria and Indicators were established during the development of the ToR based on feedback from Indigenous communities, government agencies, and the public. Prior to undertaking the Comparative Evaluation of Alternative Methods process, a Public Event, accompanied by a virtual event, was held to present the Criteria and Indicators to the public and invite additional feedback. To fully characterize these indicators and to adopt measures by which potential effects could be identified, several considerations were developed for each indicator. These considerations are provided below in **Table 3-1**.

Table 3-1: Considerations for Indicators

Criteria	Indicators	Considerations
Effect on surface water quality	<ul style="list-style-type: none"> ▪ Predicted effects on surface water quality on-site and off-site 	<ul style="list-style-type: none"> ▪ Sediment loading (i.e., Total Suspended Solids [TSS] and related parameters) on proposed stormwater mitigation in nearby and receiving waterways ▪ Expected changes in site design footprint, which can impact the sizing of treatment volumes due to variation of total drainage area directly connected to treatment facilities
Effect on surface water quantity	<ul style="list-style-type: none"> ▪ Predicted change in drainage areas and land use ▪ Predicted occurrence and degree of off-site effects 	<ul style="list-style-type: none"> ▪ Expected change in runoff volume and peak flows in drainage features ▪ Expected degree of change to off-site effects on surface water quantity within the Site Study Area (SSA) and off-site within the Local Study Area (LSA)

The net effects associated with the three Alternative Landfill Configuration Options and two Alternative Leachate Management Options identified during the Alternative Methods phase of the EA were based on conceptual designs and the following assumptions.

Table 3-2: General Assumptions for Evaluation of Surface Water Resources Criteria

Criteria	Assumptions
Effect on surface water quality	The landfill will be engineered with a leachate collector system (LCS), and liner designed to meet or exceed O.Reg. 232/98 requirements to safeguard against seepage to water receivers.
Effect on surface water quantity	Landfill will have a stormwater management system that facilitates reduction of peak flow rates to existing or pre-development conditions for design storm events as required by O.Reg. 232/98 Landfill Standards.

The net effects were reviewed within the context of the preliminary design plans developed for the Preferred Method, as identified in the FCR, to determine the type and extent of any additional investigations required to ensure a comprehensive assessment of net effects. Additional investigations were then carried out, where necessary, in order to augment the previous work undertaken. Feedback previously received from the EA consultation process was incorporated into the assessment approach, where appropriate.

With a more detailed understanding of the potential impact from the preliminary landfill and leachate treatment designs on the Surface Water Resources environment, the previously identified potential effects and recommended mitigation or compensation measures associated with the Preferred Method (documented in the Surface Water Resources Comparative Evaluation Technical Memorandum) were reviewed to ensure their accuracy. Based on this review, the potential effects, mitigation or compensation measures, and net effects associated with the Preferred Method were confirmed and documented. In addition to identifying mitigation or compensation measures, potential enhancement opportunities associated with the preliminary design for the Preferred Method were also identified, where possible.

Following this confirmatory exercise, the requirement for a future monitoring program was identified, where appropriate. Finally, any Surface Water Resource approvals required as part of the implementation of the Preferred Method were identified.

3.2 Additional Investigations

Upon completion of the preliminary design for the Preferred Method as documented in the FCR, the environmental characteristics of the Study Area were reviewed to verify the accuracy of the assessment of net effects from the Preferred Method. From this review, it was determined that no additional investigations are required.

4 DESCRIPTION OF THE ENVIRONMENT POTENTIALLY AFFECTED

In this section, a description of the surface water environment is presented. The information is extracted from the Surface Water Resources Existing Conditions Report, and a more detailed description and list of reference sources can be found in that report.

4.1 Existing Conditions

Surface Water Resources Existing Conditions Report for the Walker South Landfill Phase 2 Environmental Assessment provides an analysis of the current surface water conditions within the study areas. A summary the key findings are provided below:

4.1.1 Drainage Patterns and Catchment Areas

The study areas encompass multiple subwatersheds, each with distinct drainage characteristics that influence surface water flow and quality. The delineation of catchment areas which was based on topography and contour data from the NPCA and the MECP was crucial in understanding the spatial extent of potential project impacts. Surface water stations for the Walker South Landfill Phase 2 Environmental Assessment program were selected based on drainage pattern information in relation to site works. Note that, in response to MECP comments received May 13, 2025, the watersheds of Eight Mile Creek and Eleven Mile Creek were delineated and were not found to be connected to site drainage.

4.1.2 Desktop Surface Water Flow and Quality

The surface water study is focused on characterizing the flow regimes of key surface water features on or near the site works, including Six Mile Creek, Ten Mile Creek, and the Welland Canal. The flow data, obtained through both desktop review and manual monitoring, revealed seasonal variations and established baseline conditions.

Historical water quality data from desktop resources indicated that most parameters generally meet provincial guidelines. However, certain parameters, such as aluminum, phosphorus and iron, were found to exceed these guidelines, suggesting naturally elevated background concentrations or potential anthropogenic influences.

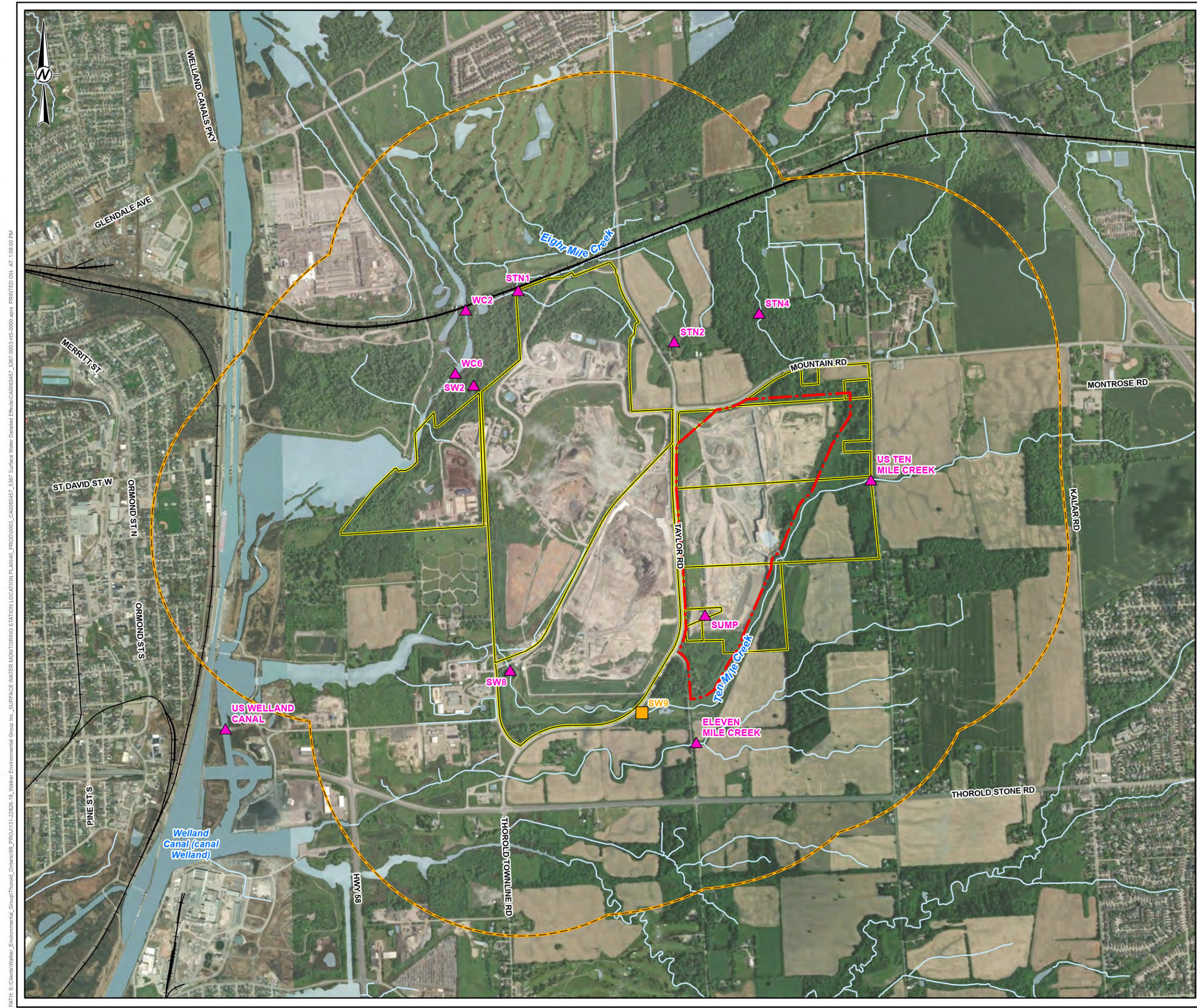
4.1.3 Historical Water Quality and Flow Results

Previously completed annual reports for existing monitoring program align with the requirements of various ECAs, ensuring that the monitoring programs meet regulatory standards. The historical data from these reports provided a valuable reference for assessing current conditions. The Permit to Take Water (PTTW) monitoring program for the Southeast Quarry included semi-annual and quarterly water quality sampling, which contributed to the overall understanding of surface water conditions in the study areas.

- Old Welland Canal: Historical monitoring results for the Old Welland Canal indicated stable or decreasing concentrations of most parameters, with some exceptions such as manganese and nitrate, which showed increasing trends.
- Ten Mile Creek: The water quality results for Ten Mile Creek revealed stable or no trends for most parameters, with an increasing trend for copper. The elevated concentrations of certain metals in December 2024 suggest potential anomalies.
- Southeast Quarry: The historical data for the Southeast Quarry indicated naturally elevated concentrations of phosphorus and iron, with stable or no trends for most other parameters. The dissolved oxygen levels at certain historical stations were within acceptable limits.

4.1.4 Field Investigations

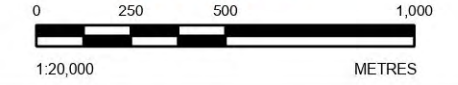
Monthly manual flow and water level measurements were completed at four surface water monitoring stations throughout the monitoring period from December 2024 to March 2026 to develop stage-discharge rating curves. Flow hydrographs were developed using stage-discharge rating curves and continuous water level records at surface water monitoring stations. Quarterly water quality sampling was conducted at eleven stations, including in-situ field measurements and comprehensive laboratory analyses for several parameters including general chemistry, nutrients, metals, organic compounds, pesticides, and microbiological parameters. **Figure 4-1** shows locations of surface water monitoring stations.



SCALE: 1:500,000

- LEGEND**
- ▲ SURFACE WATER MONITORING LOCATIONS
 - WALKER SURFACE WATER MONITORING STATION
 - + RAILWAY
 - WATERCOURSE
 - LOCAL STUDY AREA
 - SITE BOUNDARY
 - SITE STUDY AREA (SSA)
 - WATERBODY

DRAFT



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO 2. IMAGERY CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDINANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY 3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
SURFACE WATER RESOURCES DETAILED IMPACT ASSESSMENT REPORT, SOUTH LANDFILL PHASE 2, NIAGARA FALLS, ONTARIO

TITLE
SURFACE WATER MONITORING STATIONS

CONSULTANT	YYYY-MM-DD	2026-06-10
	DESIGNED	---
	PREPARED	JM
	REVIEWED	---
	APPROVED	---

PROJECT NO. CA0065457.5367 CONTROL 0003 REV. A FIGURE 4-1

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Key findings of the surface water field investigations are as follows:

Flow and water level monitoring showed that:

- Manual flows varied seasonally across stations: flows were generally higher in spring (March–May) and lower, stagnant or absent in summer and fall (July–October), except at SW2, which had flow during all visits. Flows measured during February 2026 were observed significantly higher than the other flow measurement events.
- Manual flows at monitoring stations were generally low and ranged from 0.02 L/s (at US Ten Mile Creek) to 336.67 L/s (at US Ten Mile Creek).
- Water levels exhibited an overall increase beginning in February 2025, reaching a peak between March and May 2025. This was followed by a gradual decline throughout the summer and autumn months (June to November 2025), with another peak observed in February to March 2026. These fluctuations align with seasonal patterns, including spring snowmelt and rainfall events, as well as decreased precipitation during the summer.
- Water levels and flow hydrographs at the monitoring stations generally corresponded with precipitation events that caused low to moderate flows and showed increase during spring.

Water quality monitoring showed that:

- Most water quality parameters remained within guidelines (Provincial Water Quality Objectives, the Canadian Council of Ministers of the Environment Canadian Water Quality Guidelines (Freshwater) for the Protection of Aquatic Life, Environmental Protection Act (Ontario Regulation 232/98 and Ontario Regulation 347)) during the monitoring period. Exceedances were limited to a few parameters at select stations and included total ammonia-N (6 stations), un-ionized ammonia (7), iron (5), boron (2), aluminum, copper and nitrite (one each). Total phosphorus exceeded limits at 10 stations in several events. All organic compounds, pesticides, regulated leachate, and microbiological results met applicable guidelines.

For details, refer to Surface Water Resources Existing Condition Report (WSP, 2026a).

4.2 “Future” Existing Conditions (Do Nothing Option)

The Surface Water Resources existing conditions described in **Section 4.1** reflect the current active quarry operations. The Future Existing Conditions described below reflect the currently approved post-extraction land use if the proposed landfill were not developed (i.e., the “Do Nothing Option”). Therefore, the purpose of the Future Existing Conditions scenario is to establish future baseline conditions upon which the impacts of the Preferred Method (i.e., proposed landfill operations) may be assessed.

Under the “Do Nothing” Alternative, once extraction activities end, the quarry would be rehabilitated into agricultural land in accordance with its approved rehabilitation plan. As South Landfill Phase 1 reaches capacity, it would begin its closure process, and the Walker Niagara Campus would stop accepting waste. Existing landfill infrastructure would then be either maintained, repurposed, or decommissioned, in accordance with the requirements set out in the South Landfill Phase 1 closure plan. Under the Aggregate Resources Act (ARA) site plans, this future condition includes the rehabilitation of quarry lands within the SSA to approximately 48.2 hectares of agricultural land, and the creation of a 2.4-hectare pond. Drainage within the licensed area will occur through stormwater collection trenches and ditches and then will connect to the stormwater drainage system of License No. 4437.

From surface water perspective, if the proposed landfill is not developed, future conditions (or the Do Nothing) are not expected to differ from the existing conditions, as the storm runoff generated from the site will continue to be

collected, managed and discharged at existing / pre-development levels to Welland Canal (via 1200 mm pipe and Old Welland Canal) similar to the existing conditions.

5 SURFACE WATER RESOURCES NET EFFECTS

As described in **Section 1**, following the confirmation of the Preferred Landfill Configuration Option and the Preferred Leachate Management Option, these components, together with all other project elements that were consistent across the previously assessed alternative methods, collectively formed the “Preferred Method.” The potential effects and associated mitigation or compensation measures identified were re-evaluated to confirm their validity in the context of the preliminary design. This review incorporated the refined engineering design details described in the FCR.

From this review, it was determined that hydrological modelling/assessment and stormwater management system design are required to assess the impact of Project on the surface water (quantity and quality). The hydrological assessment provided potential changes to drainage patterns and flows to the receiving environment due to Project development. The stormwater management system (i.e. ditches, pond, and outlet) was designed with necessary surface water quality and quantity control to mitigate those potential effects on the surface water quantity and quality of receiving and surrounding watercourses.

The updated assessment of predicted potential effects, recommended impact management measures, and resulting net effects is provided in **Table 5-1** and further elaborated upon in the subsections that follow.

5.1 Potential Effects on Surface Water Quality

5.1.1 Potential Effects

Potential effects on the surface water quality due to Preferred Method of Proposal Landfill development include:

- The expansion of the Project footprint and the development of the South Landfill Phase 2 will result in elevated levels of total suspended solids (TSS) and related parameter concentrations in surface water runoff originating from the capped landfill areas. If stormwater runoff from these areas is discharged into the receiving environment without adequate treatment, it would adversely affect the water quality of the receiving or surrounding watercourses such as the Old Welland Canal when discharge is to the 1200 mm pipe, or Ten Mile Creek when discharge is directed there. These impacts highlight the importance of effective stormwater management and water quality controls to mitigate potential environmental effects.
- Changes / increases in sediment loading or contaminant concentrations in the contact and non-contact storm runoff generated at the Project site may also affect surface water quality of receiving or surrounding watercourses, if not managed appropriately, during construction and operation of the Project and related infrastructure.
- Changes to the surface water quality of receiving or surrounding watercourses are expected, due to discharge of construction water / dewatering activities as necessary for the construction of key infrastructure (such as tunnel, roads, leachate pump station, leachate forcemain, additional pre-treatment on-site lagoons. Refer to Facility Characterisation report for details of key infrastructure (WSP, 2025). If not mitigated, dewatering activities can potentially affect the water quality of receiving or surrounding watercourses (i.e., Ten Mile Creek or Old Welland Canal).
- Accidental seepage of leachate to the surface presents a risk to the surrounding environment. If such seepage occurs, there is the possibility that the leachate could enter the on-site drainage system, eventually making its way to the natural environment. This scenario could result in the impairment of water quality within nearby or connected watercourses, such as the Old Walland Canal and Ten Mile Creek. Without appropriate mitigation measures in place, leachate leaks pose a serious threat due to its potential high toxicity, which can

be especially harmful to aquatic life. The contamination of water bodies not only affects the immediate ecosystem but can also have far-reaching consequences for the health of local habitats and species relying on these watercourses.

5.1.2 Proposed Mitigation and Compensation Measures

Proposed mitigation and compensation measures to reduce the potential effects on surface water quality (Section 5.1.1) will involve:

- Designing the on-site stormwater management system / facility to provide TSS removals and post-closure to pre-quarry peak flow conditions. The stormwater management ponds will be designed to provide the “highest level” of quality control of stormwater (i.e., Enhanced Level (80% long-term TSS removal). Water quality storage requirements will be determined based on Table 3.2 of the Ontario Stormwater Management Planning and Design Manual (Ministry of Environment, 2003).
- For details on the proposed stormwater management system for the site, refer to Hydrological Modelling and Stormwater Management Design System Report (WSP, 2026b) included as **Appendix A**. Two stormwater management ponds located northeast (north stormwater management pond) and south (south stormwater management pond) of the site, adjacent to the landfill, are proposed. The design of each of the stormwater management ponds includes a permanent pool that meets the Enhanced Level (80% TSS removal).
- Further, all the storm runoff from the site will be temporary stored in the proposed stormwater management ponds. Following suitable laboratory test results based on leachate potential indicator parameters of concern, the retained stormwater will be batch discharged at a controlled rate.
- The north stormwater management pond will discharge to Ten Mile Creek. The south stormwater management pond will include two options for discharge to provide flexibility for operations. The south pond can either be discharge to the existing 1200 mm diameter pipe and then to the Old Welland Canal, or it could be discharged to Ten Mile Creek.
- Segregating the precipitation and groundwater seepage on the undeveloped portions of the existing quarry floor (i.e., where no liner construction or waste placement activities have yet occurred) from the active landfill areas using berms, ditches and sumps. This water (non-contact water) will be managed through the existing approved quarry water management system. Any precipitation or water that comes into contact with the active working area, portions of the landfill that do not have final cover or new cells once constructed will be considered as potentially contaminated (contact water). Berming, ditches, grading and other works will be used to contain contact water within the uncapped area of the landfill where it will be directed into the leachate collection system for treatment as landfill leachate.
- Acquiring Environmental Compliance Approval (ECA) through Ministry of the Environment, Conservation and Parks (MECP). Per Section 53 of *Ontario Water Resources Act* (Government of Ontario, 1990b), an ECA is required for construction and operation of stormwater management facilities and / or changes to the existing on-site sewage works. An ECA for the proposed stormwater management facility will be obtained prior to construction and operation of the facility. Overall, the proposed stormwater management facility will be designed, constructed and operated in accordance with the permits and approvals through the Ministry of the Environment, Conservation and Parks.
- Compliance with discharge of construction water (dewatering) requirements in accordance with Ontario Regulation 63/16 under the *Environmental Protection Act* (Government of Ontario, 1990a), as applicable, recognizing that these activities will require permitting or approvals through the MECP. As part of the permitting and / or approvals process associated with permit for construction dewatering (e.g., Environmental

Activity and Sector Registry and/or Environmental Compliance Approval), a Water Taking and Discharge Plan and supporting technical analysis will be developed, as required, noting that, by design, the applicable water quantity and quality criteria (e.g., effluent limits) associated with the plan will be protective of the existing surface water, groundwater, and natural environment conditions in the local area and, in turn, are expected to result in minimal changes (if any) to streamflows, water levels, and the concentrations of suspended solids and chemical constituents in nearby watercourses.

- Designing and constructing the landfill with an engineered LCS, and liner that meet or exceed O.Reg. 232/98 requirements to safeguard against seepage to water receivers. The LCS piping will drain to a sump at the southwest corner of the landfill floor. The sump will have inclined riser pipes within which a submersible pump will be installed for leachate removal. The collected leachate will be pumped via a forcemain to the existing onsite leachate lagoons for pre-treatment prior to discharge to the municipal sanitary sewer system for further treatment. For details on Leachate Collection System and Leachate Management System refer to Facility Characterisation report (WSP, 2025).
- Conducting environmental monitoring (including water quality sampling and testing as noted in **Section 8**), where appropriate, to confirm the effectiveness of proposed mitigation measures as well as to maintain and demonstrate compliance with regulatory permits / approvals. It is anticipated that the ECA will include routine water quality monitoring requirements as well as monitoring required prior to pond discharge.

5.1.3 Net Effects

With the implementation of proposed mitigation measures, and noting that the construction and development activities will comply with applicable regulation and guidelines, the discharge of water from the site is not expected to result in increase in TSS and related parameter concentrations in the receiving (i.e., Ten Mile Creek or the Old Welland Canal via 1200 mm pipe) and surrounding watercourses. Further, the continued use of the existing municipal wastewater treatment system for the expanded South Landfill area will likely result in no to low net effects with respect to surface water resources. Therefore overall, no net effects are expected on surface water quality due to Preferred Method of Proposal Landfill development.

5.2 Potential Effects on Surface Water Quantity

5.2.1 Potential Effects

Potential effects on the surface water quantity due to Preferred Method of Proposal Landfill development includes:

- The land use change from a quarry to a waste disposal facility (landfill mound) will alter the existing land use, resulting in changes to surface characteristics such as slope, drainage area, and runoff coefficients. These modifications have the potential to disrupt the natural surface water drainage patterns, which may lead to an increased risk of both on-site and off-site runoff and flooding if appropriate mitigation measures are not implemented. It is important to note that the proposed landfill will be constructed within an exhausted quarry, and there will be no changes to the depth or size of the final quarry excavation.
- The on-site impacts on surface water quantity will be influenced by the maximum slope angle and the estimated total stormwater catchment/landfill footprint. Increased slopes will have an overall effect to increase peak flows entering the proposed perimeter ditch and stormwater management ponds. The total stormwater catchment will also impact the total runoff from the landfill. The off-site effects from the perspective of surface water include off-site volume and peak flow at the site boundary. As slopes are also increased within the catchment areas, the change will cause an earlier and higher peak flows of stormwater runoff. Further, the land-use change will also result in higher on-site volume. If the site runoff volumes and runoff release rates are not controlled, it could have adverse effects such as erosion of flooding within the receiving watercourses.

- As discussed earlier in **Section 5.1.1**, an increase to surface water quantity of receiving or surrounding watercourses may be expected, due to discharge of construction water / dewatering activity for the construction of key infrastructure (such as the tunnel, roads, leachate pump station, leachate forcemain, or for lagoon upgrades). During the construction and development stage, construction activities may require groundwater taking and discharge of construction water. Refer to Facility Characterisation report for details of key infrastructure (WSP, 2025). If not mitigated, these activities can potentially affect the water quantity (flows and water levels) of receiving or surrounding watercourses (i.e., Ten Mile Creek or Old Welland Canal via 1200 mm pipe).
- For preferred method of leachate management, the development will require additional infrastructure, including the construction of lagoon upgrades and an extra or upgraded forcemain. These facilities are necessary to manage leachate effectively. This expansion may result in further changes to the existing land use, potentially increasing the site's runoff generation capacity. The construction and operation of these new facilities could alter surface characteristics, leading to higher volumes of runoff.

5.2.2 Proposed Mitigation and Compensation Measures

Proposed mitigation and compensation measures to reduce the potential effects on surface water quantity (**Section 5.2.1**) will involve:

- Designing the stormwater management system / facility to provide post-closure to pre-quarry peak flow conditions.
 - The proposed stormwater ponds will not only be designed to provide quality treatment, but these will also be designed to attenuate peak flow rates to existing or pre-development conditions for design storm events ranging from 1:2-year through 1:100-year return periods, as required by O.Reg. 232/98 Landfill Standards and local guidelines (e.g., Niagara Peninsula Conservation Authority Stormwater Management Guidelines (AECOM, 2010), and the MECP Stormwater Management, Planning and Design Manual (Ministry of Environment, 2003).
 - Off-site discharge to surface water will be maintained to existing/pre-development conditions (i.e., no increase in peak flow in the receiving and surrounding watercourses), noting that all the storm runoff will be detained in proposed stormwater management ponds and tested for water quality prior to batch discharging to the receiving and surrounding watercourses (e.g., Ten Mile Creek, Old Welland Canal).
 - For details on stormwater management system design, refer to Hydrological Modelling and Stormwater Management System Design Report (WSP, 2026b) included as **Appendix A**. Proposed ponds are sized to retain runoff volumes for storms up to and including 1:100-year storm, without discharge, and are designed to provide post-closure to pre-quarry peak flow release rate conditions. All the storm runoff from the site will be stored in the proposed stormwater management ponds, laboratory tested for potential parameters of concern and batch discharged at the pre-development release rates after verifying the discharge water quality.
 - Consideration to climate change have also been incorporated in the design based on 2021–2050 climate-adjusted Intensity Duration Frequency (IDF) curves. Surface water conveyance ditches and emergency overflow spillways were designed to accommodate 1:100-year storm runoff rates based on the 2021–2050 climate-adjusted IDF curves for high emission scenario (RCP 8.5).
- Acquiring Environmental Compliance Approval (ECA) through the MECP. Per Section 53 of *Ontario Water Resources Act* (Government of Ontario, 1990b), an ECA is required for construction and operation of stormwater management facilities and / or changes to the existing on-site sewage works.

- Compliance with discharge of construction water (dewatering) requirements in accordance with Ontario Regulation 63/16 under the *Environmental Protection Act* (Government of Ontario, 1990a), as applicable, recognizing that these activities will require permitting or approvals through the MECP. Refer to **Section 5.1.2** for details.
- Conducting environmental monitoring (including water quantity as noted in **Section 8**), where appropriate, to confirm the effectiveness proposed mitigation measures as well as to maintain and demonstrate compliance with regulatory permits / approvals.

5.2.3 Net Effects

The existing hydrological conditions at the site and surrounding off-site areas are well understood (i.e., surface water flow and quality are known and predictable) through decades of studies and monitoring at the East Landfill, South Landfill and their previous quarries. With the implementation of proposed mitigation measures, the discharge of runoff from the site is not expected to increase in peak flow and water levels in the receiving (i.e., Old Welland Canal, Ten Mile Creek) and surrounding watercourses. The storm runoff release to the Ten Mile Creek would bring the flow regime to pre-development conditions (pre-quarry), noting that under the existing conditions the storm runoff is discharged to Old Welland Canal via 1200 mm pipe. Therefore, no net effects are expected to the surface water quantity.

Table 5-1: Surface Water Resources Potential Environmental Effects, Proposed Impact Management Measures, and Net Effects

Criteria	Indicator	Potential Effects	Impact Management Measures	Net Effects
Effect on surface water quality	Predicted effects on surface water quality on-site and off-site	<ul style="list-style-type: none"> ▪ Increase in sediment loading (i.e., Total Suspended Solids [TSS] and related parameter concentrations) to Ten Mile Creek or Old Welland Canal via 1,200 mm pipe due to the development and operation of the landfill. ▪ Generation of contact and non-contact storm runoff and discharge to receiving environment. ▪ Impact to surface water quality of receiving watercourses from discharge of construction water. During the construction and development stage, key infrastructure and facilities will be constructed that may require water taking and discharge of construction water. ▪ Impact to surface water quality from potential leachate seep. 	<ul style="list-style-type: none"> ▪ Two stormwater management ponds located northeast and south in the SSA, adjacent to landfill, are proposed. The design of the stormwater management ponds includes a permanent pool that meets the enhanced level of TSS removal (i.e., Enhanced (80%) long-term TSS removal to provide the “highest level” of quality control of stormwater as per Table 3.2 of the Ontario Stormwater Management Planning and Design Manual (MECP, 2003). The proposed stormwater management system will be designed, constructed, and operated in accordance with applicable separate approvals (e.g., ECA through MECP), guidelines and industry practices. ▪ All storm runoff up to and including from the 1:100-year event will initially be retained in the proposed stormwater management ponds. Laboratory testing will be completed to confirm the water quality complies with ECA release requirements prior to batch discharge to the receiving environment (Ten Mile Creek or Old Welland Canal via 1200 mm pipe). ▪ Non-contact stormwater during the construction and development of the landfill will be segregated and handled appropriately via existing and proposed on-site stormwater management system. Any contact stormwater will be directed to the leachate collection and treatment system. ▪ Any discharge of construction water will comply with applicable regulations, guidelines, permits and industry practices, and will be permitted appropriately. ▪ The landfill will be designed and constructed to meet or exceed O.Reg. 232/98 requirements to safeguard against seepage to water receivers. This includes a leachate collection system to manage leachate levels and regular inspections of landfill side slopes. In the event a leachate seep would occur, it would reach the perimeter ditching and ultimately the stormwater management ponds. Sampling and laboratory testing of the stormwater pond prior to batch discharging would detect any leachate impacts and the pond water would be directed to the leachate collection system, rather than to the receiving environment. ▪ Environmental monitoring will be completed in accordance the various ECAs. 	<p>Discharge to surface water with no significant increase in TSS and related parameter concentrations in the receiving (i.e., Ten Mile Creek or the Old Welland Canal) and surrounding watercourses.</p> <p>NO NET EFFECTS</p>
Effect on surface water quantity	Predicted change in drainage areas and land use	<ul style="list-style-type: none"> ▪ Potential increase in runoff and flooding due to changes in land cover and surface characteristics of landfill development area such as slope, drainage area and runoff coefficient. ▪ Potential increase in runoff and flooding due to changes in land cover due from development of additional infrastructure and ancillary facilities. 	<ul style="list-style-type: none"> ▪ Stormwater Management system / facility will be designed to provide controlled discharge rate to Ten Mile Creek or to the Old Welland Canal via the 1,200 mm pipe based on post-closure to pre-quarry peak flow conditions. ▪ Surface water conveyance ditches and emergency overflow spillways will be designed to accommodate 1:100-year storm runoff rates based on 2021–2050 climate-adjusted IDF curves for high emission scenario (RCP 8.5). ▪ The discharge from the pond will be batch discharged after confirmation sampling, so it is likely to occur following peak flows within the receivers (i.e. not coinciding with) from precipitation events. ▪ The stormwater management system and sewage works will be designed, constructed, and operated in accordance with applicable separate approvals (e.g., ECA through MECP), guidelines and industry practices. ▪ Environmental monitoring will be completed in accordance the various ECAs. 	<p>Discharge to surface water with no increase in peak flow in the receiving and surrounding watercourses (i.e., Ten Mile Creek or the Old Welland Canal).</p> <p>No effect to surface water quantity at off-site receivers (i.e., Ten Mile Creek or the Old Welland Canal) due to development of additional infrastructure.</p> <p>NO NET EFFECTS</p>
	Predicted occurrence and degree of off-site effects	<ul style="list-style-type: none"> ▪ Potential for increased flows offsite from discharge of construction water. During the construction and development stage, key infrastructure and facilities will be constructed that may require water taking and discharge of construction water. ▪ Potential increase in storm runoff and discharge to the receiving and surrounding environment. ▪ The construction of a waste disposal (landfill) facility and additional infrastructure have the potential to disrupt natural surface water drainage patterns, causing a potential for increased flooding of off-site receivers. 	<ul style="list-style-type: none"> ▪ Any discharge of construction water will comply with applicable regulations, guidelines, permits and industry practices, and will be permitted appropriately ▪ Stormwater Management system / facility will be designed to provide controlled discharge rate to Ten Mile Creek or to the Old Welland Canal via the 1,200 mm pipe based on post-closure to pre-quarry peak flow conditions. ▪ Surface water conveyance ditches and emergency overflow spillways will be designed to accommodate 1:100-year storm runoff rates based on 2021–2050 climate-adjusted IDF curves for high emission scenario (RCP 8.5). ▪ The stormwater management system and sewage works will be designed, constructed, and operated in accordance with applicable separate approvals (e.g., ECA through MECP), guidelines and industry practices. ▪ Environmental monitoring will be completed in accordance with various ECAs. 	<p>Discharge to surface water with no increase in peak flow in the surrounding off-site watercourses/receivers (i.e., Ten Mile Creek or the Old Welland Canal).</p> <p>NO NET EFFECTS</p>

6 CUMULATIVE IMPACT ANALYSIS

As part of the approved Terms of Reference (ToR), Walker committed to undertaking an assessment of the cumulative effects of the landfill and other Campus components/facilities and other non-Walker projects that are existing, planned, approved or reasonably foreseeable. The following were considered in the assessment of cumulative impacts:

- Walker Activities/Projects on Campus
 - Ongoing quarry operations
 - New residential drop off area
 - RNG 2 – expansion of existing renewable natural gas facilities
- Walker Projects off Campus
 - Uppers Quarry
- Non-Walker Projects
 - Garden City Bridge Twinning
 - Glendale Secondary Plan Area development
 - Development at Niagara College’s Niagara-on-the-Lake Campus
 - Northwest Secondary Plan Area development
 - Golf course/agro-tourism development to east of the Walker Campus
 - Garner West Secondary Plan Area development
 - Welland Thorold Power Line Project

The effects on surface water quantity and quality from the Walker activities/Projects on Campus and the proposed South Landfill Phase 2 activities will overlap spatially and temporally. However, the effects are not expected to cumulate because the existing operations are approved and future developments will be in compliance with the regulations, guidelines and industry practices (including stormwater quantity and quality controls) and the effluent released from the other projects on the Campus are similarly expected to be monitored to ensure they meet the discharge requirements. Therefore, the predicted cumulative effects (increases in the surface water quantity or the negative change to water quality) to the natural/receiving environment are not expected to be significant and greater than predicted Project net effect (no net effect).

The effects from the Walker’s Uppers Quarry project located outside of the LSA are expected to overlap spatially (at RSA level) and temporally, noting that the project schedule (start, duration and end) and details on water management are not known. It is expected that the ultimate receiver of the stormwater runoff will be Welland Canal. From surface water perspective, it is anticipated that the Uppers Quarry project will be designed to provide surface water quantity and quality control and the effluent released from the project will be monitored to ensure it meets applicable regulations, and therefore cumulative effects are not expected from the Uppers Quarry project.

Similarly, effects from non-Walker projects located within the LSA (Golf course/agro-tourism development to east of the Walker Campus) are expected to spatially and temporally overlap. From surface water perspective, it is anticipated that the project will be designed to provide surface water quantity and quality control and the effluent released from the project will also be monitored to ensure it meets applicable regulations, and therefore cumulative effects are not expected to be significant and greater than predicted Project net effect (no net effect). Nonetheless, monitoring in Ten Mile Creek upstream of the SSA (downstream of the development site) will be undertaken to identify potential water quality issues.

Effects from other non-Walker projects within the RSA but outside of LSA (i.e., Garden City Bridge Twinning, Glendale Secondary Plan Area development, development at Niagara College's Niagara-on-the-Lake Campus, Northwest Secondary Plan Area development, Garner West Secondary Plan Area development and Welland Thorold Power Line Project) will spatially (at the RSA level) and temporally overlap. However, from surface water perspective, surface water quantity and quality controls are anticipated to be provided, and therefore the cumulative effects are not expected to be significant and greater than predicted Project net effect (no net effect).

7 CLIMATE CHANGE CONSIDERATIONS

In accordance with the Minister-approved ToR, the detailed impact assessment is to include consideration of climate change. In support of the province of Ontario's Climate Change Action Plan, the Ministry of the Environment, Conservation and Parks (MECP) developed a Guide entitled "Consideration of Climate Change in Environmental Assessment in Ontario" (the Guide) to aid proponents in considering climate change as part of EAs for infrastructure and facilities (MECP, 2016).

The Guide outlines the Ministry's expectations for considering climate change throughout the EA process. As stated in Section 3 of the Guide, consideration is to include:

- Greenhouse gas (GHG) emissions
- Effects of a project on climate change
- Effects of climate change on a project
- How the project will minimize identified negative effects on climate change.

The preceding was considered as part of the South Landfill Phase 2 EA in addressing the potential climate risks to the Alternative Methods. During the impact assessment, the climate change adaptation and mitigation analysis undertaken for the Alternative Methods stage was used and augmented, as needed, to develop climate change mitigation and adaptation measures for the Preferred Method. Climate change considerations relevant to surface water are documented in the following subsections.

7.1 Potential Effects of the Undertaking on Climate Change

From surface water perspective, no potential effects of the undertaking on climate changes are expected.

7.1.1 Mitigation

No additional mitigation measures are required.

7.2 Potential Effects of Climate Change on the Undertaking

Climate change has the potential to affect many of the existing weather patterns and current conditions influencing the Project. Climate change will directly alter temperature and precipitation patterns, both in terms of

average conditions and extreme events. Climate models that provide projections of future climatic conditions show change in rainfall pattern, among other changes to local climate, which will lead to heavier and more frequent rainfall events. Extreme rainfall amounts over short periods can lead to flooding due to runoff. Climate change effects are uncertain, but probable to occur and may affect surface water quantity and quality.

It is expected that the planned 20 years operational period of the landfill expansion will be too short to be significantly affected by impacts from climate change. However, during the post-closure period, longer term changes in precipitation patterns and temperature could possibly affect the vegetative cover growth on the closed landfill and/or runoff of surface water from the landfill final cover and the performance of the components that comprise the stormwater management system (e.g., stormwater management ponds, ditches, emergency overflow spillway). For example, an increase in precipitation and/or an increase in storm intensity or duration compared to historical design storms would increase the amount of runoff, potentially resulting in surface erosion of the vegetated landfill final cover surface and exceedance of the capacity of the stormwater management system.

7.2.1 Adaptation

To mitigate the climate change impacts, the following mitigation measures were incorporated into the design of stormwater management system for the South Landfill Phase 2:

- Stormwater management ponds have been stress-tested to accommodate the runoff volumes projected under 2021–2050 climate-adjusted Intensity-Duration-Frequency (IDF) curves for high emission scenario (RCP 8.5). During larger storm events, this added capacity will improve runoff retention and reduce potential effects on downstream off-site receivers. In addition, the permanent storage volume in each proposed pond has been designed to achieve 80% TSS removal (enhanced treatment) based on a conservative 35% imperviousness assumption. This will improve removal of suspended solids during larger storms and help reduce potential surface water quality effects on the off-site receivers.
- Design of ditches and emergency overflow spillways were also designed to accommodate runoff rates based on 2021–2050 climate-adjusted IDF curves for high emission scenario (RCP 8.5) to check/confirm that the stormwater runoff conveyance could still be expected to manage the increased flows.

The evaluation indicates that under the South Landfill Phase 2 conditions, the proposed stormwater management facilities will be capable of acceptably controlling discharge from the site, including consideration of increased precipitation associated with climate change as described above.

For details on climate change considering in the stormwater management system design, refer to Hydrological Modelling and Stormwater Management System Design Report (WSP, 2026b) appended to **Appendix A**.

8 ENVIRONMENTAL MONITORING

To ensure that the mitigation measures identified in **Section 5** are implemented as envisioned, a strategy and schedule was developed for monitoring environmental effects. With these mitigation measures and monitoring requirements in mind, commitments have also been proposed for ensuring that they are carried out as part of the construction, operation, and maintenance of the landfill.

8.1 Environmental Effects Monitoring

A monitoring strategy and schedule was developed based on the Surface Water Impact Assessment carried out for the Preferred Method to ensure that 1) predicted net negative effects are not exceeded, and 2) unexpected

negative effects are addressed. **Table 8-1** lists the proposed monitoring requirements for each potential effect identified in the Surface Water Impact Assessment. It is anticipated that the existing ECA for the South Landfill (1032-9M5LRW, April 20, 2016) will be amended to include the two new stormwater pond facilities and that the monitoring and trigger parameters will be consistent.

Table 8-1: Surface Water Proposed Monitoring Requirements

Potential Effect	Proposed Monitoring Requirement	Associated Licences, Permits or Authorizations
Surface Water Quantity	Environmental monitoring (water quantity) as appropriate in accordance with the construction water discharge requirements during construction and development of landfill and related infrastructure.	Environmental Compliance Approval (ECA) or Environmental Activity and Sector Registry (EASR), as applicable depending upon construction activity.
Surface Water Quality	Environmental monitoring (water quality) as appropriate in accordance with the construction water discharge requirements during construction and development of landfill and related infrastructure. In addition, monitoring / inspecting all erosion and sediment management measures to verify the performance and effectiveness of mitigation measures.	Environmental Compliance Approval (ECA) or Environmental Activity and Sector Registry (EASR), as applicable depending upon construction / development activity.
	<p>Environmental monitoring and sampling at the following stations to be conducted during the operations phase of the Project in accordance with the monitoring requirements outlined in the existing stormwater management ECA No. 1032-9M5LRW April 20, 2016:</p> <ul style="list-style-type: none"> ▪ North Stormwater Management Pond outlet ▪ South Stormwater Management Pond outlet ▪ North Stormwater Management Pond emergency overflow outlet ▪ South Stormwater Management Pond emergency overflow outlet ▪ Ten Mile Creek station upstream of North Stormwater Management Pond outlet¹ <p>In addition to quarterly and bi-annual sampling at abovementioned monitoring stations for parameters listed in ECA No. 1032-9M5LRW, stormwater sampling should also be completed at outlets of North and South stormwater management ponds prior to any planned batch discharge for trigger parameters listed in the ECA No. 1032-9M5LRW.</p> <p>For details about proposed environmental monitoring program, refer to Hydrological Modelling and Stormwater Management Report in Appendix A.</p>	Environmental compliance approval (ECA) for operations

Note:

1. To record the Ten Mile Creek background concentrations. Samples to be laboratory tested for same parameters as the North and South Stormwater Management Pond outlet samples.

8.2 Development of an Environmental Management Plan

An Environmental Management Plan (EMP) will be prepared following approval of the undertaking by the Minister of the Environment, Conservation and Parks and prior to construction. The EMP will include a description of the proposed mitigation measures, commitments, and monitoring.

9 COMMITMENTS

The following commitments have been proposed for ensuring that the identified mitigation or compensation measures and monitoring requirements are carried out as part of the construction, operation, and maintenance of the undertaking:

- Stormwater management system / facility providing quantity and quality control
- Climate change considerations in the design of stormwater management system / facility
- Compliance to permits and approval for the on-site stormwater management and sewage works
- Implementation of environmental monitoring program

10 SURFACE WATER APPROVALS REQUIRED FOR THE UNDERTAKING

The following approvals are required for surface water-related components for the proposed undertaking:

- Construction phase
 - Environmental Activity and Sector Registry (EASR) or Environmental Compliance Approval (ECA)
- Operation phase
 - Environmental Compliance Approval (ECA)

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APPENDIX A

**Hydrological modelling and
Stormwater Management System
Design Report**



DRAFT REPORT

Hydrological Modelling and Stormwater Management System Design Report

Walker South Landfill Phase 2 Environmental Assessment

Submitted to:

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Table of Contents

1	INTRODUCTION	1
1.1	Objectives.....	1
2	METEOROLOGICAL AND INTENSITY-DURATION-FREQUENCY DATA	1
2.1	Meteorological Data	1
2.1.1	Intensity-Duration-Frequency for Design Storm Events	2
2.1.2	Climate Change Adjustments	3
2.1.3	Climate Change Scaled Intensity-Duration-Frequency for Design Storm Events	3
3	DRAINAGE CONDITIONS	4
4	HYDROLOGICAL ASSESSMENT AND STORMWATER MANAGEMENT SYSTEM DESIGN	5
4.1	Hydrological Modelling Parameters and Results	6
4.2	Stormwater Management System Design	9
4.2.1	Stormwater Quality Control.....	9
4.2.2	Stormwater Quantity Control.....	9
4.2.3	Total Required Storage.....	10
4.2.4	Release Rate to the Receiving / Surrounding Environment	10
4.2.5	Surface Water Conveyance Ditches	12
4.2.6	Forebay Design Requirement.....	13
4.2.7	Emergency Overflow Spillway/Weir	15
5	EROSION AND SEDIMENT CONTROL PLAN	17
6	ENVIRONMENTAL MONITORING PROGRAM	17
7	CONCLUSIONS	20
8	LIMITATIONS AND ASSUMPTIONS	21
9	CLOSURE	21
10	REFERENCES	22

TABLES

Table-1: Geographical Information of Climate Stations.....	1
Table-2: Average Monthly and Annual Climate Data at Welland-Pelham Station (1991 to 2020).....	2
Table-3: Environment Canada – Welland-Pelham - Rainfall Intensity-Duration-Frequency Data, 2006 - 2021	2
Table-4: 2021-2050 Climate Change Adjusted Rainfall Intensity-Duration-Frequency Data.....	3
Table-5: Changes to the Southeast Quarry Drainage Area Due to the Proposed South Landfill Phase 2 Expansion.....	5
Table-6: Development Condition and Model Inputs	7
Table 7: Development Conditions and the Unmitigated Peak Runoff Rates Under 1:2-year to 1:100-year storms.....	8
Table-8: Required Storage Volumes for Quality Control	9
Table-9: Required Active Storage Volume for Quantity Control.....	9
Table-10: Required Storage Volume for Quality and Quantity Controls	10
Table-11: Provided Storage Volume for Quality and Quantity Controls	10
Table-12: Summary of Proposed Ditch Sizes.....	12
Table-13: Surface Water Conveyance Ditch Sizing	12
Table-14: Forebay Setting Length	13
Table-15: Dispersion Length	14
Table-16: Required Forebay Length.....	14
Table-17: Minimum Forebay Width	14
Table-18: Average Expected Velocity in Forebay	14
Table-19: Overflow Spillway/Weir Sizing Calculations	15
Table-20: Summary of Proposed SWM Ponds - MECP Design Criteria	15
Table-21: Monitoring Program – Stormwater Management Facilities	18
Table-22: Monitoring Parameter: North and South SWM Ponds Discharge Outlets	18
Table-23: Monitoring Parameters: North and South Ponds Discharge Outlets.....	19
Table-24: Monitoring Parameters: Emergency Overflow Outlet Locations	19
Table-25: Trigger Parameters (Source/Reference: ECA # 1032-9M5LRW, dated April 20, 2016).....	20

FIGURES

Figure 1: General Site Plan and Catchment Area	25
Figure 2: Existing Site Conditions - Drainage.....	26
Figure 3: Proposed Site Conditions - Drainage.....	27

Figure 4: Proposed Stormwater Management Plan – Conceptual Design.....28

Figure 5: Proposed Stormwater Management Plan – Preliminary Design Details North SWM Pond.....29

Figure 6: Proposed Stormwater Management Plan – Preliminary Design Details South SWM Pond30

Figure 7: Proposed Erosion and Sediment Control Measures31

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Walker Environmental Group (Walker) to assess surface water characteristics, under the current and future conditions, in support of an Environmental Assessment (EA) to develop the next phase of the existing South Landfill (i.e., South Landfill Phase 2, the Site) located at the Walker Resource Management Campus (Campus).

The proposed South Landfill Phase 2 would extend its approved capacity by approximately 19.7 million m³ 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.

1.1 Objectives

The principal objective of the surface water modelling is to evaluate the storm flow characteristics under various development conditions (existing, future existing, pre- and post-development) conditions and provide a preliminary stormwater management system design in order to assess and mitigate the impacts of the Site's stormwater runoff (water that does not come into contact with waste) on the receiving and surrounding environment (e.g., Ten Mile Creek, Old Welland Canal).

2 METEOROLOGICAL AND INTENSITY-DURATION-FREQUENCY DATA

2.1 Meteorological Data

Two Environment Canada operated climate stations are located at approximately 17 km and 23 km southwest of the study area. The geographical details of these climate stations are presented in **Table-1**. These stations are listed as Welland-Pelham (6139449), and Welland (6139445); the Welland station operated from 1872 to 2014, while the Welland-Pelham ('Climate Station') station began operating at the airport in 2014. Hourly weather and climate data are available from 2006 to 2026 at this location, although precipitation is only available from 2014. For the purposes of the modelling input, data from the Welland-Pelham station was selected since it represents the most complete dataset for the recent period.

Table-1: Geographical Information of Climate Stations

Station Name	Station ID	Latitude	Longitude	Elevation
Welland-Pelham	ID:6139449	42°58'00.000" N	79°20'00.000" W	178.00 m
Welland	ID:6139445	42°59'33.096" N	79°15'40.098" W	175.30 m

Table-2 summarizes average monthly and annual climate data for Welland-Pelham between 1991 to 2020. The climate normals produced by Environment Canada for the Welland-Pelham are assumed to be representative of those at the Site given the proximity to the Site (the station is 23 km south west of the Site), comparable elevation (the station gauge is at 178 masl, equivalent to the 175-185 masl range at the Site and availability of most recent data. Annual mean air temperature was 8.9°C with above-zero mean monthly temperatures from March to November (inclusive). Monthly mean air temperatures ranged from -4.1° (January) to 21.5°C (July). Annual total precipitation was 967 mm with 844.2 mm of rainfall and 141 cm of snowfall. Rainfall occurred throughout the year, with the highest amounts recorded in May through to November. Snowfall accounts for the balance of total

precipitation accumulating over the winter months with significant melt typically occurring in the months of December and February.

Table-2: Average Monthly and Annual Climate Data at Welland-Pelham Station (1991 to 2020)

Period	Mean Monthly Air Temperature (°C)	Total Monthly Precipitation (mm)	Monthly Rainfall (mm)	Monthly Snowfall (cm)
January	-4.1	81.6	49.6	43.9
February	-3.8	52.8	25.8	23.7
March	0.7	70.3	41.2	28
April	7.1	83.1	72.8	4.7
May	13.7	81	84.2	0
June	19	85.7	78.8	0
July	21.5	84	88.3	0
August	20.7	78.7	82.6	0
September	17	96	101.5	0
October	10.6	88.5	88.8	0.4
November	4.5	83.7	85.3	8.7
December	-0.7	81.6	45.3	31.7
Annual	8.9	967	844.2	141

2.1.1 Intensity-Duration-Frequency for Design Storm Events

The Environment Canada intensity-duration-frequency (IDF) data from the Welland-Pelham climate station is presented in **Table-3**. These values are based on historical rainfall information (from 2006 to 2021) and are used to estimate rainfall depths associated with peak rainfall events with durations from 5-minutes to 24-hours for return periods between 1:2-year and 1:100-year. The values were also used to generate rainfall hyetographs for 1:2-year through 1:100-year rainfall events. The hyetographs were used in the hydrological assessment to estimate peak flow hydrographs.

Table-3: Environment Canada – Welland-Pelham - Rainfall Intensity-Duration-Frequency Data, 2006 - 2021

Rainfall Duration	Return Period (years)					
	1:2-year	1:5-year	1:10-year	1:25-year	1:50-year	1:100-year
	Rainfall Depth (mm)					
5-minute	8.7	10.4	11.6	13	14.1	15.1
10-minute	12.9	15.4	17.2	19.3	20.9	22.5

Rainfall Duration	Return Period (years)					
	1:2-year	1:5-year	1:10-year	1:25-year	1:50-year	1:100-year
	Rainfall Depth (mm)					
15-minute	15.6	19.4	21.9	25.1	27.5	29.8
30-minute	20.3	25.4	28.8	33.1	36.2	39.4
1-hour	22.9	28.4	32	36.5	39.9	43.2
2-hour	27.4	35.1	40.2	46.7	51.5	56.2
6-hour	36.7	46.9	53.7	62.2	68.5	74.8
12-hour	41.7	53.5	61.4	71.3	78.6	85.9
24-hour	47.7	61.9	71.3	83.2	92	100.8

2.1.2 Climate Change Adjustments

The approved Terms of Reference (ToR) Site EA requires that climate change should be considered in this environmental assessment. Climate change was accounted for as follows:

- Adjustments to the peak rainfall event hyetographs based on climate change-scaled IDF curves for high emission scenario (RCP 8.5).

2.1.3 Climate Change Scaled Intensity-Duration-Frequency for Design Storm Events

The climate change-scaled IDF curves for the Welland-Pelham station for the periods of 2021 to 2050 were obtained from climatedata.ca website (climatedata.ca, 2026) for high emission scenario (RCP 8.5).

The climate change-scaled IDF data for the period of interest are presented in **Table-4**. Results show increasing rainfall depth for future time periods compared to existing conditions. These values were used to generate storm hyetographs to model peak flow conditions due to climate change.

Table-4: 2021-2050 Climate Change Adjusted Rainfall Intensity-Duration-Frequency Data

Rainfall Duration	Return Period (years)					
	1:2-year	1:5-year	1:10-year	1:25-year	1:50-year	1:100-year
	Rainfall Depth (mm)					
5-minute	10.3	12.3	13.6	15.3	16.5	17.8
10-minute	15.2	18.2	20.2	22.7	24.5	26.3
15-minute	18.3	22.8	25.8	29.5	32.3	35.0
30-minute	24.0	30.0	34.0	39.0	42.5	46.5

Rainfall Duration	Return Period (years)					
	1:2-year	1:5-year	1:10-year	1:25-year	1:50-year	1:100-year
	Rainfall Depth (mm)					
1-hour	27.0	33.0	38.0	43.0	47.0	51.0
2-hour	32.0	42.0	48.0	54.0	60.0	66.0
6-hour	43.2	55.2	60.0	72.0	78.0	90.0
12-hour	49.2	63.6	72.0	82.8	92.4	102.0
24-hour	55.2	74.4	84.0	98.4	108.0	117.6

3 DRAINAGE CONDITIONS

The proposed South Landfill Phase 2 is located within the Ten Mile Creek watershed. The proposed landfill will be constructed within an exhausted Southeast Quarry. The construction of a waste disposal facility has the potential to disrupt natural surface water drainage patterns, causing a potential for increased flooding. **Figure 1** shows the general site plan and catchment area of Ten Mile Creek at a monitoring station west of the Site (SW8).

The existing Southeast Quarry has a footprint of approximately 66 ha. The South Landfill Phase 2 will have a footprint of approximately 81.30 ha, owned and operated by Walker, that will 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.

Under the existing condition, the water from the Southeast Quarry Sump, following retention for sediment settling, is pumped west under Taylor Road into a 1200 mm diameter pipe. This 1200 mm pipe conveys flow west around the south end of the South Landfill, then north under the East Landfill before discharging it to the Old Welland Canal. **Figure 2** shows the layout of existing on-site Walker Drainage System.

As the South Landfill Phase 2 expansion proceeds, storm runoff from the landfill will be collected and directed towards the proposed stormwater management ponds for retention and to provide post- to pre- (i.e., post-closure to pre-quarry) peak flow conditions. The ponds will be designed to attenuate peak flow rates to existing or pre-development (pre-quarry) conditions for design storm events from 1:2-year through 1:100-year return periods, as required by O.Reg. 232/98 Landfill Standards. The proposed stormwater management facility will also be designed to provide quality treatment.

The proposed stormwater management plan for the South Landfill Phase 2 includes two stormwater management (SWM) ponds located in the northeast (North SWM Pond) and south (South SWM Pond) of the Site adjacent to the proposed South Landfill Phase 2 (**Figure 3**). The proposed landfill drainage area is divided into four catchments (North, East, West and South), with the North catchment draining to North SWM Pond and, the remainder to the South SWM Pond via proposed on-site surface water conveyance ditches.

Figure 3 shows the stormwater management plan highlighting locations of the North and South SWM Ponds, perimeter ditches, and delineation of local catchments draining runoff to the proposed SWM ponds.

The changes in storm flows were accounted for in the hydrological model by incorporating changes to watershed/catchment area contributing to the storm runoff, as provided in **Table-5**. To maintain consistency in drainage area for post- to pre- peak flows comparisons, two pre-development conditions: pre-development (pre-quarry and only quarry footprint) with a drainage area of 66 ha and pre-development (pre-quarry with the landfill footprint) with a drainage area of 81 ha were assessment. The results of pre-development condition (pre-quarry, quarry footprint) were used to compare to the future existing condition (rehabilitated quarry), and the results of pre-development condition (pre-quarry, landfill footprint) were used to compare to the proposed post-development condition (expansion to landfill, post closure).

Note that the future existing condition (rehabilitated quarry) corresponds to ‘Do Nothing’ option of the impact assessment of the South Landfill Phase 2, i.e., the landfill is not expanded, the quarry is exhausted and the area is rehabilitated.

Table-5: Changes to the Southeast Quarry Drainage Area Due to the Proposed South Landfill Phase 2 Expansion

Watershed	Catchment Area (km2)			
	Pre-development Condition (Pre-quarry, Quarry Footprint)	Pre-development Condition (Pre-quarry, Landfill Footprint)	Proposed Condition (Expansion to Landfill, Post-closure)	Future Existing Condition (Rehabilitated Quarry)
Southeast Quarry / South Landfill Phase 2	0.66	0.81	0.81	0.66

4 HYDROLOGICAL ASSESSMENT AND STORMWATER MANAGEMENT SYSTEM DESIGN

To assess the impact of the proposed landfill expansion on the surface water quantity in the nearby receiver (Ten Mile Creek, Old Welland Canal), the hydrological assessment of the peak runoff rates from the proposed South Landfill Phase 2 watershed under various development conditions was completed. The Southeast Quarry and the South Landfill Phase 2 catchments were assessed under the pre-development (pre-quarry with existing quarry footprint (66 ha) and pre quarry with proposed landfill footprint (81 ha)), post-development (expansion to landfill, post-closure) and future existing (rehabilitated quarry) conditions.

The peak storm flows under different development conditions were determined using the U.S. Environmental Protection Agency (EPA) Stormwater SWMM software for the 1:2- to 1:100-year storm events. Under the proposed conditions stormwater management system for the South Landfill Phase 2 will consist of perimeter ditches draining into two proposed stormwater management (SWM) ponds located in the northeast (North SWM Pond) and the south (South SWM Pond) of the Site, adjacent to the proposed South Landfill Phase 2. The design criteria for the SWM ponds were as follows:

- Stormwater quantity control** – The ponds will be operated in a batch discharge mode such that they will retain all storm runoff up to and including from the 1:100-year storm without discharge. Following water quality sampling and confirmation of suitable results, the retained volume will be discharged such that post-expansion (post-closure) outlet flows will be controlled to corresponding pre-expansion (pre-quarry) flows for the 1:2-year through the 1:100-year return period design storm. Niagara Peninsula Conservation Authority

Stormwater Management Guidelines (AECOM, 2010), recommends, at a minimum, the 3-hour Chicago, 12-hour AES and 24-hour SCS distributions should be considered. In addition, the peak runoff flows were also estimated for Hurricane Hazel.

- **Stormwater quality control** – Provide enhanced (80%) long-term TSS removal to provide the “highest level” of quality control of stormwater. Water quality storage requirements were determined based on Table 3.2 of the Stormwater Management Planning and Design Manual (Ministry of Environment, 2003)

The stormwater management system design was stress tested for 2021-2050 climate change-scaled IDF (**Section 2.1.3**). Ditches were sized to convey the 1:100 return period design storm as per O. Reg. 232/98. While all storm distributions (24-hour SCS type II, 12-hour AES, and 3-hour Chicago) were assessed for the storage capacity requirements and the release rate estimation, Chicago 3-hour storm flows were used for sizing the ditches and Hurricane Hazel and 1:100-year storm (under climate change) flows for sizing of the emergency overflow spillways of the proposed SWM ponds.

4.1 Hydrological Modelling Parameters and Results

The hydrological modelling parameters for the modelled catchments under different development conditions are provided in **Table-6**, and the storm distributions with the rainfall amount, and the unmitigated peak runoff rates are provided in **Table 7**.

As expected, the post-development storm runoff from the expanded South Landfill Phase 2 (post-closure) would increase compared to the corresponding pre-development (pre-quarry) conditions requiring post- to pre-development flow control. The pre-development (pre-quarry, landfill footprint) flows for 3-hour Chicago storm were noted to be lowest compared to other storm distributions and were adopted as the release rates for the quantity control (post- to pre- development peak flows control).

The storm peak flows under future existing (rehabilitated quarry), the ‘Do Nothing’ option, were estimated and were found to be generally 4 to 8% more than pre-development flows, except for 1:2-year 3-hour Chicago storm that was 12% more than the corresponding pre-development (pre-quarry, quarry footprint) flows. The increase in storm flows under the future existing conditions is due to changes in land cover and catchments slopes and are not expected to impact the flows in the nearby stream as the storm runoff will be captured, retained and released at the pre-development rates. Refer to **Table-6** for details on modelling parameters for pre-development (pre-quarry with existing quarry footprint (66 ha) and pre quarry with proposed landfill footprint (81 ha)), post-development (expansion to landfill, post-closure) and future existing (rehabilitated quarry) conditions.

Table-6: Development Condition and Model Inputs

Development Conditions	Area (ha)	Width (m)	Slope (%)	Site Imperviousness (%)	Mannings N Impervious	Mannings N Pervious	Depression Storage Impervious (mm)	Depression Storage pervious (mm)	Curve Number	Drying Time (days)
Proposed South Landfill Phase 2 Watershed										
Pre-development Condition (Pre-Quarry, Quarry Footprint)										
Catchment (101)	66	631	0.5	0	0.015	0.25	1	5	85	7
Pre-development Condition (Pre-Quarry, Landfill Footprint)										
Catchment (1001)	81	631	0.5	0	0.015	0.25	1	5	85	7
Post-development Condition (Expansion to Landfill, Post-closure)										
North Catchment (201)	26.1	1160	10.6 ¹	0 ²	0.015	0.25	1	5	85	7
East Catchment (202)	23.5	940	10.6 ¹	0 ²	0.015	0.25	1	5	85	7
West Catchment (203)	23.9	950	10.6 ¹	0 ²	0.015	0.25	1	5	85	7
South Catchment (204) ³	7.3	243	0.5	0 ²	0.015	0.25	1	5	88	7
Future Existing Condition (Rehabilitated-Quarry)										
Rehabilitated Catchment (301)	66	631	0.8	0	0.015	0.25	1	5	86	7

Notes:

1. Based on the approximate average slope of proposed landfill mound and drainage path to the proposed stormwater management ponds.
2. Assumed 35% for permanent pool/storage estimate.
3. For conservative estimate, South catchment is assumed to drain to South SWM Pond after development (post-closure).

Table 7: Development Conditions and the Unmitigated Peak Runoff Rates Under 1:2-year to 1:100-year storms

Development Case	Sub-catchment	Peak Flow (m ³ /s)													Hurricane Hazel ²
		Area (ha)	25 mm 3-hour Chicago storm	1:2-year 3-hour Chicago Storm	1:100-year 3-hour Chicago Storm	1:2-year 12-hour AES Storm	1:100-year 12-hour AES Storm	1:2-year 24-hour SCS Type II Storm	1:5-year 24-hour SCS Type II Storm	1:10-year 24-hour SCS Type II Storm	1:25-year 24-hour SCS Type II Storm	1:50-year 24-hour SCS Type II Storm	1:100-year 24-hour SCS Type II Storm	1:100-year 24-hour SCS Type II Storm (2021-2050)	
Rainfall Amount (mm)	-	-	25	31.1	61	41.7	85.9	47.7	61.9	71.3	83.2	92	100.8	117.6	285
Proposed South Landfill Phase 2 Watershed															
Pre-development Condition (Pre-Quarry, Quarry Footprint)	-	66	-	0.05	0.45	0.13	0.76	0.13	0.26	0.37	0.54	0.66	0.83	1.16	5.13
Pre-development Condition (Pre-Quarry, Landfill Footprint)	-	81	-	0.05	0.47	0.13	0.81	0.14	0.28	0.39	0.57	0.69	0.87	1.22	5.86
Post-development Condition (expansion to landfill, post-closure) ¹	North	26.1	0.07	0.17	1.25	0.24	0.93	0.45	1.09	1.61	2.32	2.77	3.39	4.52	3.24
	East, West and South	54.7	0.14	0.32	2.30	0.47	1.80	0.81	1.93	2.84	4.12	4.94	6.07	8.15	7.29
	Total	81	0.21	0.49	3.55	0.71	2.73	1.26	3.02	4.45	6.44	7.71	9.46	12.67	10.93
Future Existing Condition (Rehabilitated-Quarry)															
Future Existing Conditions (Rehabilitated-Quarry)	-	66	-	0.06	0.48	0.14	0.79	0.14	0.28	0.4	0.57	0.69	0.86	1.21	5.13

Note:

1. Flows from all sub-catchments (North, East, West and South Catchments).
2. For Hurricane Hazel, a curve number (CN) of 94 was used

4.2 Stormwater Management System Design

As discussed above, stormwater management plan includes the North SWM Pond and the South SWM Pond which will receive runoff from the network of surface water conveyance ditches. Both ponds are designed as wet ponds having permanent pool and active storage to provide required quality and quantity controls.

Figure 4 shows proposed the stormwater management conceptual plan highlighting locations of the North and South SWM Ponds, perimeter ditches, and delineation of local catchments draining runoff to the proposed SWM ponds. The following sub-sections provide details of stormwater management system design.

4.2.1 Stormwater Quality Control

Based on Table 3.2 of the Ministry of Environment, Conservation and Parks (MECP) Stormwater Management planning and Design Manual (Ministry of Environment, 2003), the sizing of the permanent pool to meet Enhanced Level (80% TSS removal) water quality treatment for a wet pond was estimated. A summary of the data, assumptions and estimates is provided in **Table-8**.

Table-8: Required Storage Volumes for Quality Control

Pond	Drainage Area (ha)	Imperviousness (%)	Total Volume (m ³)	Extended Detention Volume (m ³)	Permanent Pool Volume (m ³) ²
North SWM Pond	26.1	35 ¹	3,648	1,042	2,606
South SWM Pond	54.7	35 ¹	7,664	2,190	5,474

Notes:

1. Assumed imperviousness of 35% for permanent pool volume estimate. This corresponds to lowest published impervious level in Table 3.2 (Ministry of Environment, 2003).
2. These estimates are based on the lowest published impervious level of 35% in Table 3.2 (Ministry of Environment, 2003).

4.2.2 Stormwater Quantity Control

All stormwater runoff from the proposed South Landfill Phase 2 will be stored in the proposed SWM ponds, laboratory tested for potential parameter of concern impacts and then batch discharged after confirming the discharge water quality. Since the runoff cannot be released during the storm event (i.e., all the runoff is to be retained on-site prior to discharge), the 1:100-year storms will provide the maximum required active storage. The required active storage volumes for 1:100-year storms (3-hour Chicago, 12-hour AES and 24-hour SCS Type II) for North and South SWM Ponds are provided in **Table-9**.

Table-9: Required Active Storage Volume for Quantity Control

Pond	Storm Event	Peak Runoff to Pond (m ³ /s)	Maximum Active Storage Volume (m ³) ²
North SWM Pond	1:100-year 3-hour Chicago II Storm	1.25	7,579
	1:100-year 12-hour AES Storm	0.93	13,194
	1:100-year 24-hour SCS Type II Storm	3.39	16,836
	1:100-year 24-hour SCS Type II Storm (2021-2050 climate change scaled-IDF)	4.52	20,911
	1:100-year 3-hour Chicago II Storm	1.06, 1.07, 0.17 ¹	16,029

Pond	Storm Event	Peak Runoff to Pond (m ³ /s)	Maximum Active Storage Volume (m ³) ²
South SWM Pond	1:100-year 12-hour AES Storm	0.81, 0.81, 0.18 ¹	28,253
	1:100-year 24-hour SCS Type II Storm	2.86, 2.9, 0.31 ¹	35,865
	1:100-year 24-hour SCS Type II Storm (2021-2050 climate change scaled-IDF)	3.84, 3.89, 0.42 ¹	44,424

Note:

1. First, 2nd and 3rd values represent peak runoff rates from the East, West and South catchments draining to the South SWM Pond.
2. **Bold** values represent maximum required storage for quantity control, not including climate change scenarios.

4.2.3 Total Required Storage

Total storage is the sum of storage for stormwater quality control (**Table-8**) and quantity control (**Table-9**). A summary of total storage is provided in **Table-10**.

Table-10: Required Storage Volume for Quality and Quantity Controls

Pond	Permanent Storage (m ³)	Active Storage (m ³)	Total Storage (m ³)
North SWM Pond	2,606	16,836	19,442
South SWM Pond	5,474	35,865	41,339

To meet the storage requirements, proposed SWM pond sizes are presented in **Table-11**.

Table-11: Provided Storage Volume for Quality and Quantity Controls

Pond	Bottom Width and Length (m)	Side Slope	Permanent Pool Depth (m)	Total Depth (Excluding freeboard) (m)	Permanent Storage Provided (m ³)	Active Storage Provided (m ³)	Total Storage (m ³)
North SWM Pond	7 x 575	3:1	1	2.7	5,697	16,957	22,654
South SWM Pond	75 x 225 ¹	3:1	1	2.8	17,785	36,746	54,531

Note:

1. 225 m represent average length of the South SWM Pond.

The proposed North SWM Pond will provide permanent and active storage volumes of 5,697 m³ and 16,957 m³, respectively, that exceed the storage requirements (**Table-10**). Similarly, the South SWM Pond will provide permanent and active storage volumes of 17,785 m³ and 36,746 m³ respectively that exceed the storage requirements (**Table-10**). The storage capacity in both ponds was stress tested for storage under the 2021-2050 climate change scaled-IDF. Both ponds showed availability of additional temporary storage above 1:100-year storm level in the form of depth / storage to hold water for emergency weir flow and the pond freeboard.

4.2.4 Release Rate to the Receiving / Surrounding Environment

Based on the hydrological modelling results (**Table 7**), the lowest (conservative) release rates from the Site based on the pre-development (pre-quarry, landfill footprint (66 ha)) condition to the Ten Mile Creek, were estimated to be 0.05 m³/s and 0.47 m³/s for the 1:2-year and 1:100-year, 3-hour Chicago storms, respectively. The post-

development (expansion to landfill) discharges from both SWM ponds will be maintained below the pre-development runoff rates.

A two-stage outlet will be provided at both proposed SWM ponds to control the runoff to the receiving environment. Refer to **Figure 5** and **Figure 6** for details. Specific details of the two-stage outlets are as follows:

- The North SWM Pond outlet structure will consist of a 125 mm orifice plate at 1 m above the pond base (i.e. at the top of the permanent pool level) and a 280 mm orifice plate outlet at 1.5 m above the base (0.5m above the permanent pool level). The combined maximum release rate from the two outlet controls under the 1:100-year storm event storage level was estimated to be 0.22 m³/s. The draw-down time from the peak 1:100-year level to the permanent pool level was estimated to be approximately 3 days (69 hours) based on MOE Equation 4.11 (Ministry of Environment, 2003).
- The South SWM Pond outlet structure will consist of a 125 mm orifice plate at 1 m above the pond base (i.e. at the top of the permanent pool level) and a 280 mm pipe orifice outlet at 1.5 m above the base (0.5m above the permanent pool level). The combined maximum release rate from the two outlet controls under the 1:100-year storm event storage level was estimated to 0.23 m³/s. The draw-down time from the peak 1:100-year level to the permanent pool level was estimated to be approximately 14 days (341 hours) based on MOE Equation 4.11 (Ministry of Environment, 2003).
- The combined maximum release rate from both proposed SWM ponds under 1:100-year storm event was estimated 0.44 m³/s, which is less than the pre-development (runoff rate for 1:100-year 3-hour Chicago storm which was 0.47 m³/s.
- The secondary orifice on each pond is located 0.5 m above the permanent pool. The maximum expected flows from the North SWM Pond when the water level is at 0.5 m deep is 0.022 m³/s, while the maximum flow from the South SWM Pond with a starting depth of 0.5 m is 0.022m³/s. These depths correspond to the approximate depth of the runoff volume from a 1:2-year storm event and the combined discharge is less than the pre-development runoff rate of 0.05m³/s.

The discharge from the North SWM Pond will discharge to Ten Mile Creek. The South SWM Pond include two options to provide operational flexibility. The South SWM Pond can either be discharged to the existing 1200 mm pipe and then to the Old Welland Canal, as the current quarry sump does, or it could be discharged to Ten Mile Creek via a diversion structure to be located downstream of the South SWM Pond outlet. However, a discharge plan must be prepared to ensure that the total batch discharge from the Proposed South Landfill Phase 2 and other on-Campus stormwater facilities to the 1200 mm pipe does not exceed its flow carrying capacity and the release rate target of the receiving environment (Old Welland Canal, which is a regulated watercourse and ultimately discharges to Welland Canal).

It is understood that under the existing conditions, storm runoff from Southeast Quarry is batch discharged to Old Welland Canal via the 1200 mm pipe. It anticipated that the batch release of storm runoff from the SWM ponds to the Ten Mile Creek will return the flow regime to near pre-development conditions and would not affect the flow regime in the Ten Mile Creek.

The flow capacity of the 1200 mm pipe that discharges runoff from the existing Southeast Quarry to the Old Welland Canal was also assessed. At the 0.1% longitudinal slope, the capacity is estimated to be 1.29 m³/s. The maximum release rate from the South SWM Pond for 1:100-year 3-hour Chicago storms was estimated to be 17% of the 1200 mm pipe capacity when running full.

4.2.5 Surface Water Conveyance Ditches

During the continuing operations phase of the proposed South Landfill Phase 2 and the post-closure, it is proposed that the stormwater runoff from the proposed South Landfill Phase 2 will be collected by the proposed grass-lined trapezoidal shaped ditches and will be directed to a proposed North and South SWM Ponds. **Table-12** provides summary of proposed ditch sizes.

Table-12: Summary of Proposed Ditch Sizes

Stormwater Drainage Channel	Channel Cover and Cross Section Shape	Bed Width (m)	Design Parameters	
			Channel Depth (m) ¹	Channel Longitudinal Slope
North perimeter ditch	Grassed, trapezoidal	1.5	0.95	0.3%
East perimeter ditch				0.3%
West perimeter ditch				0.3%
South ditch	Grassed, trapezoidal	1	0.6	0.3%

Note:

1. Includes freeboard of 0.3 m

The on-site ditches have been designed to convey the peak runoff rate from the 1:100-year storm event and have been stress tested for climate change. A 3-hour Chicago distribution design storm was used to assess the surface water runoff from the contributing drainage areas for each ditch. The detailed calculations for required ditch sizing are provided in **Table-13**.

Table-13: Surface Water Conveyance Ditch Sizing

Description	North Catchment (201) Ditch	East Catchment (202) Ditch	West Catchment (203) Ditch	South Catchment (204) Ditch
1:100-year peak flow rate (m ³ /s)	1.25	1.06	1.07	0.17
Required Sizing				
Width, B (m)	1.5	1.5	1.5	1
Flow Depth, h (m)	0.6	0.6	0.6	0.25
Side slope, Z:1	3	3	3	3
Mannings' roughness	0.035	0.035	0.035	0.035
Channel bed slope, S (m/m)	0.003	0.003	0.003	0.003
Calculations				
Area, A (m ²)	1.98	1.98	1.98	0.44
Perimeter, P (m)	5.295	5.295	5.295	2.581
Hydraulic radius, R (m)	0.374	0.374	0.374	0.169
Calculated Flow rate, Q (m ³ /s) using Manning's Equation	1.61	1.61	1.61	0.21
Check	OK >Design flow rate	OK >Design flow rate	OK >Design flow rate	OK >Design flow rate

Refer to **Figure 6** for details.

4.2.6 Forebay Design Requirement

The following calculation summarizes the design requirements of the forebay as per the Section 4.6.2 of the Ministry of Environment Stormwater Management, Planning and Design Manual (Ministry of Environment, 2003).

Minimum Forebay Setting Length

$$Dist = \sqrt{\frac{rQ_p}{V_s}}$$

Where,

Dist= Forebay length (m)

r = Length-to-width ratio of forebay

Q_p = Peak flow rate from the pond during design quality storm (25 mm 3-hour Chicago storm)

V_s= Settling velocity (MECP recommended value is 0.0003 m/s)

Forebay settling length calculation for South and North SWM Ponds are provided in **Table-14**.

Table-14: Forebay Setting Length

Parameter	South SWM Pond	North SWM Pond
r	3.0	82.1
Q _p (m ³ /s) ¹	0.14	0.07
V _s (m/s)	0.0003	0.0003
Dist (m)	37.4	138.4

Note:

1. Total inflow to South SWM Pond from all ditches

Minimum Dispersion Length

$$Dist = \frac{8Q}{dV_f}$$

Where,

Dist= Length of dispersion (m)

Q= Inlet inflow rate (m³/s) [1:10-year 3-hour Chicago storm peak flow]

d= Depth of permanent pool in the forebay (m)

V_f= Desired velocity in the forebay (m/s)

Dispersion length calculation for South and North SWM Ponds are provided in **Table-15**.

Table-15: Dispersion Length

Parameter	South SWM Pond	North SWM Pond
Q (m ³ /s) ¹	1.0	0.53
d (m)	1	1
V _f (m/s)	0.5	0.5
Dist (m)	16.0	8.5

Note:

1. Total inflow to South SWM Pond from all ditches

The required forebay lengths based on the calculations above are noted below in **Table-16**.

Table-16: Required Forebay Length

Parameter	South SWM Pond	North SWM Pond
Forebay Length (m)	38	139

Minimum Forebay Bottom Width

$$Width = \frac{Dist}{8}$$

Where,

Width= Greater of the minimum forebay length or dispersion (m)

Forebay width calculation for South and North SWM Ponds are provided in **Table-17**.

Table-17: Minimum Forebay Width

Parameter	South SWM Pond	North SWM Pond
Dist (m)	38	139
Forebay width (m)	4.7	17.3

Note that due to site-specific constraints, a reduced width of 7 m was provided. An average velocity check (provided below) showed that the provided width satisfies the velocity requirement.

Average Velocity Check

For 1:10-year 3-hour Chicago storm, the inflow velocity in the forebay was estimated and provided in **Table-18**. The velocity is less than 0.15 m/s which, as stated in the MOE Stormwater Management, Planning and Design Manual (Ministry of Environment, 2003), is the empirically recognized maximum permissible velocity before which erosion will occur in a channel.

Table-18: Average Expected Velocity in Forebay

Parameter	South SWM Pond	North SWM Pond
Total depth of forebay (m)	1	1
Bottom width of forebay (m)	4.7	7.0
Flow rate (1:10-year 3-hour Chicago), Q (m ³ /s)	1	0.53
Side slope (z:1)	3	3
Cross-sectional area (m ²) ¹	7.68	10.0

Parameter	South SWM Pond	North SWM Pond
Velocity, Q/A (m/s)	0.13	0.05
Check	OK <0.15	OK <0.15

4.2.7 Emergency Overflow Spillway/Weir

Emergency overflow spillways/weirs were designed as rectangular weirs. Design calculations for both the South and North SWM Ponds are provided in **Table-19**. Design flow rates were taken as the greater of the Hurricane Hazel and 2021-2051 climate change scaled-IDF 1:100-year SCS type II storms.

Table-19: Overflow Spillway/Weir Sizing Calculations

Parameter	South SWM Pond	North SWM Pond	Note
Design peak flow rate (m ³ /s)	8.2	4.5	1:100-year 24-hour SCS Type II (2021-2050 climate change scaled-IDF)
Weir Coefficient, C _w	1.7	1.7	
Required Size			
Depth of water above crest, H (m)	0.5	0.5	
Weir length, L (m)	13.56	7.52	
Proposed Size			
Depth of water above weir crest, H (m)	0.5	0.5	
Weir length, L (m)	14	8	
Calculated flow, Q (=C _w LH ^{1.5}) (m ³ /s)	8.4	4.8	
Check	OK >Design peak flow	OK >Design peak flow	

Table-20 provides the design values for the proposed SWM ponds and compares these values to the minimum or preferred criteria as per Table 4.6 of the MOE manual (Ministry of Environment, 2003).

Table-20: Summary of Proposed SWM Ponds - MECP Design Criteria

Design Element	North SWM Pond		South SWM Pond	
	Design Value	Comparison to MECP Criteria	Design Value	Comparison to MECP Criteria
Drainage Area	26 ha	Meets Preferred Criteria (≥10 ha)	55 ha	Meets Preferred Criteria (≥ 10 ha)
Treatment Volume	Permanent Storage = 2,606 m ³ Active Storage = 16,836 m ³	Provided Permanent Pool Meets Minimum Criteria. Provided Active Storage meets Post-to-Pre control.	Permanent Storage = 5,474 m ³ Active Storage = 35,865 m ³	Provided Permanent Pool Meets Minimum Criteria. Provided Active Storage meets Post-to-Pre control.

Design Element	North SWM Pond		South SWM Pond	
	Design Value	Comparison to MECP Criteria	Design Value	Comparison to MECP Criteria
Active Detention Time	Storm runoff to be detained and tested before release. Approximately 69 hours from 1:100-year storm level to Permanent Pool level.	Meets Preferred Criteria (>24 hrs)	Storm runoff to be detained and tested before release. Approximately 341 hours from 1:100-year storm level to Permanent Pool level.	Meets Preferred Criteria (>24 hrs)
Forebay	Depth = 1 m Volume = 24.8 % of Total Permanent Volume	Meets Criteria: Minimum depth = 1m, however exceeds less than 20% of Permanent Pool Volume by 4.8% due to site-specific constraints.	Depth = 1 m Volume = 7.4 % of Total Permanent Volume	Meets Criteria: Minimum depth = 1m and less than 20% of Permanent Pool Volume.
Length-to-Width Ratio	82	Exceeds Minimum Criteria (3:1)	3.0	Exceeds Minimum Criteria (3:1)
Permanent Pool Depth	1 m	Meets Criteria: Mean Depth < 1 Max Depth < 3m	1 m	Meets Criteria: Mean Depth < 1 Max Depth < 3m
Active storage Depth	1.7 m	Meets Criteria: Max Depth < 2m	1.8 m	Meets Criteria: Max Depth < 2m
Side Slopes	1(V):3(H)	Does not meet Minimum Criteria of 5H:1V for 3 m above and below permanent pool due to space limitations. However, this is acceptable since the landfill site has controlled access.	1(V):3(H)	Does not meet Minimum Criteria of 5H:1V for 3 m above and below permanent pool due to space limitations. However, this is acceptable since the landfill site has controlled access.
Inlet	Ditch	-	Ditch	-
Outlet	Two-stage outlet with 125 mm and 280 mm orifice plates discharging to 525 mm diameter outlet pipe at 1% slope	Meets minimum Criteria	Two-stage outlet with 125 mm and 280 mm orifice plates discharging to 525 mm diameter outlet pipe at 1% slope	Meets minimum Criteria

Design Element	North SWM Pond		South SWM Pond	
	Design Value	Comparison to MECP Criteria	Design Value	Comparison to MECP Criteria
Maintenance access	Access for backhoes or dredging equipment provided. No Maintenance pipe provided.	Meets Criteria	Access for backhoes or dredging equipment provided. No Maintenance pipe provided.	Meets Criteria
Buffer	Not Provided	Does not meet Minimum Criteria of 7.5 m above maximum water quality/erosion control water level due to space constraints. However, this is a landfill site with restricted access.	Not Provided	Does not meet Minimum Criteria of 7.5 m above maximum water quality/erosion control water level due to space constraints. However, this is a landfill site with restricted access.

5 EROSION AND SEDIMENT CONTROL PLAN

Walker is required to implement erosion and sediment control (ESC) measures during construction of the South Landfill Phase 2 and related infrastructure. Prior to construction, an ESC plan will be developed and implemented. ESC measures will be maintained until the Site is stabilized or as directed by the Site Engineer and/or the regulator authority. ESC measures will be inspected after each significant rainfall event (rainfall depth amount larger than 25 mm) and maintained in proper working conditions.

The ESC measures to prevent the migration of silt laden runoff to the receiving environment will include but not limited to silt fences, fibre roll check dams, strawbale/straw wattles flow check dams, sediment traps...etc. Prior to construction, a detailed construction management plan should be prepared and implemented by the sub-contractor. Refer to Figure 7 for details.

6 ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring of the proposed stormwater management (SWM) facilities for South Landfill Phase 2 during the operations phase is recommended to be conducted in accordance with the monitoring requirements outlined in the existing stormwater management Environmental Compliance Approval (ECA) No. 1032-9M5LRW dated April 20, 2016 at the following new monitoring stations.

- North SWM Pond outlet
- South SWM Pond outlet
- North SWM Pond emergency overflow outlet
- South SWM Pond emergency overflow outlet
- Ten Mile creek station upstream of North SWM Pond outlet

Details of the recommended environmental monitoring program are as follows:

- 1) Walker shall collect stormwater samples from the designated sampling location at sampling frequency and analyse for the sampling parameters outlined in Table-21.
- 2) The methods and protocols for sampling, analysis and recording shall conform the methods and protocols specified in the existing ECA No. 1032-9M5LRW dated April 20, 2016.
- 3) For the parameters monitored under monitoring program in Table-21 and for those with a designated Provincial Water Quality Objectives (PWQO), Walker shall use best efforts to design, construct and operate the Works to ensure that their respective PWQO are not exceeded.
- 4) The sampling frequencies in **Table-21** in respect to any parameter are the minimum requirements which may, after two (2) years of monitoring, be modified upon review by the Qualified Professional (QP) and / or regulating authorities (e.g., MECP District Manager), as required.

Table-21: Monitoring Program – Stormwater Management Facilities

Sampling Location	Sampling Type	Sampling Frequency	Sampling Parameter	Effluent Objectives
North SWM Pond outlet	Grab	Four (4) times annually during planned discharge events ¹	Table-22	PWQO
	Grab	Two (2) times annually during planned discharge events ¹	Table-23	PWQO
South SWM Pond outlet	Grab	Four (4) times annually during planned discharge events ¹	Table-22	PWQO
	Grab	Two (2) times annually during planned discharge events ¹	Table-23	PWQO
North SWM Pond emergency overflow outlet	Grab	During any emergency overflow event	Table-24	PWQO
South SWM Pond emergency overflow outlet	Grab	During any emergency overflow event	Table-24	PWQO
Ten Mile creek station upstream of North SWM pond outlet	Grab	Quarterly (four (4) times annually)	Table-22	-

Note:

1. For discharge events longer than two (2) weeks, a minimum of one (1) sample shall be collected every two (2) weeks.

Table-22: Monitoring Parameter: North and South SWM Ponds Discharge Outlets

Stormwater Monitoring – North and South SWM Ponds Discharge Outlets		
Parameters	Parameters	Parameters
pH (Field)	Total Phenols	Aluminum
Conductivity (Field)	Total Ammonia Nitrogen (TAN)	Antimony
Dissolved Oxygen (Field)	Un-ionized Ammonia	Arsenic
Temperature (Field)	Organic Nitrogen	Barium
Total Suspended Solids (TSS)	Total Kjeldhal Nitrogen (TKN)	Boron
Total Dissolved Solids (TSS)	Nitrate	Cadmium
Alkalinity	Nitrite	Chromium

Stormwater Monitoring – North and South SWM Ponds Discharge Outlets		
Parameters	Parameters	Parameters
Hardness	Biochemical Oxygen Demand (BOD)	Copper
Chloride	Chemical Oxygen Demand (COD)	Iron
Sodium	Total Phosphorus (TP)	Lead
Calcium	Total Organic Carbon (TOC)	Manganese
Magnesium	Dissolved Organic Carbon (DOC)	Nickel
Potassium	Oil and Grease	Selenium
Sulphate	-	Zinc

Table-23: Monitoring Parameters: North and South Ponds Discharge Outlets

Stormwater Monitoring – North and South SWM Ponds Discharge Outlets	
Parameters	Parameters
Benzene	Ethylbenzene
Toluene	Xylenes

Table-24: Monitoring Parameters: Emergency Overflow Outlet Locations

Stormwater Monitoring – Emergency Overflow Outlet Locations		
Parameters	Parameters	Parameters
pH (Field)	Total Phenols	Boron
Conductivity (Field)	Total Ammonia Nitrogen (TAN)	Iron
Dissolved Oxygen (Field)	Total Kjeldhal Nitrogen (TKN)	Manganese
Temperature (Field)	Nitrate	-
Total Suspended Solids (TSS)	Nitrite	-
Total Dissolved Solids (TDS)	Biochemical Oxygen Demand (BOD)	-
Alkalinity	Chemical Oxygen Demand (COD)	-
Chloride	Total Phosphorus (TP)	-
Sodium	Total Organic Carbon (TOC)	-
Calcium	Un-ionized Ammonia (calculated)	-
Magnesium	-	-
Potassium	-	-
Sulphate	-	-

- 1) Walker to prepare a Stormwater Contingency and Remedial Action Plan for the stormwater management facilities prior to operations of facilities.
- 2) Walker shall keep the outlet gate valve of the North and South SWM Ponds in a normally closed position during normal operation periods.
- 3) Prior to any planned discharge of stormwater from the North and South SWM Ponds (through 1200 mm pipe or to Ten Mile Creek), Walker shall collect stormwater grab sample from a designated sampling location within the North and South SWM Pond and analyse for the parameters listed in the **Table-25**. In the event

that the exceedance of the trigger concentration level for any parameter(s) is (are) confirmed under the second round of sampling, implement "Stormwater Contingency and Remedial Action Plan" and follow next steps in accordance with the requirements outlined in the existing ECA No. 1032-9M5LRW dated April 20, 2016.

Table-25: Trigger Parameters (Source/Reference: ECA # 1032-9M5LRW, dated April 20, 2016)

Parameters	Trigger Level (mg/L unless otherwise indicated)
Un-ionized Ammonia	0.1
Conductivity	2,500 uS/cm
pH	>9.0 <6.0
Dissolved Oxygen	5 mg/L for 20 °C 6 mg/L for 10 °C 7 mg/L for 5 °C 8 mg/L for 0 °C

- 1) In the event that a monitoring result for any of the parameters listed in **Table-25** exceeds its/their corresponding trigger level(s), Walker shall re-sample for parameter(s) exceeding its/their trigger levels within one (1) month period after receipt of the laboratory analysis results to confirm the reported exceedance(s). If the exceedance of the trigger concentration level for any parameter(s) is (are) confirmed under the second round of sampling, Walker shall implement the "Stormwater Contingency and Remedial Action Plan" and follow steps as outlined in the existing ECA 1032-9M5LRW dated April 20, 2016.
- 2) Walker to maintain a record of the date and the volume of leachate contaminated stormwater disposed of through the on-site leachate collection and treatment system or disposed of to an approved off-site sewage treatment plant for proper treatment.
- 3) Walker to monitor and maintain the water level in the North and South SWM Ponds at a level that ensures adequate storage is available for stormwater runoff associated with major storm events by ensuring that detained stormwater is disposed of in a timely manner to minimize the occurrence of emergency overflow during major storm events.
- 4) Walker to retain all records and information related to or resulting from the monitoring activities for a minimum of five (5) years.

7 CONCLUSIONS

The proposed South Landfill Phase 2 surface water management plan has been developed to provide an effective site drainage system while addressing stormwater quantity control, and stormwater quality treatment. The supporting hydrologic and hydraulic analyses, together with the modelling results, demonstrate that the proposed North SWM Pond and South SWM Pond will provide adequate stormwater treatment and runoff attenuation for the contributing South Landfill Phase 2 area during post-development (post-closure).

This report is intended to serve as supporting documentation for the Surface Water Detailed Impact Assessment Report.

8 LIMITATIONS AND ASSUMPTIONS

A summary of limitations and assumptions are as follows:

- Stormwater management system design is prepared based on the general guidelines presented in Niagara Peninsula Conservation Authority Stormwater Management Guidelines (AECOM, 2010) and the Ministry of Environment, Conservation and Parks (MECP) Stormwater Management planning and Design Manual (Ministry of Environment, 2003). At the detailed design stage, consultations with the regulators (e.g., NPCA, MECP) will be required to confirm the site-specific (if any) design criteria for stormwater quantity and quality controls.
- The hydrological assessment is based on the South Landfill Phase 2 development plan presented in this report. Any change to Landfill Configuration (i.e., site area, slope, landcover) will require re-assessment and changes to the stormwater management system component sizing (e.g., ponds, ditches).
- Stormwater management system design presented in this report is intended to serve as supporting document for Surface Water Resources Detailed Impact Assessment only.

9 CLOSURE

We trust that this summary of hydrological modelling and preliminary stormwater management system design for the detailed impact assessment of Walker's South Landfill Phase 2 Project addresses Walker's needs at this time. If you have any questions or concerns, please do not hesitate to contact the undersigned.

10 REFERENCES

AECOM. (2010). *Niagara Peninsula Conservation Authority Stormwater Managment Guidelines*.

climatedata.ca. (2026). *IDF Data and Climate Change*. Retrieved April 2026, from <https://climatedata.ca/>

Ministry of Environment. (2003). *Stormwater Management, Planning and Design Manual*.

Signature Page

WSP Canada Inc.

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Mohsin Siddique, PhD, PEng.
Senior Water Resources Engineer

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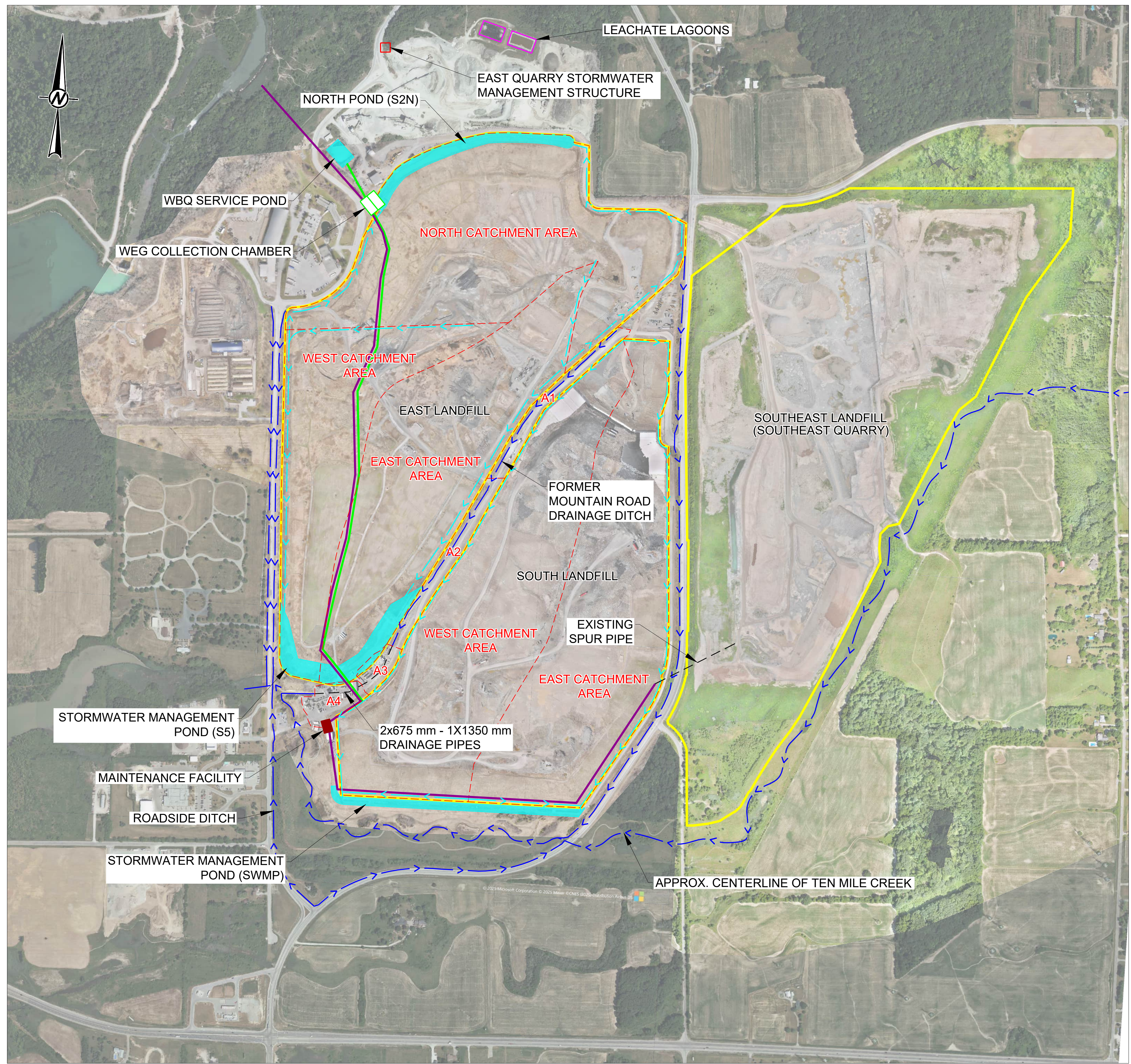
Douglas Kerr, PEng
Senior Principal Engineer

MS/DK/al/lid

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FIGURES

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	CATCHMENT AREA BOUNDARY
	LANDFILL SURFACE WATER DRAINAGE DITCH SHOWING FLOW DIRECTION
	EXTERIOR SURFACE WATER DRAINAGE DITCH SHOWING FLOW DIRECTION
	STORMWATER MANAGEMENT POND
	GROUNDWATER COLLECTION SYSTEM (GWCS)
	WALKER ENVIRONMENTAL GROUP INC. (WEG) DRAINAGE SYSTEM (1200 mm Ø PIPE)

NOTE(S)

1. PROJECTION: UTM NAD83-17N (CSRS 2010).
2. ELEVATIONS ARE GEODETIC (masl). DATUM IS BASED ON NRCAN HT2.0 (CGVD2013).

REFERENCE(S)

1. IMAGERY: © 2025 MICROSOFT CORPORATION © MAXAR © CNES (2025) DISTRIBUTION AIRBUS DS.
2. BASE PLAN FEATURES FROM OPEN DATA, CITY OF NIAGARA FALLS.
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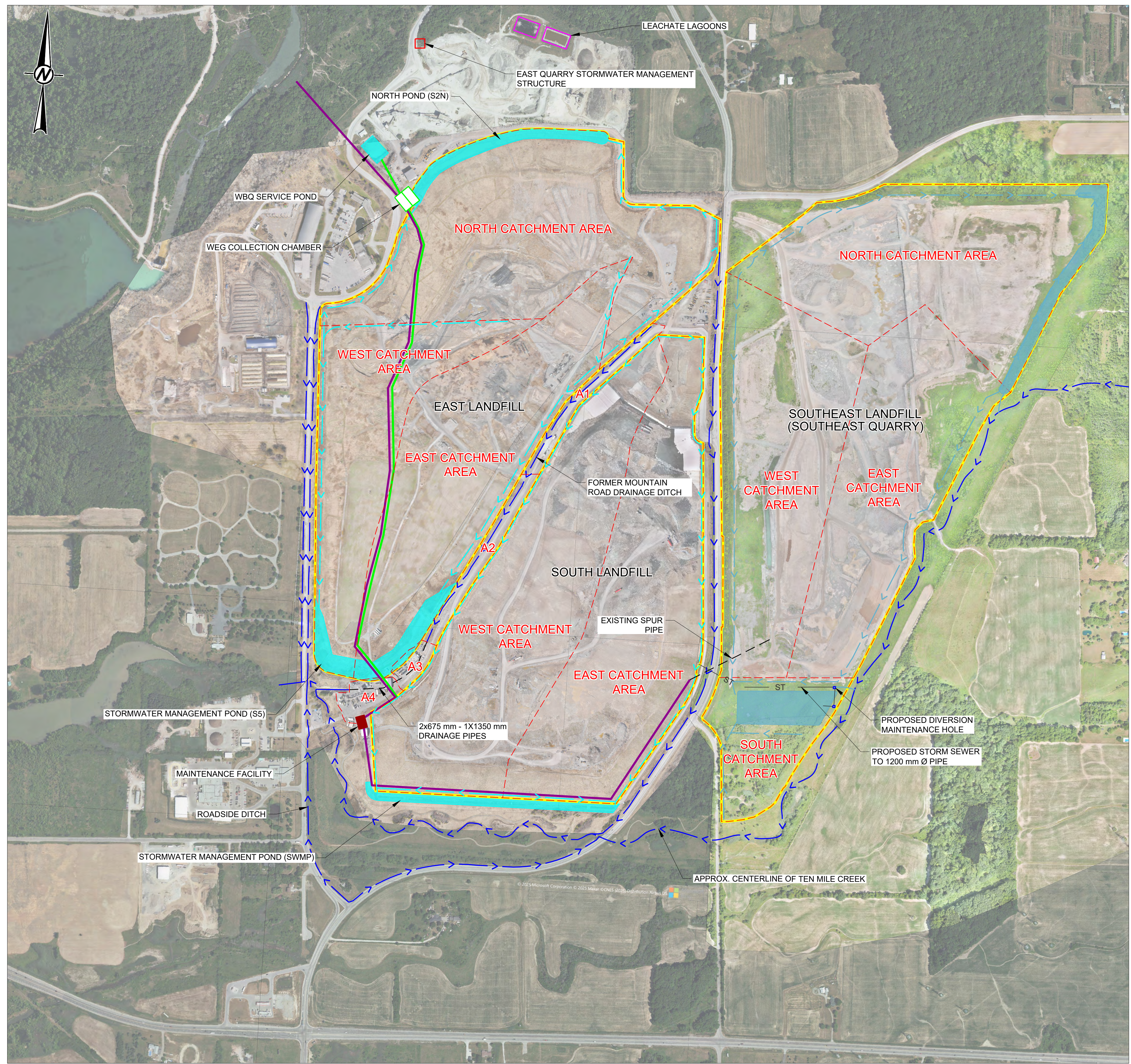
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	PREPARED	SJL	
	REVIEWED	MS	
	APPROVED	DM	
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LEGEND

	LANDFILL BOUNDARY
	CATCHMENT AREA BOUNDARY
	LANDFILL SURFACE WATER DRAINAGE DITCH SHOWING FLOW DIRECTION
	EXTERIOR SURFACE WATER DRAINAGE DITCH SHOWING FLOW DIRECTION
	STORMWATER MANAGEMENT POND
	GROUNDWATER COLLECTION SYSTEM (GWCS)
	WALKER ENVIRONMENTAL GROUP INC. (WEG) DRAINAGE SYSTEM (1200 mm Ø PIPE)
	PROPOSED LANDFILL SURFACE WATER DRAINAGE DITCH SHOWING FLOW DIRECTION
	PROPOSED STORMWATER MANAGEMENT POND
	PROPOSED DRAINAGE PIPE
	ST STORMWATER PIPE

NOTES

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WALKER ENVIRONMENTAL GROUP

PROJECT
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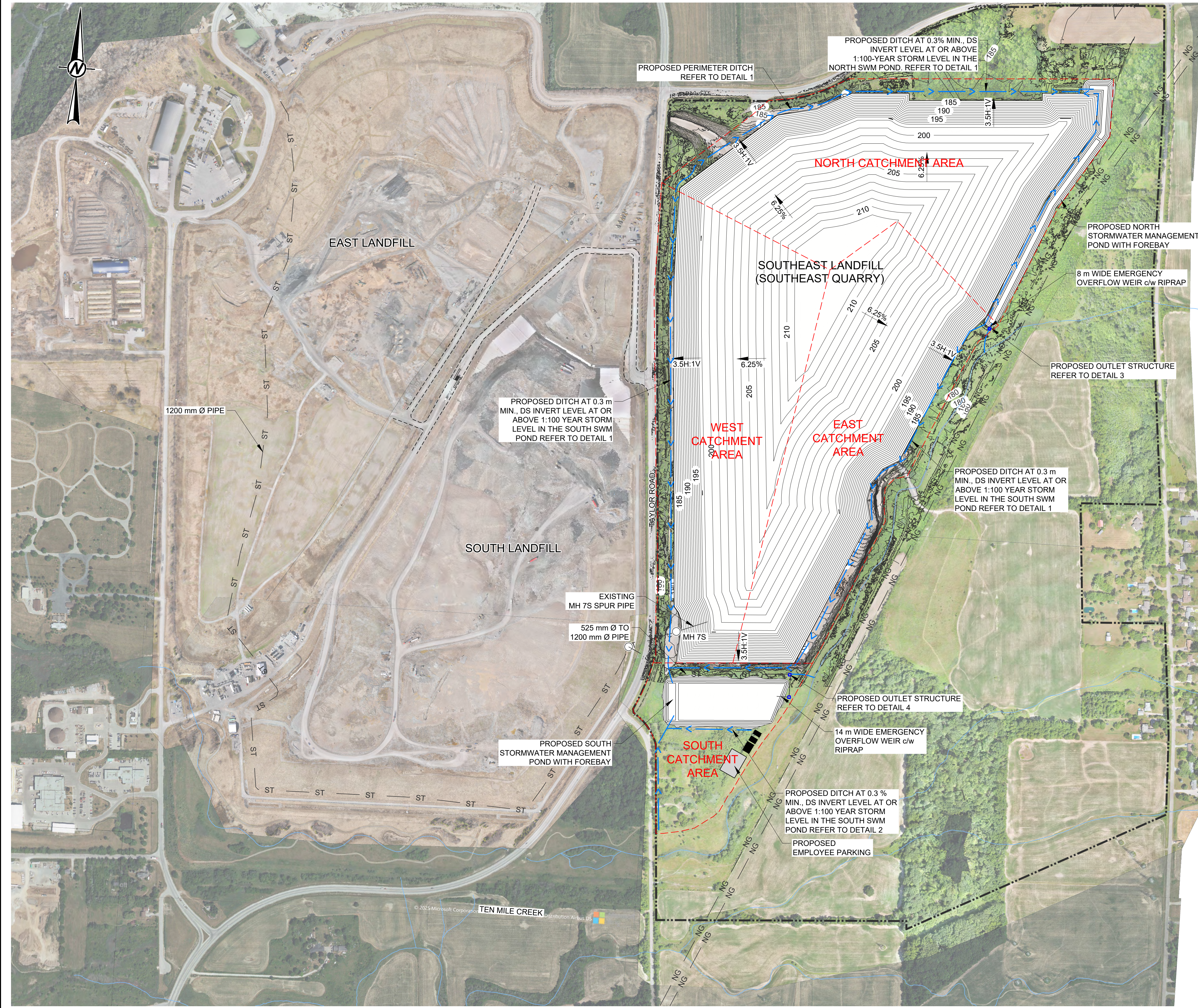
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	PREPARED	SJL
	REVIEWED	DVK
	APPROVED	DVK

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LEGEND

- SITE PROPERTY LINE (177.44 Ha)
- - - WASTE DISPOSAL SITE BOUNDARY LIMITS (D-4 GUIDE) (81.30 Ha)
- - - LIMIT OF FILL (D-4 GUIDE) (62.59 Ha)
- 170 GROUND SURFACE CONTOUR (1.0 m INTERVAL)
- HAUL ROAD
- CREEK
- NG TRANS-CANADA NATURAL GAS PIPELINE R.O.W.
- STORMWATER MAINTENANCE HOLE
- ST STORMWATER PIPE
- 205 PROPOSED TOP OF FINAL COVER CONTOUR (1.0 m INTERVAL)
- 3.5H:1V 6.25% PROPOSED TOP OF FINAL COVER SLOPE (H:V) OR GRADE (%)
- PROPOSED STORMWATER MANAGEMENT DITCH / FLOW
- - - CATCHMENT AREA BOUNDARY

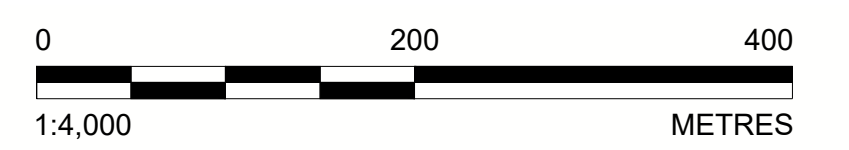
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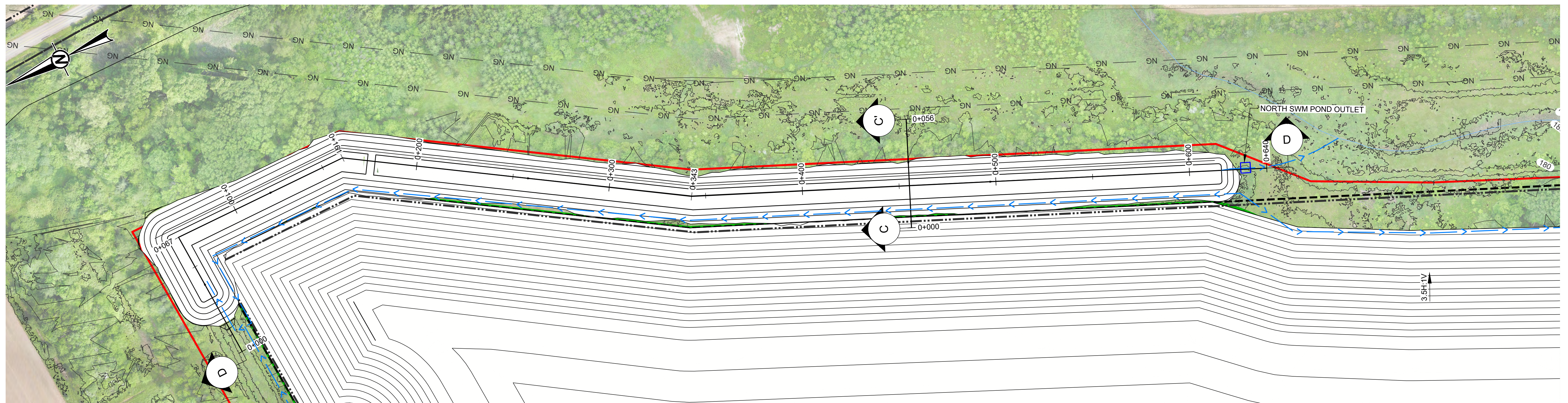
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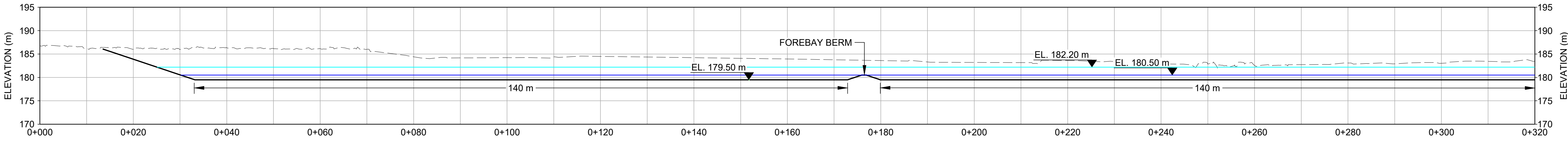
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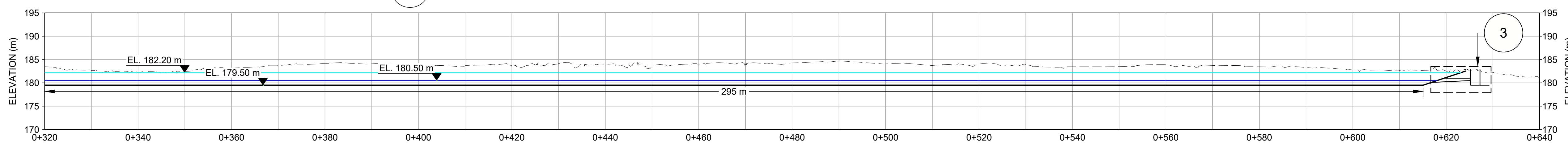
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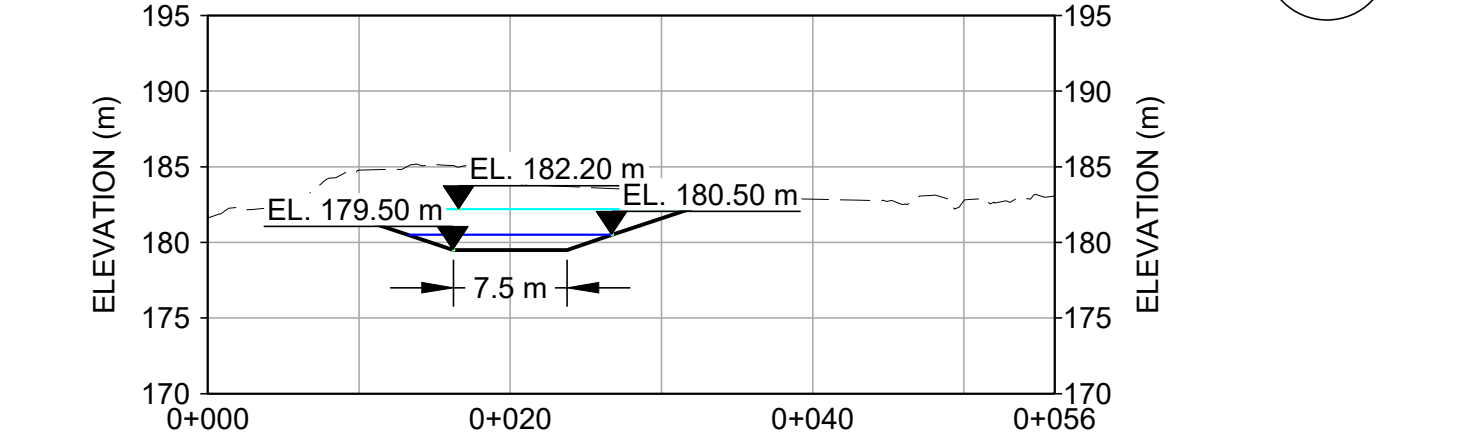
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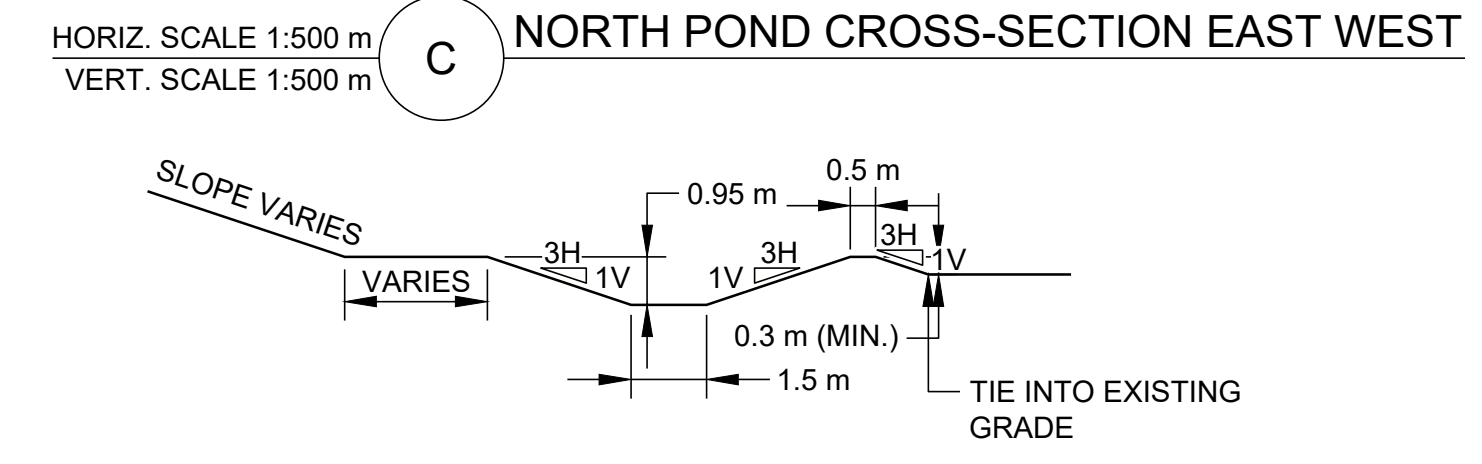
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HORIZ. SCALE 1:500 m
VERT. SCALE 1:500 m



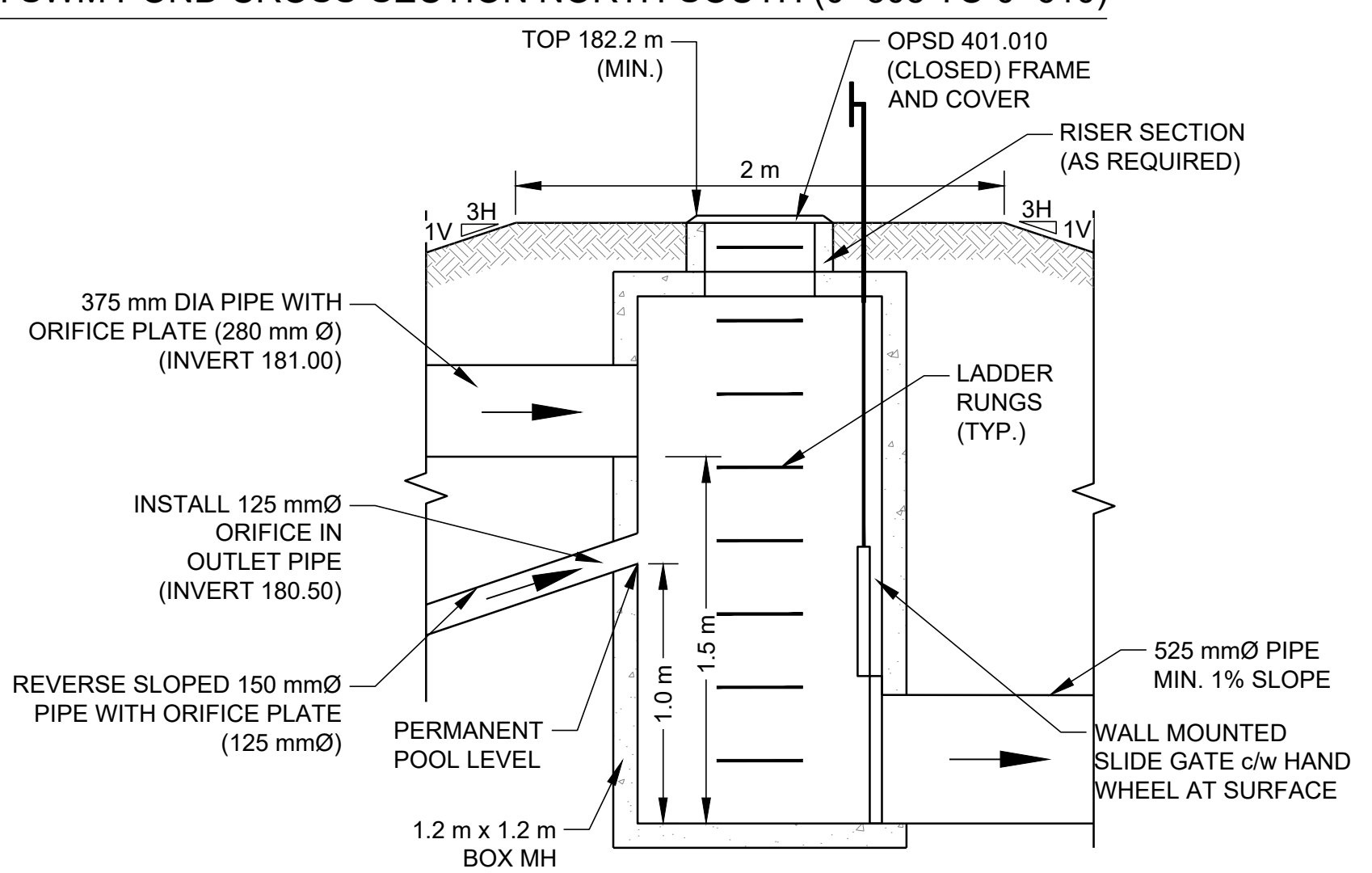
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VERT. SCALE 1:500 m



NORTH POND CROSS-SECTION EAST WEST
HORIZ. SCALE 1:500 m
VERT. SCALE 1:500 m



PROPOSED DITCH DETAIL
SCALE 1:150 m



PROPOSED NORTH SWM POND OUTLET STRUCTURE
SCALE 1:25 m

LEGEND

- EXISTING GROUND SURFACE (SEE REFERENCE 1)
- PROPOSED POND BASE
- PERMANENT POOL
- MAXIMUM ACTIVE STORAGE

- NOTES**
1. PROJECTION: UTM NAD83-17N (CSRS 2010).
 2. ELEVATIONS ARE GEODETIC (masl). DATUM IS BASED ON NRCAN HT2.0 (CGVD2013).

REFERENCE

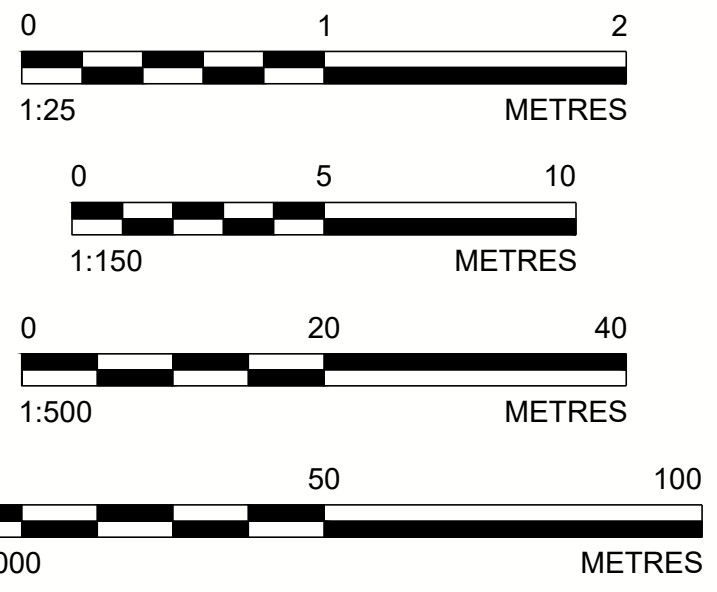
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PREPARED	JM/JY
REVIEWED	DVK
APPROVED	DVK

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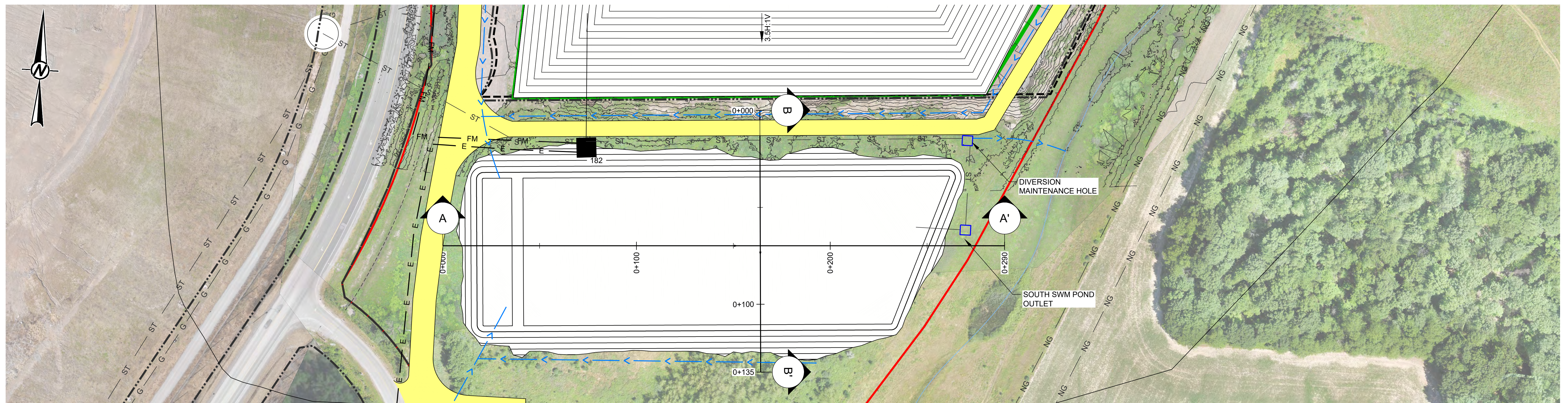
PROJECT
SURFACE WATER RESOURCES DETAILED IMPACT ASSESSMENT REPORT, SOUTH LANDFILL PHASE 2
NIAGARA FALLS, ONTARIO

TITLE
PRELIMINARY DESIGN DETAILS
NORTH SWM POND

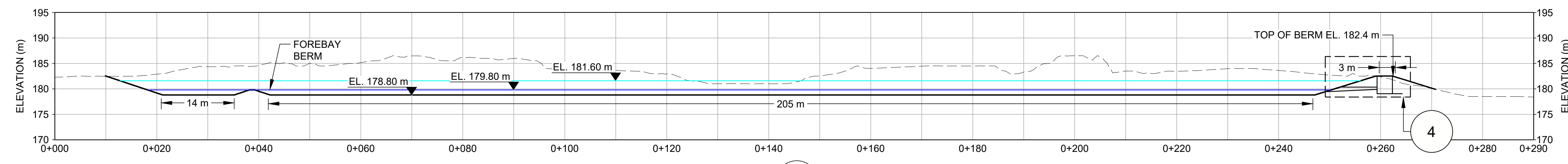
PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0004	B	5

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

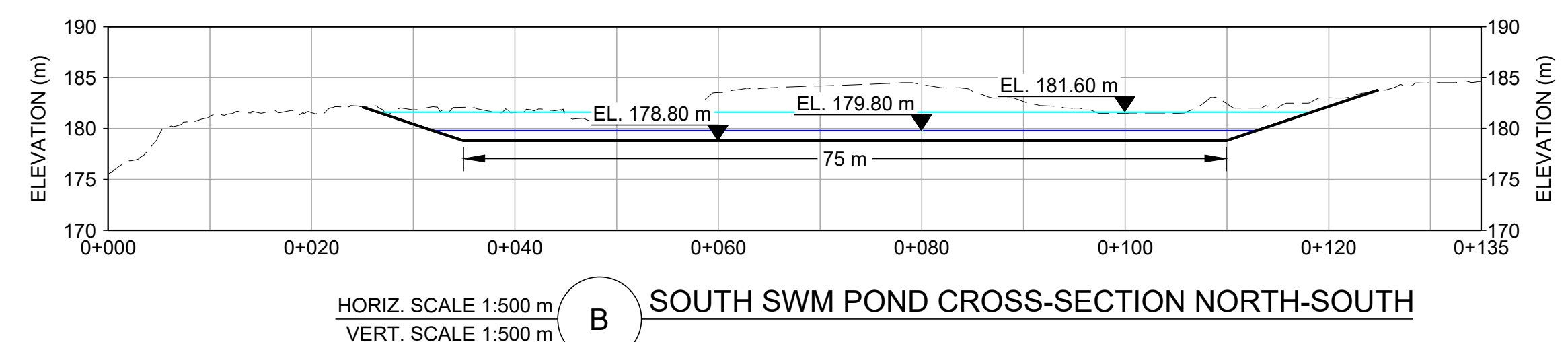
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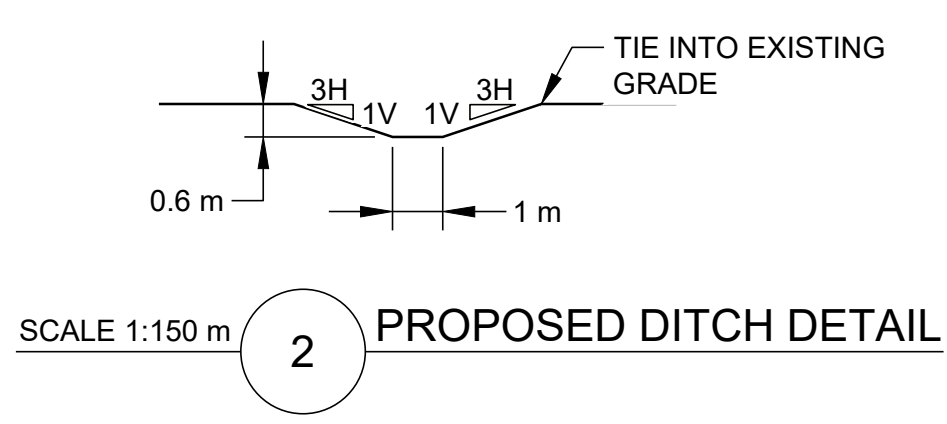
PLAN VIEW
SCALE 1:1 000 m



A SOUTH SWM POND CROSS-SECTION EAST-WEST
HORIZ. SCALE 1:500 m
VERT. SCALE 1:500 m



B SOUTH SWM POND CROSS-SECTION NORTH-SOUTH
HORIZ. SCALE 1:500 m
VERT. SCALE 1:500 m



2 PROPOSED DITCH DETAIL
SCALE 1:150 m

LEGEND

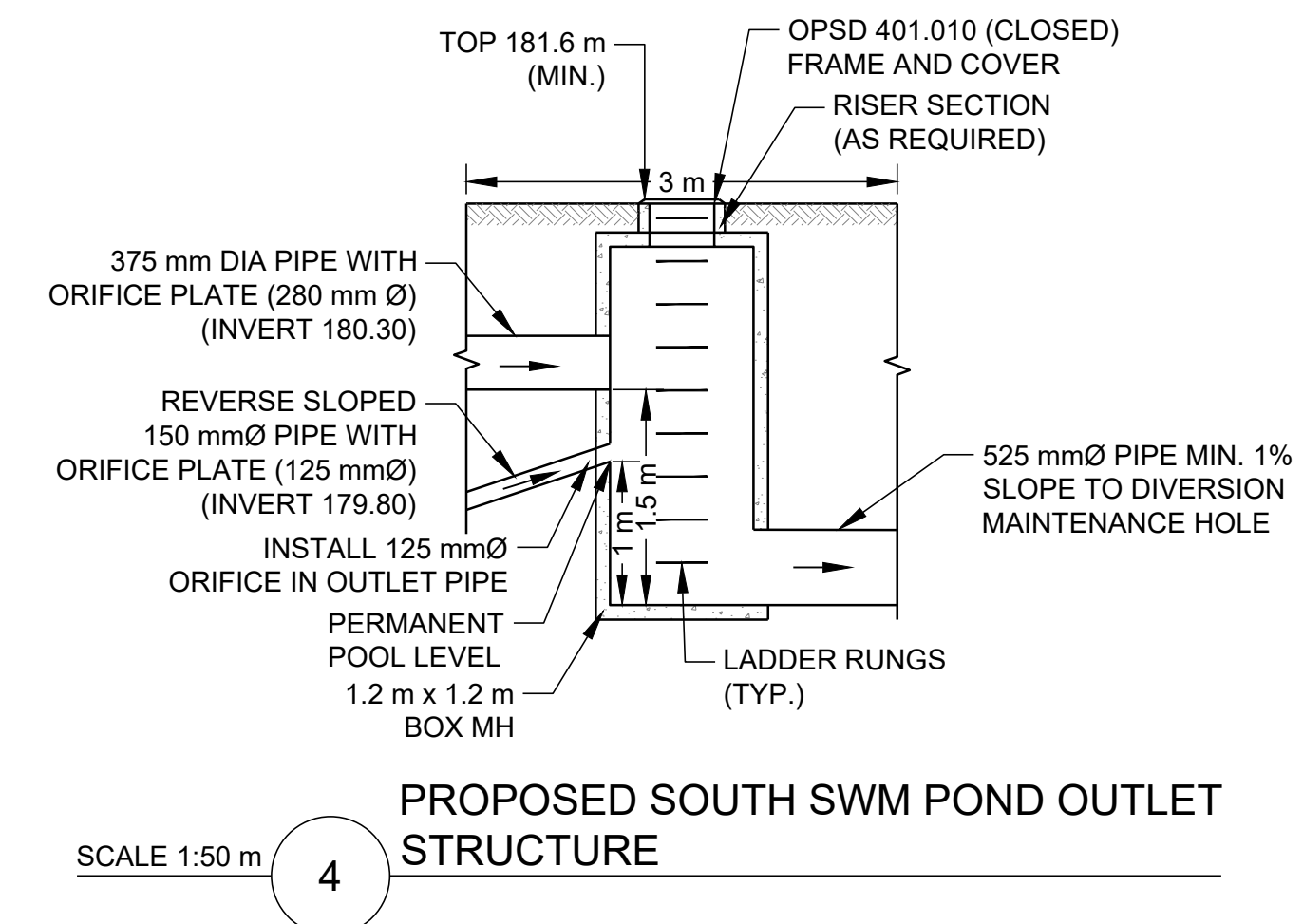
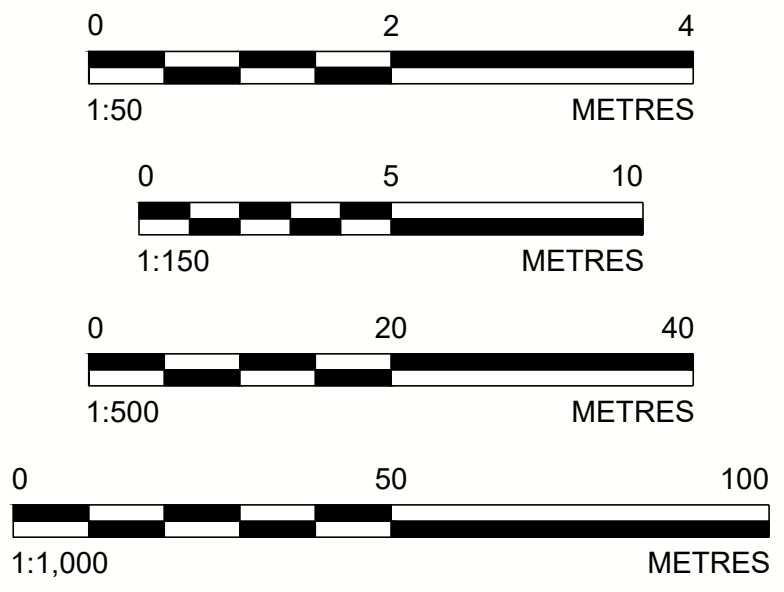
- - - - - EXISTING GROUND SURFACE (SEE REFERENCE 1)
- PROPOSED POND BASE
- PERMANENT POOL
- MAXIMUM ACTIVE STORAGE

- NOTES**
- PROJECTION: UTM NAD83-17N (CSRS 2010).
 - ELEVATIONS ARE GEODETIC (masl). DATUM IS BASED ON NRCAN HT2.0 (CGVD2013).

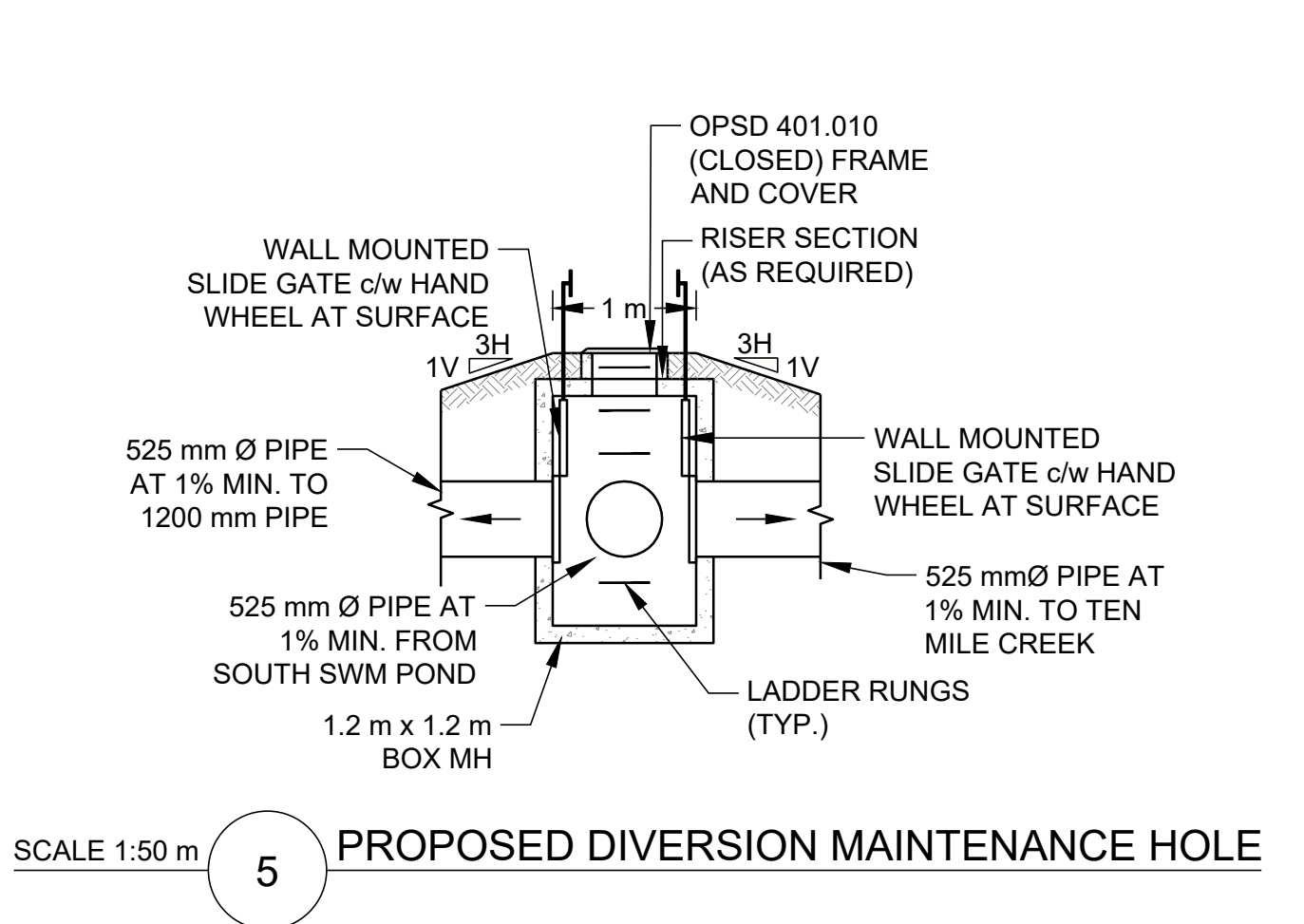
REFERENCE

- EXISTING GROUND IS BASED ON UAV SURVEY DATED JUNE 12, 2025 BY WALKER.

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4 PROPOSED SOUTH SWM POND OUTLET STRUCTURE
SCALE 1:50 m



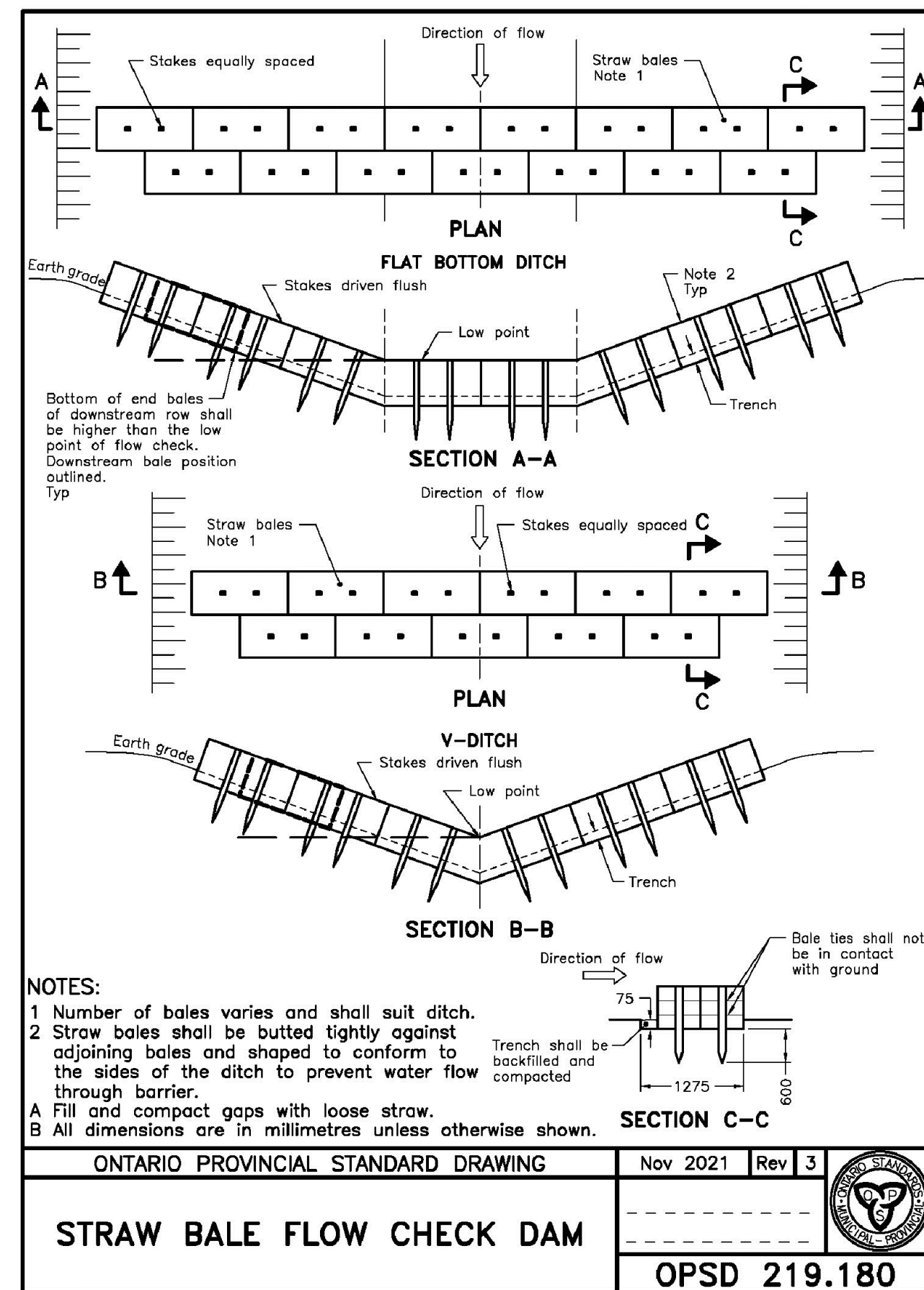
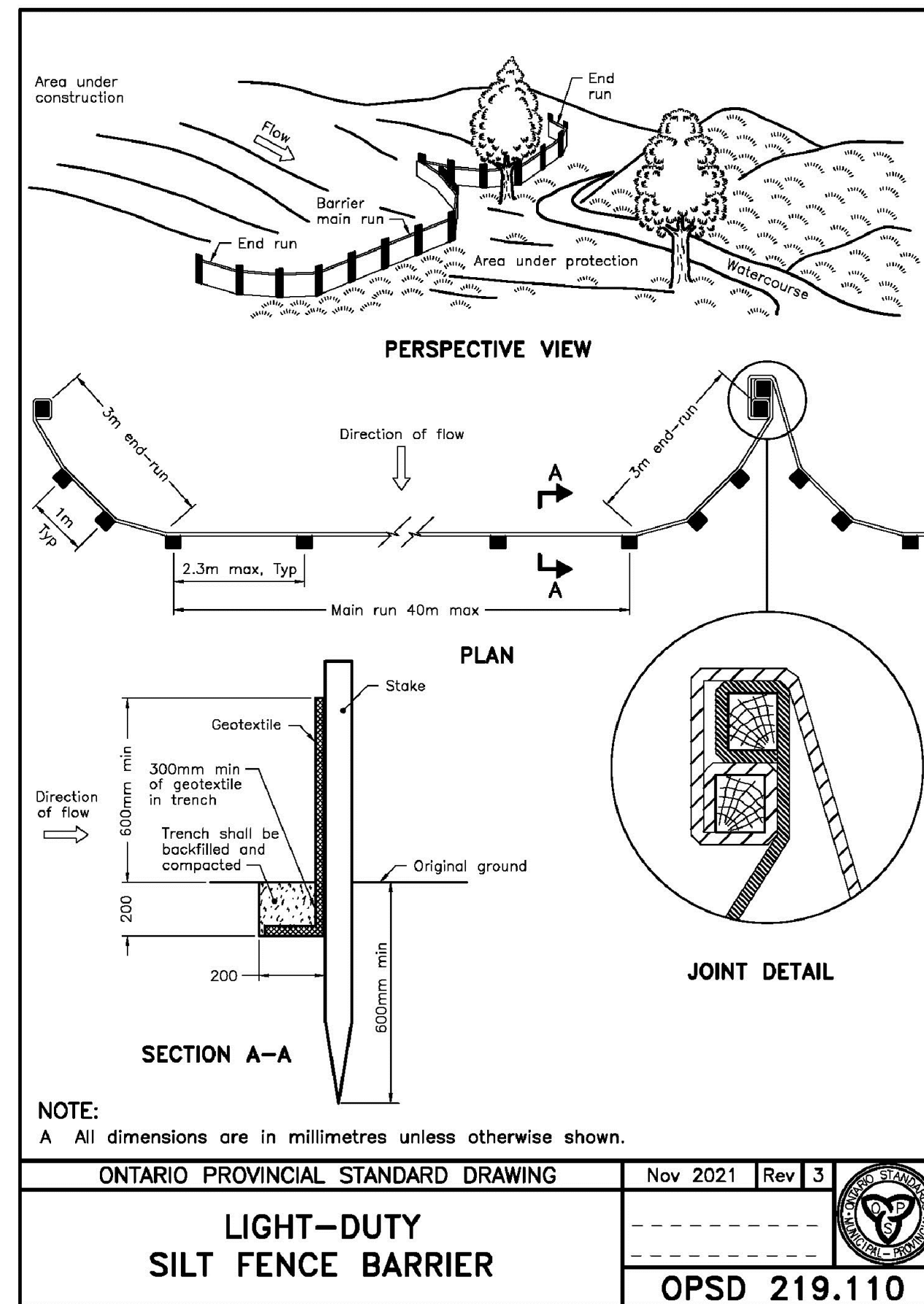
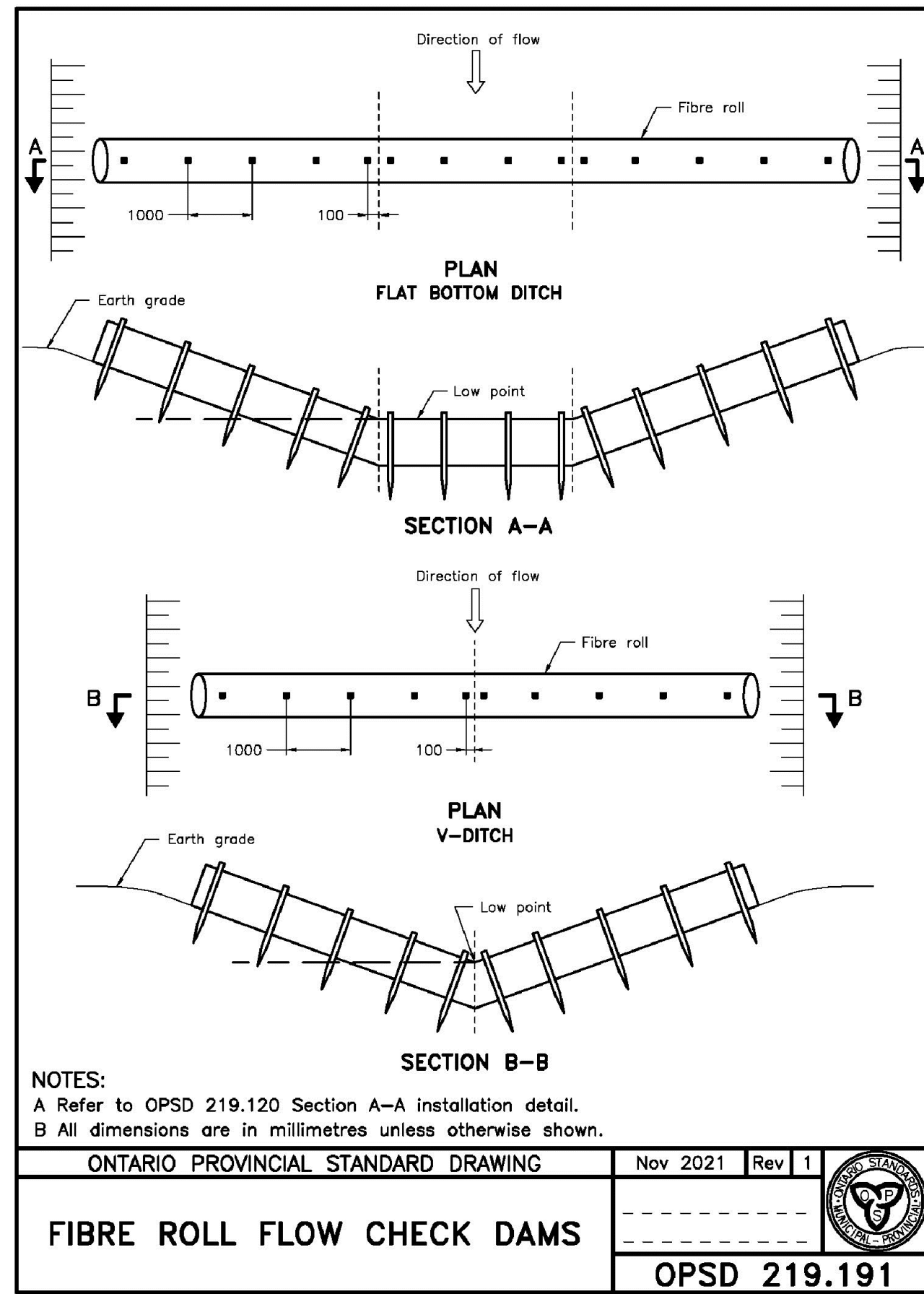
5 PROPOSED DIVERSION MAINTENANCE HOLE
SCALE 1:50 m

CLIENT	WALKER ENVIRONMENTAL GROUP		
CONSULTANT	YYYY-MM-DD	2026-06-24	
	DESIGNED	MS	
	PREPARED	JM/JY	
	REVIEWED	DVK	
	APPROVED	DVK	

PROJECT	SURFACE WATER RESOURCES DETAILED IMPACT ASSESSMENT REPORT, SOUTH LANDFILL PHASE 2 NIAGARA FALLS, ONTARIO		
TITLE	PRELIMINARY DESIGN DETAILS SOUTH SWM POND		
PROJECT NO.	CONTROL	REV.	FIGURE
CA0065457.5367	0004	B	6

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

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NOTES

- UPON OBTAINING ALL THE REQUIRED PERMITS AND APPROVALS FROM THE REGULATING AGENCIES, THE DEVELOPMENT OF THE SITE IS EXPECTED TO CONSIDER THE FOLLOWING EROSION AND SEDIMENT CONTROL (ESC) MEASURES PRIOR TO AND DURING THE CONSTRUCTION ACTIVITIES:
 - PRIOR TO ANY TOPSOIL REMOVAL OR GRADING, THE WORK AREA IS TO BE SURROUNDED BY A SINGLE ROW OF LIGHT-DUTY SILT FENCE PER ONTARIO PROVINCIAL STANDARD DRAWING (OPSD 219.110),
 - STRAW BALES PER OPSD 219.180 INSTALLED DOWNSTREAM OF THE WORK AREA AND UPSTREAM OF THE SURROUNDING SILT FENCE,
 - STOCKPILED MATERIAL SHOULD BE LOCATED WITHIN THE SILT FENCE BOUNDARY. STOCKPILED TOPSOIL MATERIAL SHOULD ALSO BE COVERED WITH TARPS OR COCONUT FIBER MATS, TO REDUCE SEDIMENT WASH OFF,
 - THE PROPOSED ESC MEASURES ARE TO BE INSPECTED DAILY BY THE CONTRACTOR AND DEFICIENCY ADDRESSED,
 - ALL AREAS THAT HAVE BEEN WORKED BUT WILL NOT RECEIVE FURTHER GRADING WITHIN 24 HOURS SHALL BE STABILIZED WITH A SUITABLE TEMPORARY SEED MIX TO REDUCE THE RISK OF EROSION,
 - GRADED AREAS SHOULD BE SEEDED ONCE FINAL GRADING IS GRADED IS COMPLETE, AND
 - THE PROPOSED ESC MEASURES SHALL REMAIN IN PLACE UNTIL POST-CONSTRUCTION PLANTING HAS SUFFICIENTLY STABILIZED THE SITE.
- THE CONTRACTOR SHALL PREPARE AND BE RESPONSIBLE FOR ANY NECESSARY PUMPING ARRANGEMENTS THAT MAY BE REQUIRED FOR DEWATERING EXCAVATIONS FOR THE INSTALLATION OF THE PROPOSED STORMWATER MANAGEMENT FEATURES. POTENTIAL WATER MAY BE ENCOUNTERED FROM SURFACE AS WELL AS GROUNDWATER SOURCES.
- DEWATERING ACTIVITIES WILL DISCHARGE ONLY CLEAN WATER, AND APPROVAL OF ITS DISCHARGE TO SURFACE OR SUB-SURFACE INFRASTRUCTURE WILL BE APPROVED BY THE RESPONSIBLE REGULATORY AGENCY PRIOR TO CONSTRUCTION. SEDIMENT BAGS ARE RECOMMENDED TO BE USED, TO ENSURE THE DISCHARGED WATER IS TREATED FOR POTENTIAL SUSPENDED SOLIDS FROM THE SITE CONSTRUCTION/DISTURBANCE ACTIVITIES.

NOT FOR CONSTRUCTION
DRAFT

CLIENT
WALKER ENVIRONMENTAL GROUP

PROJECT
SURFACE WATER RESOURCES DETAILED IMPACT ASSESSMENT REPORT, SOUTH LANDFILL PHASE 2 NIAGARA FALLS, ONTARIO

TITLE
DETAILS OF THE PROPOSED EROSION AND SEDIMENT CONTROL MEASURES

CONSULTANT	YYYY-MM-DD	2026-06-24
	DESIGNED	MS
	PREPARED	JM/JY
	REVIEWED	DVK
	APPROVED	DVK

PROJECT NO. CONTROL REV. FIGURE
CA0065457.5367 0004 B 7

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

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