DRAFT

REPORT

SURFACE WATER ASSESSMENT

SOUTHWESTERN LANDFILL ENVIRONMENTAL ASSESSMENT

TOWNSHIP OF ZORRA, ONTARIO

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1.0 INTRODUCTION

An Environmental Assessment ("EA") is being prepared by Walker Environmental Group Inc. ("Walker") under Ontario's Environmental Assessment Act ("Act") for the 'provision of future landfill capacity at the Carmeuse Lime (Canada) Ltd. (Carmeuse) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario'.

This is one in a series of technical studies that have been completed by qualified experts to examine the potential effects of the proposed landfill site on the environment, all in accordance with the requirements set out in the Approved Amended Terms of Reference ("ToR") dated May 10, 2016. This report accompanies and supports the Environmental Assessment Report prepared by Walker.

Walker has carried out extensive consultation with government agencies, Aboriginal groups and interested members of the public regarding this study; details are provided separately in the EA report.

This report summarizes the results of the surface water assessment and net effects analysis.

2.0 PURPOSE AND OBJECTIVES

The **purpose** of this study is to complete a surface water assessment of the landfill proposed by Walker.

The overall **objectives** of the study are listed below, in accordance with the requirements for the assessment of an undertaking as set out in Section 6.1(2)(c) of the Environmental Assessment Act, and as specifically detailed in Section 8.1 of the ToR:

- Describe the **environment potentially affected** by the proposed undertaking, including both the existing environment as well as the environment that would otherwise be likely to exist in the future without the proposed undertaking.
- Carry out an evaluation of the **environmental effects** of the proposed undertaking, using the relevant environmental assessment criteria set out in the ToR (see Appendix B).
- Carry out an evaluation of any additional impact management actions that may be necessary to **prevent, change or mitigate any (negative) environmental effects**.
- Prepare a description and evaluation of the **environmental advantages and disadvantages** of the proposed undertaking, based on the net environmental effects that will result following mitigation.
- Prepare monitoring, contingency and impact management plans to **remedy the environmental effects** of the proposed undertaking.

3.0 THE PROPOSED UNDERTAKING

The landfill proposed by Walker is described in detail in the Environmental Assessment Report. Following is a brief summary for the benefit of the reader, highlighting aspects of the proposal most relevant to this study.

The landfill is to be located on a portion of Carmeuse's landholdings at its Beachville Quarry Operations in the Township of Zorra, Oxford County. Approximately 17.4 million m^3 of solid, non-hazardous waste and daily/intermediate cover will be deposited within a footprint of about 54 ha. The balance 73.9 ha site will be comprised of buffer areas for monitoring, maintenance, environmental controls and other necessary infrastructure (Figure 1 in Appendix A).

Landfill construction will proceed progressively in a series of cells, generally from north-to-south (Figure 1 in Appendix A). The former quarry floor will be backfilled to within about 30 to 40 metres below ground surface with engineered fill, and then a Generic Design Option II – Double Liner system (as specified by the Ministry of Environment, Conservation & Parks in the Landfill Standards under O. Reg. 232/98; see Figure 2 in Appendix A) will be constructed across the bottom and up the sides of the landfill to contain and collect leachate (Figure 3 in Appendix A). Up to 850,000 tonnes per year of solid, non-hazardous waste, and up to 250,000 tonnes per year of daily/intermediate cover material (typically soil) will then be placed and compacted above the liner in a series of small working areas approximately 0.2 ha in size at any given time, in order to minimize the exposed waste. Waste will be covered with soil/ soil-like materials on a daily basis, and a final cover with vegetation will be applied when the landfill reaches its final height, which peaks at about 15 m above ground. A landfill gas collection system will also be installed as the landfill/cell development progresses.

Most of the supporting infrastructure for the landfill will be located in the buffer area along the northern site perimeter, including the leachate and gas treatment plants. Leachate collected from the liner system will be treated on-site and the clean effluent from the treatment plant will be discharged into the Patterson-Robbins Drain next to the treatment plant. Clean precipitation and groundwater that has not come into contact with waste will be segregated and treated in one of two stormwater management ponds before being discharged from the site (Figure 1 in Appendix A). Landfill gas will be collected in a network of extraction wells and pipes. Initially the landfill gas will be flared (combusted), but when the quantities permit, it is expected that the gas will be beneficially utilized as a renewable fuel.

The site will be open for waste deliveries from 7:00 a.m. to 5:00 p.m. on weekdays and from 7:00 a.m. to 1:00 p.m. on Saturdays, but closed on Sundays and statutory holidays. On-site construction activities may start up to one hour before opening and continue up to two hours after closure. The primary designated haul route (i.e., for all waste trucks except deliveries from the local area, if any) is from Highway 401 north along County Road #6, then west into the quarry property; trucks will then follow a newly constructed haul route across the quarry site to a landfill site entrance at the northwestern corner of the site (Figure 4 in Appendix A). Vehicle traffic, including waste trucks as well as construction vehicles and staff, is expected to average approximately 210 trips per day.

Nuisance controls will include speed enforcement, regular haul road cleaning (on- and off-site), litter fencing and pick-up, and bird/pest management, with a public complaints reporting and response system.

There will be monitoring programs for equipment operations, leachate, groundwater, surface water, air emissions, gas, noise, and particulates (dust).

The landfill is anticipated to receive waste for approximately 20 years commencing in about 2023. After closure, maintenance and operation of the relevant environmental controls and monitoring will carry on during the post-closure period, until there is no further risk of environmental contamination. The end-use is assumed to be passive green space and/or agriculture, but the design is flexible to accommodate other potential end-uses.

4.0 ENVIRONMENTAL ASSESSMENT CRITERIA AND INDICATORS

The environmental assessment criteria, as approved in the ToR, are tabulated in Appendix B, Table B-1. In the table, check marks indicate which technical studies are assigned primary ("lead") responsibility for assessing each of the criteria. Following are the EA criteria which are assigned to this study:

Table - 1: Environmental Assessment Criteria Assigned to the Study

EA Criteria	Definition/Rationale
Effects due to contact with contaminated groundwater or surface water	Contaminants associated with a waste disposal site have the potential to seep into the groundwater or surface water. This could pose a public health concern if it enters local drinking water supplies, or if it mixes with surface water.
Flood and erosion hazard	The construction of a waste disposal facility can disrupt natural surface water drainage patterns, causing a potential for increased flooding.
Loss/displacement of surface water resources	Construction of a waste disposal facility may cause the removal of all or part of a natural stream or pond.
Effects on stream baseflow quantity/quality	The presence of the waste disposal facility has the potential to affect the quality or quantity of baseflow to surface water.

Furthermore, the criteria for this EA were designed to be cross-disciplinary to permit an assessment of cumulative effects. Table B-2 in Appendix B, from the ToR, illustrates some (though not necessarily all) of the key interconnectivities between the studies. As a result, this study provides input/data to additional environmental criteria that will be addressed through studies conducted by other experts including (but not limited to):

- Displacement of residents from houses – Any residents living on a future waste disposal site will have to relocate, which can cause inconvenience and stress to the residents.
- Disruption to use and enjoyment of residential properties – Potential nuisance effects associated with the waste disposal facility operation, or traffic moving to and from the waste disposal facility along the haul route, may disturb the daily activities and uses of residential properties. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.
- Disruption to use and enjoyment of public facilities and institutions – Potential nuisance effect associated with waste disposal facility operations, or traffic moving to and from the waste disposal facility, may disturb the daily activities at community facilities. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.
- Nuisance associated with vermin – Waste disposal facilities can attract vermin and birds, which can be a nuisance and lead to a decrease in property enjoyment by area residents. Vermin and birds can also be nuisance to agricultural operations.

- Effects on land resources, traditional activities or other interests of Aboriginal Communities – Major new developments of any type may have positive or negative effects on the interests of Aboriginal Communities (i.e., business opportunities, joint ventures).
- Changes to community character/cohesion – Community character and cohesion refer to physical characteristics, social stability, attractiveness as a place to live and patterns of social interaction. A waste disposal facility may actually or perceptually interfere with these important community attributes.
- Loss/disruption of recreational resources – Waste disposal facility operations and traffic may displace/disrupt existing recreational resources in the area, which could adversely affect the community at large. Disturbance could result from noise, dust, odour, visibility, birds and traffic congestion. Recreational resources include naturalist and interpretive opportunities.
- Displacement of agricultural land – The establishment of a waste disposal facility has the potential to displace existing or potential agricultural resources, including the loss of prime agricultural land.
- Disruption of farm operations – The establishment and operation of the waste disposal facility may affect agricultural crop or livestock production and related agriculture activities.
- Impact on the availability of groundwater supply to wells – A waste disposal facility can impact the availability of groundwater supply if groundwater is pumped from aquifers or if recharge to aquifers is reduced.
- Explosive hazard due to combustible gas accumulation in enclosed or confined spaces - Gas produced within a waste disposal facility (e.g., methane) can move through the ground and accumulate in enclosed or confined spaces (e.g., manholes, basements, sheds, etc.) on or immediately adjacent to the waste disposal facility. There is potential for the methane to form potentially explosive mixtures in air, creating an explosion and fire hazard.

Indicators identify how the potential environmental effects will be measured for each criterion. Following are the indicators that were applied to each of the primary EA criteria addressed in this assessment:

Table - 2: Proposed Indicators for Each Environmental Assessment Criteria

EA Criteria	Proposed Indicators/Measures
Effects due to contact with contaminated groundwater and surface water	■ Ontario Regulation 347 General – Waste Management (as amended). ■ Ontario Regulation 232/98 Landfilling Sites (as amended). ■ Safe Drinking Water Act, 2002, Ontario Regulation 169/03 Ontario Drinking Water Quality Standards. ■ Water Management – Policies, Guidelines and Provincial Water Quality Objectives” (PWQO) (Guideline B-1-3). ■ Guideline B-7 Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities. ■ Guideline B-7-1 Determination of Contaminant Limits and Attenuation Zones.

EA Criteria	Proposed Indicators/Measures
	■ Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment (CCME).
Flood and erosion hazard	■ Ontario Regulation 232/98, Landfilling Sites (as amended). ■ Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. ■ Technical Guide: River and Stream System Flooding Hazard Limits – Ontario Ministry of Natural Resources (OMNR), 2002. ■ Technical Guide: River and Stream System Erosion Hazard Limits, OMNR, 2002. ■ Environmental Planning Policy Manual for UTRCA, June 2006. ■ UTRCA Regulation Limit (O. Reg 157/06).
Loss/displacement of surface water resources	■ Ontario Regulation 347, General – Waste Management (as amended). ■ Ontario Regulation 232/98, Landfilling Sites (as amended). ■ Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. ■ Applicable Regulations under the Ontario Conservation Authorities Act.
Effects on stream baseflow quantity/quality	■ Sections 53 and 34 of the OWRA. ■ Environmental Protection Act (EPA). ■ Guide to Permit to Take Water Application (2007). ■ Water Taking Regulation O. Reg. 387/04. ■ Appropriate water quality guidelines (e.g. PWQO or CCME).

4.1 Summary of Indicators/Measures

An overview of how each of the environmental indicators was used to assess potential effects of the project, on surface water resources, is included in Table 3 below.

Table - 3: Indicator/Measure Summaries.

EA Criteria	Proposed Indicators/Measures	Summary of Indicator (as it relates to the Surface Water Assessment) Description / Applicability
Effects due to contact with contaminated groundwater and surface water	Ontario Regulation 347 General – Waste Management (as amended).	Regulation 347 provides a general guide to waste management in Ontario. This includes guidance for the designation of waste material as well as standards for waste generation and disposal sites, among other items. The regulation restricts drainage that may cause pollution downstream, however it contains no quantitative guidelines for contaminants leaving waste disposal sites. Therefore, it has only been considered for general guidance and not for detailed analysis.
	Ontario Regulation 232/98 Landfilling Sites (as amended).	Regulation 232/98 provides more detailed guidance to the design, operation, and closure of landfilling sites in Ontario. This guidance includes recommendations for surface water quality, including a reference the Provincial Water Quality Objectives (PWQO) which are discussed below. There are no quantitative guidelines for water quantity, therefore the regulation has only been considered for general guidance in this report.
	Safe Drinking Water Act, 2002, Ontario Regulation 169/03 Ontario Drinking Water Quality Standards (ODWQS).	The Safe Drinking Water Act and the related Regulation 169/03 standards govern installation, licensing, operation, and standards enforcement of private and public drinking water supply systems. Surface water in the Patterson-Robbins Drain Complex is not used for drinking water supply and the site is not within wellhead or intake protection zones according to the Source Water Protection Atlas (Ministry of Environment, Conservation, and Parks), however a comparison between the water quality assessment results and these standards have been completed to provide general insight into water quality.
	Water Management – Policies, Guidelines and Provincial Water Quality Objectives" (PWQO) (Guideline B-1-3).	The Provincial Water Quality Objectives (PWQOs) are constituent concentrations intended to provide a baseline for assessing the quality of surface water in Ontario, and are often used as the baseline for assessing waste effluent requirements. The PWQOs provide quantitative objectives for many of the constituents examined in this EA, and were used as the primary guideline in this assessment.
	Guideline B-7 Incorporation of the Reasonable Use Concept into MOEE Groundwater	This guideline is intended to determine reasonable use of groundwater in areas adjacent to sources of contaminants, as well as to determine contaminant discharges considered acceptable by the Ministry as it relates to groundwater. This guideline only applies to groundwater quality management and was not considered in the evaluation of surface water resources.

EA Criteria	Proposed Indicators/Measures	Summary of Indicator (as it relates to the Surface Water Assessment) Description / Applicability
	Management Activities.	
	Guideline B-7-1 Determination of Contaminant Limits and Attenuation Zones.	Building upon guideline B-7, this guideline establishes a procedure to evaluate groundwater impacts on sites adjacent to a contamination source. This guideline is used to establish limits and expectations for sites with potential groundwater contamination. This guideline pertains to groundwater contamination and was not used in the evaluation of surface water quality.
	Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment (CCME).	CCME guidelines are a set of quantitative guidelines set for water, tissue, sediment, and soil under a variety of uses. It was developed to provide an integrated set of guidelines which could be used by water, soil, and biology task groups as well as other external stakeholders. For the purposes of this study it was determined that CCME guidelines for aquatic life and agricultural use would be considered for water quality evaluation.
	Sections 53 and 34 of the OWRA	Under section 34 no more than 50,000 L of water per day may be taken by any means except in accordance with a permit issued under section 34.1. Discharge from the leachate treatment plant and stormwater management ponds are considered sewage and will need to be approved under section 53. Approvals under the OWRA will be addressed at a later stage of approval.
Flood and erosion hazard	Ontario Regulation 232/98, Landfilling Sites (as amended).	Regulation 232/98 provides detailed guidance to the design, operation, and closure of landfilling sites in Ontario. This guidance includes surface water quantity control as a consideration in assessment, however there are no quantitative guidelines for flood and erosion hazards, The Regulation has been considered for general guidance in this regard.
	Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.	<u>Proximity to an inland lake</u> Under section 2. (1)(a), in order to undertake development close to an inland lake that may experience flooding or erosion, the project site must be beyond the 100 Year flood level with a 15 metre allowance unless with a permit. The application must be filed with the Authority and must contain the following information under section 4:

EA Criteria	Proposed Indicators/Measures	Summary of Indicator (as it relates to the Surface Water Assessment) Description / Applicability
		Flood event standards The applicable flood event standards under section 11 are used to determine the maximum susceptibility to flooding of lands or areas within the watersheds in the area of jurisdiction of the conservation authority are the Hurricane Hazel Flood Event Standard, the 100 Year Flood Event Standard and the 100-year flood level plus wave uprush.
	Technical Guide: River and Stream System Flooding Hazard Limits – Ontario Ministry of Natural Resources (OMNR), 2002.	This guide provides methods for flood related calculations – including flood flows and floodplain calculations. The project site is not within the 100-year floodplain levels of the nearby water courses, and so not applicable for this site.
	Technical Guide: River and Stream System Erosion Hazard Limits, OMNR, 2002	This document provides guidance on stream engineering and/or working at stream banks. As the project site is not within the limits of the Thames River, this document is not applicable.
	Environmental Planning Policy Manual for UTRCA, June 2006.	This manual provides policies and guidance with respect to natural resources and hazards. The manual also provides information regarding stormwater management facilities. As this site is not designated as hazardous, and does not interfere with a watercourse, this manual may be used for reference only.
	UTRCA Regulation Limit (O. Reg 157/06)	This Regulation provides guidance for the development of areas near wetlands, hazardous lands, and rivers/ streams. The discharge pathways for the leachate treatment plant and the stormwater management ponds may enter a regulatory setback prior to entering the receiving watercourse. All required permits will be obtained prior to construction of these discharge pathways.
Loss/ displacement of surface water resources	*Ontario Regulation 347, General – Waste Management (as amended).*	Regulation 347 provides a general guide to waste management in Ontario, including guidance for the designation of waste material as well as standards for waste generation and disposal sites, among other items. The Regulation contains no quantitative guidelines for the loss/displacement of surface water resources, and therefore has only been considered for general guidance and not for detailed analysis.

EA Criteria	Proposed Indicators/Measures	Summary of Indicator (as it relates to the Surface Water Assessment) Description / Applicability
	Ontario Regulation 232/98, Landfilling Sites (as amended).	Regulation 232/98 provides more detailed guidance to the design, operation, and closure of landfilling sites in Ontario. This guidance includes surface water resources impacts as a consideration in assessment, however there are no quantitative guidelines for loss or displacement of surface water resources. The Regulation has been considered for general guidance in this regard.
	Ontario Regulation 166/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.	<u>Proximity to an inland lake</u> Under section 2. (1)(a), in order to undertake development close to an inland lake that may experience flooding or erosion, the project site must be beyond the 100 Year flood level with a 15-metre allowance unless with a permit. The application must be filed with the Authority and must contain the following information under section 4: <u>Flood event standards</u> The applicable flood event standards under section 11. are used to determine the maximum susceptibility to flooding of lands or areas within the watersheds in the area of jurisdiction of the Authority are the Hurricane Hazel Flood Event Standard, the 100 Year Flood Event Standard and the 100-year flood level plus wave uprush.
	Applicable Regulations under the Ontario Conservation Authorities Act.	Under the Ontario Conservation Authorities Act, the UTRCA Regulation Limit (O. Reg 157/06) will be applicable for this project site. *Ontario Conservation Authorities Act.* <u>31. (2) Interference with public work</u> Where a project or a part thereof may interfere with a public work of Ontario, the authority shall file with the Minister of Infrastructure a plan and description of the project with a statement of the interference with the public work that may occur and a statement of how the authority proposes to remedy the interference. The project will not proceed until receiving the approval in writing of the Minister of Infrastructure. <u>31. (3): Interference with highway.</u> If the project will interfere with a public road or highway (i.e. 35th Line, Road 64, and/or Highway 6) through flooding or high water levels, the conservation authority will file with the Minister of Transportation a plan and description of the project with a statement of the interference that will occur and a statement of how the authority proposes to remedy the interference. The project will not proceed until the authority has

EA Criteria	Proposed Indicators/Measures	Summary of Indicator (as it relates to the Surface Water Assessment) Description / Applicability
		received the approval in writing of the Minister of Transportation. R.S.O. 1990, c. C.27, s. 32 (3).
Effects on stream baseflow quantity/ quality	*Sections 53 and 34 of the OWRA*	Under section 34 no more than 50,000 L of water per day may be taken by any means except in accordance with a permit issued under section 34.1. Discharge from the leachate treatment plant and stormwater management ponds are considered industrial sewage and will need to be approved under section 53. Approvals under the OWRA will be addressed at the permitting and approvals stage of this project.
	Environmental Protection Act (EPA).	This Act contains several relevant regulations and policies, including O. Reg 232/98 for Landfilling Sites which contains the requirements for surface water assessments, surface water control and monitoring.
	Guide to Permit to Take Water Application (2007)	If the construction site will need to be dewatered (from either groundwater or surface water) and the volume of water is greater than those specified in the Guide, an application for a permit will need to be filed under the appropriate category.
	Water Taking Regulation O. Reg. 387/04.	Regulation 387/04 provides guidance on the allowable quantity of water that may be taken per day from a water body. The Act states that for a construction project that is diverting water for the purpose of creating a dewatered work area, provided that the upstream and downstream water levels are not affected and the water is removed without a pump and returned to the same water body, no permit is needed.
	Appropriate water quality guidelines (e.g. PWQO or CCME)	Impact to effects on stream baseflow quantity and quality were based on regulations and guidelines described above, including Ontario Regulation 232/98, PWQO guidelines, and CCME Guidelines, where applicable.

5.0 STUDY DURATIONS

Two main study durations (or time frames) for this proposed landfill have been identified in the ToR:

Operational Period	The time during which the waste disposal facility is constructed, filled with waste, and capped. These activities are combined since they occur progressively (i.e., overlap) on a cell-by-cell basis, and they have a similar range of potential effects (e.g., there is heavy equipment active on the site).
Post-Closure Period	The time after the site is closed to waste receipt. Activities are normally limited to operation of control systems, routine property maintenance and monitoring, and thus have a more limited range of potential effects.

The approved EA Criteria in Table B-1, Appendix B indicate the relevant study duration(s) associated with each of the criteria used in this assessment.

In addition, **common reference periods** or milestone dates were also defined for the operational period of the landfill:

Start of Construction	Est. 2020	Just prior to the start of landfill construction and operation, representing the existing baseline conditions.
Mid-Point	Est. 2030	Approximately midway through the landfill construction and operation.
Closure	Est. 2040	At the completion of the landfill construction and operation, representing the full operating size of the proposed landfill.

6.0 STUDY AREAS

For the purposes of this EA, three general **study areas** were established in the ToR:

On-Site and in the Site Vicinity:	On-site includes the proposed waste disposal facility plus the associated buffer zones. Site vicinity is the area immediately adjacent to the waste disposal facility property that is directly affected by the on-site activities. Its size is variable depending on the particular criteria being addressed.
Along the Haul Routes:	The primary route along which the waste disposal facility truck traffic would move between a major provincial highway and the proposed waste disposal facility site entrance, plus the properties directly adjacent to these roads.
Wider Area:	The broader community, generally beyond the immediate site vicinity. Depending on the particular criteria this may include neighbourhoods, local municipalities, Oxford County, or the Province of Ontario.

The tables of approved EA Criteria in Appendix B indicate the relevant study duration(s) associated with each of the criteria in this assessment.

Although these three general study areas were common across all of the studies, their actual physical boundaries were not necessarily identical for every study or criterion; a flexible approach was used and the study area boundaries were adjusted as the work progressed to ensure that they adequately encompassed the significant effects of the proposed landfill.

For this assessment, the final study areas are the watershed catchments of the Patterson-Robbins Drain, the East Tributary and the Thames River.

Table - 4: Study Areas Associated with Each Environmental Criteria.

EA Criteria	Associated Study Area
Effects due to contact with contaminated groundwater or surface water	On-Site and Site Vicinity – The On-site study area includes the existing Carmeuse Lime (Canada) Limited site and the landfill buffer zone. The site vicinity also includes the catchments of the Patterson-Robbins Drain downstream of the discharge locations from the landfill. The Patterson-Robbins Drain is a tributary of the Thames river, with the confluence upstream of the town of Ingersoll.
Flood and erosion hazard	On-Site and Site Vicinity – The On-site study area includes the existing Carmeuse Lime (Canada) Limited site and the landfill buffer zone. The site vicinity also includes the catchments of the Patterson-Robbins Drain downstream of the discharge locations from the landfill. The Patterson-Robbins Drain is a tributary of the Thames river, with the confluence slightly of the town of Ingersoll.
Loss/displacement of surface water resources	On-Site and Site Vicinity – The On-site study area includes the existing Carmeuse Lime (Canada) Limited site and the landfill buffer zone. The site vicinity also includes the catchments of the Patterson-Robbins Drain downstream of the discharge locations from the landfill. The Patterson-Robbins Drain is a tributary of the Thames river, with the confluence slightly of the town of Ingersoll.
Effects on stream baseflow quantity/quality	On-Site and Site Vicinity – The On-site study area includes the existing Carmeuse Lime (Canada) Limited site and the landfill buffer zone. The site vicinity also includes the catchments of the Patterson-Robbins Drain downstream of the discharge locations from the landfill. It should be noted that the Patterson-Robbins Drain is a tributary of the Thames river, with the confluence upstream of the town of Ingersoll.

Where appropriate and relevant, common receptor points were also selected collaboratively by the technical experts so that the potential overlapping or cumulative effects of the proposed landfill could be assessed at these common receptor points. The common receptor points used in this study are:

- SW-1a is located in Patterson-Robbins Drain, southwest of the quarry where Patterson-Robbins Drain contributes to the Thames River. This location is a model-only location and is not a monitoring station that is part of the surface water monitoring program.
- SW-2 is located in the Patterson-Robbins Drain, west of the quarry and downstream of the Road 64 crossing culvert. This is the second-most downstream station in The Patterson-Robbins Drain, approximately 1,600 m upstream of SW-1a. 1.
- Thames River/SW-6 is located in the Thames River at Pemberton Street. This station is located downstream of all the other monitoring stations.

These locations can be seen in Figure 1 and are chosen because they are located downstream of the discharges from the proposed landfill.

7.0 METHODOLOGIES

In order to evaluate the environmental impacts based on the criteria mentioned above, the following field investigations and desktop analyses were conducted in accordance with the Surface Water Study work-plan:

- Surface water monitoring program which includes monthly manual water level and flow measurements, as well as continuous water level measurements via pressure loggers.
- Water quality monitoring of key parameters by sampling directly from watercourses.
- Collection of existing data from governmental and conservation agencies including meteorological data, hydrometric data and climate change data.
- Development of a calibrated hydrological model to evaluate the flow characteristics under different operations and closure scenarios.
- Design of a storm water management system to control runoff generated by the proposed landfill.
- Mixing analysis to evaluate the water quality in the Patterson-Robbins drain.

7.1 Field Monitoring Program

The principal objective of the 2017-2018 surface water investigations was to characterize the flow regime and water quality of key surface water features, including Patterson-Robbins Drain, the east tributary and the Thames River to quantify the physical/chemical baseline conditions. The Patterson-Robbins Drain is a tributary of the Thames River west of the Carmeuse quarry and it is also known colloquially as Cemetery Creek. East tributary, as referred to in this study, is an unnamed tributary of the Thames River located to the east of the Carmeuse quarry.

The data collected from the field monitoring program were used to provide baseline conditions for the watercourses in the area and calibrate the hydrological models. The models were subsequently used to estimate future conditions and climate change adjustments as well as assess the effects of proposed landfill storm water management.

7.1.1 Flow and Water Level Measurements

The surface water monitoring stations were set up in the Patterson-Robbins Drain, the east tributary and in the Thames River, as shown in Figure 1 in Appendix C.

Manual flow measurements were collected monthly at all monitoring stations to verify and refine stage-discharge rating curve relationships. Rating curves were then used with continuous level measurements to estimate continuous flow hydrographs.

Continuous flow/water level monitoring was undertaken at the four monitoring stations in the tributaries of the Thames River (SW-1, SW-2, SW-3, and SW-4) to assess seasonal fluctuations in streamflow.

Continuous water level records were obtained from two monitoring stations operated by Environment Canada and also at a monitoring station operated by the Upper Thames River Conservation Authority as shown on Figure 3 in Appendix C. Due to the quality and duration of these records, additional continuous monitoring stations were not installed on the Thames River.

For a more detailed description of the water level and flow monitoring program, please refer to Appendix C.

7.1.2 Water Quality Sampling

Water quality sampling was conducted at all flow monitoring stations identified above, as well as the two quarry discharge locations (centre plant and east plant) shown on Figure 1 in Appendix C. All water samples were stored in sample bottles, pre-charged with preservative (as required), provided by the laboratory. Samples were sent under chain of custody documentation to Maxxam Analytics and analyzed for metals, metalloids, anions, nutrients, volatile and semi-volatile organics and other general water quality parameters.

For a more detailed description of the water quality monitoring program, please refer to Appendix C.

7.2 Patterson-Robbins Drain and Thames River Hydrological Model

Version 4.3 of the Hydrologic Modeling System developed by the United States Army Corps of Engineers Hydrologic Engineering Center (HEC-HMS) was used to simulate flows in the Patterson-Robbins Drain and the Thames River. The model was discretized with sub-basins based on the surface water monitoring stations as described in Appendix D. The HEC-HMS model was calibrated to the monitoring data collected during the baseline monitoring program from November 2017 to December 2018 (where possible).

To generate continuous flows (average year for future scenarios), the model used the soil moisture accounting method. To generate peak flows (design storm events), the Soil Conservation Service (SCS) Curve Number (CN) method was used. Figure 3 in Appendix D shows a schematic of the modelled drainage system. Details of the hydrological model can be found in Appendix D.

7.2.1 Model Inputs

Geographical data used in the model, such as drainage basin characteristics, are as described in section 2.3. The model simulations used Environment Canada meteorological data for the London CS station. The input parameters used included hourly precipitation and temperature. Daily evapotranspiration data was derived from the precipitation and temperature data using the methods described in Johnstone & Louie (1983).

Adjustments for climate change are described in section 9.1.2 as well as in Appendix D.

7.2.2 Scenarios

A total of eight (8) scenarios were simulated using the HEC-HMS model, including four (4) peak flow models and four (4) average year models;

- Return period storms (existing conditions): Evaluating the potential for flooding under existing conditions used the return period storms data from Environment Canada.
- Return period storms (2011-2040): The potential for future flooding under full operating conditions (i.e. the last day of operations) was evaluated using return period storm events with climate change adjustments made to the rain fall intensity-duration data using the IDF_CC tool developed by Western University, Ontario.
- Return period storms (2041-2070): The potential for flooding under future flooding under full operating conditions (i.e. the last day of operations) was evaluated using return period storm events with climate change adjustments made to the rainfall intensity-duration data using the IDF_CC tool developed by Western University, Ontario.
- Return period storms (2071-2100): The potential for flooding under future flooding under full operating conditions (i.e. the last day of operations) was evaluated using return period storm events with climate change adjustments made to the rainfall intensity-duration-frequency data using the IDF_CC tool developed by Western University, Ontario.
- Average year (Existing Conditions): Average flow conditions were evaluated with the HEC-HMS model, using the precipitation record at London CS station.
- Average year (2011-2040): Average flow conditions were evaluated with the HEC-HMS model, using the London CS precipitation record adjusted for climate change (2011-2040 period).
- Average year (2041-2070): Average flow conditions were evaluated with the HEC-HMS model, using the London CS precipitation record adjusted for climate change (2041-2070 period).
- Average year (2071-2100) Average flow conditions were evaluated with the HEC-HMS model, using the London CS precipitation record adjusted for climate change (2071-2100 period).

7.3 Receiving Watercourse Water Quality Analysis

The water quality analysis uses projected surface water flows and water quality to estimate water quality concentrations at several locations within the receiving watercourse(s). Figure 1 shows the 3 mixing locations along the Patterson-Robbins Drain and the Thames River: SW1a, SW2, and SW6. Baseline watercourse flow, leachate treatment plant effluent, and stormwater management pond discharge make up the 3 major flow contributions at each mixing location.

The water quality analysis was conducted under three flow conditions; average flow conditions, $7Q_{20}$ (low flow condition), and 2-year return period storm (high flow condition, including an adjustment for climate change as described in Section 9.2.2.2). The average flow conditions were calculated from the average year of precipitation in the period of available record at the Environment Canada climate station London CS. The low flow conditions were based on the $7Q_{20}$ which was evaluated as the minimum 7-day average flow over a 20 year period. The high flow condition was evaluated from the peak flow response to a 2-year return period storm event at London CS.

Further details of the methodology and key assumptions are described in Appendix E.

7.4 Stormwater Management

The construction of the landfill will increase the drainage area of the Patterson-Robbins Drain by redirecting runoff from the proposed landfill footprint, which is currently directed to the Carmeuse Quarry drainage system, to the Patterson Robbins Drain.

Version 4.3 of the Hydrologic Modeling System developed by the United States Army Corps of Engineers Hydrologic Engineering Center (HEC-HMS) was used to model the final landfill cover and the pre-quarry land area, to obtain flows for a pre-to-post development comparison. The pre-quarry conditions were evaluated for the stormwater management design only to compare to stormwater discharge conditions prior to major development at the site. This assessment was completed to support future permitting of the stormwater management ponds.

Two stormwater management ponds, one on the north side and one on the south side of landfill, have been proposed to manage stormwater runoff from the site. The proposed stormwater management ponds were designed according to the Ministry of the Environment (now MECP) Stormwater Management Planning and Design Manual (MOE, 2003). The proposed stormwater management ponds were designed to detain and control post-development discharge from the 2 through 100 yr return period storms under existing conditions, as well as under the three anticipated climate change scenarios (2011-2040, 2041-2070, 2071-2100). The design storms were based on the IDF data from the Environment Canada Climate Station London CS. Further details of the stormwater management design can be found in Appendix F (stormwater management memo).

8.0 DATA COLLECTION

8.1 Background Data

8.1.1 Weather/Climate Data

The hourly precipitation and temperature data used for the hydrological modelling were taken from the Environment Canada station London CS (6144478) due to its proximity to the site and availability of data in the time period of interest. The IDF data for the evaluation of peak flow events from the frequency of storm events was also taken from the London CS station. Further details of the data can be found in Appendix D.

Table - 5: Geographical Information of Climate Stations

Station Name	Station ID	Latitude	Longitude	Elevation
London CS	ID:6144478	43°02'00.0" N	81°09'00.0" W	278 masl

8.1.2 Drainage Patterns and Catchment Areas

The catchment boundaries for the watercourses evaluated in the assessment are presented on Figure 2 in Appendix D. The catchments were delineated based on available topography and contour data from MNRF. The catchment areas include all upstream sub-catchments (e.g., catchment area at SW-6 includes catchment area at SW-5). The area of the catchments can be found in Appendix D.

8.1.3 Non-Walker Surface Water Data

Continuous water level and flow records were also obtained from the water survey of Canada monitoring station Thames River at Ingersoll, Cedar Creek at Woodstock and the Pittock Dam as shown in Figure 3 in Appendix C and Table - 6.

Table - 6: Non-Walker Surface Water Monitoring Stations.

Location	Station ID	General Description	Operating Organization	Period of Record
Thames River at Ingersoll	02GD016	On Thames River	Environment Canada/Water Survey of Canada	1957-Present
Cedar Creek at Woodstock	02GD011	Tributary to Thames River	Environment Canada/Water Survey of Canada	June 24, 1951 - Present
Pittock Dam and Reservoir	02PIT/02GD012	Upstream of Thames River South Branch	Upper Thames River Conservation Authority	January 1, 2000 to Present

8.1.4 Carmeuse Quarry Discharge

Figure 3 in Appendix C shows the two discharges from the Carmeuse Quarry operations to the Thames River. The daily pump rates for these two discharges, center plant and east plant, are shown on Figure 11 in Appendix C. The center plant discharges significantly more water than the east plant. The discharge volumes from center plant are comparable with the discharge from the Patterson-Robbins Drain (SW-1 and SW-2), discharging approximately 300 L/s on average. The east plant flow rate records fluctuate around approximately 50 L/s.

8.2 Field Data

8.2.1 Manual Flow and Water Level Measurements

Manual flow and water level measurements were collected monthly between July 2017 to December 2018. Manual water level measurements were recorded using a water level staff gauge installed at each station, which was surveyed to record in masl (meters above sea level). Manual flow measurements were collected using an electromagnetic velocity flow meter and the velocity-area method. The manual water level and flow results can be found in Appendix C.

8.2.2 Continuous Flow Monitoring

The available flow records at the Patterson-Robbins Drain were characterized by a series of snowmelt and/or rainfall generated peak flows that punctuated relatively stable low to moderate flow levels (or dry channel conditions at some stations). These runoff peaks reflected the input of water from direct precipitation, augmented at some streams/watercourses by storage and/or groundwater. Water levels measured at SW-1, SW-2, SW-3, SW-4, SW-5 and SW-6 exhibited generally consistent seasonal trends across all the stations. As seen on Figures 4 to 7 in Appendix C, the beginning of the monitoring period in late fall is characterized by higher water levels which continued throughout the winter with peaks corresponding to rainfall/snowmelt events. From late spring to late August, the water level is seen to decrease gradually towards summer.

8.2.3 Water Quality Monitoring

The laboratory water quality results for the monitoring period of 2017-2018 are presented in Tables 13 to 20 of Appendix C for the monitoring stations SW-1 to SW-6 as well as center plant and east plant locations as described in section 2.3. The results are compared to their respective regulatory guidelines (PWQO, Environmental Protection Act (Ontario Regulation 232/98 and Ontario Regulation 347) to evaluate the occurrence of exceedances.

8.2.4 Patterson-Robbins Drain Hydrological Model

The Patterson-Robbins Drain hydrological model, as described in section 7.2 was used to estimate the average flows and peak flows under storm events for the three periods of interest considering climate change. The model was calibrated against the monitored data from November 9th, 2017 to December 12th, 2018 and the details of the results can be found in Appendix D.

8.2.5 Receiving Watercourse Water Quality Analysis

Estimation of stormwater management pond effluent constituent concentrations was based on monitoring data for the S5 stormwater pond at the East landfill, located in Niagara Falls, Ontario (provided by Walker). The proposed Southwestern Landfill is of a similar design and will be operated in a similar way to the East Landfill. The complete list of parameters and their concentrations is included in Appendix E.

8.2.6 Stormwater Pond Design

There were no significant field-measured data used for the design of the stormwater management ponds, as the design is primarily based on modelled results and proposed design specifications for the landfill cover. Field measured elevations for the discharge locations constrained and informed the pond design. For more details on the inputs to the Stormwater Pond design, see Appendix F.

9.0 ENVIRONMENT POTENTIALLY AFFECTED BY THE UNDERTAKING

Section 6.1(2)(c)(i) of the *Environmental Assessment Act* requires a “description of the environment that will be affected or might reasonably be expected to be affected, directly or indirectly”. Section 8.2 of the ToR describes the methodology by which the environment potentially affected by the proposed landfill is to be developed, notably including both the existing environment as well as the environment that would be expected to exist in the future without the proposed undertaking (i.e., the environmental baseline conditions, or the “do nothing” alternative).

9.1 Baseline Assumptions

9.1.1 Land Use Forecast

A common set of assumptions were provided by MHBC Planning on behalf of Walker regarding the forecasted land uses in the area, so that this study could reflect any reasonably foreseeable changes in the uses of the land on and around the proposed landfill site (including the expected ongoing operation of the quarries and lime plants in the vicinity of the site). These assumptions are detailed in Walker’s Environmental Assessment Report, while a brief summary of the aspects relevant to this study follows.

The study area is located within Oxford County and the majority of the new growth within the County is projected in the three urban areas, including Woodstock, Ingersoll and Tillsonburg. Growth and change in land use are described for three major periods in the MHBC report. Within the 2023 planning horizon, development will be primarily located on the south east boarder of the Town of Ingersoll. Growth continues into 2033 planning horizon with expansion expected in the south of Ingersoll, into the Township of South-West Oxford near Highway 401. Minimal growth and development is expected in the Village of Beachville and the Rural Cluster of Centerville and will be mainly through infill. As for the 2043 planning horizon, the developments described in the previous periods will have been serviced and fully functional. These local and regional developments are not expected to affect the surface water assessment.

No known proposed developments are located within the 1 km study area and no significant change in land use is expected in the site vicinity except the development of the quarry during the operational period. This would result in 0.04 km^2 reduction in the catchment area of SW2.

9.1.2 Climate Change Forecast

Another set of common assumptions that were established for the purpose of this EA is the potential for climate change, so that these could be considered in the individual studies of the potential effects of the proposed landfill. These assumptions are detailed in Walker's Environmental Assessment Report and basically adopt the guidance in the Ontario Ministry of Natural Resources and Forestry's Climate change projections for Ontario: An updated synthesis for policymakers and planners.

Minister's amendment #12 to the approved amended terms of reference site EA required that climate change should be considered in this environmental assessment. The impacts of climate were accounted for in two ways:

- Adjustments to historical average year hourly timeseries for temperature and precipitation were made using "Climate Change Projections for Ontario: An updated synthesis of policymakers and planners" (MNRF, 2015).
- Adjustments to the peak rainfall event hyetographs were made using the IDF_CC tool

9.2 Environmental Baseline Conditions

9.2.1 Existing Conditions

This section describes the average flows, peak flows and water quality under existing land use conditions.

9.2.1.1 Average Flows

The average flows in the Patterson-Robbins Drain and the Thames River under existing conditions were estimated using the monitored flow data by Walker and non-Walker sources as well as a hydrological model. This estimate considered an average year based on annual precipitation. The model year that was assumed to be average was 2016, based on the period of record at London CS. The modelled average annual flows are 0.081 m^3/s, 0.094 m^3/s and 7.1 m^3/s at SW2, SW1a and SW6 respectively. Similarly, the modelled maximum monthly average flows are 0.14 m^3/s, 0.17 m^3/s and 12.5 m^3/s at SW2, SW1a and SW6 respectively, all of which occurring in March.

Table - 7: Average Flows for Existing Conditions

Average Flows (m^3/s)			
Month	**SW2**	**SW1a**	**SW6**
January	0.0864	0.0992	9.30
February	0.0892	0.103	7.73
March	0.144	0.167	12.5
April	0.0500	0.0580	3.91
May	0.0582	0.0673	4.99
June	0.0541	0.0627	4.61
July	0.128	0.149	11.3
August	0.120	0.139	10.1
September	0.0636	0.0737	5.20
October	0.0516	0.0598	4.35
November	0.0710	0.0824	6.14
December	0.0513	0.0594	4.23
Annual Average	0.0809	0.0937	7.05

9.2.1.2 Peak Flows

The one in two-year (1:2 year) return period flows, under existing conditions, were estimated using the hydrological model with the IDF storm data at London CS. The 1:2 year peak flows were identified as 1.59 m^3/s, 2.094 m^3/s and 69.5 m^3/s at SW2, SW1a and SW6 respectively.

Table - 8: Peak flows under existing conditions

Peak Flows (m^3/s)			
Flow Condition	**SW2**	**SW1a**	**SW6**
1:2 Year Peak Flow (m^3/s)	1.59	2.09	69.5
1:5 Year Peak Flow (m^3/s)	4.25	5.59	121
1:10 Year Peak Flow (m^3/s)	6.65	8.77	160
1:25 Year Peak Flow (m^3/s)	10.4	13.7	217
1:50 Year Peak Flow (m^3/s)	13.4	17.6	260
1:100 Year Peak Flow (m^3/s)	16.6	22.0	306

9.2.1.3 Water Quality

Baseline water quality for the Patterson-Robbins Drain Complex and the Thames River is based on water quality monitoring completed during 2017-2018, as described in Section 8.2.3. It was found that background concentrations for some constituents in both the Thames River and the Patterson-Robbins Drain were higher than the identified environmental objectives. See Appendix C for more detail on water quality monitoring results. The 2017 Watershed report card from the Upper Thames River Conservation Authority gives a water quality grade of "D" (poor quality) to surface water in the Ingersoll corridor, with an emphasis on evaluating the Thames River in this area. Additionally, the report card identifies that the Ingersoll corridor has multiple high quality tributaries. Baseline monitoring showed guideline exceedances in 3 constituents between the Patterson-Robbins Drain and the Thames River (Fluoride, Nitrite, and Total Phosphorus). Elevated levels of these constituents are common in agricultural runoff.

9.2.2 Future Baseline Conditions

This section describes the average flow and peak flow conditions expected within Patterson-Robbins Drain and Thames River downstream of the proposed landfill. The future baseline conditions will be affected by the development of the quarry as well as climate change. While the exact timeline for development of the quarry cannot be predicted, the following effects on catchment area have been approximated based on current rates of aggregate extraction and increases in footprint area. For the operational period (2011-2040), the quarry is expected to expand and result in reduction of the Patterson-Robbins Drain catchment by 0.04 km^2. For the post-closure period 1 (2041-2070) and post-closure period 2 (2071-2100), the catchment of Patterson-Robbins Drain is estimated to be further reduced by 0.39 km^2 and 0.81 km^2 respectively, compared to the existing conditions,. Climate change conditions are also accounted for as described in section 9.1.2.

9.2.2.1 Average Flows

The results of the hydrological model for the average year of rainfall are presented for three periods of interest: 2011-2040, 2041-2070, 2071-2100.

Table - 9: Modelled Monthly and Annual Average Flows at SW1a Under Future Baseline Conditions

Average Flows (m^3/s)			
Month	2011-2040	2041-2070	2071-2100
January	0.116	0.112	0.108
February	0.0849	0.0850	0.0850
March	0.101	0.100	0.0959
April	0.162	0.166	0.155
May	0.0541	0.0553	0.0513
June	0.0685	0.0662	0.0624
July	0.0643	0.0617	0.0583
August	0.163	0.156	0.147
September	0.127	0.125	0.117
October	0.0769	0.0783	0.0730
November	0.0630	0.0645	0.0601
December	0.0835	0.0898	0.0885
Annual	0.0970	0.0967	0.0918

The average flows at SW1a are presented in Table - 9. No significant changes in flows were projected under average flows for all future scenarios. The annual average flows are 0.0970 m^3/s for the operational period and 0.0967 m^3/s and 0.0918 m^3/s for the two post-closure periods. The maximum flows are 0.163 m^3/s, 0.166 m^3/s and 0.155 m^3/s for the operational period, post-closure period 1 and post-closure period 2 respectively. Similarly, the minimum flows are 0.0541 m^3/s, 0.0553 m^3/s and 0.0513 m^3/s.

Table - 10: Modelled Monthly and Annual Average Flows at SW2 Under Future Baseline Conditions

Average Flows (m^3/s)			
Month	2011-2040	2041-2070	2071-2100
January	0.100	0.0968	0.0928
February	0.0732	0.0728	0.0722
March	0.0875	0.0860	0.0814

Average Flows (m³/s)			
Month	2011-2040	2041-2070	2071-2100
April	0.140	0.142	0.131
May	0.0466	0.0473	0.0436
June	0.0591	0.0568	0.0530
July	0.0554	0.0528	0.0494
August	0.140	0.134	0.125
September	0.110	0.107	0.0997
October	0.0663	0.0670	0.0620
November	0.0544	0.0552	0.0510
December	0.0720	0.0768	0.0751
Annual	0.0837	0.0828	0.0780

The average flows at SW2 are presented in Table - 10. No significant changes in flows were predicted under average flows for all future scenarios. The annual average flows are 0.0837 m^3/s for the operational period, 0.0828 m^3/s for post-closure period 1 and 0.078 m^3/s for post-closure period 2. The maximum flows are 0.140 m^3/s, 0.132 m^3/s and 0.131 m^3/s for the operational period, post-closure period 1 and post-closure period 2 respectively. Similarly, the minimum flows are 0.0466 m^3/s, 0.0473 m^3/s and 0.0436 m^3/s.

Table - 11: Modelled Monthly and Annual Average Flows at SW6 Under Future Baseline Conditions

Average Flow (m³/s)			
Month	2011-2040	2041-2070	2071-2100
January	10.6	10.7	10.9
February	6.37	6.64	7.00
March	7.53	7.77	7.79
April	12.1	12.8	12.6
May	3.69	3.93	3.84
June	5.10	5.13	5.10
July	4.75	4.75	4.72
August	12.5	12.5	12.4

Average Flow (m^3/s)			
Month	2011-2040	2041-2070	2071-2100
September	9.09	9.33	9.23
October	5.50	5.84	5.74
November	4.62	4.92	4.83
December	6.25	7.01	7.29
Annual	7.34	7.62	7.62

The average flows at SW6 are presented in Table - 11. No significant changes in flows were predicted under average flow conditions for all future scenarios. The annual average flows are 7.34 m^3/s for the operational period, 7.62 m^3/s for post-closure period 1 and 7.62 m^3/s for post-closure period 2. The maximum flows are 12.5 m^3/s, 12.8 m^3/s and 12.6 m^3/s for the operational period, post-closure period 1 and post-closure period 2 respectively. Similarly, the minimum flows are 3.69 m^3/s , 3.93 m^3/s and 3.84 m^3/s.

9.2.2.2 Return Period Storms

The peak flows at SW1a, modelled using the climate change adjusted IDF return period storms, are presented in Table - 12 for three periods of interest: 2011-2040, 2041-2070, and 2071-2100.

Table - 12: Future Baseline Peak Flows under Climate Change at SW1a

Peak Flows (m^3/s)			
Return Period	2011-2040	2041-2070	2071-2100
1:2yr	4.28	4.37	3.86
1:5yr	10.9	10.7	9.74
1:10yr	16.5	17.1	14.2
1:25yr	24.2	28.4	25.3
1:50yr	29.3	35.4	27.9
1:100yr	34.3	41.9	35.8

The peak flows at SW2, modelled using the climate change adjusted IDF return period storms, are presented in Table - 13 for three periods of interest: 2011-2040, 2041-2070, and 2071-2100.

Table - 13: Future Baseline Peak Flows under Climate Change at SW2

Peak Flows (m^3/s)			
Return Period	**2011-2040**	**2041-2070**	**2071-2100**
1:2yr	3.41	3.45	2.86
1:5yr	8.47	8.18	7.18
1:10yr	12.7	13.0	10.5
1:25yr	18.5	21.4	18.6
1:50yr	22.4	26.6	20.5
1:100yr	26.2	31.5	26.3

The peak flows corresponding to the IDF return period storms at SW2 are presented in Table - 14 for three periods of interest: 2011-2040, 2041-2070, and 2071-2100.

Table - 14: Future Baseline Peak Flows under Climate Change at SW6

Peak Flows (m^3/s)			
Return Period	**2011-2040**	**2041-2070**	**2071-2100**
1:2yr	90.5	103	101
1:5yr	174	186	183
1:10yr	235	261	237
1:25yr	312	380	358
1:50yr	357	447	375
1:100yr	401	507	458

The variation in the estimated future peak flows are generally consistent across the locations. The peak flows increase from 2011-2040 to 2041-2070 and decrease somewhat in 2071-2100.

9.2.2.3 Water Quality

The existing baseline water quality conditions were evaluated in the baseline water quality monitoring program described in section 8.2.3. The future baseline water quality conditions were evaluated based upon the climate change scenarios and changes to upstream catchment areas (i.e. quarry development). There are no major land use changes planned for the Patterson-Robbins Drain catchment over the available planning horizon, and therefore the baseline conditions are expected to remain similar to existing conditions. Baseline monitoring (2017-2018) showed PWQO/CCME exceedances in 3 constituents between the Patterson-Robbins Drain and the

Thames River (Fluoride, Nitrite, and Total Phosphorus). Elevated levels of these constituents are common in agricultural drainage areas such as the Patterson-Robbins Drain or the Thames River.

10.0 EVALUATION OF THE PROPOSED LANDFILL

Section 6.1 (2)(c) and (d) of the Act, and the ToR, require an evaluation of:

- The effects that will be caused on the environment;
- The actions necessary to prevent, change, mitigate or remedy the effects on the environment; and,
- An evaluation of the advantages and disadvantages (net effects) to the environment.

This section presents the assessment of these matters as it relates to the surface water assessment, and for each of the EA criteria related to this study.

The effects of the proposed Southwestern Landfill on surface water resources in the Patterson-Robbins Drain and the Thames River were evaluated at analysis points SW-1, SW-1, and SW-6 under the identified climate change periods.

10.1 Effects due to contact with contaminated groundwater or surface water (Criterion 4)

10.1.1 Potential Effects

A Receiving Watercourse Water Quality Assessment was completed to evaluate the effects on surface water quality. This analysis combined flows and constituent concentrations in a mass balance to estimate the final concentrations in the Patterson-Robbins Drain and the Thames River. Discharge concentrations were estimated for the stormwater management pond and leachate treatment plant effluent based on water quality collected at similar facilities.

Potential effects on the Patterson-Robbins Drain and the Thames River include elevated levels of water quality constituents primarily due to one of three reasons: 1) surface water runoff from the landfill capped areas, which are discharged through the stormwater management ponds; 2) treated effluent discharge into the Patterson-Robbins Drain from the leachate treatment plant; or 3) Baseline exceedances of guideline criteria found during background monitoring. Surface water runoff effects will be minimized by using a clean cap material. Additional treatment of surface water runoff in stormwater management ponds will minimize contaminants, particularly in suspended load. Collected leachate will go through a leachate treatment plant, which will reduce constituent concentrations to approved levels before the effluent is discharged into the Patterson-Robbins Drain.

The assessment resulted in additional potential exceedances in the examined guidelines (PWQO, CCME, and ODWQS) for a variety of constituents. The main contributor to these additional exceedances was stormwater management pond discharge, which is projected to have elevated concentrations of some common stormwater constituents sourced from the cap materials, and the discharge from the leachate plant was assumed to meet PWQO standards, which are occasionally higher than ODWQS or CCME guidelines. This assumption caused projected exceedances from leachate in some of the ODWQS and CCME guidelines, while maintaining concentrations at or under PWQO.

It is important to note that water quality estimates for the stormwater management pond discharge were based on monitoring data from the S5 stormwater pond at the East Landfill in Niagara Falls, operated by Walker. It is possible that for every site, landfill or otherwise, there are site specific characteristics of soil and runoff quality, which may not be an exact analog to the proposed Southwestern Landfill in the Township of Zorra. Additionally, for multiple constituents, background PWQO exceedances are not atypical in Ontario watercourses. Baseline monitoring was carried out under generally average flow conditions, and this monitoring data has been applied to all scenarios. It is likely that under higher or lower flow conditions, multiple constituent concentrations would increase. It is expected that, under high flows, the stormwater management pond discharge water quality would be similar to that resulting from the surrounding land use because of the use of carefully managed capping materials.

The site area and receiving watercourses are not currently used as a source of drinking water, no wellhead protection area E (WHPA-E) or intake protection zone (IPZ) exists in this area (MECP, Online Source Protection Information Atlas), however the Ontario drinking water quality standards (ODWQS) were used as a guideline for the water quality assessment. Walker has communicated that they are committed to including the required water quality treatment to manage the site discharges.

Although a number of water quality standards and guidelines were evaluated, many of the projected exceedances are not relevant because the particular uses of the receiving watercourse and background water quality in the area. Site specific discharge criteria will be developed in consultation with MECP during the permitting and approvals stage of this project. The required monitoring and enforceable site specific discharge criteria will be included on the ECAs for the site. As a result of compliance with the site specific discharge criteria, no adverse water quality effects are expected in the receiving watercourses.

Other guidelines and regulations, such as Ontario Regulations 347, 232/98, and 169/03, as well as MECP guidelines B-7 and B-7-1, were consulted in determining water quality limits, however these regulations were deemed not applicable for the purposes of examining quantitative surface water quality in this case. See Section 4.1 for more details on guideline/regulation selection for surface water quality purposes.

For further details regarding the Receiving Watercourse Water Quality Assessment, see Appendix E.

10.1.2 Potential for Cumulative Effects

Minimal development is expected throughout the Patterson-Robbins drain catchment over the current planning horizon according to the Land Use Planning Forecast Report prepared by MHBC, dated October 2017. Outside of the proposed Southwestern Landfill, the only other major change in land use that is anticipated (by 2103) within the catchment area is the development of currently operating quarries to full build-out. The quarry development (by 2103) is not expected to significantly change the baseline water quality in the catchment, as the overall land uses within the catchment will not change. The future quarry development will only reduce the areas draining the receiving watercourse and should not significantly effect its water quality.

PWQO, CCME, and ODWQS guidelines were used to evaluate water quality constituents in the Patterson-Robbins Drain and the Thames River. Baseline monitoring recorded background exceedances in the two watercourses. The Water Quality Assessment resulted in potential additional exceedances of the examined criteria, based on additional inputs from the stormwater management ponds and leachate treatment plant discharge, which was assumed to be equal to PWQO guidelines, causing exceedances of some CCME and ODWQS criteria.

10.1.3 Additional Mitigation Recommendations

Relevant water quality standards in the receiving watercourse(s) will be met as a result of the design of the stormwater management pond, its collection system and leachate treatment facility. Therefore, no significant effects on water quality are anticipated. Site specific discharge criteria will be developed in consultation with MECP during the permitting and approvals stage of this project. The required monitoring and enforceable site specific discharge criteria will be included on the ECAs for the site. As a result of compliance with the site specific discharge criteria, no adverse water quality effects are expected in the receiving watercourses.

No Additional mitigation is recommended to manage contact with contaminated surface water.

10.1.4 Net Effects

No net effects on the receiving watercourse are anticipated from contact with contaminated surface water.

10.1.5 Summary

The leachate treatment plant and stormwater management system will be designed and regulated to achieve the relevant water quality standards in the receiving watercourse(s). Therefore, no potential effects on receiving water quality are anticipated due to contact with contaminated surface water.

10.2 Flood and Erosion Hazard (Criterion 5)

10.2.1 Potential Effects

The proposed landfill will increase the catchment area of Patterson-Robbins Drain by approximately 7.5% (at the point of confluence with the Thames River) or 0.76 km^2, which will increase the total surface water runoff. The increase in runoff will be managed in the two storm water management ponds as described in Appendix F.

The potential risk of flooding and erosion would be the highest under high flow conditions with high water levels and velocities in the watercourses sufficient to mobilize the sediment and over top banks. Therefore, storm events were evaluated under the different project scenarios at the Site discharges and the receiving watercourses. Climate change was accounted for in the storm events for the operational period from (2011-2040), the post-closure period 1 (2041-2070) and the post-closure period 2 (2071-2100) as described in section 9.1.2.

The comparison of the 2-year storm peak flows with or without the landfill for the three periods of interests are presented in detail in Table 19-21. For the 1:2 year peak flows, the increase in flow due to the landfill ranges between at 0.684 m^3/s to 0.754 m^3/s at SW-1a, 0.266 m^3/s and 0.284 m^3/s at SW-2 and 0.1 m^3s to 0.103 m^3/s at SW6/Thames River. The percent difference ranges from 15.98% to 19.52%, 7.79% to 9.93% and 0.09% to 0.10% at SW-1a, SW2 and SW6/Thames River respectively.

Although the peak flows in the receiving watercourse(s) are increasing, this increase would occur gradually. The catchment area of the stormwater management ponds will increase slowly over the life of the landfill and the discharge flows will increase with it. Therefore, the increase to peak flows will occur over many years. This gradual increase in peak flows is not expected to affect the risk of flooding and erosion in the receiving watercourse(s), since the watercourse crossings and stream channels can contain these additional flows. The additional peak flows associated with the increase in catchment to the Patterson-Robbins Drain related to the development of the landfill, is merely reinstating flows and catchment that originally drained to Patterson-Robbins Drain prior to the quarry development. As such, the gradual increase in flow from the landfill stormwater management ponds will be at least partially offset by the gradual reduction in drainage area contributing to the Patterson-Robbins Drain resulting from ongoing quarry development.

Guidelines listed in Table - 3 were considered for this study. Ontario Regulation 232/98 provides detailed guidance to the design, operation, and closure of landfilling sites in Ontario. This regulation has been considered only as general guidance since it does not have quantitative guidelines for flooding and erosion hazards. Ontario Regulation 166/06 includes considerations for inland lakes and flood standards but the proposed site is not located within the described hazard zone and thus, not applicable to this study. Similarly, Technical Guide: River and Stream System Flooding Hazard Limits – Ontario Ministry of Natural Resources (OMNR), 2002, Technical Guide: River and Stream System Erosion Hazard Limits, OMNR, 2002 and UTRCA Regulation Limit (O. Reg 157/06) may only apply to the portions of the discharge pathway that connects to the receiving watercourse. The required permits and authorizations will be acquired prior to construction. The study area is also not a designated hazard zone and thus Environmental Planning Policy Manual for UTRCA, June 2016 does not apply to this study.

10.2.2 Potential for Cumulative Effects

Development in the receiving watercourse catchment area is expected to be minimal (by 2043) and therefore, no cumulative changes to catchment area or land use are expected. Consequently, the hydrological and hydraulic characteristics of the receiving watercourses are not expected to change from other existing/future activities from the available information that has a potential to cause cumulative effects during the operational period.

For the post-closure period from 2041-2070, the quarry expansion is expected to result in a reduction of 0.39 km^2 (3.9%) relative to the existing conditions from the catchment area of Patterson-Robbins Drain. Similarly, the catchment area is expected to decrease by 0.81 km^2 (8.2%) during the post-closure period from 2071-2100. This reduction in catchment area will result in an overall reduction in stream flow. The decrease in peak flow due to the development of the quarry will decrease the risk of erosion and flooding during these periods.

10.2.3 Additional Mitigation Recommendations

No additional mitigation is recommended for the design and operation of the landfill to manage the risk of increased flooding and erosion.

10.2.4 Net Effects

No net effects on the receiving watercourse are anticipated from an increase in flooding and erosion as a result of the landfill.

10.2.5 Summary

The proposed landfill will result in increase in peak flows due to the increase in catchment area. The resulting peak flows will be managed in the stormwater ponds. Alternatively, the post-closure flows will be reduced by the development of the quarry reducing future risk of erosion and flooding in the receiving watercourse. The summary of the changes and the effects are summarised in Table 19 to Table 21. With the storm water management ponds controlling the peak flows, no significant erosion or flooding is anticipated as a result of the landfill.

10.3 Loss/displacement of surface water resources (Criterion 32)

10.3.1 Potential Effects

The proposed design and construction of the landfill will not require the removal or diversion of any existing watercourses in the study area. The development of the landfill area will increase the catchment area of the Patterson-Robbins Drain, since this area is currently draining to Thames River via quarry drainage system and stormwater management ponds. The runoff from the proposed landfill will be managed through storm water management ponds and could have potential effects to the hydrological and hydraulic characteristics of the Patterson-Robbins Drain.

The proposed landfill is expected to add 0.76 km^2 of catchment area to the site and to the receiving water courses. In terms of the Patterson-Robbins Drain, this accounts for a 7.5% increase in catchment area. Surface water resources are not expected to be lost or displaced. The increase in flow under average conditions is expected to be less than 5% at Patterson-Robbins Drain. Therefore, no significant change to the flow regime is projected in the receiving watercourse as a result of the landfill. For additional detail regarding the predicted changes to stream flow please refer to Appendix E.

Guidelines listed in Table - 3 were considered for this study. Ontario Regulation 347 is considered only as general guidance as no quantitative guidelines for the loss/displacement of water resources were mentioned. Ontario Regulation 232/98 provides detailed guidance to the design, operation, and closure of landfilling sites in Ontario. This regulation has been considered only as general guidance since it does not have quantitative guidelines for the loss/displacement of surface water resources. Ontario Regulation 166/06 list considerations for inland lakes and flood standards but the proposed site is not located within the described hazard zone and thus, not applicable to this study. Under the Ontario Conservation Authorities Act, the UTRCA Regulation Limit (O. Reg 157/06) will be applicable for this project site. The project will not proceed until receiving the approval in writing of the Minister of Infrastructure for consideration of interference with public work and with the highway.

10.3.2 Potential for Cumulative Effects

The development in the receiving watercourse catchment area is limited to the excavation of the quarry. The continued development of the quarry during the operational and post-closure periods would result in the reduction of catchment area of Patterson-Robbins Drain. For the post-closure period from 2041-2070, the quarry development is expected to result in a reduction of 0.39 km^2 (3.9%) relative to the existing conditions from the catchment area of Patterson-Robbins Drain. Similarly, the catchment area is expected to decrease by 0.81 km^2 (8.2%) during the post-closure period from 2071-2100. Consequently, the average flows in Patterson-Robbins would increase due to the proposed landfill but they are expected to decrease by the end of the post-closure period due to the ongoing development of the quarry. The average flows are estimated to increase between 8-10% at SW2, 10-11% at SW1a and 0.13-0.14% at SW6/Thames River.

10.3.3 Additional Mitigation Recommendations

From the surface water assessment, no additional mitigation is needed for the design and operation of the landfill as the watercourses in the area are not expected to be removed or diverted.

10.3.4 Net Effects

No net effects on the receiving watercourse are anticipated from the loss or displacement of surface water resources as a result of the landfill.

10.3.5 Summary

The proposed landfill is not expected to result in the loss or displacement of surface water resources. The increased drainage area from the landfill is expected to increase the flow in the receiving water courses by approximately 5% at the time of landfill closure. Table 17 shows the summary of criterion 32.

10.4 Effects on stream baseflow quantity/quality (Criterion 34)

10.4.1 Potential Effects

As discussed in hydrogeological assessment, the proposed landfill will have no effect on the stream baseflow with respect to groundwater contribution. However, there is a potential effect on the baseflow quantity from surface water contributions. The contribution is expected to come from the leachate treatment system that discharges into Patterson-Robbins drain. No potential effect is expected in terms of water quality since the leachate treatment system will be designed so that effluent concentration meets approved discharge limits.

The proposed landfill is expected to increase the stream baseflow quantity in the Patterson-Robbins Drain (at SW1a) by 5.77 L/s during the operational period (2011-2040), 6.44 L/s during the post-closure period 1 (2041-2070) and 6.63 L/s for the post-closure period 2 (2071-2100). The effluent from the leachate discharge plant will be treated to PWQO standards and is not expected to cause a net effect on the stream baseflow quality.

Guidelines listed in Table - 3 were considered for this study. Approvals under Sections 53 and 34 of OWRA will be required for the stormwater management ponds, ditches, and the leachate treatment plant on site, however approval under the OWRA will occur at the permitting and approvals stage of this project. Environmental Protection Act (EPA) contains several relevant regulations and policies, including O. Reg 232/98 for Landfilling Sites which contains the requirements for surface water assessments, surface water control and monitoring. These guidelines will be considered for monitoring activities. Guide to Permit to Take Water Application (2007) will be taken into consideration in the event the site needs to be dewatered and the volume of water is greater than those specified in the guide. Similarly, Water Taking Regulation O. Reg. 387/04 will be considered if water needs to be taken during the lifespan of the project. PWQO guidelines and CCME guideline will be considered during monitoring activities and exceedances will be investigated further.

10.4.2 Potential for Cumulative Effects

The development in the receiving watercourse catchment area is limited to the development of the quarry. For the post-closure period from 2041-2070, the quarry development is expected to result in a reduction of 0.39 km^2 (3.9%) relative to the existing conditions from the catchment area of Patterson-Robbins Drain. Similarly, the catchment area is expected to decrease by 0.81 km^2 (8.2%) during the post-closure period from 2071-2100. This reduction in catchment area may decrease the baseflow in the receiving watercourse or potentially extend the period of dry conditions. As a result of landfill development, the discharge from the leachate treatment plant is expected to increase the baseflow in Patterson-Robbins Drain between 5.77 L/s to 6.63 L/s; thereby partially offsetting the anticipated effects of continued quarry development.

10.4.3 Additional Mitigation Recommendations

No additional mitigation is recommended for the design and operation of the landfill as no significant effects are predicted on the stream baseflow quantity and quality.

10.4.4 Net Effects

No net effects are anticipated on the receiving watercourse stream baseflow quantity and quality as a result of the landfill.

10.4.5 Summary

The stream baseflow is expected to increase as the leachate treatment plant will contribute under low flow periods. The water quality is not expected to be affected as treatment will meet approved discharge limits. The summary can be found in Table 18. This projected change in baseflow in the receiving watercourse is not expected to have a significant effect on the hydrologic and hydraulic processes.

11.0 MONITORING, CONTINGENCY AND IMPACT MANAGEMENT RECOMMENDATIONS

11.1 Monitoring & Contingency Plans

Ontario Regulation 232/98 contains requirements for the design, operation, closure and post-closure care of municipal waste landfilling sites. This regulation states that surface water monitoring is necessary to demonstrate the landfill is performing as designed. Consequently, surface water monitoring should continue in the receiving watercourse(s). The Walker monitoring stations (SW1, SW2 and SW6) used for this EA are suitable locations for continued monitoring in the receiving watercourse. Additional monitoring locations will be added at the outlet of the stormwater management ponds and the leachate treatment plant in the future. According to subsection 6.7 of Ontario regulation 232/98, semi-annual monitoring should be done for a list of inorganic and organic constituents including metals and volatiles organics. Stream characteristics such as flow, temperature and dissolved oxygen content should also be monitored semi-annually. A reduced list of parameters should be monitored on two other occasions in the year. The constituents to be monitored can be found in Schedule 5 of Ontario Regulation 232/98.

The receiving watercourses downstream of the landfill discharges should also be inspected annually during the landfill operation for signs of increased flooding and erosion.

Should any unexpected effect be detected from the monitoring program, further investigations will be conducted to evaluate the source and impact of the effect. Walker has proposed a number of contingency measures for this landfill, should an unexpected or unplanned surface water issue be identified as a result of the monitoring program, including:

- Spill control procedures;
- Routine inspection for leachate seeps on and around the landfill, with procedures to contain and control any seepages pending the development and implementation of a long-term contingency program;
- Retention of any contaminated storm water found in the storm water ponds, with provision for diversion to the leachate treatment plant for treatment and discharge, as necessary; and,
- The provision for temporary non-contact storm water retention capacity in the landfill, quarry floor and leachate treatment lagoons, as appropriate, should excessive flooding occur.

11.2 Impact Management

No additional impact management is considered necessary since the mitigation designed into this proposed landfill (principally the leachate treatment and storm water management systems), along with the recommended monitoring and contingency plans, should be sufficient to manage surface water at the site.

12.0 REFERENCES

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MacNaughton Hermsen Britton Clarkson Planning Limited (MHBC). 2017. Landuse Planning Forecast Report. 2017.

Ministry of the Environment, Conservation, and Parks (MECP), 2019. Source Protection Information Atlas. https://www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/Index.html?site=SourceWaterProtection&viewer=SWPViewer&locale=en-US

Signature Page

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https://golderassociates.sharepoint.com/sites/13349g/3000 surface water/4. reporting/1. ea report/rev.4/1664706-r-revd-surface water ea-10jan2020.docx

TABLES

Table 15: Summary of Criterion 4 - Contact with Contaminated GW or SW

Study Area	Duration	Baseline ("Do Nothing" Alternative)	Potential Effects		Additional Mitigation	Net Effects		Impact Management
			Landfill	Cumulative		Landfill	Cumulative	
Vicinity	Operational Period	The natural groundwater quality is typical of limestone terrain. Groundwater beneath the site and in the site vicinity is currently captured through quarry dewatering and discharged to the Thames River, where it meets Provincial water quality requirements. The Patterson-Robbins Drain flows through the west side of the site emptying into the Thames River to the south. It will experience a slight reduction in catchment area, and flow, as the quarry gradually expands and diverts water directly to the Thames. Surface water quality is, and will continue to be, typical of rural agricultural run-off.	The double composite liner system specified by the Ministry is designed to protect ground water for the full contaminating lifespan of the leachate. Any run-off that comes into contact with the active landfill will be segregated and treated at the leachate treatment plant prior to discharge from the site, while non-contact run-off will pass through the storm water management system prior to discharge, ensuring that both meet required discharge standards. As a result, there will be no significant risk to public health and safety due to groundwater or surface water contamination.	Groundwater at the site boundary will meet provincial Reasonable Use requirements, so there will be no cumulative effect. Discharges from the storm water management system could marginally raise the concentrations of some constituents in the surface water, although there will be no significant risk to public health and safety due to groundwater or surface water contamination.	None required.	None.	None.	Monitoring and contingency plans for unexpected leachate escape or other spills.
	Post-Closure Period	Quarry dewatering will continue to capture groundwater beneath the site and in the site vicinity as the quarry expands north and east, and discharge it into the Thames River. In the very long term (expected to be hundreds of years), after quarry dewatering ends and the quarry is fully rehabilitated, groundwater levels beneath the site with recover and follow regional flow patterns. The catchment area and flow in the Patterson-Robbins Drain will continue to decline gradually in the long-term as the quarry expands, although the water quality is likely to remain similar.	The double composite liner system specified by the Ministry is designed to protect ground water for the full contaminating lifespan of the leachate. After closure the final cover on the landfill will ensure that all run-off is segregated from the waste, and passes through the storm water management system prior to discharge, ensuring that it meets required discharge standards. As a result, there will be no significant risk to public health and safety due to groundwater or surface water contamination.	As above.	None required.	None.	None.	Monitoring and contingency plans for unexpected leachate escape or other spills.

Table 16: Summary of Criterion 5 - Flood Hazard

Study Area	Duration	Baseline (“Do Nothing” Alternative)	Potential Effects		Additional Mitigation	Net Effects		Impact Management
			Landfill	Cumulative		Landfill	Cumulative	
On-Site & Vicinity	Operational Period	The adjacent Patterson-Robbins Drain will experience a slight loss of catchment and related flow as the quarry expands and diverts runoff directly to the Thames. This will be partially offset by climate change. Overall there will be no significant increase in flooding hazard.	The landfill will increase the catchment of the Patterson-Robbins Drain by about 7.5% and increase average flow by less than 5%.	Any increased flow from the landfill site to the Patterson-Robbins Drain will be partially offset by the decreases associated with the quarry expansion.	None required.	No significant increase in flooding hazard in the Patterson-Robbins Drain or the Thames River.	No significant increase in flooding hazard in the Patterson-Robbins Drain or the Thames River.	Surface water monitoring, with contingency plans to temporarily retain and manage storm water on-site during peak storm periods.
	Post-Closure Period	The gradual loss of catchment and related flow in the adjacent Patterson-Robbins Drain will continue in the longer term as the quarry expands and diverts runoff directly to the Thames. This will be partially offset by climate change. Overall there will be no significant increase in flooding hazard.	No further increases in catchment or flow from the landfill site after closure.	Continuing expansion of the quarry during the post-closure period will more than offset the increases in catchment and flow in the Patterson-Robbins Drain related to the landfill.	None required.	No significant increase in flooding hazard in the Patterson-Robbins Drain or the Thames River.	No significant increase in flooding hazard in the Patterson-Robbins Drain or the Thames River.	Surface water monitoring, with contingency plans to temporarily retain and manage storm water on-site during peak storm periods.

Table 17: Summary of Criterion 32 - Displacement of SW Resources

Study Area	Duration	Baseline ("Do Nothing" Alternative)	Potential Effects		Additional Mitigation	Net Effects		Impact Management
			Landfill	Cumulative		Landfill	Cumulative	
On-Site & Site Vicinity	Operational Period	The Patterson-Robbins Drain is the only watercourse on the site, crossing the northwestern corner between the proposed landfill and leachate treatment plant.	No water bodies or watercourses would be removed or displaced in order to construct and operate the proposed landfill.	In the very long term, a portion of the east branch of the Patterson-Robbins Drain upstream of the site may have to be diverted for quarry development.	Not required.	None.	None.	Not required.

Table 18: Summary of Criterion 34 - Effects on Stream Baseflow

Study Area	Duration	Baseline (“Do Nothing” Alternative)	Potential Effects		Additional Mitigation	Net Effects		Impact Management
			Landfill	Cumulative		Landfill	Cumulative	
On-Site & Site Vicinity	Operational Period	There is minimal potential for any significant groundwater baseflow to Cemetery Creek or the Thames River from the site or site vicinity, since the quarry dewatering effectively captures groundwater within this area and discharges it directly to the Thames River. (With the exception of interflow - shallow recharge through the overburden soils very near to the streams.) Surface water baseflow may decrease slightly as quarrying removes upstream catchment to the Patterson-Robbins Drain.	Groundwater levels beneath the site and in the site vicinity will be controlled by quarry dewatering and remain below the base of the landfill, which will be constructed on backfill well above the quarry floor and isolated from the groundwater by the liner. Therefore, the landfill operation will have no significant effects on groundwater levels or flow, and therefore no effect on groundwater baseflow to adjacent streams. Surface water baseflow may increase marginally due to input from the leachate treatment plant.	Surface water baseflow from the leachate treatment plant will offset reductions due to ongoing loss of quarry catchment.	None required.	No significant change to the overall baseflow in Cemetery Creek or Thames River.	No significant change to the overall baseflow in Cemetery Creek or Thames River.	Monitoring to confirm water levels and flows.
	Post-Closure Period	As above; quarry expansion and dewatering is expected to continue throughout the post-closure period.	Groundwater levels beneath the site and in the site vicinity will continue to be controlled by quarry dewatering, which is expected to continue throughout the landfill post-closure period. The landfill will be isolated from the groundwater by the liner system, and will have no significant effects on groundwater levels or flow, and therefore no effect on groundwater baseflow to adjacent streams. Surface water baseflow may increase marginally due to input from the leachate treatment plant.	As above.	None required.	No significant change to the overall baseflow in Cemetery Creek or Thames River.	No significant change to the overall baseflow in Cemetery Creek or Thames River.	Monitoring to confirm water levels and flows.

Table 19: Peak Flows Effects for Location SW2

Duration	Baseline ("Do Nothing" Alternative)	Potential Effects	
		Landfill	Cumulative
Operational Period (2011-2040)	3.413 m^3/s (2 Year Peak Flow)	3.679 m^3/s (2 Year Peak Flow)	3.679 m^3/s (2 Year Peak Flow)
Post-Closure Period (2041-2070)	3.612 m^3/s (2 Year Peak Flow)	3.897 m^3/s (2 Year Peak Flow)	3.897 m^3/s (2 Year Peak Flow)
Post-Closure Period (2070-2100)	3.189 m^3/s (2 Year Peak Flow)	3.480 m^3/s (2 Year Peak Flow)	3.480 m^3/s (2 Year Peak Flow)

Table 20: Peak Flows Effects for Location SW1a

Duration	Baseline ("Do Nothing" Alternative)	Potential Effects	
		Landfill	Cumulative
Operational Period (2011-2040)	4.279 m^3/s (2 Year Peak Flow)	4.963 m^3/s (2 Year Peak Flow)	4.963 m^3/s (2 Year Peak Flow)
Post-Closure Period (2041-2070)	4.541 m^3/s (2 Year Peak Flow)	5.258 m^3/s (2 Year Peak Flow)	5.258 m^3/s (2 Year Peak Flow)
Post-Closure Period (2070-2100)	4.201 m^3/s (2 Year Peak Flow)	4.955 m^3/s (2 Year Peak Flow)	4.955 m^3/s (2 Year Peak Flow)

Table 21: Peak Flows Effects for Location SW6/ Thames River

Duration	Baseline ("Do Nothing" Alternative)	Potential Effects	
		Landfill	Cumulative
Operational Period (2011-2040)	90.447 m^3/s (2 Year Peak Flow)	90.547 m^3/s (2 Year Peak Flow)	90.547 m^3/s (2 Year Peak Flow)
Post-Closure Period (2041-2070)	102.882 m^3/s (2 Year Peak Flow)	102.985 m^3/s (2 Year Peak Flow)	102.985 m^3/s (2 Year Peak Flow)
Post-Closure Period (2071-2100)	101.287 m^3/s (2 Year Peak Flow)	101.389 m^3/s (2 Year Peak Flow)	101.389 m^3/s (2 Year Peak Flow)

FIGURES

LEGEND

- COMMON RECEPTOR POINTS
- WATERCOURSE
- WATERBODY

DRAFT

0 500 1,000

1:22,000 Metres

NOTE(S)

1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)

1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
SOUTHWESTERN LANDFILL

TITLE
COMMON RECEPTOR POINTS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-11
DESIGNED	PR
PREPARED	PR
REVIEWED	CD
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
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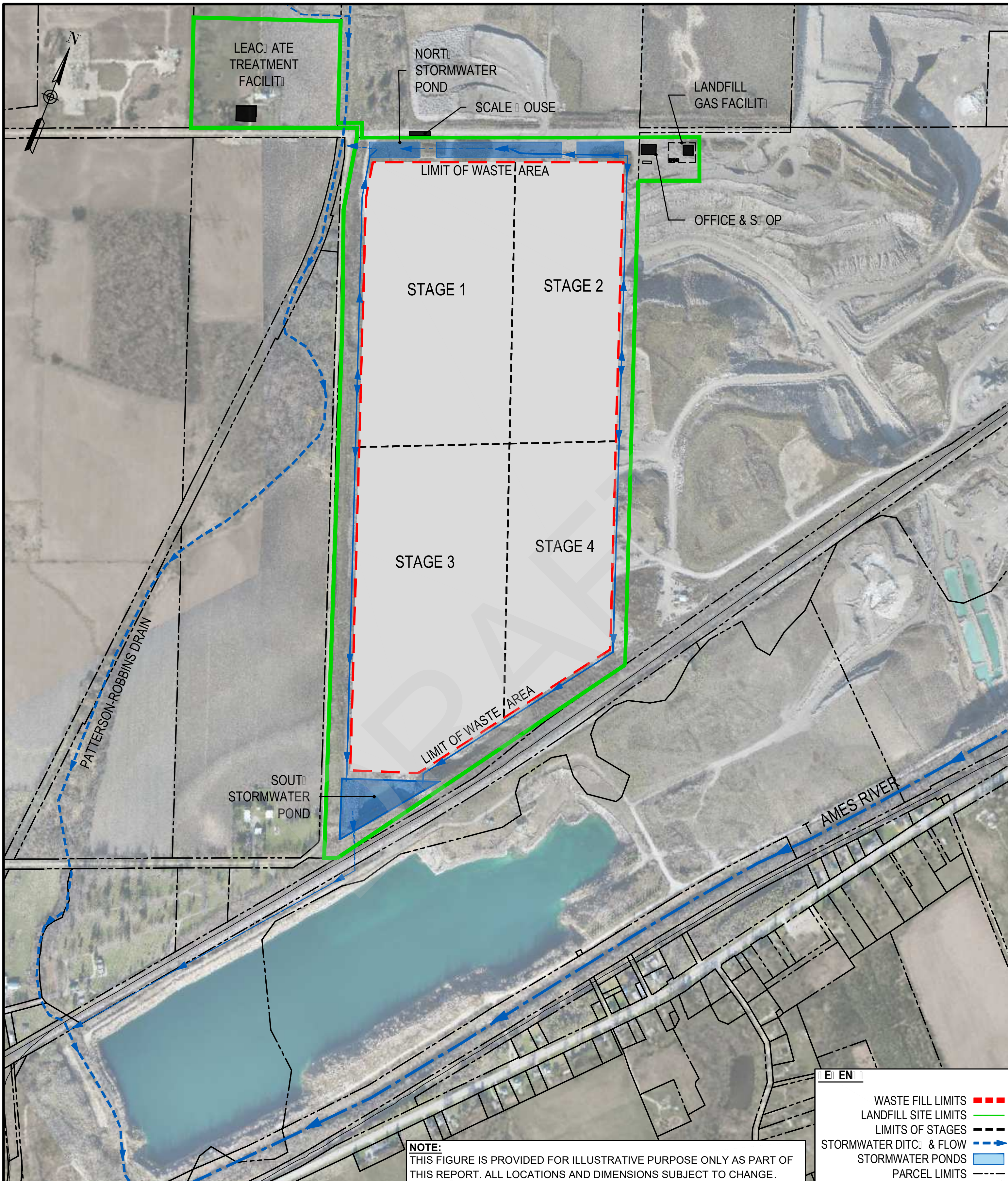
APPENDIX A

Detailed Landfill Plans



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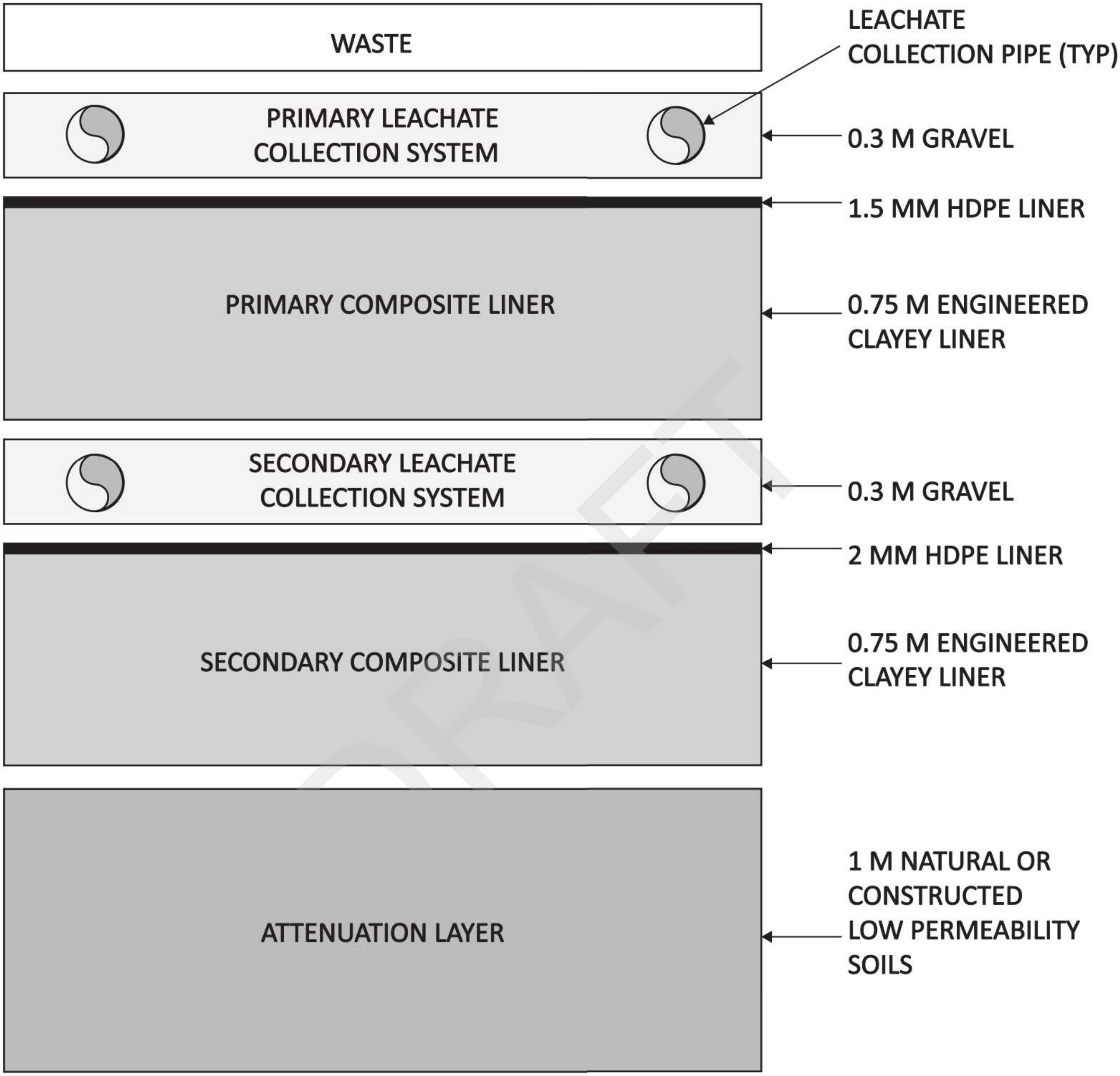

NOTE:
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	LANDFILL LINER S□STEM	TT□m□□rr□	NTS	7JAN19
		Approved	Drawing No.	Revision No.
		DFry	Figure □	C

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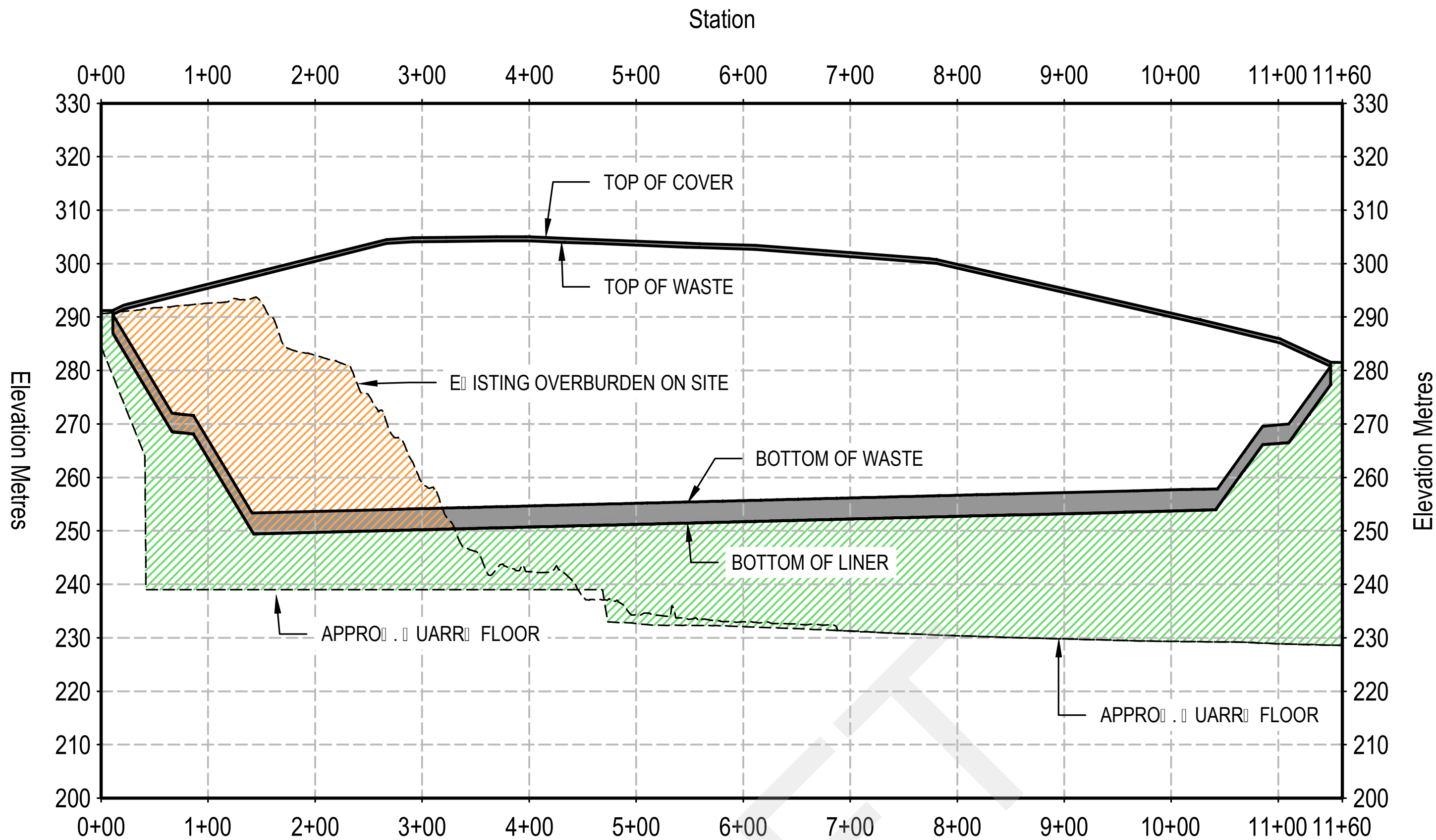
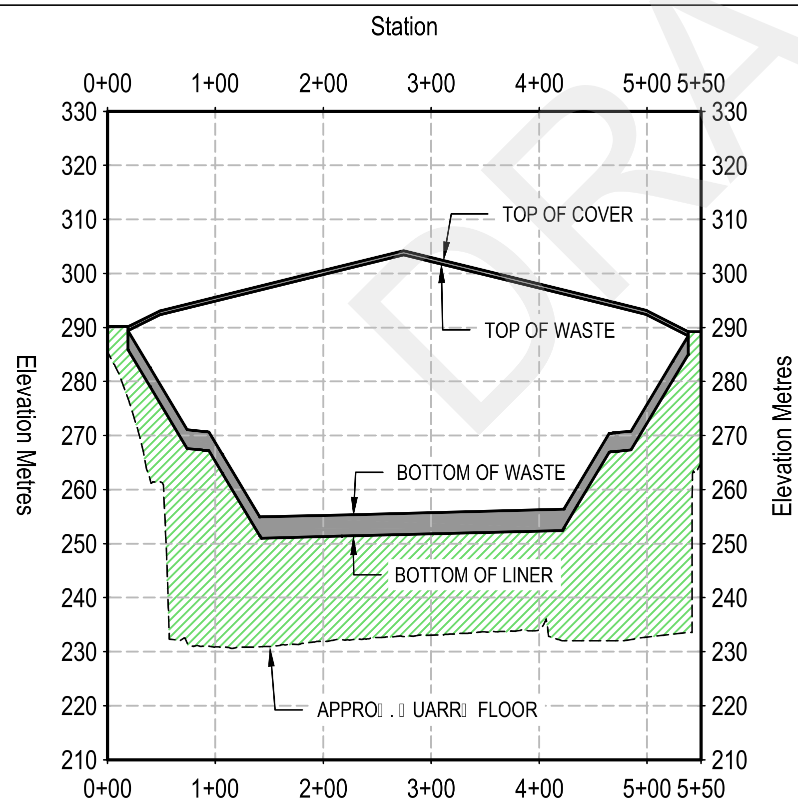


NORTH–SOUTH SECTION VIEW



WEST–EAST SECTION VIEW

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		Approved: DFry	Drawing No.: **Figure**	Revision No.: **E**

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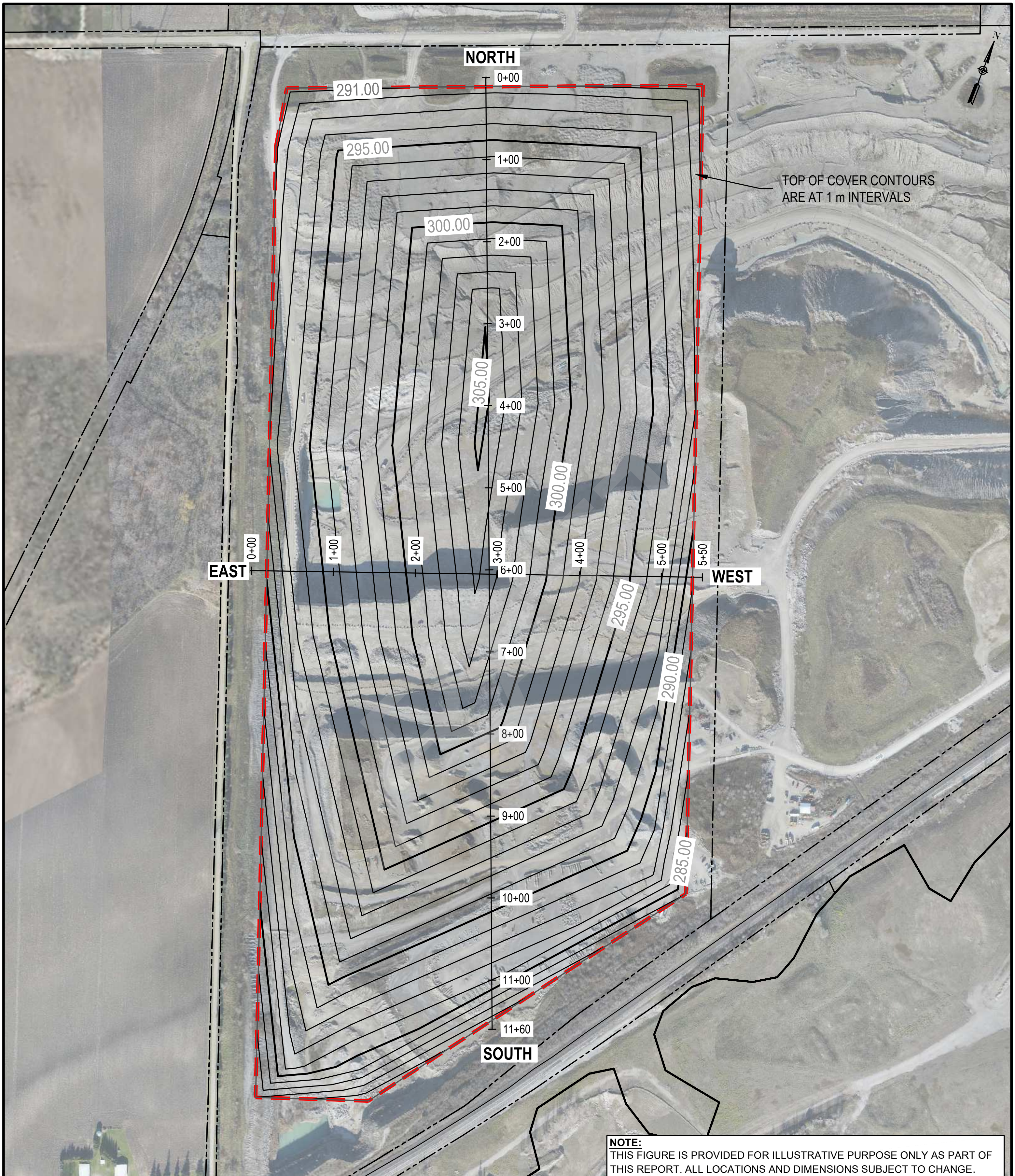

NOTE:
THIS FIGURE IS PROVIDED FOR ILLUSTRATIVE PURPOSE ONLY AS PART OF THIS REPORT. ALL LOCATIONS AND DIMENSIONS SUBJECT TO CHANGE.

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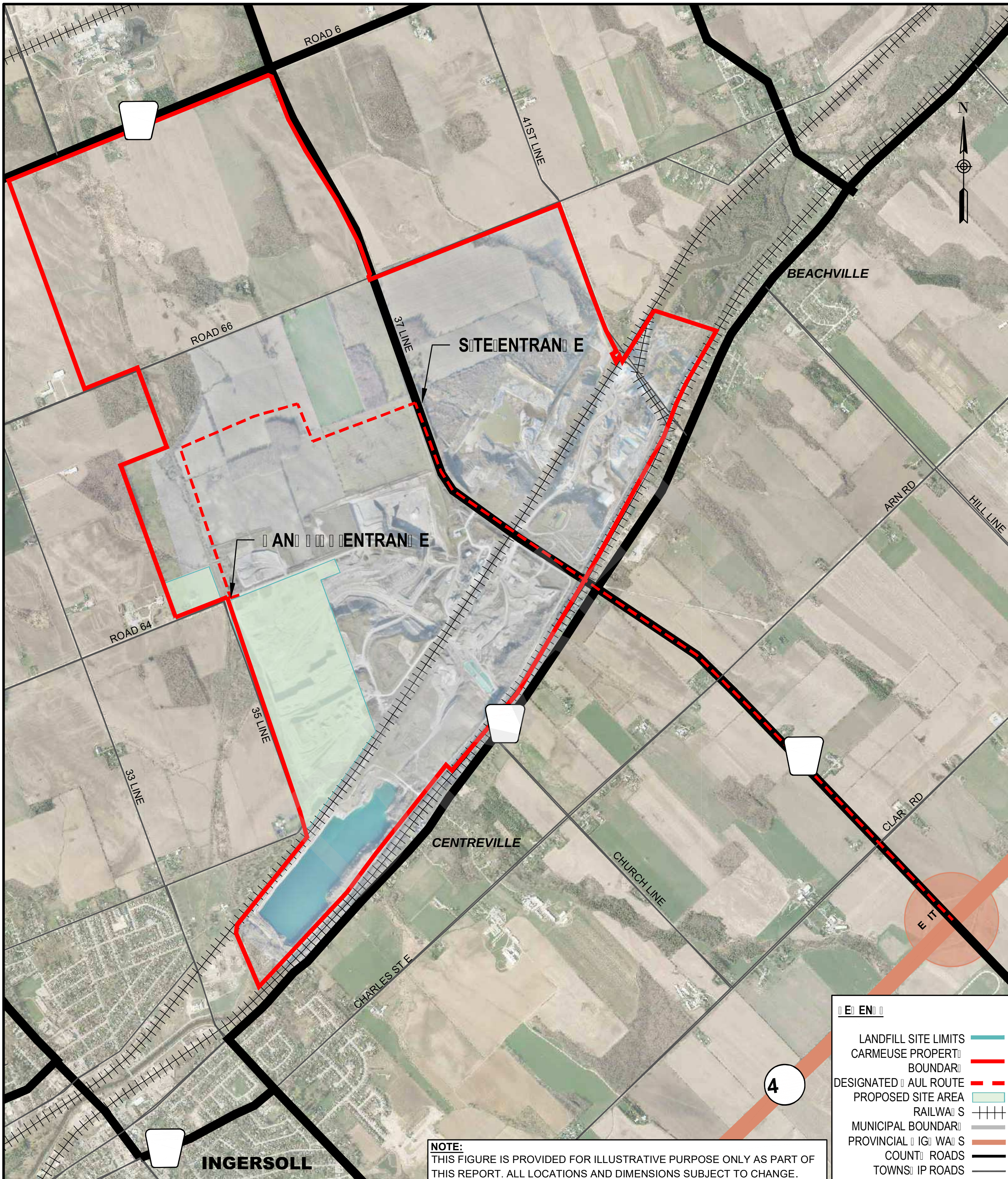

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		JThompson	1□30000	0□JAN20
	Drawing	Approved	Drawing No.	Revision No.
	SITE LOCATION □ HAUL ROUTE	DFry	Figure □	E

File Name: \\10.99.10.56\data\WEG\CAD & ENG\NWSL\967243- SWLF\EA Figures\Technical Report\Figure 5 (From Draft EA)_(D)_20DCE19.dwg Plotted: Jan 08, 2020 @ 1:40pm by Joseph

APPENDIX B

Environmental Assessment Criteria and Studies

Table B-1 – EA Criteria Table

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
	Public Health & Safety																			
1	Explosive hazard due to combustible gas accumulation in confined spaces.	Gas produced within a waste disposal facility (e.g., methane) can move through the ground and accumulate in confined spaces (e.g., manholes, basements, etc.) on or immediately adjacent to the waste disposal facility. There is potential for the gas to combust, creating an explosion and fire hazard.							☑							✓			✓	✓
2	Effects due to exposure to air emissions.	Waste disposal facilities can produce gases containing contaminants that degrade air quality if they are emitted to the atmosphere. Other operations, such as leachate collection facilities, can also produce emissions that could degrade air quality in the vicinity of the site. Air quality in the vicinity of the site should meet regulated air quality standards in order to protect public health.		☑						☑						✓			✓	✓
3	Effects due to fine particulate exposure.	Construction, operation, and truck haulage activities at a waste disposal facility can lead to increased levels of particulate (dust) in the air. Airbourne fine particulate is a health concern in certain size ranges exposure durations.		☑						☑						✓	✓		✓	
4	Effects due to contact with contaminated groundwater or surface water.	Contaminants associated with a waste disposal site have the potential to seep into the groundwater or surface water. This could pose a public health concern if it enters local drinking water supplies, or if it mixes with surface water.							☑	☑						✓			✓	✓
5	Flood hazard.	The construction of a waste disposal facility can disrupt natural surface water drainage patterns, causing a potential for increased flooding.							☑							✓			✓	✓
6	Disease transmission *via* insects or vermin.	Insects and vermin drawn to a waste disposal facility may have the potential to transmit diseases.					☑									✓			✓	✓
	Public Health & Safety (continued)																			
7	Potential for traffic collisions.	The risk of traffic collisions may increase along the haul routes to the waste disposal facility. This includes the risk to pedestrian, bicycle and farm machinery.												☑			✓		✓	

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
8	Aviation impacts due to bird interference.	Birds may be attracted to waste disposal facilities. This can pose a risk of bird strikes on aircraft in the vicinity of the site, especially during take-off and landing altitudes.					☑									✓			✓	
Social and Cultural																				
9	Displacement of residents from houses.	Any residents living on a future waste disposal site will have to relocate, which can cause inconvenience and stress to the residents.											☑			✓			✓	✓
10	Disruption to use and enjoyment of residential properties.	Potential nuisance effects associated with the waste disposal facility operation, or traffic moving to and from the waste disposal facility along the haul route, may disturb the daily activities and uses of residential properties. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.											☑			✓	✓		✓	✓
11	Disruption to use and enjoyment of public facilities and institutions.	Potential nuisance effects associated with waste disposal facility operations, or traffic moving to and from the waste disposal facility, may disturb the daily activities at community facilities. Disturbances could result from noise, dust, litter, odour, visibility, birds and traffic congestion.											☑			✓	✓		✓	
12	Disruption to local traffic networks.	Increased traffic volume resulting from a waste disposal facility could disturb the overall traffic flow along the haul routes, and effectively reduce the available road capacity.												☑			✓		✓	
13	Visual impact of the waste disposal facility.	Development and operation of a waste disposal facility can affect the visual appeal of a landscape.													☑	✓			✓	✓
14	Nuisance associated with vermin.	Waste disposal facilities can attract vermin and birds, which can be a nuisance and lead to a decrease in property enjoyment by area residents. Vermin and birds can also be a nuisance to											☑			✓			✓	

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

	Criteria	Definition/ Rationale	Studies Addressing the Criteria: Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	Study Areas: On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Duration: Operational Period	Post-Closure Period
Social and Cultural (continued)																				
15	Displacement/disturbance of cultural/heritage resources.	Cultural resources (including heritage buildings, cemeteries and cultural landscapes) are an important component of human heritage. These non-renewable cultural resources may be displaced by the construction of a waste disposal facility. The use and enjoyment of cultural resources may also be disturbed by the ongoing operation and traffic. Disturbances could result from noise, dust, odour, visibility, birds, litter and traffic congestion.				☑										✓	✓		✓	✓
16	Effects on land resources, traditional activities or other interests of Aboriginal Communities.	Major new developments of any type may have positive or negative effects on the interests of Aboriginal Communities (i.e., businesses opportunities, joint ventures)											☑					✓	✓	✓
17	Displacement/destruction of archaeological resources.	Archaeological resources are non-renewable cultural resources that can be destroyed by the construction and operation of a waste disposal facility.			☑											✓			✓	
18	Level of public service provided by the waste disposal facility.	The presence of a waste disposal operation within a municipality can provide an increased level of public service (e.g., convenient access to waste disposal services) to local residents and businesses, as well as those in the broader community(ies).						☑										✓	✓	✓
19	Effects on other public services.	The presence of a waste disposal facility may have positive or negative spin-off effects on other public services in the community (e.g., leachate trucking, waste water treatment capacity, if there is discharge to the sewer system).						☑									✓	✓	✓	✓

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
Social and Cultural (continued)																				
20	Changes to community character/cohesion.	Community character and cohesion refer to physical characteristics, social stability, attractiveness as a place to live and patterns of social interaction. A waste disposal facility may actually or perceptually interfere with these important community attributes.											☑			✓	✓	✓	✓	✓
21	Compatibility with municipal land use designations and official plans.	A waste disposal facility has the potential to affect the viability of present and future land uses, which may have an effect on planning decisions made in the surrounding community.									☑					✓		✓	✓	✓
Economics																				
22	Displacement/disruption of businesses or farms.	Any on-site businesses or farms would be displaced by a waste disposal facility, and there could be financial losses as a result of relocation. Some types of businesses located in the site vicinity or along the haul routes may suffer financial losses due to the potential nuisance effects or perceived effects associated with the operation of a waste disposal facility such as noise, litter, dust, odour, visibility, birds, vermin and traffic congestion.						☑								✓	✓		✓	
23	Property value impacts.	The establishment and operation of a waste disposal facility may adversely affect property values in the site vicinity or along the haul routes.						☑								✓	✓		✓	✓
24	Direct employment in waste disposal facility construction and operation.	A waste disposal facility may create new employment opportunities both in the construction and day-to-day operation.						☑										✓	✓	
25	Indirect employment in related industries and services.	A waste disposal facility has the potential to have impacts on employment opportunities in local firms supplying products or services directly, or as secondary suppliers.						☑										✓	✓	

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

			Studies Addressing the Criteria													Study Areas			Duration	
	Criteria	Definition/ Rationale	Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
Economics (continued)																				
26	New business opportunities related directly to waste disposal facility construction and operation.	A large capital project, such as the construction and operation of a waste disposal facility, can create new opportunities for local businesses supplying products or services.						☑										✓	✓	
27	New business opportunities in related industries and services.	New opportunities may be created for local businesses, or as secondary suppliers to industries working for the waste disposal facility (e.g., restaurants, gas stations, machine shops, repair shops, welding shops, equipment rentals, etc.).						☑										✓	✓	
28	Public costs for indirect liabilities.	Some public services may have to be upgraded to accommodate the establishment and operation of a waste disposal facility (e.g., snow removal, sewer and water connections, etc.).						☑										✓	✓	✓
29	Effects on the municipal tax base.	A waste disposal facility has the potential to affect municipal tax revenues from the site it occupies.						☑										✓	✓	✓
30	Effect on the cost of service to customers.	The costs of constructing a waste disposal facility will effect the price of tipping fees to the site. This affects the cost of service to customers in Oxford County and the province.						☑										✓	✓	
31	Effects on the provincial/ federal tax base.	A waste disposal facility has the potential to affect provincial/federal tax revenues.						☑										✓	✓	✓
Natural Environment & Resources																				
32	Loss/displacement of surface water resources.	Construction of a waste disposal facility may cause the removal of all or part of a natural stream or pond.							☑							✓			✓	
33	Impact on the availability of groundwater supply to wells.	A waste disposal facility can impact the availability of groundwater supply if groundwater is pumped from aquifers or if recharge to aquifers is reduced.							☑							✓			✓	✓
34	Effects on stream baseflow quantity/quality.	The presence of a waste disposal facility has the potential to affect the quality or quantity of baseflow to surface water.							☑							✓			✓	✓

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

#	Criteria	Definition/ Rationale	Studies Addressing the Criteria													Study Areas			Duration	
			Agriculture	Air Quality	Archaeology	Cultural Heritage	Ecology	Economic/ Financial	Groundwater/ Surface Water	Human Health	Land Use	Noise/Vibration	Social	Traffic	Visual/ Landscape	On-Site & Site Vicinity	Along the Haul Routes	Wider Area	Operational Period	Post-Closure Period
Natural Environment & Resources (Continued)																				
35	Loss/disturbance of terrestrial ecosystems.	Terrestrial ecosystems refer to the land-based habitats connected through the vegetation cover; their protection and integration maintains and regulates ecological health. Waste disposal facility operations and/or traffic may remove or disturb the functioning of these systems.					☑									✓	✓		✓	
36	Loss/disturbance of aquatic ecosystems.	Aquatic ecosystems refer to the water-based habitats connected through the surface water; their protection and integration maintains and regulates ecological health. Waste disposal facility operations may remove or disturb the functioning of these systems.					☑									✓			✓	
37	Displacement of agricultural land.	The establishment of a waste disposal facility has the potential to displace existing or potential agricultural resources, including the loss of prime agricultural land.	☑													✓			✓	✓
38	Disruption of farm operations.	The establishment and operation of the waste disposal facility may affect agricultural crop or livestock production and related agriculture activities	☑													✓	✓		✓	✓
39	Sterilization of industrial mineral resources.	The establishment of a waste disposal facility may limit the opportunity to extract industrial mineral resources located beneath the site.									☑					✓			✓	✓
40	Displacement of forestry resources.	The establishment of a waste disposal facility may limit the opportunity to utilize forestry resources on or near the site.									☑					✓			✓	✓
41	Loss/disruption of recreational resources.	Waste disposal facility operations and traffic may displace/disrupt existing recreational resources in the area, which could adversely affect the community at large. Disturbances could result from noise, dust, odour, visibility, birds and traffic congestion. Recreational resources include naturalist and interpretive opportunities.											☑			✓	✓		✓	✓

☑ Study that will be primarily responsible for addressing criterion.

Note: Many of the studies will provide key input to criteria that will be address through other impact assessment studies.

Table B-2 – EA Technical Studies Interconnectivity Matrix

Because effectively evaluating the EA criteria provided in Table B-1 may require input from experts in many disciplines, WEG adopted a methodology that facilitates a cross-functional approach among the experts. Each EA criterion has been assigned a 'lead' expert for reporting purposes (see Table B-1). The lead expert is responsible for coordinating efforts with any other expert they determine necessary to effectively report on that criterion as well as providing information to other experts who need input from them to report on any other criteria. Table B-2 provides possible relationships required between experts to effectively report on their respective EA criteria. The actual relationships will be developed during the EA process in consultation with interested parties.

		Reference Studies												
		Agriculture	**Air Quality**	**Archaeology**	**Cultural Heritage**	**Ecology**	**Economic / Financial**	**Groundwater / Surface Water**	**Human Health**	**Land Use**	**Noise / Vibration**	**Social**	**Traffic**	**Visual/ Landscape**
Technical Studies	Agriculture		✓							✓	✓		✓	
	Air Quality												✓	
	Archaeology													
	Cultural Heritage									✓		✓		✓
	Ecology		✓					✓			✓		✓	
	Economic / Financial	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Groundwater / Surface Water	✓										✓		
	Human Health		✓					✓			✓			
	Land Use													
	Noise / Vibration													
	Social	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	Traffic	✓								✓		✓		
	Visual Landscape											✓		

APPENDIX C

Baseline Surface Water Monitoring Report

REPORT

Baseline Surface Water Monitoring Report

Southwestern Landfill at Carmeuse Ingersoll Quarry

Submitted to:

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June 2019

Distribution List

1 e-copy - Walker Environmental Inc.

1 e-copy - Golder Associates Ltd.

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TABLES

FIGURES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Walker Environmental Group (WEG) to conduct a baseline surface water monitoring program in support of an Environmental Assessment for the future waste landfill located at the Carmeuse Lime (Canada) site in Oxford County. The proposed landfill is for solid, non-hazardous waste generated in the Province of Ontario. Figure 1 shows the proposed site location (the Site).

The Carmeuse Lime Quarry is located in Southern Ontario between Ingersoll and Beachville, Ontario as part of the Beachville operations of Carmeuse Lime (Canada) Ltd. The quarry produces quicklime (calcium oxide), chemical grade limestones, and milled limestones.

1.1 Objectives

The principal objective of the 2017-2018 surface water investigations was to characterize the flow regime and water quality of key surface water features adjacent to the Site, including Patterson-Robbins Drain (also known as Cemetery Creek) i in order to determine the physical/chemical baseline conditions.

2.0 METHODOLOGY

The methods used for the data collection and analysis in this study are described in this section.

2.1 Drainage Patterns and Catchment Areas

A review and analysis of Water Survey of Canada (WSC) hydrometric information and MNRF Land Information Ontario (LIO) contour data was conducted to characterize the drainage patterns and catchments for locations in the Patterson-Robbins Drain and the Thames River watershed. The data were used to generate catchment characteristics for the tributaries and the Thames River at the monitoring locations.

In the study area, there are two tributaries that flow into the Thames River. The east tributary flows into the Thames River upstream of the Carmeuse Quarry and the west tributary (Patterson-Robbins Drain) to the downstream. There are also two discharge locations from the quarry directly to the Thames River (i.e., the East Plant and Central Plant). All locations are shown in Figure 1.

2.2 Manual Flow and Water Level Measurements

Manual flow measurements were generally obtained in conjunction with the 2017-2018 water quality sampling program (described in Section 2.3) and to verify and refine stage-discharge rating curve relationships (see Section 3.2.1).

The spot flow measurements were estimated using the velocity-area method. Representative channel cross sections were generally established and marked at each surface water station. A tape measure was extended the length of each cross-section during the measurement event. Streamflow velocities and corresponding water depths were collected at various intervals along the cross section: 0.10 m to 0.20 m spacing for the majority of watercourses and 0.75 m to 1.0 m spacing at the stations located on the Thames River. Current velocities were recorded with a HACH Electromagnetic Flow Meter Model FH950 (EM Flow Meter) at 60% of the total water depth (for water depths less than 0.50 m) or at both 20% and 80% and then averaged (for water depths greater than 0.50 m). Velocity and depth measurements were obtained by wading channels at all the monitoring stations.

a staff gauge was installed at each surface water monitoring station. The staff gauge was attached to a steel T-post which was set in the channel bed. Water level measurements are read from the staff gauge in conjunction with the spot flow measurements. The monitoring station elevations were surveyed relative to mean sea level using a GPS surveyor. Water levels are recorded in meters above sea level.

2.3 Continuous Water Level Monitoring

Continuous water level monitoring was undertaken at the stations presented in the table Table-1 below and on Figure 1 to assess seasonal streamflow regimes in the watercourses adjacent to the Site.

Table-1: Walker Surface Water Monitoring Stations.

Location	Station ID	General Description	Continuous Water Level/Flow Instrumentation	Period of Record
Patterson-Robbins Drain	SW-1	Tributary to Thames River	DIVER Logger	November 2017 – April 2019
Patterson-Robbins Drain	SW-2	Tributary to Thames River	DIVER Logger	November 2017 – April 2019
Eastern Tributary	SW-3	Tributary to Thames River	DIVER Logger	November 2017 – April 2019
Eastern Tributary	SW-4	Tributary to Thames River	DIVER Logger	November 2017 – April 2019

[1] DIVER Logger installed/maintained by Golder and represents a non-vented pressure transducer that was compensated for atmospheric pressure using a DIVER Barologger

The continuous water level records at SW-1, SW-2, SW-3, and SW-4 were obtained/developed by Golder and generally included data from late November 2017 to December 2018. All continuous water level data were logged at 15-minute intervals.

2.4 Continuous Flow Monitoring

To obtain continuous flow data, the spot measurements of water level and flow were used to develop stage-discharge rating curves. The rating curves for stations SW-1, SW-2, SW-3 and SW-4 were developed by correlating the flow and the corresponding discharge in a power function.

Cross-sectional channel surveys were completed at each continuous monitoring station and tied to local benchmarks, where possible. The surveyed data were then used to construct a hydraulic model in HECRAS, which was developed by the US Army Corp of Engineers. HEC-RAS (River Analysis System) is a one-dimensional hydraulic backwater model that calculates water surface profiles based on known channel geometry and flow rates. Manning’s roughness coefficients are assigned to the model to represent hydraulic roughness or resistance to flow. Manning’s roughness values were selected from the literature (Chin, 2000) based on observed channel characteristics. The rating curves were calibrated and validated with the model and the manual measurements.

HEC-RAS models were used to generate theoretical stage-discharge rating curves for each location. Fully developed rating curves are typically one or a series of curves of the form $Q = a*(Y - Y_o)^b$, where Q is the stream flow rate in litres per second, a and b are a fitted coefficient and exponent, respectively, Y is the water depth in metres and Y_o is an estimated water depth in metres where a zero flow rate will occur (e.g., the bottom of the channel or standing water in the channel due to downstream control).

Continuous water level and flow records were obtained from two monitoring stations operated by Water Survey of Canada and also at a monitoring station operated by the Upper Thames River Conservation Authority as shown in Figure 3 and Table-2.

Table-2: Non-Walker Surface Water Monitoring Stations.

Location	Station ID	General Description	Operating Organization	Period of Record
Thames River at Ingersoll	02GD016	On Thames River	Environment Canada/Water Survey of Canada	April 10, 195 - Present
Cedar Creek at Woodstock	02GD011	Tributary to Thames River	Environment Canada/Water Survey of Canada	June 24, 1951 - Present
Pittock Dam and Reservoir	02PIT/02GD012	Upstream of Thames River South Branch	Upper Thames River Conservation Authority	January 1, 2000 to Present

2.5 Water Quality Sampling

Water quality sampling was conducted at the monitoring stations SW-1, SW-2, SW-3, SW-4, SW-5, SW-6, centre plant and east plant (Figure 1). All water samples were stored in sample bottles, pre-charged with preservative (as required), provided by the laboratory. Samples were sent under chain of custody documentation to Maxxam Analytics and analyzed for the following parameter lists:

Table-3: Summary of Parameters Sampled for the Monitoring Program

	Description	Frequency
Parameter List #1	Total dissolved solids	Collected six times over monitoring period
Parameter List #2	Cl, Cd, Pb, Benzene, 1,4-Dichlorobenzene, Methylene Chloride (Dichloromethane), Toluene, Vinyl Chloride (Table 1 of O.Reg232/98).	Collected four times over the monitoring period

3.0 RESULTS

3.1 Drainage Patterns and Catchment Areas

The catchment boundaries for the various watercourse stations at Patterson-Robbins Drain and Thames River are presented on Figure 2. The catchments were delineated based on available topography and contour data from MNRF. The catchment areas are listed in Table-4 and, where applicable, include all upstream sub-catchments (e.g., catchment area at SW-6 includes catchment area at SW-5).

Table-4: Catchment Areas at Monitoring Locations

Basin	Station ID	General Description	Catchment Area (km^2)
Patterson-Robbins Drain	SW-1	Downstream of Tributary to Thames River South of Carmeuse Quarry	9.93
	SW-2	Upstream of Tributary to Thames River South of Carmeuse Quarry	7.75
Eastern Tributary	SW-3	Upstream of Tributary to Thames River North of Carmeuse Quarry	0.960
	SW-4	Downstream of Tributary to Thames River North of Carmeuse Quarry	1.39
Thames River	SW-5	Thames River Upstream of Carmeuse Quarry	425
	SW-6	Thames River downstream of Carmeuse Quarry	474

3.2 Manual Water Level Measurements

The 2017-2018 manual water level results are summarized in . Table A1 in Appendix A lists the complete record of monitored water levels.

Table-5: Statistics of the Manual Water Level Measurements

	Surface Water Level (masl)[1]					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
Maximum	273.13	286.01	300.98	284.18	286.66	269.78
Minimum	272.97	285.86	300.82	284.02	286.08	269.23
Average	273.06	285.94	300.92	284.13	286.30	269.41

[1] The water levels are measured in meters above sea level.

3.3 Manual Flow Measurements

The 2017-2018 manual flow rate measurement results are summarized in Table A2 in appendix A lists the complete record of monitored flow rates.

Table-6: Statistics of the Manual Flow Measurements

	Flow Rate (m^3/s)[1]					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
Maximum	0.143	0.103	0.017	0.027	11.4	9.44
Minimum	0.002	0.004	0	0	1.04	1.25
Average	0.067	0.049	0.009	0.011	4.04	4.48

[1] The flow rates are measured in cubic meters per second.

The surface water monitoring rounds from November 2018 to December 2018 were characterized by low flow/water levels conditions throughout the Patterson-Robbins Drain and Thames River with minor responses to intermittent rainfall events. The monitoring visits from November 2017 to June 2018 and from November to December 2018 were characterised by moderate to high flow/water levels conditions, a result of rainfall, snow melt and frozen ground conditions.

Measured water levels in Patterson-Robbins Drain (SW1 and SW2) fluctuated within a 0.16 m range over the monitoring period. Measured flows at these stations fluctuated between 2 - 143 L/s and 4 - 103 L/s (SW1 and SW2, respectively).

The range of fluctuation in the East Tributary (SW3 and SW4) is approximately 0.16 m, similar to the Patterson-Robbins Drain. The flow rates range between 0 – 17 L/s and 0 – 27 L/s (SW3 and SW4, respectively).

In the Thames River (SW5 and SW6), the water level fluctuated within a 0.59 m range over the monitoring period. The flow rates ranged between 1.043 – 11.363 L/s and 1.251 – 9.436 L/s (SW3 and SW4, respectively).

3.3.1 Continuous Monitoring

3.3.1.1 General

Water level and flow hydrographs were generated for all continuous flow monitoring stations (Figures 4 to 7). The figures are supplemented by daily total precipitation and daily mean temperature records from the Environment Canada climate station (London CS, 6144478).

Continuous atmospheric pressure records were collected at the Site and water level records were collected at stations SW-1, SW-2, SW-3, and SW-4 using dataloggers as previously discussed. Water level information was used in conjunction with the rating curves to estimate daily flow rates at each of the monitoring stations.

Table-7 shows the continuous water level measurements from the loggers, setup at the respective stations during the monitoring period.

Table-7: Statistics of Continuous Water Levels

	Continuous Water Levels (masl)[1]			
	SW-1	SW-2	SW-3	SW-4
Maximum	273.53	287.08	301.43	284.56
Minimum	272.93	285.78	300.82	284.02
Average	273.07	285.96	300.93	284.15

[1] Water levels are meters above sea level.

Table-8 shows the continuous water level measurements from the loggers, setup at the respective stations during the monitoring period

Table-8: Statistics of Continuous Flows

	Continuous Estimated Flow Rate (m^3/s)[1]			
	SW-1	SW-2	SW-3	SW-4
Maximum	1.21	3.30	0.356	0.359
Minimum	0	0	0	0
Average	0.0940	0.0900	0.0240	0.0250

[1] Flows are measured in cubic meters per second.

Similar to the measured water levels, the available continuous records at the Site were characterized by a series of snowmelt and/or rainfall generated peak water levels that punctuated relatively stable low to moderate water levels (or dry channel conditions at some stations). Continuous water levels at SW-1, SW-2, SW-3 and SW-4, exhibited generally consistent seasonal trends across all the stations. As seen on Figures 4 to 7, the beginning of the monitoring period in late fall is characterized by higher water levels which continued throughout the winter with peaks corresponding to rainfall/snowmelt events. From late spring to late August, the water level is seen to decrease gradually towards summer.

The water levels in the Patterson-Robbins Drain fluctuate within a range of 0.59 m and those in the East Tributary fluctuate within a range of 0.61 m range. The flow ranges between 0 – 1.21 m^3/s and 0 – 3.298 m^3/s in the Patterson-Robbins Drain (SW1 and SW2). Similarly, the flow ranges between 0 – 0.356 m^3/s and 0 – 0.359 m^3/s in the East Tributary(SW3 and SW4).

3.3.1.2 Flows at Non-Walker Monitoring Locations

Flows and water levels are also recorded from non-Walker monitoring locations in the Thames River and Cedar Creek. The Environment Canada monitoring station Thames River at Ingersoll (02GD016) is located on the Thames River downstream of SW-6 (Figure 1). Another station is also located at Cedar Creek in Woodstock (02GD011), which is a tributary of Thames River near Woodstock. Data from the Pittock Dam was also acquired form the Upper Thames River Conservation Authority and is presented in Figure 8 to 10.

The statistics of water surface elevations at the non-Walker stations are presented in Table-9 and the flow rates are presented in Table-10.

Table-9: Summary of Water Surface Elevations at Non-Walker Monitoring Stations

	Water Elevations (masl)[1]		
	Thames River at Ingersoll	Cedar Creek at Woodstock	Pittock Dam
Maximum	265.89	282.98	287.52
Minimum	263.40	282.06	282.70
Average	263.71	282.19	285.38

[1] Water surface elevations are measured in meters above mean sea level.

Table-10: Summary of Flow rates at Non-Walker Monitoring Stations

	Flow Rate (m^3/s)[1]		
	Thames River at Ingersoll	Cedar Creek at Woodstock	Pittock Dam
Maximum	78.2	13.9	54.5
Minimum	1.24	0.176	0
Average	6.85	1.13	5.20

[1] Flows are measured in cubic meters per second.

The water levels fluctuate within a range of 2.49 m, 0.92 m, and 4.81m (relative to the guage datum) at the Thames River, Cedar Creek and the Pittock Dam respectively. The maximum flow rate during the monitoring period (November 2018 to December 2019) at the gauging stations in the Thames river and Cedar Creek is 78.2 and 13.9 m^3/s, both of which occurred on 20 February 2018. The maximum discharge from the Pittock Dam (54.5 m^3/s) also occurred on the same day. These runoff peaks are in response to precipitation, in some cases, augmented by storage and/or snow melt. The maximum flows occurred at approximately the same time as at the Walker monitoring stations while the magnitude of the flow rates was much higher than the Walker monitoring stations since Thames river and Cedar creek are much larger watercourses with larger drainage areas. Higher flows are observed from Fall to Spring and low flows in the Summer during the period of the Walker monitoring program. The seasonal trends of continuous flow and water level data at all three non-Walker monitoring stations (Figures 8 to 9) are generally consistent with SW-1 to SW4 with snowmelt and/or rainfall generated peak flows that punctuated relatively stable low to moderate flow levels. The manual measurements by Walker on the Thames (SW-5 and SW-6) agree with the data from Thames River at Ingersoll station.

3.3.1.3 Carmeuse Quarry Discharge

Figure 3 shows the two discharges from the Carmeruse Quarry to the Thames River. The daily volume outflow for center plant and east plant locations are shown in Figure 11. The volume from center plant was significantly higher than that of east plant. over the monitoring period (November 2017 to December 2018) the maximum daily discharge volume at Center Plant is 48,300 m^3 and the East Plant is 23,500 m^3. The average daily discharge volumes are 31,400 m^3 and 6,170 m^3 at Center Plant and East Plant respectively.

3.4 Water Quality

The laboratory water quality results for the monitoring period of 2017-2018 are presented in Tables 13-20 for the monitoring stations SW1 to SW6 as well as center plant and east plant locations as described in section 2.3. The results are compared to their respective regulatory guidelines (Provincial Water Quality Objectives (PWQO), Canadian Council of Ministers of the Environment (CCME), Ontario Drinking Water Quality Standards (ODWQS), Environmental Protection Act (Ontario Regulation 232/98) and Environmental Protection Act (Ontario Regulation 347)) to evaluate the occurrence of exceedances. The CCME guidelines contains several water quality limits and were prioritised in the order of long-term aquatic, short-term aquatic, irrigation for agriculture and livestock for agriculture.

Exceedances were observed for Fluoride at SW-1, SW-2, SW-3, SW-4, SW-5, SW-6 during the sampling even in May 2018. Nitrate exceedances were also observed at SW-1, SW-2, SW-3, SW-4, SW-5, SW-6 during the sampling even in May 2018 and February 2019. The Thames River stations (SW-5 and SW-6) showed exceedances of total phosphorous on February 2019. Dissolved Chloride exceedances were observed at SW-5 in February 2019 and at SW-6 in March 2018 and February 2019. An exceedance of Nitrite was observed at the East Plant monitoring location in February 2019.

4.0 SUMMARY AND CONCLUSION

- Water level measurements and the derived flow rates at the Walker surface monitoring stations (SW-1, SW-2, SW-3, SW-4, SW-5 and SW-6) during the monitoring period (November 2017 to December 2018) showed a consistent seasonal trend. High flow events, triggered by snowmelt/rainfall, were observed from late Fall to late Spring with low flow rates during the summer.
- The maximum flow rate during the monitoring period occurred on January 12th at SW-1 (1.21 m^3/s), February 20th at SW-2 (3.30 m^3/s), February 20th at SW-3 (0.36 m^3/s) and January 11th at SW-4 (0.36 m^3/s).
- Water level and flow data from non-Walker monitoring stations, Thames River at Ingersoll and Cedar Creek at Woodstock, showed a seasonal trend and peak events consistent with the Walker monitoring stations.
- Water quality monitoring results were compared to their respective regulatory guidelines (Provincial Water Quality Objectives (PWQO), Canadian Council of Ministers of the Environment (CCME), Ontario Drinking Water Quality Standards (ODWQS), Environmental Protection Act (Ontario Regulation 232/98) and Environmental Protection Act (Ontario Regulation 347)). Occasional exceedances of Fluoride, Chloride, Nitrite, Nitrate, and Phosphorous were observed.

Signature Page

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https://golderassociates.sharepoint.com/sites/13349g/3000 surface water/4. reporting/3. monitoring report/1664706-r-reva-walker monitoring report-12jun2019.docx

TABLES

Table-11: Measured Water Level Measurements

Date	Surface Water Level (masl)[1]					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
November 9, 2017	273.05	285.923	300.938	284.152	–[1]	–[1]
November 17, 2017	273.095	285.959	300.978	284.182	286.240	269.430
December 19, 2017	273.086	285.966	300.933	284.152	286.088	269.278
January 19, 2018	273.085	285.976	300.948	284.177	286.430	269.590
February 8, 2018	273.030	285.903	300.908	284.122	286.275	269.300
March 14, 2018	273.080	285.961	300.928	284.142	286.210	269.350
April 10, 2018	273.110	286.001	300.948	284.167	286.655	269.780
May 4, 2018	273.100	285.991	300.928	284.152	286.332	269.476
June 26, 2018	273.125	286.006	300.928	284.147	286.340	269.520
July 18, 2018	272.975	285.861	300.828	284.022	286.075	269.230
August 23, 2018	272.995	285.870	300.868	284.094	286.590	269.590
September 25, 2018	272.965	285.861	300.823	284.022	286.145	269.260
October 23, 2018	273.015	285.871	300.873	284.082	286.150	269.285
November 19, 2018	273.085	285.946	300.943	284.147	286.290	269.260
December 18, 2018	273.105	285.981	300.956	284.172	286.305	269.450

1 The water levels are measured in meters above sea level.

Table-12: Manual Flow Measurements

Date	Flow Rate (m3/s)					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
November 17, 2017	0.071	0.049	0.011	0.015	5.39	6.542
December 19, 2017	0.070	0.063	0.007	0.007	2.632	3.229
January 19, 2018	0.091	0.102	0.011	0.016	3.564	6.262
February 8, 2018	0.062	0.03	0.004	0.006	3.065	2.152
March 14, 2018	0.083	0.061	0.008	0.012	2.912	3.277
April 10, 2018	0.131	0.095	0.017	0.027	–[2]	–[2]
May 4, 2018	0.107	0.079	0.009	0.01	5.179	5.513
June 26, 2018	0.143	0.103	0.014	0.013	4.935	5.122
July 18, 2018	0.006	0.004	–[1]	–[1]	1.043	1.251
August 23, 2018	0.012	0.006	0.001	0.002	11.363	9.436
September 25, 2018	0.002	0.004	–[1]	–[1]	1.832	1.884
October 23, 2018	0.006	0.007	0.001	0	1.972	2.49
November 19, 2018	0.057	0.012	0.005	0.006	4.114	4.796
December 18, 2018	0.091	0.064	0.014	0.014	4.537	6.220

[1] No flow was observed (Dry condition).

[2] Flows were not collected on the Thames River due to unsafe flow conditions

DRAFT TABLE 13
WATER QUALITY RESULTS AT SW1

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES (1-6)	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	3	4	2	1	<1	–	3	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	44	38	–	–	74	–	–	–	34	–	33
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	0.14	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.023	–	–	–	–	–	–	–	0.01
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	8.35	–	–	–	–	–	–	–	11.7
Total Phosphorus	mg/L	0.02 (2)	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.009
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-	–	40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.015	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	-	-	-	–	–	–	–	0.034	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 (3)	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 (4),(6)	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 (5)	-	-	0.2	0.1	0.01	–	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.0021	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.007	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00111	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0013	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00095	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.00096	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0014	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0035	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00075	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00061	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00083	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00093	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0008	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0011	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00087	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00076	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00093	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 14
WATER QUALITY RESULTS AT SW2

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES [1–5]	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	10	3	6	2	<1	–	2	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	45	41	–	–	110	–	–	–	36	–	36
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	0.15	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.021	–	–	–	–	–	–	–	0.015
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	8.02	–	–	–	–	–	–	–	12.4
Total Phosphorus	mg/L	0.02 [2]	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.011
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-	–	40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.016	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	-	-	-	–	–	–	–	0.038	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 [3]	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 [4],[6]	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 [5]	-	-	0.2	0.1	0.01	–	–	<0.0005	<0.0005	0.0029	–	0.00052	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.0029	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.014	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.002	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00096	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0009	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0011	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0014	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0015	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0031	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00097	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00051	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00042	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00057	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00064	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0007	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.00097	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00067	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00097	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00052	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00081	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 μm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 15
WATER QUALITY RESULTS AT SW3

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES (1–5)	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	8	4	–	3	1	–	7	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	34	40	–	–	80	–	–	–	36	–	34
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	**0.15**	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.039	–	–	–	–	–	–	–	<0.01
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	**11.1**	–	–	–	–	–	–	–	**16.2**
Total Phosphorus	mg/L	0.02 (2)	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.007
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-	–	40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.012	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	-	-	-	–	–	–	–	0.046	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 (3)	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 (4),(6)	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 (5)	-	-	0.2	0.1	0.01	–	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.0041	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–

PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.007	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00093	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0024	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.02	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0017	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0039	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0024	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00087	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0013	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0016	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0012	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.006	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0039	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 16
WATER QUALITY RESULTS AT SW4

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES (1–5)	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	8	<1	–	1	2	–	3	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	35	38	–	–	74	–	–	–	35	–	33
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	**0.14**	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.036	–	–	–	–	–	–	–	<0.01
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	**8.19**	–	–	–	–	–	–	–	**13.3**
Total Phosphorus	mg/L	0.02 (2)	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.01
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-		40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.011	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	-	-	-	–	–	–	–	0.039	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 (3)	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 (4),(6)	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 (5)	-	-	0.2	0.1	0.01	–	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.0033	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–		–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.007	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0013	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00097	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0011	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0014	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0015	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0014	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0035	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00093	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0013	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0014	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.00083	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0011	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 17
WATER QUALITY RESULTS SW5

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES (1–5)	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	7	72	9	6	7	–	4	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	81	110	–	–	77	–	–	–	78	–	170
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	0.16	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.056	–	–	–	–	–	–	–	0.403
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	5.62	–	–	–	–	–	–	–	6.64
Total Phosphorus	mg/L	0.02 (2)	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	**0.038**
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-		40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.023	–	–	–	–	–	–	–	–
Ba	mg/L	-	-	-	-	-	-	–	–	–	–	0.040	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 (3)	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 (4),(6)	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 (5)	-	-	0.2	0.1	0.01	–	–	0.00059	<0.0005	<0.0005	–	0.0025	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.0009	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–		–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.007	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00087	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0012	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0064	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0034	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00072	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00059	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0008	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00089	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.00091	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0013	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00096	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00073	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0011	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 18
WATER QUALITY RESULTS AT SW6

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES (1–5)	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	10	38	9	5	5	–	20	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	80	120	–	–	78	–	–	–	84	–	160
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	0.19	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	0.079	–	–	–	–	–	–	–	0.329
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	6.78	–	–	–	–	–	–	–	6.96
Total Phosphorus	mg/L	0.02 (2)	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.033
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-		40	–	–	<0.050	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	0.017	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	-	-	-	–	–	–	–	0.038	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 (3)	0.00009	0.001	0.0051	0.08	0.005	–	–	<0.0001	<0.0001	<0.0001	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 (4),(6)	0.001	-	0.008	0.05	0.05	–	–	–	–	<0.005	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	<0.0001	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 (5)	-	-	0.2	0.1	0.01	–	–	<0.0005	<0.0005	<0.0005	–	0.0015	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	<0.002	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	0.00096	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	<0.0005	<0.0005	<0.0005	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	<0.002	<0.002	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	<0.0002	<0.0002	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	<0.0002	<0.0002	<0.0002	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	<0.0002	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	<0.0002	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	<0.0002	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	<0.0005	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	<0.0002	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	<0.002	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	<0.01	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	<0.0002	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	<0.0002	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	<0.001	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	<0.00025	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	<0.005	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	<0.0005	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	<0.002	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	<0.0005	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	<0.005	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	<0.001	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	<0.001	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	<0.001	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	<0.0009	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	<0.0025	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	<0.0005	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	<0.0005	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	<0.0005	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	<0.005	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	<0.0005	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	<0.0005	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	<0.005	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	<0.0005	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	<0.001	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	<0.000009	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	<0.0005	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	<0.0005	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	<0.001	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	<0.0005	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	<0.0005	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	<0.01	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	<0.007	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	<0.01	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	<0.002	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	<0.001	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	<0.01	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	<0.000005	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	<0.000005	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	<0.000005	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.00005	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	<0.000005	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	<0.000005	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	<0.000003	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	<0.000005	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	<0.000009	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	<0.00001	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	<0.00001	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	<0.0002	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0012	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0009	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0011	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	<0.001	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0068	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0014	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0015	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.003	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00098	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.0008	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00065	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.00089	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.001	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	<0.0014	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0015	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.001	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.00081	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	<0.0012	–	–	–	–	–	–	–	–

Notes:

– Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 19

WATER QUALITY RESULTS AT CENTER PLANT

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES [(1–5)]	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	12	10	11	8	17	–	15	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	–	–	–	–	85	–	–	–	88	–	90
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	–	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	–	–	–	–	–	–	–	–	<0.010
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	–	–	–	–	–	–	–	–	1.5
Total Phosphorus	mg/L	0.02 [(2)]	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.019
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-	–	40	–	–	–	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	–	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	–	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	0.010	0.005	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 [(3)]	0.00009	0.001	0.0051	0.08	0.005	–	–	–	–	–	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 [(4),(6)]	0.001	-	0.008	0.05	0.05	–	–	–	–	–	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	–	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 [(5)]	-	-	0.2	0.1	0.01	–	–	–	–	–	–	<0.0005	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	–	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	–	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	–	–	–	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	–	–	–	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	–	–	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	–	–	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	–	–	–	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	–	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	–	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	–	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	–	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	–	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	–	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	–	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	–	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	–	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	–	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	–	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	–	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	–	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	–	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	–	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	–	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	–	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	–	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	–	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	–	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	–	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	–	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	–	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	–	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	–	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	–	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	–	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	–	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	–	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	–	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	–	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	–	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	–	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	–	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	–	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	–	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	–	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	–	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	–	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	–	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	–	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	–	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	–	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	–	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	–	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	–	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	–	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	–	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	–	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	–	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	–	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	–	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	–	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	–	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	–	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	–	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	–	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	–	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	–	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes:

– Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0~100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30~80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

DRAFT TABLE 20
WATER QUALITY RESULTS AT EAST PLANT

PARAMETER	UNITS	PROVINCIAL WATER QUALITY OBJECTIVES [1–5]	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN ENVIRONMENTAL QUALITY GUIDELINES (CEQG)				ONTARIO DRINKING WATER QUALITY STANDARDS	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 232/98	ENVIRONMENTAL PROTECTION ACT ONTARIO REGULATION 347	17-Nov-17	14-Mar-18	04-May-18	18-Jul-18	23-Aug-18	25-Sep-18	23-Oct-18	19-Nov-18	18-Dec-18	31-Jan-19	20-Feb-19
			Aquatic (Long Term)	Aquatic (Short Term)	Agriculture (Irrigation)	Agriculture (Livestock)														
GENERAL PARAMETERS																				
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	18	22	7	2	3	–	6	–
ANIONS & NUTRIENTS																				
Cl	mg/L	–	120	600	-	-	-	–	–	–	–	–	–	47	–	–	–	46	–	46
F	mg/L	–	0.12	-	1	-	1.5	–	–	–	–	–	–	–	–	–	–	–	–	–
NO_2	mg/L as N	–	0.06	-	-	10	10	–	–	–	–	–	–	–	–	–	–	–	–	**0.105**
NO_3	mg/L as N	–	13	-	-	-	1	–	–	–	–	–	–	–	–	–	–	–	–	2.95
Total Phosphorus	mg/L	0.02 [2]	0.035	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	0.007
Miscellaneous Parameters																				
NTA	mg/L	–	-	-	-	-	-	–	40	–	–	–	–	–	–	–	–	–	–	–
METALS & METALLOIDS																				
Ag	mg/L	0.0001	0.00025	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
As	mg/L	0.005	0.005	-	0.1	0.025	0.01	–	–	–	–	–	–	–	–	–	–	–	–	–
B	mg/L	0.20	1.50	29.00	-	5.00	5.00	–	–	–	–	–	–	–	–	–	–	–	–	–
Ba	mg/L	–	-	-	0.010	0.005	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Cd	mg/L	0.0001, 0.0005 [3]	0.00009	0.001	0.0051	0.08	0.005	–	–	–	–	–	–	<0.0001	–	–	–	<0.0001	–	–
Cr	mg/L	0.001 [4],[6]	0.001	-	0.008	0.05	0.05	–	–	–	–	–	–	–	–	–	–	–	–	–
Hg	mg/L	0.0002	0.026	-	-	0.003	0.001	–	–	–	–	–	–	–	–	–	–	–	–	–
Pb	mg/L	0.001, 0.003, 0.005 [5]	-	-	0.2	0.1	0.01	–	–	–	–	–	–	<0.0005	–	–	–	<0.0005	–	–
Se	mg/L	0.1	0.001	-	0.02	0.05	0.05	–	–	–	–	–	–	–	–	–	–	–	–	–
U (Total)	mg/L	0.005	0.015	0.033	0.01	0.2	0.02	–	–	–	–	–	–	–	–	–	–	–	–	–
VOLATILE ORGANICS																				
Benzene	mg/L	0.1	0.37	-	-	-	0.001	0.005	–	–	–	–	–	<0.0002	–	–	–	<0.0001	–	–
1,4-Dichlorobenzene	mg/L	0.004	0.026	-	-	-	0.005	0.5	–	–	–	–	–	<0.0005	–	–	–	<0.0002	–	–
Methylene Chloride(Dichloromethane)	mg/L	0.1	0.0981	-	-	0.05	0	0.05	–	–	–	–	–	<0.002	–	–	–	<0.0005	–	–
Toluene	mg/L	0.0008	0.002	-	-	0.024	0.06	–	–	–	–	–	–	<0.0002	–	–	–	<0.0002	–	–
Vinyl Chloride	mg/L	0.6	-	-	-	-	0.001	0.002	–	–	–	–	–	<0.0002	–	–	–	<0.0002	–	–
Carbon Tetrachloride	mg/L	–	0.0133	-	-	0.005	0.002	0.057	–	–	–	–	–	–	–	–	–	–	–	–
Chlorobenzene	mg/L	0.015	-	-	-	-	0	–	0.057	–	–	–	–	–	–	–	–	–	–	–
Chloroform	mg/L	–	0.0018	-	-	0.1	0	–	10	–	–	–	–	–	–	–	–	–	–	–
1,2-Dichlorobenzene	mg/L	0.0025	0.0007	-	-	-	0.2	–	20	–	–	–	–	–	–	–	–	–	–	–
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	0.005	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
1,1-Dichloroethylene	mg/L	0.04	-	-	-	-	0.014	–	1.4	–	–	–	–	–	–	–	–	–	–	–
Methylene Chloride(Dichloromethane)	mg/L	–	0.0981	-	-	0.05	0.05	–	5	–	–	–	–	–	–	–	–	–	–	–
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.4	-	-	-	-	0	–	200	–	–	–	–	–	–	–	–	–	–	–
Tetrachloroethylene	mg/L	0.05	0.11	-	-	-	0.01	–	3	–	–	–	–	–	–	–	–	–	–	–
Trichloroethylene	mg/L	0.02	0.021	-	-	0.05	0.005	–	5	–	–	–	–	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS																				
2,3,4,6-Tetrachlorophenol	mg/L	0.001	0.001	-	-	-	0.1	–	10	–	–	–	–	–	–	–	–	–	–	–
2,4,5-T	mg/L	–	-	-	-	-	0	–	28	–	–	–	–	–	–	–	–	–	–	–
2,4,6-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
2,4-D	mg/L	–	0.004	-	-	0.1	0.1	–	10	–	–	–	–	–	–	–	–	–	–	–
2,4-Dichlorophenol	mg/L	0.0002	0.0002	-	-	-	0.9	–	90	–	–	–	–	–	–	–	–	–	–	–
Aldicarb	mg/L	–	0.001	-	0.0549	0.011	0	–	0.9	–	–	–	–	–	–	–	–	–	–	–
Atrazine	mg/L	–	0.0018	-	0.01	0.005	0.005	–	–	–	–	–	–	–	–	–	–	–	–	–
Des-ethyl atrazine	mg/L	–	-	-	0.01	0.005	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Atrazine + Desethyl-atrazine	mg/L	–	-	-	-	-	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Bendiocarb	mg/L	–	-	-	-	-	0	–	4	–	–	–	–	–	–	–	–	–	–	–
Bromoxynil	mg/L	–	0.005	-	0.00033	0.011	0.005	–	0.5	–	–	–	–	–	–	–	–	–	–	–
Carbaryl	mg/L	0.0002	0.0002	0.0033	-	1.1	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Carbofuran	mg/L	–	0.0018	-	-	0.045	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Chlorpyrifos (Dursban)	mg/L	0.000001	0.000002	-	-	0.024	0.09	–	9	–	–	–	–	–	–	–	–	–	–	–
Cyanazine (Bladex)	mg/L	–	0.002	-	0.0005	0.01	0	–	1	–	–	–	–	–	–	–	–	–	–	–
Diazinon	mg/L	0.00008	-	-	-	-	0.02	–	2	–	–	–	–	–	–	–	–	–	–	–
Dicamba	mg/L	0.2	0.01	-	0.000006	0.122	0.12	–	12	–	–	–	–	–	–	–	–	–	–	–
Diclofop-methyl	mg/L	–	0.0061	-	0.00018	0.009	0.009	–	0.9	–	–	–	–	–	–	–	–	–	–	–
Dimethoate	mg/L	–	0.0062	-	-	0.003	0.02	–	2	–	–	–	–	–	–	–	–	–	–	–
Dinoseb	mg/L	–	0.00005	-	0.016	0.15	0	–	1	–	–	–	–	–	–	–	–	–	–	–
m/p-Cresol	mg/L	0.001	-	-	-	-	0	–	200/1	–	–	–	–	–	–	–	–	–	–	–
Malathion	mg/L	0.0001	-	-	-	-	0.19	–	19	–	–	–	–	–	–	–	–	–	–	–
o-Cresol	mg/L	–	-	-	-	-	0	–	200	–	–	–	–	–	–	–	–	–	–	–
Metolachlor	mg/L	0.003	0.0078	-	0.028	0.05	0.05	–	5	–	–	–	–	–	–	–	–	–	–	–
Metribuzin (Sencor)	mg/L	–	0.001	-	0.0005	0.08	0.08	–	8	–	–	–	–	–	–	–	–	–	–	–
Ethyl Parathion	mg/L	–	-	-	-	-	0	–	–	–	–	–	–	–	–	–	–	–	–	–
Pentachlorophenol	mg/L	–	0.0005	-	-	-	0.06	–	6	–	–	–	–	–	–	–	–	–	–	–
Phorate	mg/L	–	-	-	-	-	0.002	–	0.2	–	–	–	–	–	–	–	–	–	–	–
Picloram	mg/L	–	0.029	-	-	-	0.19	–	19	–	–	–	–	–	–	–	–	–	–	–
Simazine	mg/L	0.01	0.01	-	0.0005	0.01	0.01	–	1	–	–	–	–	–	–	–	–	–	–	–
Terbufos	mg/L	–	-	-	-	-	0.001	–	0.1	–	–	–	–	–	–	–	–	–	–	–
Triallate	mg/L	–	0.00024	-	-	0.23	0.23	–	23	–	–	–	–	–	–	–	–	–	–	–
Benzo(a)pyrene	mg/L	–	0.000015	-	-	-	0.00001	–	0.001	–	–	–	–	–	–	–	–	–	–	–
2,4,5-TP (Silvex)	mg/L	–	-	-	-	-	0	–	1	–	–	–	–	–	–	–	–	–	–	–
2,4,5-Trichlorophenol	mg/L	0.018	0.018	-	-	-	0	–	400	–	–	–	–	–	–	–	–	–	–	–
Methyl parathion	mg/L	–	-	-	-	-	0	–	0.7	–	–	–	–	–	–	–	–	–	–	–
2,4-Dinitrotoluene	mg/L	0.004	-	-	-	-	0	–	0.13	–	–	–	–	–	–	–	–	–	–	–
Nitrobenzene	mg/L	0.00002	-	-	-	-	0	–	2	–	–	–	–	–	–	–	–	–	–	–
PESTICIDES AND HERBICIDES																				
Glyphosate	mg/L	–	0.8	27	-	0.28	0.28	–	28	–	–	–	–	–	–	–	–	–	–	–
Diquat	mg/L	0.0005	-	-	-	-	0.07	–	7	–	–	–	–	–	–	–	–	–	–	–
Diuron	mg/L	0.0016	-	-	-	-	0.15	–	15	–	–	–	–	–	–	–	–	–	–	–
Guthion (Azinphos-methyl)	mg/L	0.000005	-	-	-	-	0	–	2	–	–	–	–	–	–	–	–	–	–	–
Paraquat	mg/L	–	-	-	-	-	0.01	–	1	–	–	–	–	–	–	–	–	–	–	–
Temephos	mg/L	–	-	-	-	-	0	–	28	–	–	–	–	–	–	–	–	–	–	–

ORGANOCHLORINATED PESTICIDES																				
Aldrin + Dieldrin	mg/L	0.000001	-	-	-	-	-	–	0.07	–	–	–	–	–	–	–	–	–	–	–
Chlordane (Total)	mg/L	0.00006	-	-	-	-	-	–	0.7	–	–	–	–	–	–	–	–	–	–	–
DDT+ Metabolites	mg/L	0.000003	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Heptachlor + Heptachlor epoxide	mg/L	–	-	-	-	-	-	–	0.3	–	–	–	–	–	–	–	–	–	–	–
o,p-DDT + p,p-DDT	mg/L	–	-	-	-	-	-	–		–	–	–	–	–	–	–	–	–	–	–
Total PCB	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Aldrin	mg/L	–	-	-	-	-	-	–	0.021	–	–	–	–	–	–	–	–	–	–	–
Dieldrin	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
a-Chlordane	mg/L	0.00006	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
g-Chlordane	mg/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
o,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	–	–	–	–	–	–	–	–	–
p,p-DDT	mg/L	–	-	-	-	-	-	–	0.0039	–	–	–	–	–	–	–	–	–	–	–
Lindane	mg/L	0.00001	0.00001	-	-	0.004	-	–	0.4	–	–	–	–	–	–	–	–	–	–	–
Endrin	mg/L	0.000002	-	-	-	-	-	–	0.02	–	–	–	–	–	–	–	–	–	–	–
Heptachlor	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Heptachlor epoxide	mg/L	0.000001	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Hexachlorobenzene	mg/L	0.0000065	-	-	-	0.00052	-	–	0.13	–	–	–	–	–	–	–	–	–	–	–
Hexachlorobutadiene	mg/L	0.000009	0.0013	-	-	-	-	–	0.15	–	–	–	–	–	–	–	–	–	–	–
Hexachloroethane	mg/L	0.001	-	-	-	-	-	–	3	–	–	–	–	–	–	–	–	–	–	–
Methoxychlor	mg/L	0.00004	-	-	-	-	-	–	90	–	–	–	–	–	–	–	–	–	–	–
Toxaphene	mg/L	0.000008	-	-	-	-	-	–	0.5	–	–	–	–	–	–	–	–	–	–	–
DIOXINS AND FURANS																				
2,3,7,8-Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-dioxin	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
2,3,7,8-Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
2,3,4,7,8-Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
2,3,4,6,7,8-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,7,8,9-Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	63	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,6,7,8-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
1,2,3,4,7,8,9-Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	35	–	–	–	–	–	–	–	–	–	–	–
Octa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Tetra Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Penta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hexa Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Hepta Chlorodibenzo-p-furan	ng/L	–	-	-	-	-	-	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes:

− Concentrations represent total concentrations (samples were not filtered) with the exception of aluminum measured in 2011 -2013, which was field filtered (0.45 µm) for dissolved concentrations.

(1) MOEE [Ontario Ministry of Environment and Energy], 1999. Policies Guidelines Provincial Water Quality Objectives. Originally published in 1994, reprinted 1999.

(2) PWQO for P is based on a value to prevent excessive algae growth.

(3) PWQO for Cd depends on hardness as follows: hardness 0−100 mg/L as $CaCO_3$, PWQO = 0.0001 mg/L; hardness >100 mg/L as $CaCO_3$, PWQO = 0.0005 mg/L.

(4) PWQO for Cr used is based on either hexavalent Cr (Cr-VI at 0.001 mg/L), not trivalent Cr (Cr-III at 0.0089 mg/L).

(5) PWQO for Pb depends on hardness as follows: hardness <30 mg/L as $CaCO_3$, PWQO = 0.001 mg/L; hardness = 30−80 mg/L as $CaCO_3$, PWQO = 0.003 mg/L; hardness >80 mg/L as $CaCO_3$, PWQO = 0.005 mg/L.

(6) Some parameters have detection limits higher than the guidelines. In such cases, it is not considered to be an exceedance.

(7) The CCME document numbers correspond to 1. Aquatic (Long Term) 2. Aquatic (Short Term) 3. Agricultural (Irrigation) 4. Agricultural (Livestock)

(8) **Exceedance of PWQO**

(9) **Exceedance of CCME**

(10) **Exceedance of ODWQS**

(11) **Exceedance of Environmental Protection Act Ontario Regulation 232/98**

(12) **Exceedance of Environmental Protection Act Ontario Regulation 347**

(13) **Exceedance of more than one water quality guideline**

FIGURES

LEGEND

- SW MONITORING STATIONS
- WATERCOURSE
- WATERBODY

DRAFT

0 500 1,000

1:22,000 Metres

NOTE(S)

1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)

1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT

WALKER ENVIRONMENTAL GROUP INC.

PROJECT

SOUTHWESTERN LANDFILL

TITLE

SW MONITORING STATIONS

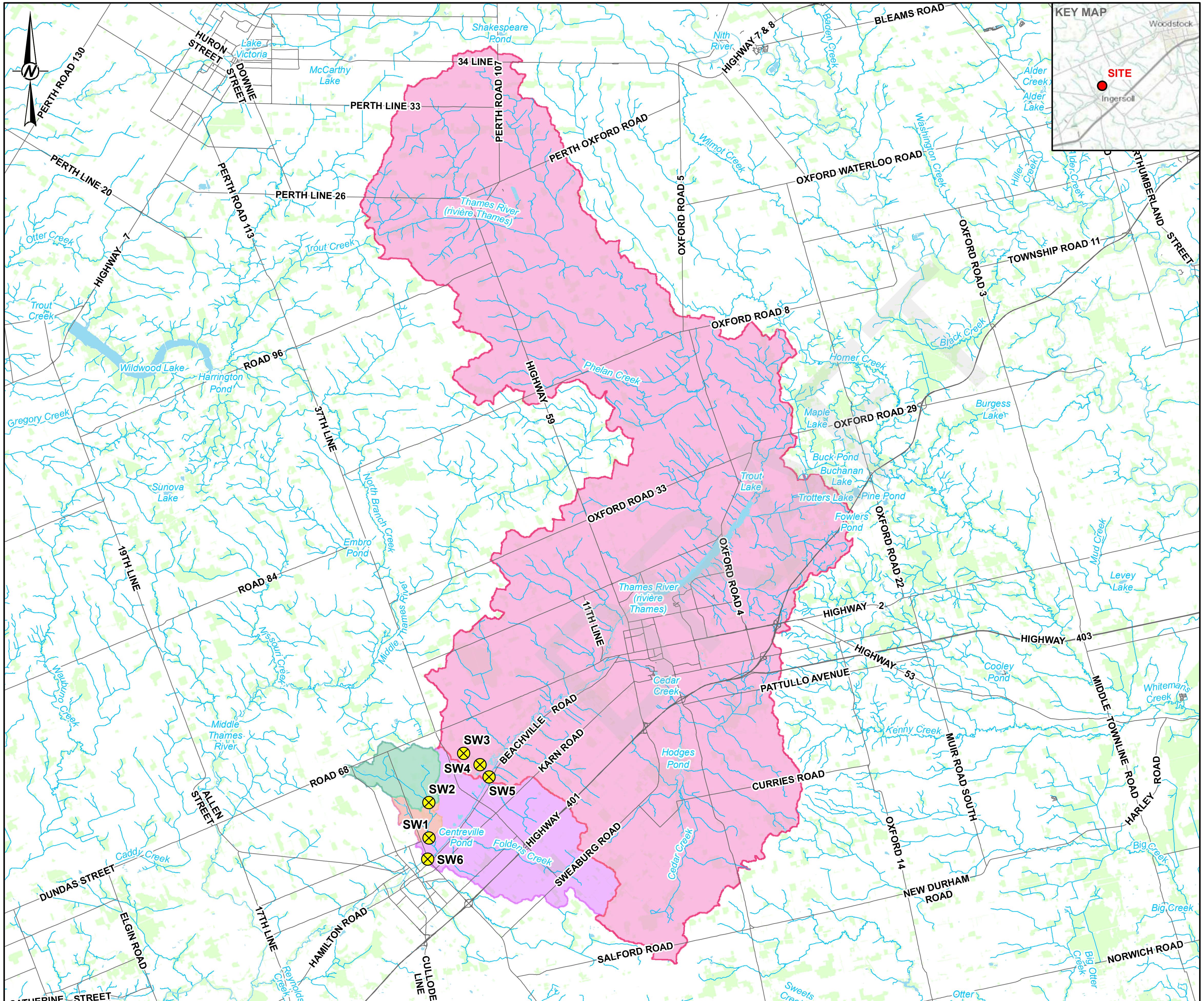
CONSULTANT

GOLDER

YYYY-MM-DD	2019-06-11
DESIGNED	PR
PREPARED	PR
REVIEWED	CD
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
1664706	0001	0	1

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



LEGEND

- SURFACE WATER MONITORING LOCATION
- ROAD
- WATERCOURSE
- WATERBODY
- WATERSHED SW1
- WATERSHED SW2
- WATERSHED SW5
- WATERSHED SW6

DRAFT

0 5 10

1:175,000 Kilometers

NOTE(S)

1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)

1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
SOUTHWESTERN LANDFILL

TITLE
WATERSHED LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-25
DESIGNED	PR
PREPARED	PR/LMM
REVIEWED	SK
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
1664706	0001	0	2

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

25mm

LEGEND

- CEDAR CREEK AT WOODSTOCK (02GD011)
- PITTOCK DAM AND RESERVOIR (02PIT/02GD012)
- THAMES RIVER AT INGERSOLL (02GD016)
- WATERCOURSE
- WATERBODY

DRAFT

0 1 2
1:52,000 KILOMETRES

NOTE(S)
1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)
1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
SOUTHWESTERN LANDFILL

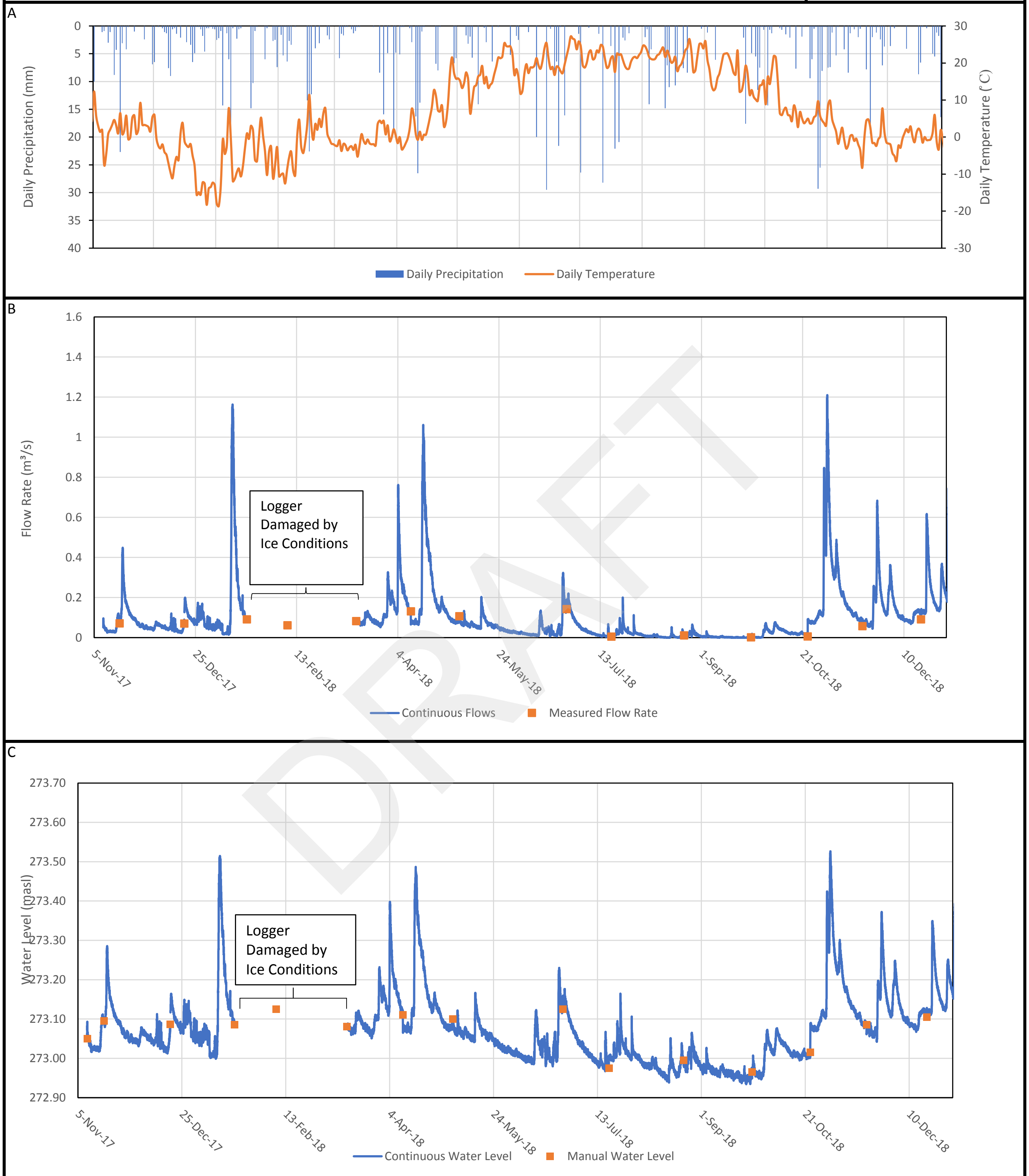
TITLE
NON-WALKER MONITORING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-11
DESIGNED	PR
PREPARED	PR/LMM
REVIEWED	CD
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
1664706	0001	0	3

Surface Water Monitoring at SW1 **DRAFT** | **FIGURE 4**



A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

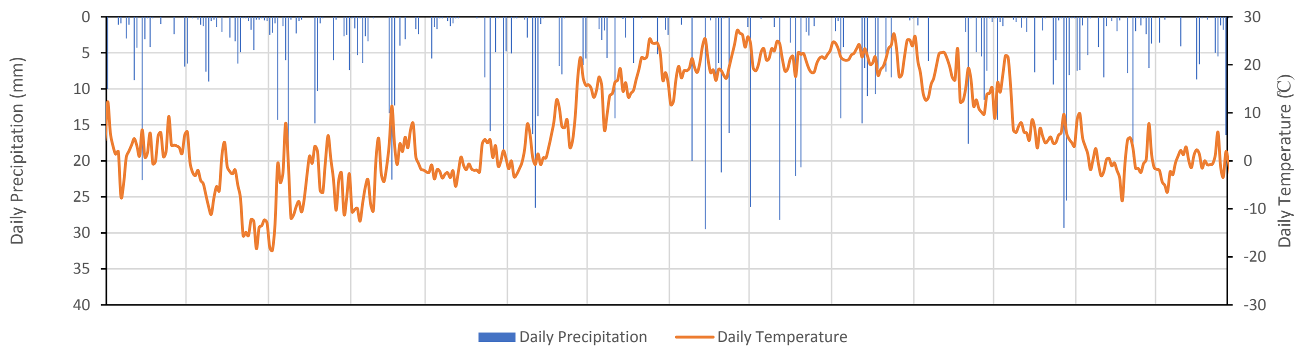
PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Surface Water Monitoring at SW2 DRAFT | **FIGURE 5**

A



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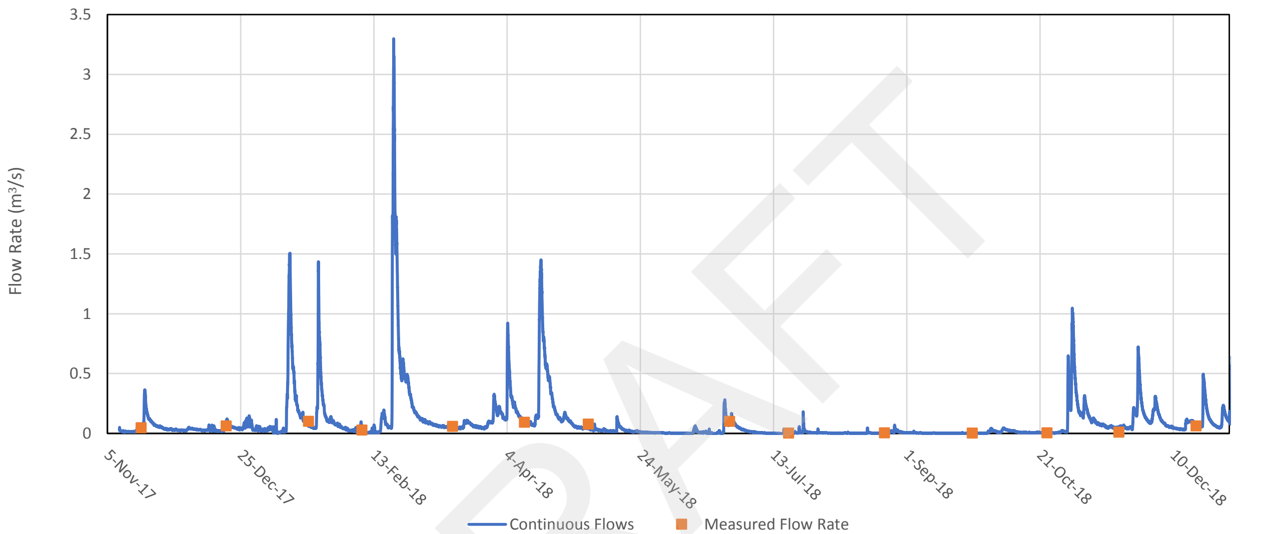
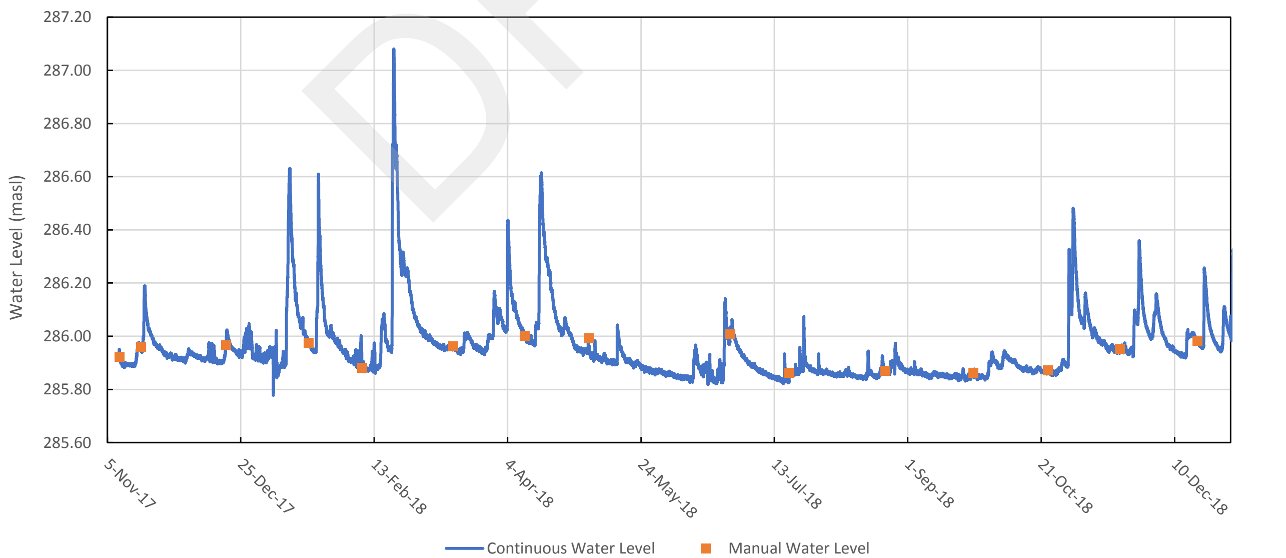


C



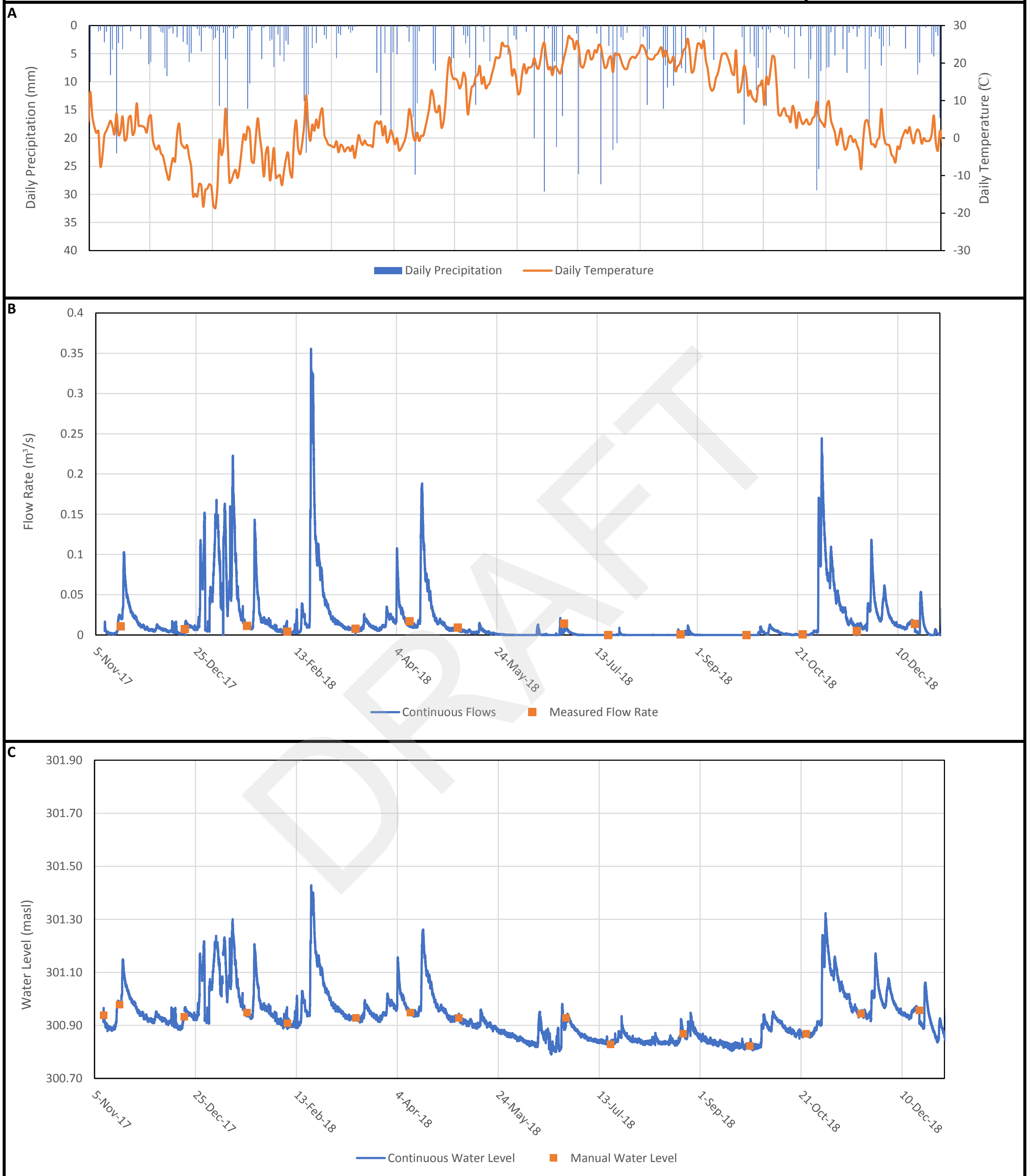
A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Surface Water Monitoring at SW3 DRAFT | **FIGURE 6**



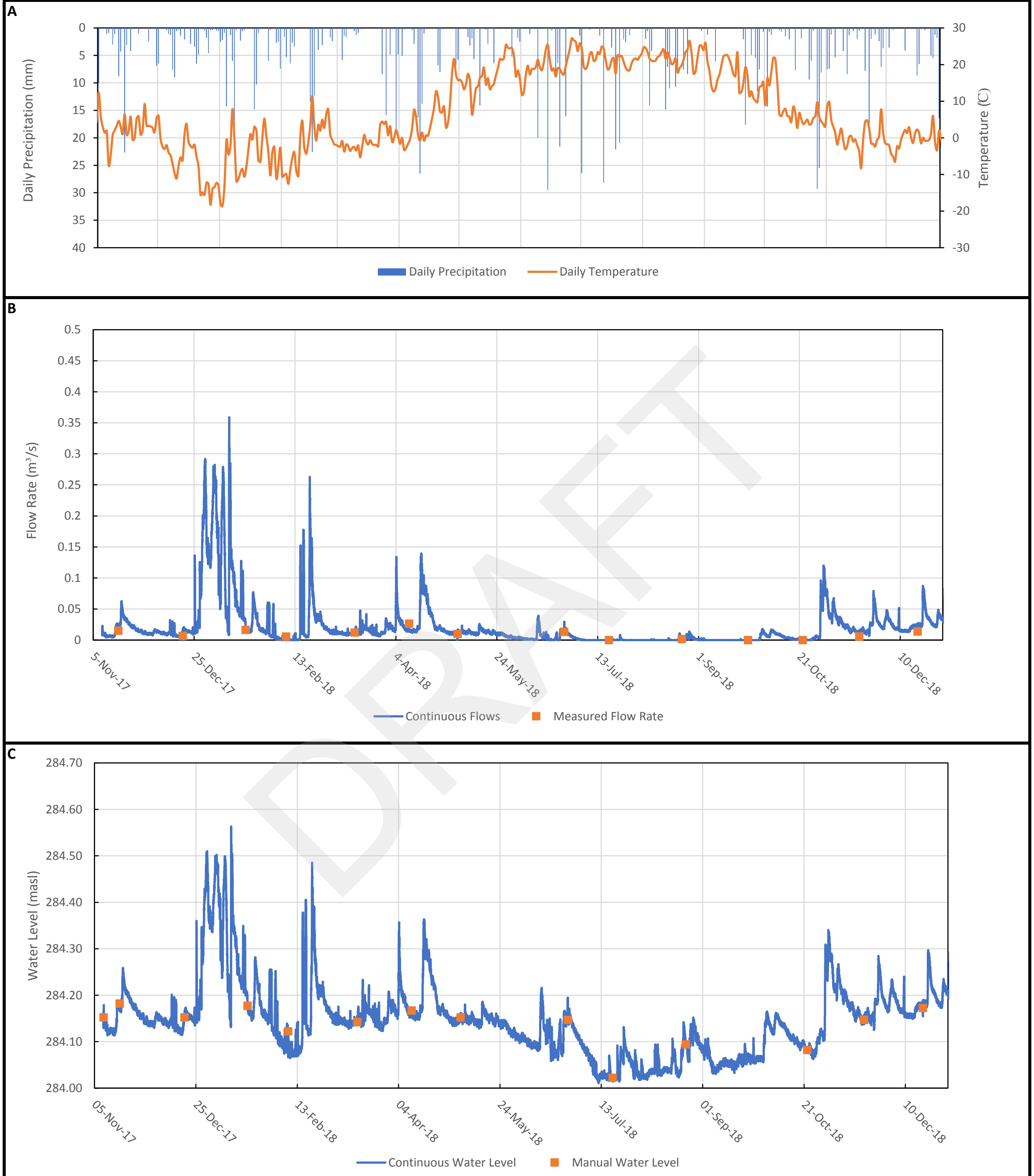
A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Surface Water Monitoring at SW4 DRAFT | **FIGURE 7**



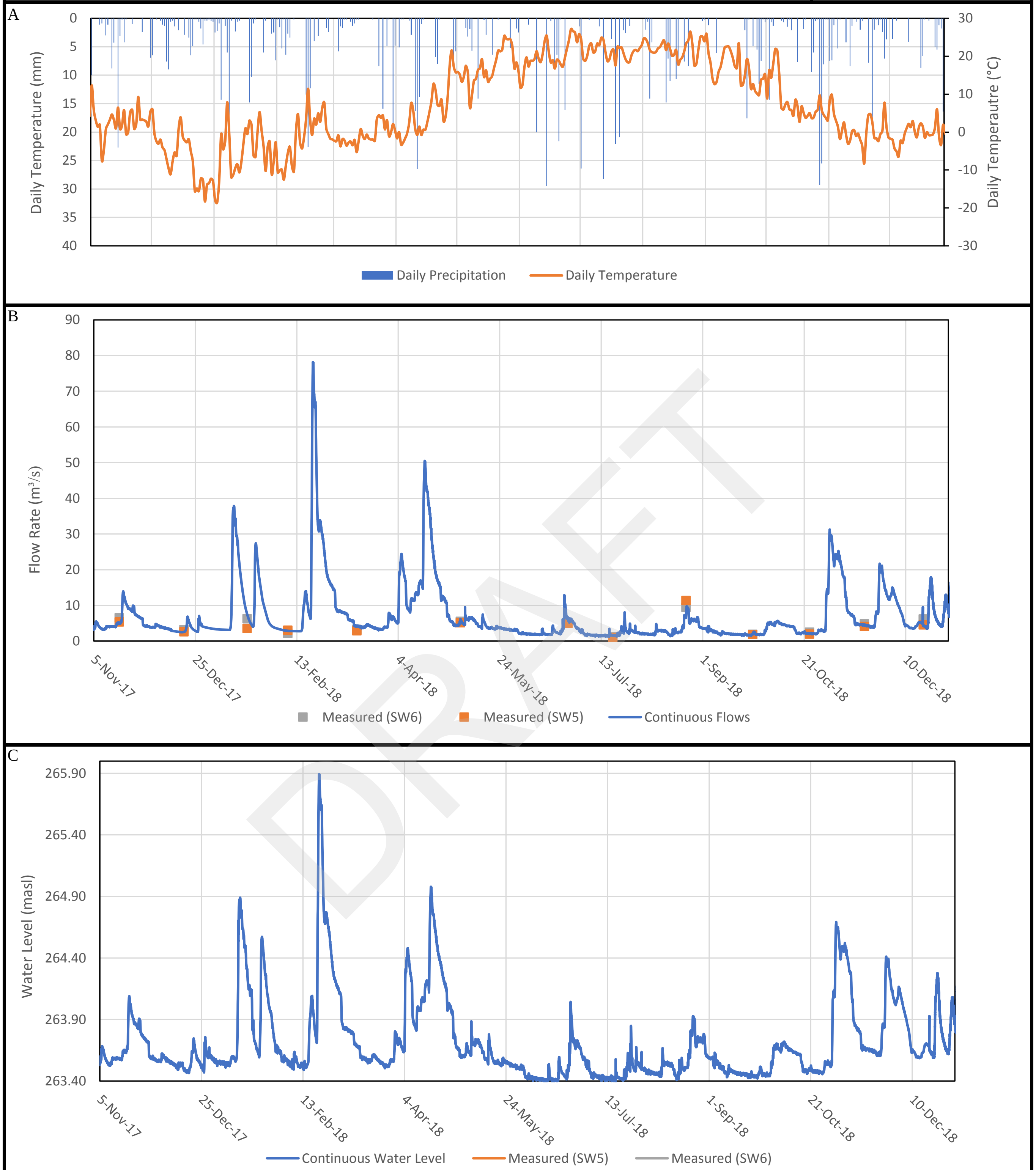
A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Non-Walker Surface Water Monitoring at EC Station Thames River at Ingersoll (02GD016) DRAFT | **FIGURE 8**



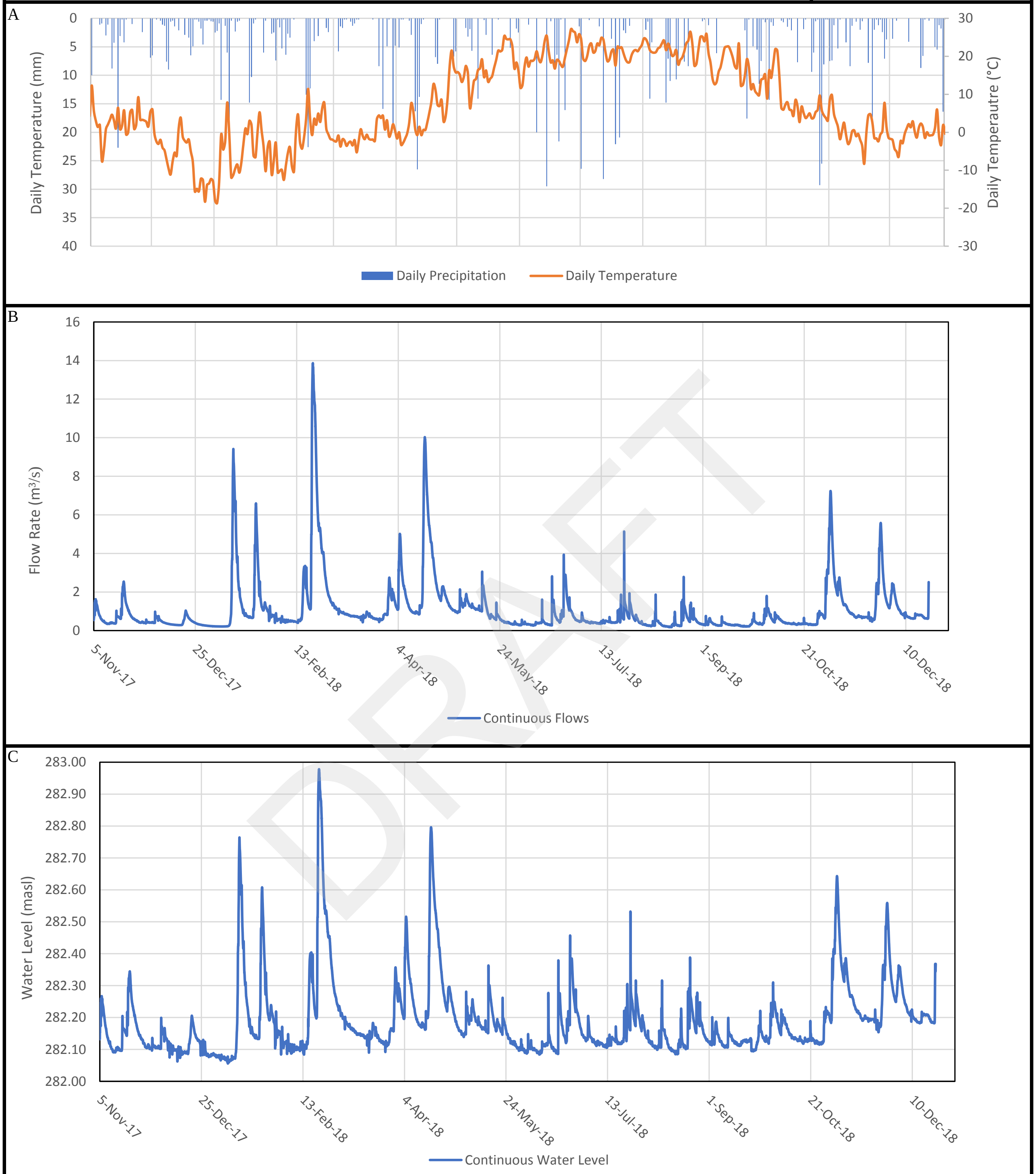
A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Non-Walker Surface Water Monitoring at EC Station Cedar Creek at Woodstock (02GD011) DRAFT | **FIGURE 9**



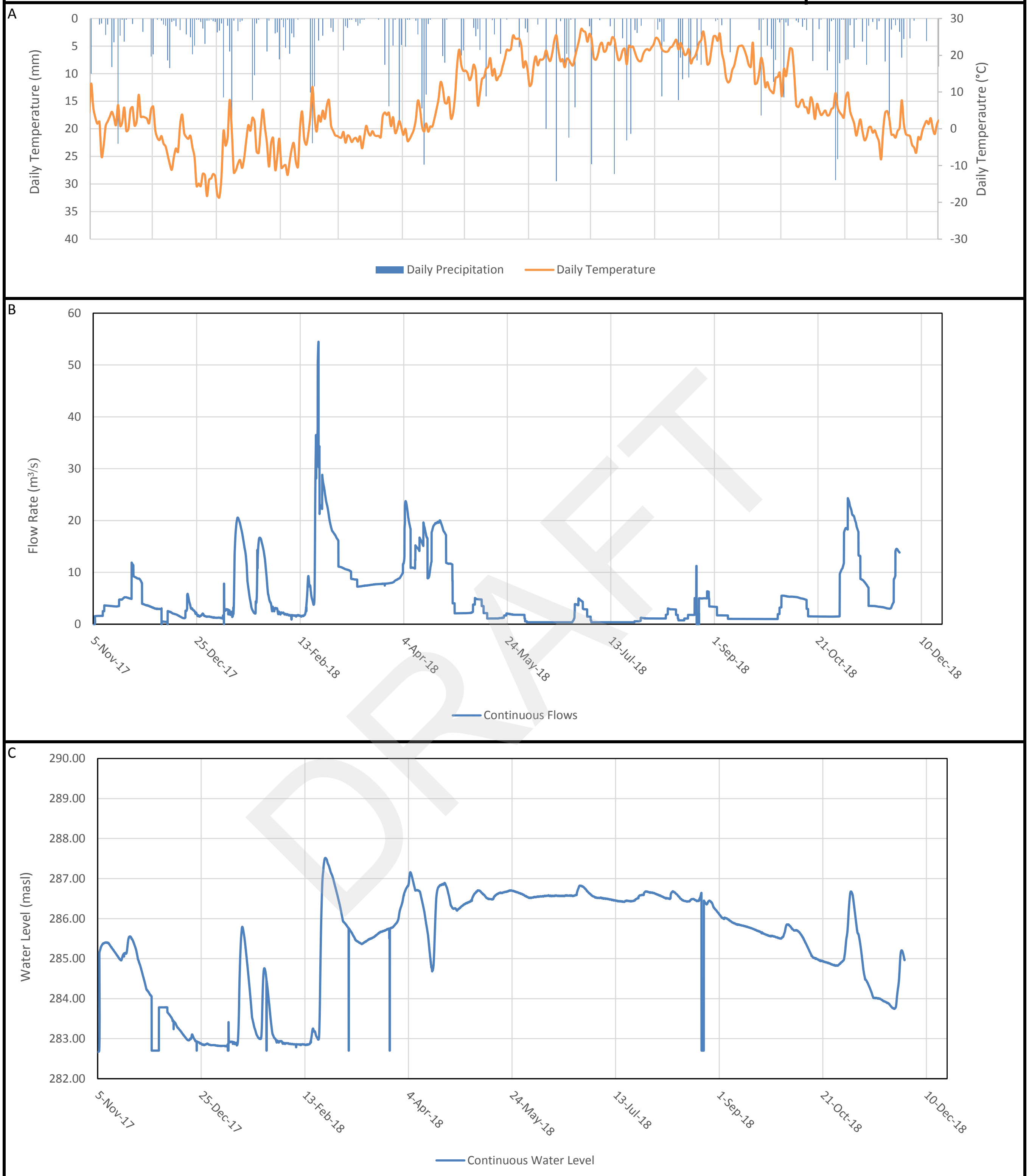
A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

Non-Walker Surface Water Monitoring at UTRCA Station Pittock Dam and Reservoir (02PIT/02GD012) DRAFT | **FIGURE 10**



A. Daily Precipitation and Temperature (London CS, EC Climate ID#6144478) B. Flow Rate C. Water Level

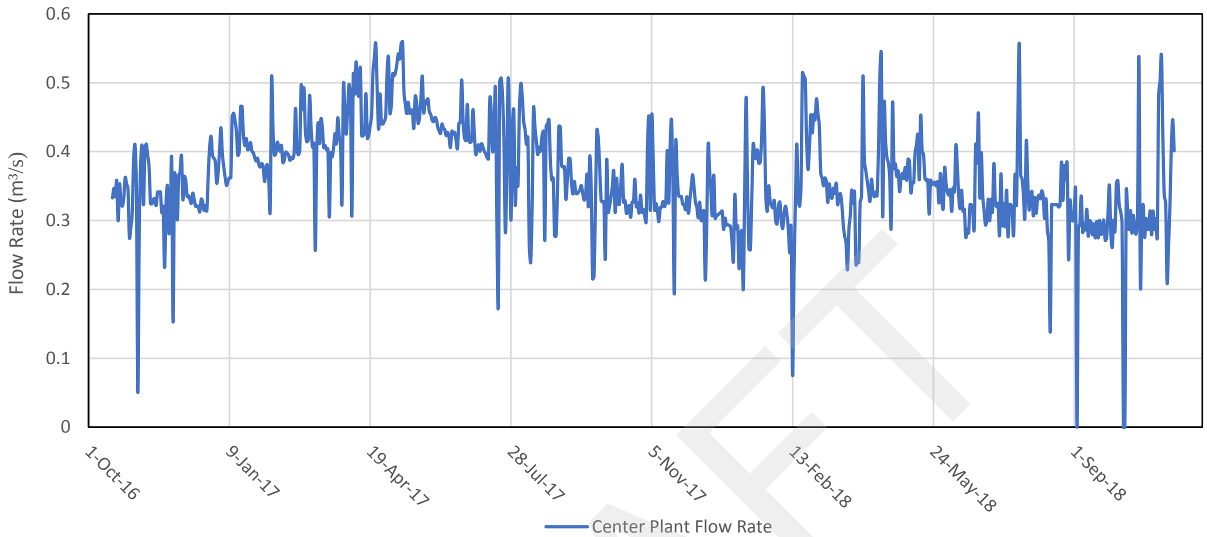
PROJECT: 1664706/3000
DATE: June 2019

GOLDER

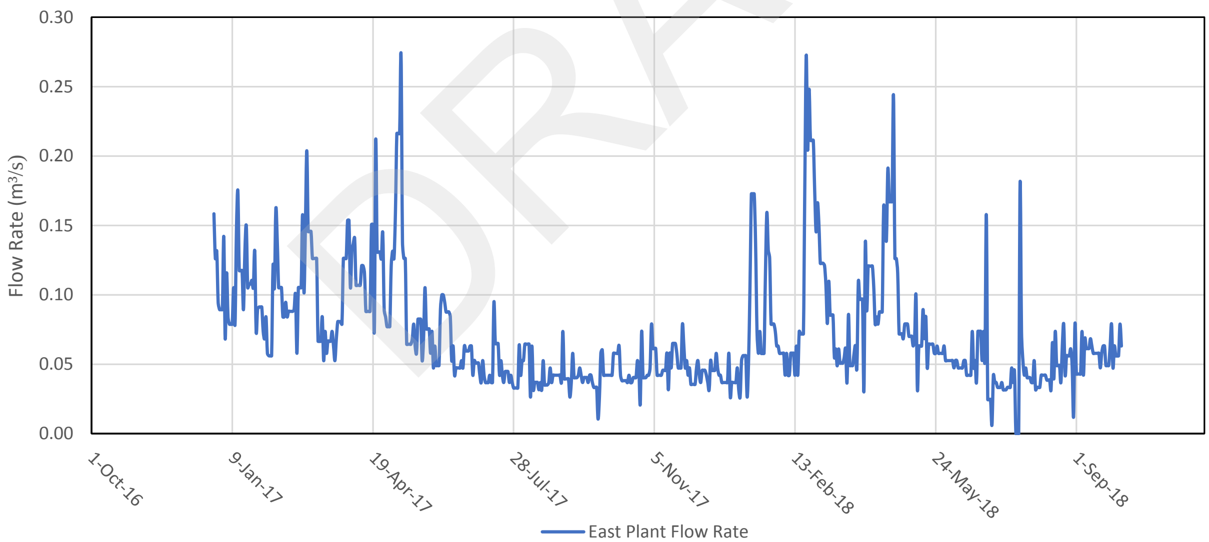
DRAWN: YT
CHECK: CDV

Carmeuse Quarry Discharge Data DRAFT	FIGURE 11

A



B



A. Center Plant Flow Rate B. East Plant Flow Rate

PROJECT: 1664706/3000
DATE: June 2019

GOLDER

DRAWN: YT
CHECK: CDV

APPENDIX D

Hydrological Modelling Report

GOLDER

DRAFT

REPORT

Hydrological Modelling Report

Southwest Landfill Centreville, Ontario

Submitted to:

Joseph M. Tomaino

Walker Environmental
160 Carnegie Street
Ingersoll, ON N5C 4A8

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100 Mississauga, Ontario, L5N 7K2 Canada

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1664706

June 2019

Distribution List

1 e-copy - Walker Environmental Inc.

1 e-copy - Golder Associates Ltd.

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TABLES

FIGURES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Walker Environmental Group (WEG) to assess surface water characteristics, under current and future conditions, in support of an Environmental Assessment for the "provision of future waste landfill capacity at the Carmeuse Lime (Canada) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario". The Carmeuse Lime Quarry (the Site) is located in Southern Ontario between Ingersoll and Beachville, Ontario (Figure 1) as part of the Beachville operations of Carmeuse Lime (Canada) Ltd. The quarry produces quicklime (calcium oxide), chemical grade limestones, and milled limestones.

1.1 Objectives

The principal objective of the surface water modelling was to evaluate the flow characteristics under current and future conditions. The specific study objectives were as follows:

- Develop a hydrological model calibrated to the data collected during the 2017-2018 monitoring program.
- Estimate the flow characteristics, under average flow conditions, adjusted for climate change for the periods of 2011 to 2040, 2041 to 2070, and 2070 to 2100.
- Estimate peak flows under return period storms adjusted for climate change for the periods of 2011 to 2040, 2041 to 2070, and 2070 to 2100.

2.0 REVIEW OF DATA

2.1 Meteorological Data

2.1.1 Average Year

Three Environment Canada operated climate stations are located at London Airport approximately 20 km west of the study area. The geographical details of these climate stations are presented in Table-1. These stations are listed as London International Airport (6144475), London A (6144473) and London CS (6068150); the London International Airport station operated from 1953 to 2012 before being renamed London A, while the London CS ('Climate Station') station began operating at the airport in 2012. Hourly weather and climate data are available from 1953 to 2019 at this location, although precipitation is only available from the London CS station. For the purposes of the modelling input, data from the London CS station was selected for use in the calibration since it represented the most complete dataset for the period of interest (i.e. the 2017-2018 monitoring period).

Table-1: Geographical information of climate stations

Station Name	Station ID	Latitude	Longitude	Elevation
London International Airport	ID:6144475	43°01'59.0" N	81°09'04.0" W	278 m
London A	ID:6144473	43°01'59.0" N	81°09'04.0" W	278 m
London CS	ID:6144478	43°02'00.0" N	81°09'00.0" W	278 m

Table-2 summarizes average monthly and annual climate data for London International Airport between 1981 to 2010. The climate normals produced by Environment Canada for the London Airport station are assumed to be representative of those at the Site given the proximity to the Site (the Airport is 23 km west of the Site), comparable elevation (the Airport gauge is at 278 masl, equivalent to the 270-290 masl range at the Site), and prevailing wind direction (shown as most frequently from the west at the Airport). Annual mean air temperature was 7.9°C with above-zero mean monthly temperatures from April to October (inclusive). Monthly mean air temperatures ranged from -5.6° (January) to 20.8°C (July). Annual total precipitation was 1011.5 mm with 845.9 mm of rainfall and 194.3 cm of snowfall. Rainfall occurred throughout the year, with the highest amounts were recorded in May through to October. 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 London International Airport (1981 to 2010)

Period	Mean Monthly Air Temperature (°C)	Total Monthly Precipitation (mm)	Monthly Rainfall (mm)	Monthly Snowfall (cm)
January	-5.6	74.2	33.4	49.3
February	-4.5	65.5	33.6	38.4
March	-0.1	71.5	46.3	29.4
April	6.8	83.4	74.7	9.4
May	13.1	89.8	89.4	0.4
June	18.3	91.7	91.7	0
July	20.8	82.7	82.7	0
August	19.7	82.9	82.9	0
September	15.5	103	103	0
October	9.2	81.3	78.1	3.2
November	3.4	98	83.2	16.6
December	-2.6	87.5	46.9	47.6
Annual	**7.9**	**1011.5**	**845.9**	**194.3**

Hourly precipitation and temperature were also obtained from 2004 to 2018 from Environment Canada for the London CS location. In addition to temperature and precipitation results, daily actual evapotranspiration data for the period were also estimated from the precipitation and temperature data using the methods described in Johnstone & Louie 1983. Based on the 1981-2010 period, 2016 was selected as representing the average year because the average annual precipitation in 2016 is the closest to the average for the recorded period.

The 2016-2018 data were used for calibrating the model (to match the 2017-2018 measured flow data for the Patterson-Robbins Drain, which is locally known as Cemetery Creek), while the 2016 data were used to estimate average annual flows.

2.1.2 Design Storm Events

The Environment Canada intensity-duration-frequency (IDF) data from London CS (Composite) are presented in Table-3. These values are based on historical rainfall information (from 1943 to 2007) and are used to estimate rainfall depths associated with peak rainfall events with durations from 5-minutes to 24-hours and return periods between 1:2-year and 1:100-year. The values were used to generate rainfall hyetographs for 1:2-year through 1:100-year, 24-hour rainfall events with the peak 5-minute intensity occurring at noon (matching the timing of the peak to the commonly-applied SCS Type II distribution) and using an alternating blocks method and longer duration intensities to define the remaining hyetographs. The hyetographs were used in the model to estimate peak flow hydrographs.

Table-3: Environment Canada – London CS - Rainfall Intensity-Duration-Frequency Data, 1943 - 2007

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	9.2	12	13.9	16.3	18.0	19.8
10-minute	13.3	18.1	21.4	25.4	28.4	31.4
15-minute	16.0	21.7	25.5	30.3	33.9	37.4
30-minute	20.6	28.2	33.3	39.6	44.4	49.1
1-hour	24.5	35.1	42.2	51.1	57.7	64.2
2-hour	29.5	41.2	48.9	58.7	65.9	73.1
6-hour	36.7	47.9	55.3	64.7	71.7	78.6
12-hour	42.9	54.0	61.4	70.8	77.7	84.6
24-hour	50.8	66.2	76.4	89.3	98.9	108.4

2.2 Climate Change Adjustments

Minister's amendment #12 to the approved amended terms of reference site EA required that climate change should be considered in this environmental assessment. Climate change was accounted for in two ways:

- Adjustments to historical average year hourly timeseries for temperature and precipitation were made using "DRAFT Baseline Forecast Assumptions – Climate Change" (Walker, 2019), which cites results from

"Climate Change Projections for Ontario: An updated synthesis of policymakers and planners" (MNRF, 2015).

- Adjustments to the peak rainfall event hyetographs were made using the IDF_CC tool using the median result from the tool-selected ensemble of global climate models and the RCP 4.5 scenario for future greenhouse gas concentrations. The RCP 4.5 scenario matches the selection in the "DRAFT Baseline Forecast Assumptions – Climate Change" (Walker, 2019). This RCP assumes worldwide greenhouse gasses emissions peak around 2040, then decline.

2.2.1 Average Year

Following the method described in "DRAFT Baseline Forecast Assumptions – Climate Change" (Walker, 2019), temperature and precipitation adjustments were made to the average year (2016) hourly temperature and precipitation timeseries for three different future periods (2011-2040 "Operations", 2040-2071 "Post-Closure", and 2071-2100 "Post Closure"), according to the methods of McDermid et al. 2015.

Table-4 summarizes the mean climate change (temperature and precipitation) assumptions to be considered during this study, where relevant. The values generally show increasing trends in temperature and precipitation compared to existing conditions, with the exception of summer precipitation (which shows a decreasing trend). In particular, winter precipitation increases account for roughly half of the annual increase in precipitation for future periods. These values were applied to the hourly timeseries to model future average flow conditions.

Table-4: Climate Change Adjustments for RCP 4.5.

	Temperature (Degrees Celsius)			Precipitation (mm)		
	Annual	Summer	Winter	Annual	Summer	Winter
2011-2040	+2.3	+2.0	+2.2	+52.0	-2.7	+28.3
2040-2071	+3.9	+3.2	+4.5	+87.0	-2.5	+34.9
2071-2100	+4.8	+4.1	+5.5	+89.0	-4.4	+46.8

Source: McDermid et al 2015.

2.2.2 Design Storm Events

The climate change adjusted IDF curves were estimated using the IDF_CC tool for the London CS location. This is an online tool provided by the University of Western Ontario to estimate future IDF values for locations in Canada (Western University 2018). The tool allows users to generate the median results from an ensemble of global circulation models (GCMs) for 50-year periods; the 50-year periods selected were centered around the future Operations and Post Closure periods.

The resulting climate change adjusted IDF data from the IDF_CC tool for the three periods of interest are presented in Table-5, Table-6, and Table-7. Results show increasing rainfall depth for future time periods compared to existing conditions, peaking in the 2041-2070 period before declining (which matches the RCP 4.5 assumption of declining greenhouse gas emissions in the latter part of the century). These values were used to generate storm hyetographs to model future peak flow conditions.

Table-5: Climate Change Adjusted Rainfall Intensity-Duration-Frequency Data, centered on 2011-2040.

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	10.41	14.42	17.04	19.69	20.60	22.85
10-minute	14.64	21.07	25.56	30.90	32.85	39.02
15-minute	17.71	25.33	30.60	36.82	39.14	45.57
30-minute	23.31	33.51	40.44	47.68	49.68	55.81
1-hour	27.43	40.84	50.31	60.36	64.25	72.16
2-hour	33.76	49.30	59.94	70.32	73.23	82.09
6-hour	42.23	57.81	67.82	77.64	80.67	88.59
12-hour	49.96	66.41	76.48	85.72	88.38	95.23
24-hour	59.55	82.50	96.97	109.12	112.35	121.60

Table-6: Climate Change Adjusted Rainfall Intensity-Duration-Frequency Data, centered on 2041-2070.

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	10.67	14.54	17.61	21.01	22.53	25.51
10-minute	15.18	21.35	26.46	32.98	35.08	41.13
15-minute	18.34	25.66	31.67	39.24	41.79	48.78
30-minute	23.95	33.80	41.75	50.56	54.41	62.31
1-hour	28.32	41.27	51.94	64.18	69.16	80.45
2-hour	34.55	49.56	61.79	74.92	80.53	91.81
6-hour	43.11	58.11	70.00	82.78	88.44	99.02
12-hour	50.91	66.47	78.87	91.42	97.02	106.48

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)					
24-hour	60.71	82.81	99.78	116.57	123.69	136.06

Table-7: Climate Change Adjusted Rainfall Intensity-Duration-Frequency Data, centered on 2071-2100.

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	10.91	14.66	16.95	21.18	22.36	24.55
10-minute	15.53	21.45	25.55	32.69	35.22	40.04
15-minute	18.75	25.78	30.57	38.99	41.91	47.42
30-minute	24.50	34.07	40.28	51.02	54.01	60.06
1-hour	28.99	41.54	50.14	64.61	68.85	77.88
2-hour	35.37	50.12	59.80	75.60	79.58	88.18
6-hour	44.09	58.76	67.49	83.40	87.43	94.89
12-hour	52.07	67.51	76.12	92.03	95.45	101.42
24-hour	62.14	83.90	96.78	117.38	121.24	129.21

2.3 Drainage Area

The Patterson-Robbins Drain is a tributary of the Thames river located on the west side of the Carmeuse quarry and the East Tributary is an unnamed tributary of the Thames river located on the east side of the Carmeuse quarry. The catchment boundaries for the various watercourse stations at Patterson-Robbins Drain, the East Tributary and Thames River, delineated based on available topography and contour data from MNRF, are presented in Figure 2. These include:

- SW-1 is located in the Patterson-Robbins Drain, southwest of the quarry and upstream of the Marion Street crossing culvert. This is the downstream-most station in the Patterson-Robbins Drain, approximately 400 m upstream of the discharge into the Thames River.

- SW-1a is located in the Patterson-Robbins Drain, southwest of the quarry where the Patterson-Robbins Drain converges into Thames River. This location is a model-only location, which is not a monitoring station part of the surface water monitoring program.
- SW-2 is located in the Patterson-Robbins Drain, west of the quarry and downstream of the Road 64 crossing culvert. This is the second-most downstream station in the Patterson-Robbins Drain, approximately 1,600 m upstream of SW-1.
- SW-3 is located in the East Tributary of the Thames River east of the quarry and at Road 66. This is the second-most downstream station in this tributary, approximately 1,600 m upstream of the discharge into the Thames River and SW-5.
- SW-4 is located in the East Tributary of the Thames River east of the quarry and at 41st Line, 800 m downstream of SW-3. It is the most downstream station in this tributary, approximately 800 m upstream of the discharge into the Thames River and SW-5.
- SW-5 is located in the Thames River at 41st Line. It is the most upstream station in the Thames River, approximately 4.5 m upstream of SW-6.
- SW-6 is located in the Thames River at Pemberton Street. This station is located downstream of all the other monitoring stations.

The catchment areas are listed in Table-8 and, where applicable, include all upstream sub-catchments (e.g., catchment area at SW-6 includes catchment area at SW-5).

Table-8: Catchment Areas at Patterson-Robbins Drain

Basin	Station ID	General Description	Catchment Area (km^2)
Patterson-Robbins Drain	SW-1	Downstream of Tributary to Thames River Southwest of Carmeuse Quarry	9.93
	SW-2	Upstream of Tributary to Thames River West of Carmeuse Quarry	7.75
	SW-3	Upstream of Tributary to Thames River North of Carmeuse Quarry	0.96
	SW-4	Downstream of Tributary to Thames River North of Carmeuse Quarry	1.39
Thames River	SW-5	Thames River Upstream of Carmeuse Quarry	425.07
	SW-6	Thames River downstream of Carmeuse Quarry	473.65

2.3.1 Drainage Area Change due to Quarry Expansion

The Carmeuse quarry is expected to continue expanding in the future. As extraction proceeds, flow that previously drained towards Cemetery Creek will instead be captures on the quarry floor and redirected towards the Carmeuse quarry sump, effectively being removed from the Cemetery Creek flows. The quarry is assumed to expand at the same rate as the last ten years of the operational period (2033-2043) as described in the land use forecast report (MHBC 2017). The footprint of the expansion is assumed to be increasing toward the north and west as per the plan drawings for licensure. This flow redirection was accounted in the hydrologic model by decreasing the areas contributing to SW2, as shown in Table-9 below.

Table-9: Modeled Future Catchment for SW2

	Catchment Area (km^2)			
	Calibration (Existing Condition)	**2011-2040**	**2041-2070**	**2071-2100**
SW2	7.75	7.71	7.36	6.94

3.0 HYDROLOGICAL MODELLING

The hydrological runoff model was developed using Version 4.3 of the Hydrologic Modeling System developed by the United States Army Corps of Engineers Hydrologic Engineering Center (HEC-HMS). The model was discretized with sub-basins based on the surface water monitoring stations as described in Golder 2019 Monitoring Report (Golder 2019). Figure 3 (below) shows a schematic of the modelled drainage system.

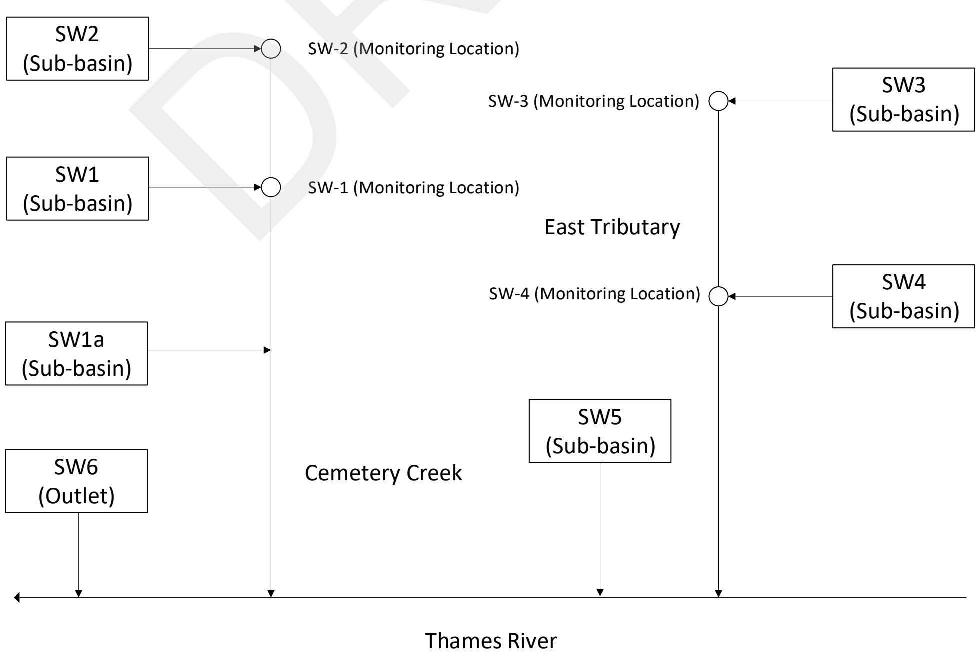

Figure 3 :Schematic of the modelled drainage system.

3.1 Model Approaches

Two implementations of the model were created to handle average flows and peak flows respectively.

- The average flow model used hourly precipitation and temperature along with daily evaporation. Losses and discharges were modelled using the soil moisture accounting method. Calibration of the water balance was achieved by adjusting soil moisture accounting parameters such as percentage of soil layer, percentage of ground water layers, maximum infiltration of layers, percentage of imperviousness, storage in soil, tension and ground water, and percolation rates.
- The peak flow model used peak rainfall event hyetographs discretized to 5-minute intervals and generated peak discharge and event flow hydrographs estimates from IDF information and the Soil Conservation Service (SCS) Curve Number (CN) method.

3.2 Model Input

Geographical data used in the models, such as drainage basin characteristics are as described in Section 2.3. The model was driven by the meteorological data at London CS:

- The average flow model used existing and future hourly timeseries (precipitation, temperature, and evapotranspiration)
- The peak flow model used hourly rainfall records for specific storm events and peak rainfall event hyetographs, based on IDF information, for the peak flow model.

3.3 Model Calibration

The average flow and peak flow models were calibrated using data collected during the surface monitoring program from November 2017 to December 2018. For details regarding the field data, please refer to the accompanying monitoring report.

The flow rate data were compared to the modelled data at the surface water monitoring stations.

- For the average flow model, soil moisture accounting parameters were calibrated to approximate the average annual flow compared to the measured values.
- For the peak flow model, SCS curve numbers were calibrated by comparing the measured and modelled peak flows resulting from two specific rainfall events measured in 2018 (April 15th-17th and November 1st-3rd).

3.3.1 Average Flow Model Calibration

The total flow volumes at each of the monitoring locations over the average flow model calibration period (November 9th, 2017 to December 12th) was compared between the measured and modelled cases as shown in Table-10. The percentage difference between the measured and modelled cases ranges between 8-13% with exception of SW1 and the Thames River (where the average flow matched to within 3.83 % and 0.74%). The lower percent difference at SW1 is a result of most differences being from the peak events which are mostly snowmelt events and the measured data was not available during some peak events due to equipment failure due to ice. On the other hand, the average flows at the Thames River match better since the catchment area of the River is orders of magnitude larger than that of the monitoring stations and the minor differences between measured and modelled data resulting from the tributary is not substantial relative to the flow of the Thames River.

Table-10: Measured and Modelled Continuous Flow Volumes for the Calibration Period

	Measured (m^3)	Modelled (m^3)	% Difference
SW1	2,770,000	2,880,000	+3.8
SW2	3,040,000	2,780,000	-8.5
SW3	628,000	567,000	-9.7
SW4	708,000	622,000	-12.1
Thames	238,220,000	236,450,000	-0.7

3.3.2 Peak Flow Model Calibration

In order to calibrate the peak flow model, peak events from the monitoring data were identified. Specifically, since the inputs to the peak flow model would be return period rainfall events, the desired calibration events should include peak flows in the measured data that were only the result of rainfall (and not responses to a mixed rainfall and snowmelt event). The peak events measured at SW1 are shown in Table-11 below; the two storm events that met the objectives (i.e. had significant rainfall during the event and above-freezing temperatures leading up to the event) and were therefore selected for calibrating the peak flow model occurred on April 15th to 17th, 2018 and November 1st to 3rd, 2018.

Table-11: Peak Flow Events Measured at SW1

Peak Flow Event	3-Day Precipitation During Event (mm)	Preceding 7-day Temperature Average before Event (Degrees Celsius)	Maximum Daily Temperature During Event (Degrees Celsius)	Peak Flow at SW1 during Event (m^3/s)
January 11-13, 2018	25.6	-10.1	+7.9	1.16
April 15-17, 2018	41.3	+1.7	+1.5	1.06
November 1-3, 2018	33.8	+5.4	+5.8	1.21
February 4-6, 2019	23.3	-11.8	+7.1	1.42
February 23-25, 2019	9.9	-6.5	+1.4	1.14
March 13-15, 2019	17.0	-5.8	+8.5	1.21

SCS Curve Numbers of 65 for the tributaries catchments (SW-1, SW-2, SW-3 and SW-4) and 70 for the Thames river watershed, were selected as optimal for matching the peak flow response from the above-mentioned rainfall events. The peak flows are presented in Table-12. The percentage difference between the measured and modelled peaks ranges between 5-60%. Priority was given to minimize the percent difference at SW-1 and the Thames River since these locations are important for the quarry and landfill impacts. The curve numbers were selected based on the November rainfall event which resulted in approximately 6% difference at both SW-1 and Thames River. Figures 4-5 show the comparison between the measured and modelled flow rates during the rainfall events.

Table-12: Measured and Modelled Peak Flow Rates for the Calibration Rainfall Events.

	April 15th to 17th, 2018			November 1st to 3rd, 2018		
	Measured (m^3/s)	Modelled (m^3/s)	Difference (%)	Measured (m^3/s)	Modelled (m^3/s)	Difference (%)
SW-1	1.061	1.005	-5.3	1.210	1.284	+6.1
SW-2	1.450	0.757	+47.8	1.047	0.892	-14.8
SW-3	0.188	0.091	-51.6	0.244	0.093	-61.9
SW-4	0.139	0.128	-7.9	0.120	0.130	+8.3
Thames	50.4	30.2	-40.1	31.3	29.4	-6.0

3.4 Model Scenarios

A total of six model scenarios were run, including 3 peak flow models and 3 average flow models:

1) Return period storms (2011-2040): The flooding conditions in the future at the end of operations were evaluated using the return period storms evaluated using the return period storms with the adjustment made for the operational period 2011 to 2040 using the IDF_CC tool and RCP 4.5.

2) Return period storms (2041-2070): The flooding conditions in the future at the end of operations were evaluated using the return period storms evaluated using the return period storms with the adjustment made for the operational period 2041 to 2070 using the IDF_CC tool and RCP 4.5.

3) Return period storms (2071-2100): The flooding conditions in the future at the end of operations were evaluated using the return period storms evaluated using the return period storms with the adjustment made for the operational period 2071 to 2100 using the IDF_CC tool and RCP 4.5.

4) Average year (2011-2040): Flow conditions for an average year in terms of precipitation in the period of record adjusted for climate change for the period of 2011 to 2040 at London CS (following WEG guidance) was evaluated using the HEC-HMS model.

5) Average year (2041-2070): Flow conditions for an average year in terms of precipitation in the period of record adjusted for climate change for the period of 2040 to 2071 at London CS (following WEG guidance) was evaluated using the HEC-HMS model.

6) Average year (2071-2100): Flow conditions for an average year in terms of precipitation in the period of record adjusted for climate change for the period of 2070 to 2100 at London CS (following WEG guidance) was evaluated using the HEC-HMS model.

3.5 Results and Discussion

Average and peak flow results from the model for the Operations and Post-Closure timelines are shown below. The results focus on three locations SW-2, SW-1a and SW-6, which are located downstream of the locations of discharge from the proposed landfill.

3.5.1 Average Flows

The results of the hydrological model, for an average year of rainfall, are presented for three periods of interest: 2011-2040, 2041-2070, 2071-2100. The average flows at SW-2, SW-1a and SW-6 are presented in Table-13. Results show increases in average annual flows at all three stations in the future as a result of increasing precipitation. The increases tend to be more pronounced during winter months, reflecting the climate change adjustments in Table-4 (which showed roughly half of the annual increase in precipitation occurring during the winter months).

Table-13: Modelled Monthly and Annual Average Flows

Average Flow (m^3/s)									
Location	SW-2			SW-1a			SW-6		
Period of interest	2011-2040	2041-2070	2071-2100	2011-2040	2041-2070	2071-2100	2011-2040	2041-2070	2071-2100
January	0.10	0.10	0.09	0.12	0.11	0.11	10.62	10.73	10.90
February	0.07	0.07	0.07	0.08	0.08	0.09	6.37	6.64	7.00
March	0.09	0.09	0.08	0.10	0.10	0.10	7.53	7.77	7.79
April	0.14	0.14	0.13	0.16	0.17	0.15	12.07	12.84	12.60
May	0.05	0.05	0.04	0.05	0.06	0.05	3.69	3.93	3.84
June	0.06	0.06	0.05	0.07	0.07	0.06	5.10	5.13	5.10
July	0.06	0.05	0.05	0.06	0.06	0.06	4.75	4.75	4.72
August	0.14	0.13	0.13	0.16	0.16	0.15	12.46	12.45	12.38
September	0.11	0.11	0.10	0.13	0.12	0.12	9.09	9.33	9.23
October	0.07	0.07	0.06	0.08	0.08	0.07	5.50	5.84	5.74
November	0.05	0.06	0.05	0.06	0.06	0.06	4.62	4.92	4.83
December	0.07	0.08	0.08	0.08	0.09	0.09	6.25	7.01	7.29
Annual	**0.08**	**0.08**	**0.08**	**0.10**	**0.10**	**0.09**	**7.34**	**7.62**	**7.62**

3.5.2 Return period storms

The peak flows corresponding to the IDF return period storms are presented in Table-14 for three periods of interest: 2011-2040, 2041-2070, and 2071-2100. The peak flows are generally consistent across the locations. The peak flows increased from 2011-2040 to 2041-2070 and decreased from 2041-2070 to 2071-2100, matching the RCP 4.5 assumption of global greenhouse gas emissions peaking in 2040 before declining in the latter part of the century.

Table-14: Modelled Peak Flows

Peak Flow (m^3/s)									
Location	SW-2			SW-1a			SW-6		
Period of interest	2011-2040	2041-2070	2071-2100	2011-2040	2041-2070	2071-2100	2011-2040	2041-2070	2071-2100
1:2-year	3.41	3.45	2.86	4.28	4.37	3.86	90.45	102.83	101.25
1:5-year	8.47	8.18	7.18	10.91	10.68	9.74	173.83	186.16	182.55
1:10-year	12.69	13.04	10.47	16.48	17.12	14.21	235.18	261.08	236.97
1:25-year	18.54	21.44	18.55	24.22	28.40	25.25	311.47	379.77	358.41
1:50-year	22.35	26.63	20.48	29.27	35.37	27.90	356.95	446.52	375.21
1:100-year	26.17	31.53	26.28	34.31	41.88	35.80	401.30	507.34	458.06

4.0 ASSUMPTIONS AND LIMITATIONS

The results presented in this technical memorandum are based on high level assumptions of the following:

- The Thames River basin is large watershed containing a complex drainage system with controlled flows such as the outflow from Pittock Dam. These controls and upstream storage were not accounted for in the peak flow models, assuming a “worst case” condition where all upstream storage reservoirs were at capacity prior to the rainfall events.
- The climate change adjustments to temperature, precipitation and IDF curves are affected by the inherent limitations of the climate change models. Projections follow the RCP 4.5 emissions scenario, which assumes worldwide greenhouse gasses emissions peak around 2040, then decline.
- For peak flows, only peak flows in response to rainfall events were evaluated. The flow measurements show that peak flows did also occur in response to combined rainfall and snowmelt events, however modelling these events would require future continuous timeseries for both precipitation and temperature, which were not part of this scope.

5.0 CLOSURE

We trust that this summary of hydrology modelling results collected to date addresses Walker's needs at this time. if you have any questions or concerns please do not hesitate to contact the undersigned.

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Signature Page

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https://golderassociates.sharepoint.com/sites/13349g/3000 surface water/4. reporting/4. hydrological modelling report/1664706-r-reva-hydrological modelling report-11jun2019.docx

FIGURES

LEGEND

- SW MONITORING STATIONS
- WATERCOURSE
- WATERBODY

DRAFT

0 500 1,000
1:22,000 Metres

NOTE(S)

1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)

1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
SOUTHWESTERN LANDFILL

TITLE
SW MONITORING STATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2019-06-11
DESIGNED	PR
PREPARED	PR
REVIEWED	CD
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
1664706	0001	0	1

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

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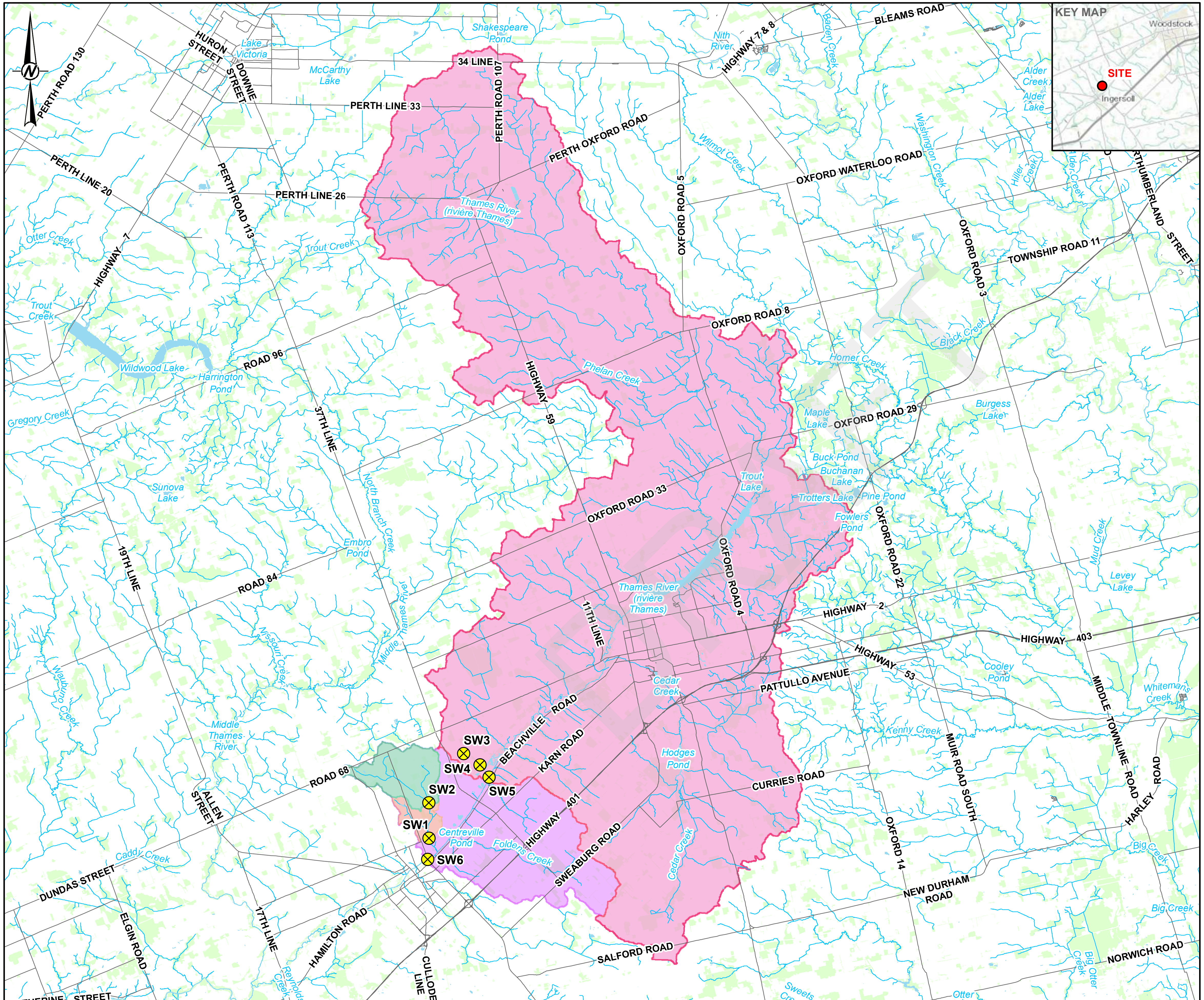


LEGEND

- SURFACE WATER MONITORING LOCATION
- ROAD
- WATERCOURSE
- WATERBODY
- WATERSHED SW1
- WATERSHED SW2
- WATERSHED SW5
- WATERSHED SW6

DRAFT

0 5 10

1:175,000 Kilometers

NOTE(S)

1. TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORTS.

REFERENCE(S)

1. BASE DATA: MNRF LIO, 2017
2. IMAGERY: MICROSOFT BING © 2017 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS
3. KEY MAP: WORLD TOPOGRAPHIC MAP, ESRI, 2017
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17

CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
SOUTHWESTERN LANDFILL

TITLE
WATERSHED LOCATIONS

CONSULTANT

GOLDER

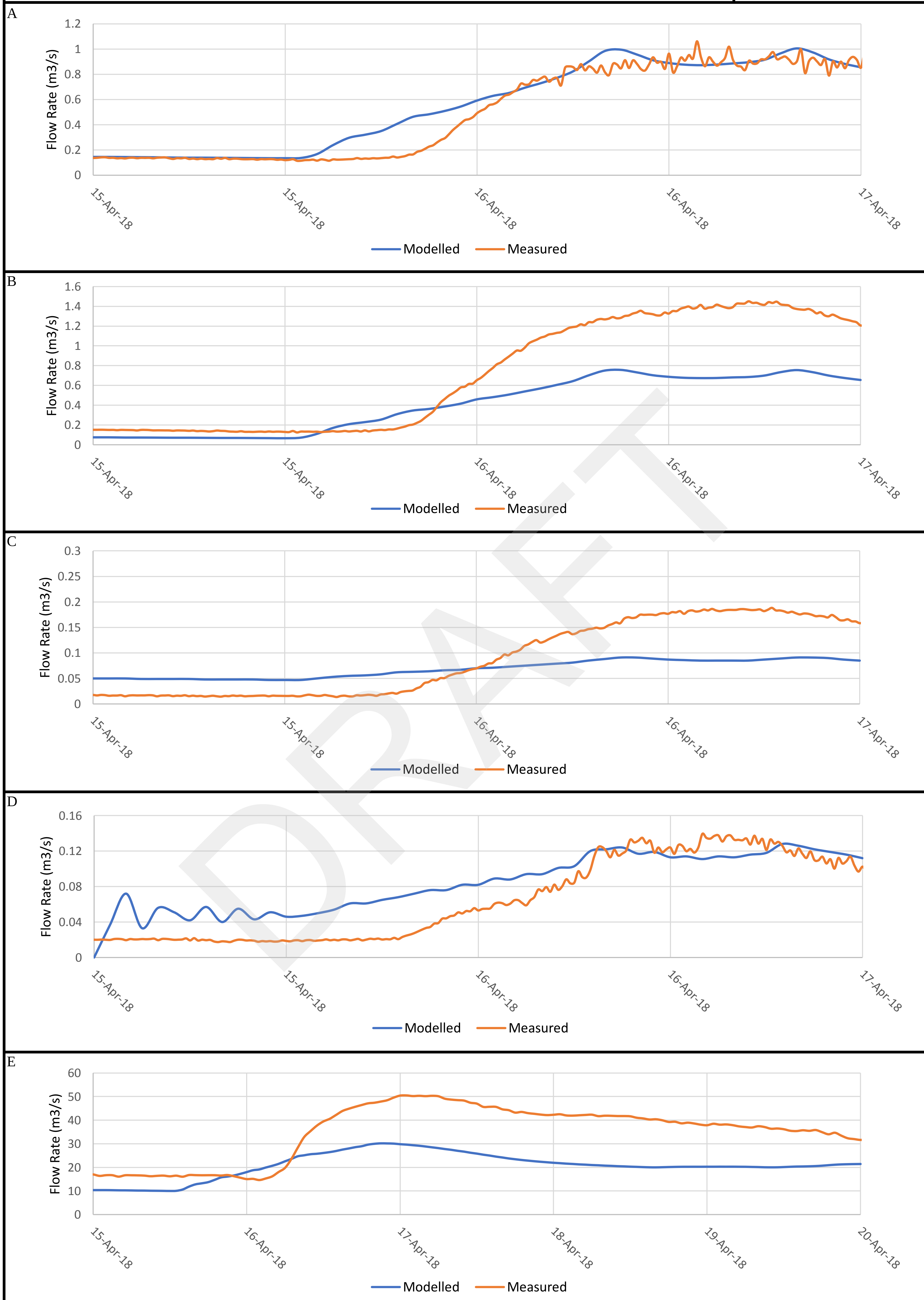
YYYY-MM-DD	2019-01-25
DESIGNED	PR
PREPARED	PR/LMM
REVIEWED	SK
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
1664706	0001	0	2

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

25mm

Comparison of Measured and Modelled Flow Rates During April Rain Fall Event DRAFT	FIGURE 4



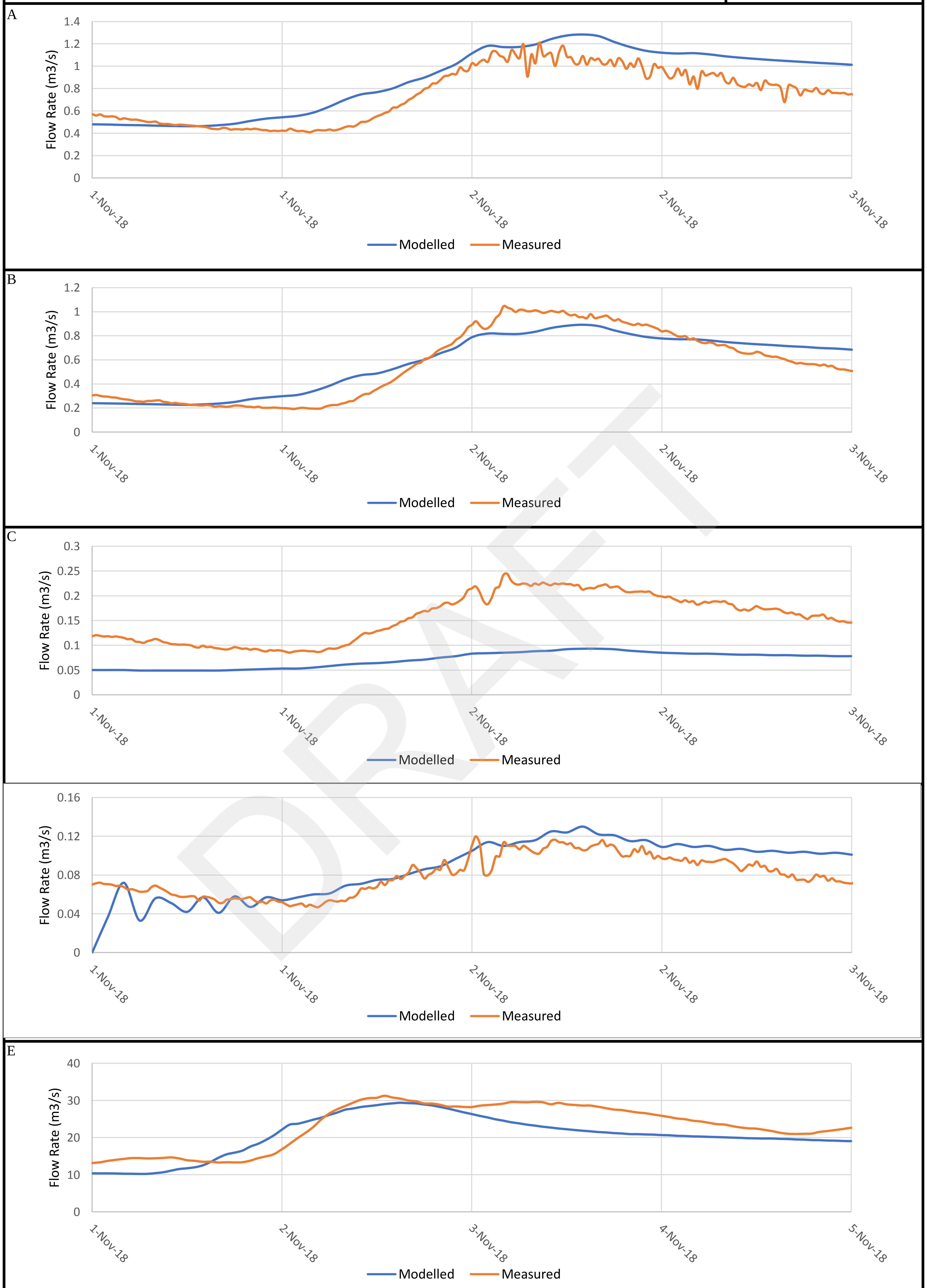
A. SW1 B. SW2 C. SW3 D. SW4 E. Thames

PROJECT: 1664706/3000
DATE: April 2019

GOLDER

DRAWN: YT
CHECK:

Comparison of Measured and Modelled Flow Rates During November Rain Fall Event DRAFT	FIGURE 5



A. SW1 B. SW2 C. SW3 D. SW4 E. Thames

PROJECT: 1664706/3000
DATE: April 2019

GOLDER

DRAWN: YT
CHECK:

APPENDIX E

Results of the Patterson-Robbins Drain Water Quality Assessment for the Walker Southwestern Landfill, Township of Zorra, Ontario

GOLDER

DRAFT

TECHNICAL MEMORANDUM

DATE June 11, 2019 **Project No.** 1664706

TO Joseph M. Tomaino, MCIP, RPP
Walker Environmental Group

CC Kevin MacKenzie

FROM Craig De Vito **EMAIL Craig_DeVito@golder.com**

DRAFT - RESULTS OF THE PATTERSON-ROBBINS DRAIN WATER QUALITY ASSESSMENT FOR THE WALKER SOUTHWESTERN LANDFILL, INGERSOLL, ONTARIO

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Walker Environmental Group (WEG) to provide a water quality assessment for the Patterson-Robbins Drain (also known as Cemetery Creek) in support of an Environmental Assessment for the "provision of future waste landfill capacity at the Carmeuse Lime (Canada) site in Oxford County for solid, non-hazardous waste generated in the Province of Ontario" (The Project). The Carmeuse Lime Quarry is located in Southern Ontario between Ingersoll and Beachville, Ontario, and is part of the Beachville operations of Carmeuse Lime (Canada) Ltd (the Site).

2.0 OBJECTIVES

The purpose of this assessment was to estimate the effects of the proposed landfill runoff and treated leachate discharge on the Patterson-Robbins Drain and the Thames River water quality under a variety of flow and climate change conditions.

3.0 BACKGROUND INFORMATION

This water quality assessment was completed based on information from other sources, including:

- Facility Characteristics Assumptions – Southwestern Landfill Environmental Assessment, Walker Environmental Group Inc., March 5, 2019;
- Flows estimated using hydrological models for the Patterson-Robbins Drain and the proposed Southwestern Landfill;
- Flow and water quality monitoring data from the Patterson-Robbins Drain and the Thames River (Golder, 2017-2018);
- Historical flow records for Thames River at the Water Survey of Canada's (WSC) Ingersoll Station (ID 02GD016);

- Weather data from Environment Canada London CS Weather Station (Climate ID 6144478). This station was selected for its length of record and proximity to the study area;
- Landuse Planning Forecast Report (MHBC, 2017); and,
- Ministry of Natural Resources and Forestry (MNRF) Climate Change Research Report 44 (MNRF, 2015).

This water quality assessment evaluates flow and potential contaminant inputs from several locations associated with the project. Figure 1, below, shows the 3 assessed mixing locations along the Patterson-Robbins Drain and the Thames River: SW1a, SW2, and SW6. The figure also outlines key flow contributors such as stormwater management (SWM) pond discharge from the proposed Southwestern Landfill and treated discharge from the leachate treatment facility.

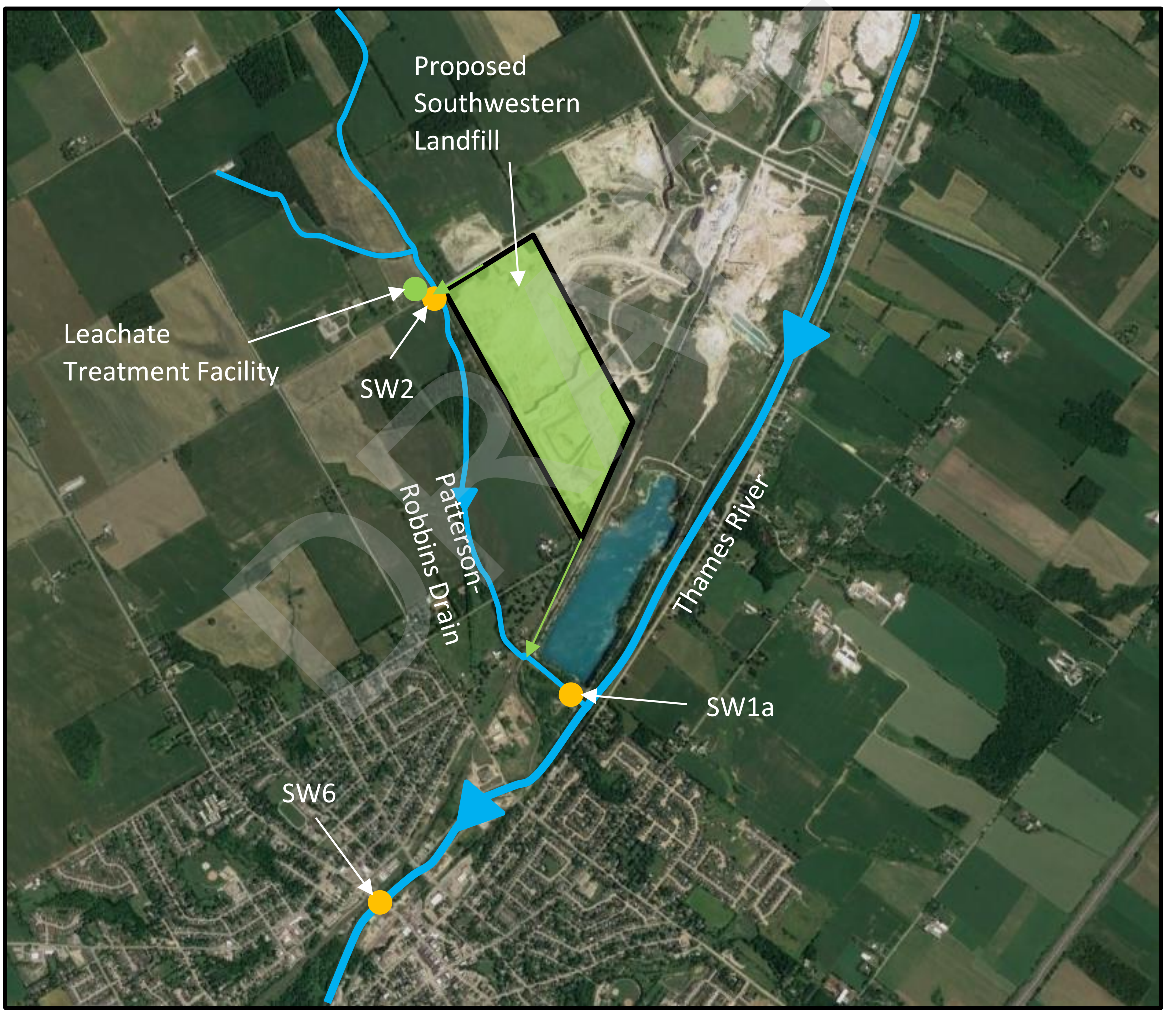


Figure 1: Water Quality Assessment Key Elements

4.0 METHODOLOGY

The following describes the methodology for estimating Patterson-Robbins Drain and Thames River flows and contaminant concentrations, and for completing the water quality assessment. There were three mixing locations analyzed in this assessment; SW1a, SW2, and SW6. These locations can be seen in Figure 1, above.

4.1 Test Cases & Flow Contributions

Figure 2, below, shows mixing locations and identifies where flow contributions were added in the analysis of the Patterson-Robbins Drain and the Thames river.

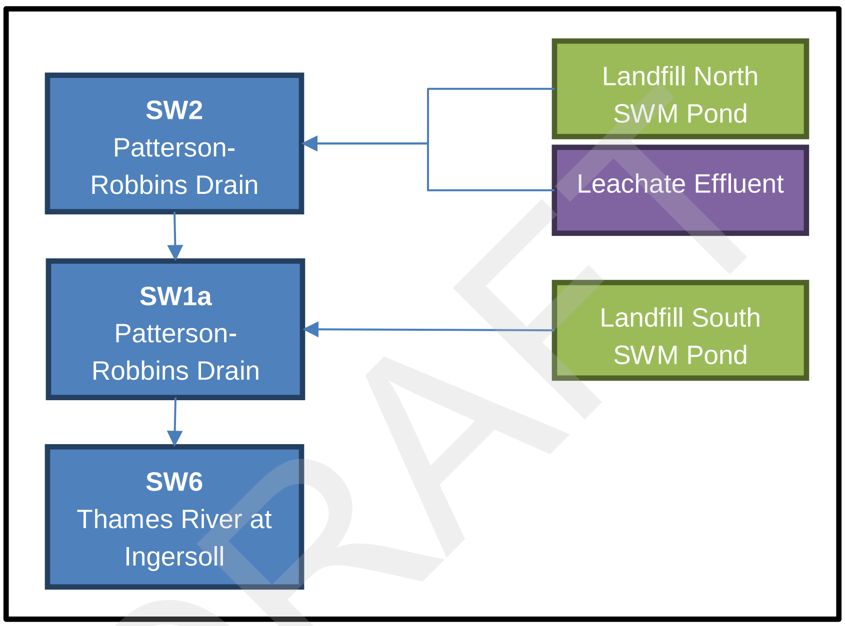


Figure 2: Flow contributions by mixing locations

For each mixing location shown above (Figure 2) in blue, flows were estimated for a variety of flow scenarios, as presented in Table 1, below. Section 4.2 describes how flows were estimated for each flow condition and climate change scenario.

Table 1: A visualization of the 9 overall flow conditions, combining 3 climate change scenarios and 3 flow conditions

Climate Change Scenario	Flow Condition Estimation Method		
	$7Q_{20}$ (low flow)	Average Flow	2 yr Return Period Flow (High Flow)
Operational (2011-2040)	Distribution analysis of continuous modelling/ historical flow data	continuous modelling for average year (Patterson-Robbins Drain) and site water balance (Landfill)	Event Modelling
Post-Operational 1 (2041-2070)			
Post-Operational 2 (2071-2100)			

4.2 Water Quality Criteria Determination

A variety of guidelines and regulations were consulted to determining water quality criteria, many of these criteria were deemed not applicable for the purposes of examining quantitative surface water quality in this case. See the table below for a summary of guideline/regulation selection for surface water quality purposes.

Table 2: Proposed Indicators of Water Quality

EA Criteria	Proposed Indicator criteria	Summary of Indicator (as it relates to the Surface Water Assessment)
Effects due to contact with contaminated groundwater and surface water	Water Management – Policies, Guidelines and Provincial Water Quality Objectives" (PWQO) (Guideline B-1-3).	The Provincial Water Quality Objectives (PWQOs) are constituent concentrations intended to provide a baseline for assessing the quality of surface water in Ontario, and are often used as the baseline for assessing waste effluent requirements. The PWQOs provide quantitative objectives for many of the constituents examined in this EA, and were used as the primary guideline in this assessment.
	Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment (CCME).	CCME guidelines are a set of quantitative guidelines set for water, tissue, sediment, and soil under a variety of uses. It was developed to provide an integrated set of guidelines which could be used by water, soil, and biology task groups as well as other external stakeholders. For the purposes of this assessment it was determined that CCME guidelines for aquatic life and agricultural use would be considered for water quality evaluation.
	Safe Drinking Water Act, 2002, Ontario Regulation 169/03 Ontario Drinking Water Quality Standards (ODWQS).	The Safe Drinking Water Act and the related Regulation 169/03 standards govern installation, licensing, operation, and standards enforcement of private and public drinking water supply systems. Surface water in the Patterson-Robbins Drain Complex is not used for drinking water supply and the site is not within wellhead or intake protection zones according to the Source Water Protection Atlas (Ministry of Environment, Conservation, and Parks), however a comparison between the water quality assessment results and these standards have been completed provide general insight into water quality.
	Sections 53 and 34 of the OWRA	Under section 34 no more than 50,000 L of water per day may be taken by any means except in accordance with a permit issued under section 34.1. Discharge from the leachate treatment plant and stormwater management ponds are considered sewage and will need to be approved under section 53. Approvals under the OWRA will be addressed at a later stage of approval.

4.3 Patterson-Robbins Drain and Thames River Flow Estimates

4.3.1 Leachate Effluent flow rates

A leachate treatment system will be implemented to treat leachate from the proposed landfill. Leachate flow rates for the operational period (2011-2040), post-operational period 1 (2041-2070) and post-operational period 2 (2071-2100) were obtained from the model developed by Golder in the hydrogeological assessment and are presented in Table 3. For the operational period, a partially open cover and leachate collection within the active landfill was assumed. For the post-operational periods, the leachate flow represents the expected infiltration through the landfill cover under post-operational conditions. It is not expected that leachate flow rates would fluctuate significantly under low and high flow events, so the flow rate was assumed constant for each scenario.

Table 3: Leachate Flow Rates

Scenarios	Leachate Flow Rate (m^3/d)
"2011-2040" Climate Change	499
"2041-2070" Climate Change	556
"2071-2100+" Climate Change	573

4.3.2 $7Q_{20}$ Flow Rates (Low Flow Condition)

Using flow outputs from the Patterson-Robbins Drain Hydrological model, annual lows for 7-day average flow were identified. The $7Q_{20}$ flow for both SW1a and SW2 were estimated to be 0 m^3/s using a 3 Parameter Log-normal analysis of the yearly 7-day low flow averages. Continuous modelling of the watershed shows that the Patterson-Robbins Drain has periods of low to zero flow during low rainfall periods. This is consistent with observations by field staff.

For location SW6, historical flow data from the WSC Ingersoll station (02GD016) were used as the base data for $7Q_{20}$ analysis, which was completed using the same methodology as stations SW1a and SW2, described above. This $7Q_{20}$ flow was used as the operational period low flow (2011-2040), and was scaled to the remaining climate change scenarios (2041-2070, 2071-2100) using the same ratio as the change between average climate change scenario flows, described below. It is understood that the Thames River in this area is regulated by a series of dams upstream of the monitoring location at SW6, however the dams have been in place over the entire record examined for the $7Q_{20}$ analysis, and there is no reason to believe that dams upstream of this station will be decommissioned at any point in the near future. Therefore, the $7Q_{20}$ assessment is still deemed to be representative of flows at SW6.

$7Q_{20}$ flow rates from the SWM ponds were assumed to be zero (0 m^3/s) for all climate change scenarios, as the pond is not expected to discharge during dry periods.

4.3.3 Average Flow Condition

Average flow rates in the Patterson-Robbins Drain were estimated using the Patterson-Robbins Drain Hydrological Model and weather data from the Environment Canada London CS Station. Using the available data, an average year (2016) was selected, which was representative of the annual average amount of total rainfall and temperature over the total available data range (2004-2018). Adjustment of the rainfall and temperature data to the three climate change scenarios was completed using scenario RCP 4.5 (MNRF, 2015) in the IDF CC tool (University of Western Ontario, 2018). Using the adjusted weather data, the average flow at each mixing location was estimated from hydrologic model outputs.

Average Pond flows, under the three climate change scenarios, were determined using a Thornthwaite water balance approach. Using the climate change adjusted rainfall and temperature data, surplus was calculated using the Thornthwaite evapotranspiration method. Annual estimated infiltration through the landfill cover is shown in Table 4, below. The remaining runoff was used to estimate the average flow of each pond over the average year.

Table 4: Estimated Annual Infiltration Through Landfill Cover

Scenarios	Annual Infiltration Through Landfill Cover (mm/a)
"2011-2040" Climate Change	307
"2041-2070" Climate Change	343
"2071-2100+" Climate Change	352

4.3.4 2yr Return Period Flow Rates (High Flow Condition)

Event modelling was completed on the Patterson-Robbins Drain Hydrological Model and the Southwestern Landfill hydrological model to obtain 1:2-year return period flows at the three mixing locations. The hyetograph for the 2-yr 24 hr Chicago event was developed based on Environment Canada IDF information for the London CC station (Climate ID 6144478) and was adjusted to the three climate change scenarios using the IDF CC tool as described in section 4.2.3.

4.4 Water Quality Estimates

4.4.1 Leachate Treatment Effluent Water Quality

Effluent quality estimates were not provided for this leachate treatment system in the Facility Characteristics Assumptions (March 5, 2019), and therefore it has been assumed that the concentration for each water quality parameter at the point of discharge is equal to the Provincial Water Quality Objective (PWQO) for parameters with a PWQO guideline. This assumption regarding the effluent water quality is consistent with the objectives of the leachate treatment plant design.

4.4.2 Patterson-Robbins Drain Baseline Water Quality

Water quality sampling data taken from the Patterson-Robbins Drain at SW1 and SW2 were used to develop background water quality assumptions. Water quality samples taken between fall 2017 to January 2019 were analysed for the water quality parameters shown in Attachment A, and the average concentration of each test parameter, over the sampling period, was used as the baseline for Patterson-Robbins Drain concentrations.

4.4.3 SWM Pond Effluent Water Quality

The effluent water quality from the SWM pond is estimated based on monitored data from the SWM pond at the Walker South Landfill located near Niagara Falls. The Walker South Landfill cover is of similar design and will be operated in a similar way to the proposed Walker Southwest Landfill. Maximum and minimum concentrations were evaluated based on the available sampling data. This quality assumption provides a reasonable estimate as to the constituents and quality of SWM pond discharge from a similar land use. While it is expected that the Walker South Landfill monitoring data is generally representative of the expected SWM pond discharge quality, it is also likely that there are site-specific and regional trends in soil and runoff quality which may not be representative of the proposed landfill site conditions and cover materials.

4.5 Water Quality Assessment

Potential contaminant loads were estimated from flows and concentrations from each contributing source. The loads were subsequently combined in a conservative mass balance calculation to estimate mixed concentrations at each mixing location. Mixing was evaluated for each climate change scenario and flow condition. See Table 1 to review the climate change scenarios and flow conditions. Water Quality was assessed against PWQO, CCME, and ODWQS guidelines to determine exceedances at each mixing location.

4.5.1 Conservative Tracer Reduction

A Tracer reduction assessment was completed, wherein a theoretical “tracer” chemical was set to discharge from the leachate treatment system in order to trace the downstream effects at SW1a, SW2, and SW6. Flow rates for each scenario were the same flow rates used in the assessment. It was assumed that background levels and inputs from other contributors were 0 mg/L. This assessment was completed for all flow conditions and climate change scenarios.

4.6 Key Assumptions

Key assumptions made in the process of this Assessment are summarised below:

- Complete mixing was assumed at each mixing point. In reality, a short mixing zone may be present; however, based on the small cross section of the Patterson-Robbins Drain, any mixing zone is expected to be small.
- Monitored background contaminant concentrations in the Patterson-Robbins Drain and the Thames River were applied to all flow conditions and climate change scenarios. It is possible that background concentrations in the Patterson-Robbins Drain, the Thames River, and the Stormwater Management ponds from the landfill could fluctuate in high and low flow events, since the monitoring program included very few (if any) high low flow water quality events.
- Effluent water quality data from the SWM ponds were assumed to be the same as that of the Walker South SWM pond (near Niagara Falls). Discharge from the SWM ponds would likely have similar constituent concentrations to the Walker South landfill, however there is potential for site-specific and regional soil and water quality differences which would differ in the proposed landfill site.
- Leachate effluent concentrations were assumed to be at the PWQO guideline concentration. For constituents without a PWQO guideline, no concentration was assigned to the constituent; however, we have assumed that the leachate treatment plant will treat all significant contaminants to an appropriate level prior to discharge. The exact effluent concentration limits will be confirmed during the permitting state of the project and will be enforced by the Environmental Compliance Approval (ECA).

5.0 RESULTS

5.1 Flow Estimates

The Flow estimates at each mixing location, under the 9 total flow scenarios are included in Table 5, below.

It is important to note that the flows in Table 5, below, are separated into the three different flow contributors:

- Drain/River flow represents the baseline flow in the Patterson-Robbins Drain or the Thames river (depending on mixing location). These flows were determined based on the Patterson-Robbins Drain Watershed Hydrologic Model outputs for $7Q_{20}$, Average flows, and 1:2-year peak flows.
- SWM Pond flows represents the discharge from the two SWM ponds combined. These flows were determined using the Southwestern Landfill Hydrological Model. The flows were combined in this table for the purposes of showing overall flow contributions. In the water quality analysis, flow contributions from the ponds have been considered at their respective discharge locations.
  - Peak flows during 1:2-year events are at the time of peak discharge in overall Patterson-Robbins Drain flow, not the peak discharge in the ponds.
- Leachate flow is the outflow from the leachate treatment system during operational scenario from 2011 to 2040 (499 m^3/d), post-operational scenario from 2041 to 2070 (556 m^3/d) and post-operational from 2070 to 2100 (573 m^3/d).

Table 5: Flow rates for all flow scenarios at each mixing location

Climate Change Scenario	Flow Contributor	Flow Conditions								
		7Q20 (m^3/s)			Average Flows (m^3/s)			1:2-year Flows (m^3/s)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
2011-2040	Drain/River	0	0	0.684	0.097	0.084	7.348	4.279	3.413	90.4
	Ponds	-	-	-	0.004	0.002	0.004	0.678	0.259	0.094
	Leachate	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
	TOTAL	***0.006***	***0.006***	***0.689***	***0.107***	***0.091***	***7.359***	***4.963***	***3.677***	***90.5***
2041-2070	Drain/River	0	0	0.710	0.097	0.083	7.618	4.371	3.445	102.8
	Ponds	-	-	-	0.004	0.002	0.004	0.713	0.274	0.097
	Leachate	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064
	TOTAL	***0.006***	***0.006***	***0.716***	***0.107***	***0.091***	***7.629***	***5.091***	***3.725***	***102.9***
2071-2100	Drain/River	0	0	0.711	0.092	0.078	7.623	3.863	2.860	101.2
	Ponds	-	-	-	0.003	0.001	0.003	0.754	0.284	0.095
	Leachate	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
	TOTAL	***0.007***	***0.007***	***0.717***	***0.102***	***0.086***	***7.633***	***4.623***	***3.150***	***101.3***

5.2 Water Quality Assessment

5.2.1 Baseline Conditions (Do Nothing Scenario)

Constituent concentrations in the Patterson-Robbins Drain and the Thames River under the “Do Nothing Scenario” are assumed to remain the same as the baseline constituent levels for both watercourses. Change in constituent concentrations are not necessarily related to climate change conditions in the future, and land development in the Patterson-Robbins Drain watershed is predicted to be minimal (MHBC, 2017). Baseline constituent concentrations for the Patterson-Robbins Drain and the Thames River are shown in Table A of Attachment A. Under baseline conditions, there are estimated exceedances for 3 constituents (Fluoride, Nitrite, Total Phosphorus) at 1 or more of the monitoring locations.

5.2.2 Landfill Water Quality Assessment with Climate Change Scenarios

Complete water quality assessment tables for all constituents under all flow conditions have been included in Attachment A.

Multiple constituents listed in the original field sampling program returned no detection (ND) in all samples, and therefore no baseline concentrations were applied within the Patterson-Robbins Drain or the Thames River. Additionally, many of the same constituents did not have PWQO guidelines, and therefore had no assumed concentration in the leachate effluent for the purposes of this assessment; however, we have assumed that the leachate treatment plant will treat all significant constituents to an appropriate level prior to discharge. Accordingly, for many constituents there were no baseline concentrations in either watercourse, as well as no assumed effluent concentrations in either the ponds or the leachate. This resulted in a no detection (“ND”) estimate in the analysis. For constituents with no baseline concentration that did have estimated leachate and/or pond concentrations, the baseline concentration was assumed to be zero (0) mg/L. For multiple constituents, the Reportable Detection Limit (RDL) was significantly higher than the examined guidelines, and therefore assuming the RDL, or 50% of RDL, would have resulted in exceedances in background levels where potentially no exceedance existed.

All exceedances in this assessment were due to one of 3 causes. Firstly, elevated baseline concentrations in either the Patterson-Robbins Drain or the Thames River caused some exceedances of the examined guidelines. Secondly, elevated effluent concentrations from SWM ponds exceeded guidelines for some constituents. SWM pond effluent concentrations were assumed based on monitoring data from the Walker South Landfill in Niagara. It is assumed that these monitoring results are largely representative of the potential SWM pond effluent from the proposed Southwest Landfill, however it is likely that there are site specific characteristics that may affect effluent quality from the site. Additionally, exceedances of some guidelines to the magnitudes represented in the South Landfill monitoring data are not uncommon for background levels in Southern Ontario. Lastly, the leachate flows caused exceedances in cases where the leachate concentration (set to PWQO guidelines) was higher than either the CCME or the ODWQS guidelines.

When the water quality assessment was completed with the potential discharges from the SWM ponds and the leachate treatment facility, an additional 22 constituents with exceedances were identified at one or more of the mixing locations. Details on the nature of each exceedance is summarized below in Table 6. For detailed results of the water quality assessment estimates, see Attachment A.

Table 6: Summary of Potential PWQO/CCME Exceedances From the Water Quality Assessment

Parameter	Flow Conditions with Exceedances			Mixing Locations with Exceedances			Exceeding Guideline			Constituent Source above Guideline[1]		
	Low Flow	Avg Flow	High Flow	SW1a	SW2	SW6	PWQO	CCME	ODWQS	Leachate	SWM Pond	Drain/River Background
1,1-Dichloroethylene	X			X	X				X	X		
1,2-Dichlorobenzene	X			X	X			X		X		
1,2-Dichloroethane	X	X		X	X			X	X	X		
2,4,6-Trichlorophenol	X			X	X				X	X		
Benzene	X	X		X	X				X	X		
Dicamba	X	X	X	X	X	X		X	X	X		
Fluoride (Fl^-)	X	X	X	X	X	X		X				X
Methylene Chloride (Dichloromethane)	X			X	X			X	X	X		
Nitrite (N)	X	X	X	X	X	X		X			X	X
N-Nitrosodimethylamine	X	X	X	X	X	X			X			
Simazine	X	X		X	X			X				
Tetrachloroethylene	X			X	X				X	X		
Total Arsenic (As)			X	X			X	X			X	
Total Boron (B)			X	X			X				X	
Total Cadmium (Cd)	X	X	X	X	X		X	X			X	

Parameter	Flow Conditions with Exceedances			Mixing Locations with Exceedances			Exceeding Guideline			Constituent Source above Guideline[1]		
	Low Flow	Avg Flow	High Flow	SW1a	SW2	SW6	PWQO	CCME	ODWQS	Leachate	SWM Pond	Drain/River Background
Total Chromium (Cr)	X	X	X	X	X		X	X			X	
Total Cyanide (CN)	X	X		X	X			X		X		
Total Selenium (Se)				X	X			X	X	X	X	
Total Silver (Ag)		X	X	X	X		X	X			X	
Trichloroethylene	X			X	X				X	X		
Vinyl Chloride	X	X	X	X	X	X			X	X		
Total Phosphorus	X	X	X	X	X	X	X	X			X	X
Iron (Pb)		X	X	X	X		X	X			X	
Copper (Cu)	X		X	X	X			X		X	X	
Zinc (Zi)	X	X	X	X	X		X	X		X	X	

1. This column represents the flow contributor which has constituent concentrations higher than the PWQO or CCME guideline, and is causing the overall concentration of the watercourse to be higher than the guideline.

5.2.3 Conservative Tracer Reduction

An assessment was completed to examine how the concentration of leachate parameters change as they flow downstream to SW1a, SW2, an SW6. A theoretical “tracer” concentration of 100% was set as the discharge concentration from the leachate treatment plant, near SW2, and was carried through to SW1a and SW6 assuming that the leachate treatment plant was the only source of the tracer in the system. This was carried out for all three climate change scenarios and all three flow conditions. Table 7, below, shows the estimated remaining tracer percentage under each scenario.

Table 7: Concentration Assessment of a Conservative "Tracer" Chemical Discharged from the Leachate Treatment Facility at 100%

Climate Change Scenario	Percent of initial concentration remaining								
	Low Flow (7Q20)			Average Flow			High Flow		
	SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Operational (2011-2040)	100%	100%	0.84%	5.41%	6.33%	0.079%	0.21%	0.21%	0.007%
Post-Operational 1 (2041-2070)	100%	100%	0.90%	6.04%	7.10%	0.085%	0.22%	0.22%	0.007%
Post-Operational 2 (2071-2100)	100%	100%	0.93%	6.53%	7.71%	0.087%	0.26%	0.27%	0.007%

6.0 SUMMARY

The following is a summary of the key findings in this report:

- Under a “do nothing” or baseline scenario, it is expected that constituent concentrations in the Patterson-Robbins Drain would remain similar to background water quality sampling results taken by Golder from 2017-2019.
- Potential guideline exceedances were estimated for 25 constituent parameters within the Patterson-Robbins Drain and the Thames River.
- Potential guideline exceedances in the Patterson-Robbins Drain and the Thames River were caused by high existing background concentrations in the watercourses, high constituent concentrations in SWM pond effluent, or Leachate Effluent.

- SWM pond effluent concentration estimates are based on effluent water quality from the Walker South SWM pond in Niagara Falls. It is assumed that these monitoring results are largely representative of the potential SWM pond effluent from the proposed Southwest Landfill, however it is likely that for some constituents, there are site specific characteristics that may affect effluent quality. Additionally, exceedances of some guidelines to the magnitudes represented in the South Landfill monitoring data are not uncommon for Southern Ontario.
- Water quality will be monitored after construction according to the conditions of the ECA. Should any water quality issues be identified as a result of monitoring after construction, they will be reported to the MECP under the conditions of the ECA. Any required corrective actions will be taken.
- Leachate concentrations were assumed to be equal to PWQO guidelines. In cases where the PWQO guideline was larger than CCME or ODWQS guidelines, leachate was a driver of exceedances in the CCME and/or ODWQS guideline. In further design stages, the leachate treatment plant will be designed to meet all standards set out in the conditions of the ECA.

- A conservative tracer reduction analysis was completed which showed significant reduction in leachate concentration at all mixing locations under average and high flow conditions, as well as significant reductions at SW6 under low-flow conditions.

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Attachments: Attachment A – Water Quality Assessment Results

https://golderassociates.sharepoint.com/sites/13349g/3000 surface water/4. reporting/5. water quality memo/water quality assessment (mixing memo)/1664706-tm-revb-water quality assessment-11jun2019.docx

ATTACHMENT A

Water Quality Assessment Results

Table A: Contaminant Concentrations by Contributing Source and Regulatory Guidelines														
Constituent	RDL	Units	Patterson-Robbins Drain / Thames River Baseline Concentrations[1,9]			SWM Ponds - Estimated Effluent Concentrations[2]		Treated Leachate Concentrations[3]	1.PWQO Limit	CCME Guideline				6. ODWQ Standards
			SW1a	SW2	SW6	Min	Max			2. Aquatic (Long Term)	3. Aquatic (Short Term)	4. Agriculture (Irrigation)	5. Agriculture (Livestock)	
1,1-Dichloroethylene	0.2	ug/L	ND	ND	ND	0.28	0.6	40	40					14
1,2,3,4,6,7,8-Hepta CDD	9.52	pg/L	ND	ND	ND									
1,2,3,4,6,7,8-Hepta CDF	9.52	pg/L	ND	ND	ND									
1,2,3,4,7,8,9-Hepta CDF	9.52	pg/L	ND	ND	ND									
1,2,3,4,7,8-Hexa CDD	9.52	pg/L	ND	ND	ND									
1,2,3,4,7,8-Hexa CDF	9.52	pg/L	ND	ND	ND									
1,2,3,6,7,8-Hexa CDD	9.52	pg/L	ND	ND	ND									
1,2,3,6,7,8-Hexa CDF	9.52	pg/L	ND	ND	ND									
1,2,3,7,8,9-Hexa CDD	9.52	pg/L	ND	ND	ND									
1,2,3,7,8,9-Hexa CDF	9.52	pg/L	ND	ND	ND									
1,2,3,7,8-Penta CDD	9.52	pg/L	ND	ND	ND									
1,2,3,7,8-Penta CDF	9.52	pg/L	ND	ND	ND									
1,2-Dichlorobenzene	0.5	ug/L	ND	ND	ND	0.14	0.5	2.5	2.5	0.7				200
1,2-Dichloroethane	0.5	ug/L	ND	ND	ND	0.1	0.5	100	100	100			5	5
1,4-Dichlorobenzene	0.5	ug/L	ND	ND	ND	0.17	0.5	4	4	26				5
2,3,4,6,7,8-Hexa CDF	9.52	pg/L	ND	ND	ND									
2,3,4,6-Tetrachlorophenol	0.5	ug/L	ND	ND	ND			1	1	1				100
2,3,4,7,8-Penta CDF	9.52	pg/L	ND	ND	ND									
2,3,7,8-Tetra CDD	9.52	pg/L	ND	ND	ND									
2,3,7,8-Tetra CDF	9.52	pg/L	ND	ND	ND									
2,4,5-T	1	ug/L	ND	ND	ND									
2,4,5-TP (Silvex)	0.5	ug/L	ND	ND	ND									
2,4,5-Trichlorophenol	0.5	ug/L	ND	ND	ND			18	18	18				
2,4,6-Trichlorophenol	0.5	ug/L	ND	ND	ND			18	18	18				5
2,4-D	1	ug/L	ND	ND	ND					4			100	100
2,4-Dichlorophenol	0.25	ug/L	ND	ND	ND			0.2	0.2	0.2				900
2,4-Dinitrotoluene	0.5	ug/L	ND	ND	ND			4	4					
a-Chlordane	0.005	ug/L	ND	ND	ND			0.06	0.06					
Aldicarb	5	ug/L	ND	ND	ND					1		54.9	11	
Aldrin	0.005	ug/L	ND	ND	ND									
Aldrin + Dieldrin	0.005	ug/L	ND	ND	ND			0.001	0.001					
Atrazine	0.5	ug/L	ND	ND	ND					1.8		10	5	5
Atrazine + Desethyl-atrazine	1	ug/L	ND	ND	ND									
Bendiocarb	2	ug/L	ND	ND	ND									
Benzene	0.2	ug/L	ND	ND	ND			100	100	370				1
Benzo(a)pyrene	0.009	ug/L	ND	ND	ND					0.015				0.01
Bromoxynil	0.5	ug/L	ND	ND	ND					5		0.33	11	5
Carbaryl	5	ug/L	ND	ND	ND			0.2	0.2	0.2	3.3		1100	90
Carbofuran	5	ug/L	ND	ND	ND					1.8			45	90
Carbon Tetrachloride	0.2	ug/L	ND	ND	ND	0.13	0.5			13.3			5	2
Chlordane (Total)	0.005	ug/L	ND	ND	ND			0.06	0.06					
Chlorobenzene	0.2	ug/L	ND	ND	ND	0.2	0.5	15	15					
Chloroform	0.2	ug/L	ND	ND	ND	0.1	0.6			1.8			100	
Chlorpyrifos (Dursban)	1	ug/L	ND	ND	ND			0.001	0.001	0.002			24	90
Cyanazine (Bladex)	1	ug/L	ND	ND	ND					2		0.5	10	
DDT+ Metabolites	0.005	ug/L	ND	ND	ND			0.003	0.003					
Des-ethyl atrazine	0.5	ug/L	ND	ND	ND									
Diazinon	1	ug/L	ND	ND	ND			0.08	0.08					20
Dicamba	1	ug/L	ND	ND	ND			200	200	10		0.006	122	120
Diclofop-methyl	0.9	ug/L	ND	ND	ND					6.1		0.18	9	9
Dieldrin	0.005	ug/L	ND	ND	ND			0.001	0.001					
Dimethoate	2.5	ug/L	ND	ND	ND					6.2			3	20
Dinoseb	1	ug/L	ND	ND	ND					0.05		16	150	
Diquat	7	ug/L	ND	ND	ND			0.5	0.5					70
Dissolved Chloride (Cl-)	1	mg/L	41.571	48.571	98.571	2.5	320			120	600			
Diuron	10	ug/L	ND	ND	ND			1.6	1.6					150
Endrin	0.005	ug/L	ND	ND	ND			0.002	0.002					
Ethyl Parathion	1	ug/L	ND	ND	ND									
Fluoride (F-)	0.1	mg/L	0.14	0.15	0.19					0.12		1		1.5
g-Chlordane	0.005	ug/L	ND	ND	ND									
Glyphosate	10	ug/L	ND	ND	ND					800	27000		280	280
Guthion (Azinphos-methyl)	2	ug/L	ND	ND	ND			0.005	0.005					
Heptachlor	0.005	ug/L	ND	ND	ND			0.001	0.001					
Heptachlor + Heptachlor epoxide	0.005	ug/L	ND	ND	ND			0.001	0.001					
Heptachlor epoxide	0.005	ug/L	ND	ND	ND			0.001	0.001					
Hexachlorobenzene	0.005	ug/L	ND	ND	ND			0.0065	0.0065				0.52	
Hexachlorobutadiene	0.009	ug/L	ND	ND	ND			0.009	0.009	1.3				
Hexachloroethane	0.01	ug/L	ND	ND	ND			1	1					
Lindane	0.003	ug/L	ND	ND	ND			0.01	0.01	0.01			4	
m/p-Cresol	0.5	ug/L	ND	ND	ND			1	1					
Malathion	5	ug/L	ND	ND	ND			0.1	0.1					190
Mercury (Hg)	1E-04	mg/L	ND	ND	ND			0.0002	0.0002	0.026			3	0.001
Methoxychlor	0.01	ug/L	ND	ND	ND			0.04	0.04					
Methyl Ethyl Ketone (2-Butanone)	10	ug/L	ND	ND	ND			400	400					
Methyl parathion	1	ug/L	ND	ND	ND									
Methylene Chloride(Dichloromethane)	2	ug/L	ND	ND	ND	0.3	4	100	100	98.1			50	50
Metolachlor	0.5	ug/L	ND	ND	ND			3	3	7.8		28	50	50
Metribuzin (Sencor)	5	ug/L	ND	ND	ND					1		0.5	80	80
Nitrate (N)	0.1	mg/L	10.03	10.21	6.87	2.5	6.41			13				10
Nitrate + Nitrite (N)	0.1	mg/L	10.04	10.23	7.08	2.7	7.41						100	
Nitrite (N)	0.01	mg/L	0.02	0.02	0.20	0.2	1			0.06			10	1
Nitrobenzene	0.5	ug/L	ND	ND	ND			0.02	0.02					
N-Nitrosodimethylamine	2	ng/L	ND	ND	ND			15000	15000					9
NTA	0.05	mg/L	ND	ND	ND									0.4
o,p-DDT	0.005	ug/L	ND	ND	ND									
o,p-DDT + p,p-DDT	0.005	ug/L	ND	ND	ND									
o-Cresol	0.5	ug/L	ND	ND	ND									
Octa CDD	95.2	pg/L	1.41	1.43	6.77									

Table A: Contaminant Concentrations by Contributing Source and Regulatory Guidelines

Constituent	RDL	Units	Patterson-Robbins Drain / Thames River Baseline Concentrations[1,9]			SWM Ponds - Estimated Effluent Concentrations[2]		Treated Leachate Concentrations[3]	1.PWQO Limit	CCME Guideline				6. ODWQ Standards
			SW1a	SW2	SW6	Min	Max			2. Aquatic (Long Term)	3. Aquatic (Short Term)	4. Agriculture (Irrigation)	5. Agriculture (Livestock)	
Octa CDF	95.2	pg/L	ND	ND	1.5									
p,p-DDT	0.005	ug/L	ND	ND	ND									
Paraquat	1	ug/L	ND	ND	ND									10
Pentachlorophenol	0.5	ug/L	ND	ND	ND					0.5				60
Phorate	0.5	ug/L	ND	ND	ND									2
Picloram	5	ug/L	ND	ND	ND					29			190	190
Simazine	1	ug/L	ND	ND	ND			10	10	10		0.5	10	10
Temephos	10	ug/L	ND	ND	ND									
Terbufos	0.5	ug/L	ND	ND	ND									1
Tetrachloroethylene	0.2	ug/L	ND	ND	ND	0.5	0.11	50	50	110				10
Toluene	0.2	ug/L	ND	ND	ND			0.8	0.8	2			24	60
Total Arsenic (As)	1	ug/L	ND	ND	ND	5.7	50	5	5	5		100	25	10
Total Barium (Ba)	2	ug/L	34	38	44	10	110							1000
Total Boron (B)	10	ug/L	15	16	26	200	1400	200	200	1500	29000		5000	5000
Total Cadmium (Cd)[5]	0.1	ug/L	ND	ND	ND	0.7	10	0.5	0.5	0.09	1	5.1	80	5
Total Chromium (Cr)[6]	5	ug/L	ND	ND	ND	13	50	1	1	1		8	50	50
Total Cyanide (CN)	0.005	mg/L	ND	ND	ND			5	5	5				0.2
Total Hepta CDD	9.52	pg/L	ND	ND	ND									
Total Hepta CDF	9.52	pg/L	ND	ND	ND									
Total Hexa CDD	9.52	pg/L	ND	ND	ND									
Total Hexa CDF	9.52	pg/L	ND	ND	ND									
Total Lead (Pb)[7]	0.5	ug/L	ND	1.71	1.5	6.5	20	5	5			200	100	10
Total PCB	0.05	ug/L	ND	ND	ND			0.001	0.001					3
Total Penta CDD	9.52	pg/L	ND	ND	ND									
Total Penta CDF	9.52	pg/L	ND	ND	ND									
Total Selenium (Se)	2	ug/L	ND	ND	ND	4	100	100	100	1		20	50	50
Total Silver (Ag)	0.1	ug/L	ND	ND	ND	0.21	10	0.1	0.1	0.25				
Total Suspended Solids	1	mg/L	2.5	5.25	13.4	10	1220							
Total Tetra CDD	9.52	pg/L	ND	ND	ND									
Total Tetra CDF	9.52	pg/L	ND	ND	ND									
Total Uranium (U)	0.1	ug/L	2.1	2.9	0.96			5	5	15	33	10	200	20
Toxaphene	0.2	ug/L	ND	ND	ND			0.008	0.008					
Triallate	1	ug/L	ND	ND	ND					0.24			230	230
Trichloroethylene	0.2	ug/L	ND	ND	ND	0.19	0.5	20	20	21			50	5
Vinyl Chloride	0.2	ug/L	ND	ND	ND	0.2	0.5	600	600					1
Total phosphorus	0.004	mg/L	0.009	0.011	0.033	0.06	0.51	0.02	0.02	0.035				
Aluminum	See note 4	mg/L				0.01	0.22							
Iron	See note 4	mg/L				0.415	16	0.3	0.3	0.3		5		
Copper (Cu)	See note 4	mg/L				0.01	0.03	0.005	0.005	0.002		0.2	0.5	
Nickel (Ni)	See note 4	mg/L				0.017	0.025	0.025	0.025	0.025		0.2	1	
Zinc (Zn)	See note 4	mg/L				0.05	0.4	0.02	0.02	0.007	37	1	50	

Notes:

1. Baseline concentrations developed from an average of sampling data over late 2017-early 2019. If sampling returned No Detection (ND), it was assumed that there was no constituent concentration in the watercourse
2. Effluent concentrations assumed based on monitoring concentrations from the Walker South Landfill, located near Niagara
3. Leachate concentrations assumed to be PWQO limits where possible
4. No Reliable Detection Limit (RDL) due to no golder sampling for specified contaminant. These contaminants only had
5. Based on an assumed >100 mg/L $CaCO_3$ hardness
6. 1 ug/L limit for hexavalent, 8.9 ug/L for trivalent
7. Varies with Alkalinity: <20 mg/L Ak: 1 ug/L; 30-80 mg/L Ak: 3ug/L ; >80 mg/L Ak: 5 ug/L. Assumed >80 mg/L Alkalinity
8. Source limits represent the following: 1. PWQO; 2. CCME Long-Term Aquatic Life; 3. CCME Short-Term Aquatic Life, 4. Agricultural (irrigation) 5. Agricultural (Livestock)
9. For the purposes of this assessment, a ND has been assumed to be 0 mg/L concentration

Table B: Estimated Mixing Concentrations, Low Flow Conditions (7Q20)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
1,1-Dichloroethylene	ug/L	40.000	40.000	0.335	40.000	40.000	0.360	40.000	40.000	0.370
1,2,3,4,6,7,8-Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	2.500	2.500	0.021	2.500	2.500	0.022	2.500	2.500	0.023
1,2-Dichloroethane	ug/L	**100.00**	**100.00**	0.84	**100.00**	**100.00**	0.90	**100.00**	**100.00**	0.93
1,4-Dichlorobenzene	ug/L	4.000	4.000	0.033	4.000	4.000	0.036	4.000	4.000	0.037
2,3,4,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ug/L	1.000	1.000	0.008	1.000	1.000	0.009	1.000	1.000	0.009
2,3,4,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/L	18.000	18.000	0.151	18.000	18.000	0.162	18.000	18.000	0.167
2,4,6-Trichlorophenol	ug/L	18.000	18.000	0.151	18.000	18.000	0.162	18.000	18.000	0.167
2,4-D	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	0.200	0.200	0.002	0.200	0.200	0.002	0.200	0.200	0.002
2,4-Dinitrotoluene	ug/L	4.000	4.000	0.033	4.000	4.000	0.036	4.000	4.000	0.037
a-Chlordane	ug/L	0.060	0.060	0.001	0.060	0.060	0.001	0.060	0.060	0.001
Aldicarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin + Dieldrin	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine + Desethyl-atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bendiocarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/L	100.000	100.000	0.837	100.000	100.000	0.900	100.000	100.000	0.926
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoxynil	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	ug/L	0.200	0.200	0.002	0.200	0.200	0.002	0.200	0.200	0.002
Carbofuran	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane (Total)	ug/L	0.060	0.060	0.001	0.060	0.060	0.001	0.060	0.060	0.001
Chlorobenzene	ug/L	15.000	15.000	0.126	15.000	15.000	0.135	15.000	15.000	0.139
Chloroform	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Cyanazine (Bladex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT+ Metabolites	ug/L	0.003	0.003	0.000	0.003	0.003	0.000	0.003	0.003	0.000
Des-ethyl atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ug/L	0.080	0.080	0.001	0.080	0.080	0.001	0.080	0.080	0.001
Dicamba	ug/L	**200.000**	**200.000**	1.674	**200.000**	**200.000**	1.800	**200.000**	**200.000**	1.851
Diclofop-methyl	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Dimethoate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diquat	ug/L	0.500	0.500	0.004	0.500	0.500	0.004	0.500	0.500	0.005
Dissolved Chloride (Cl-)	mg/L	ND	ND	97.7	ND	ND	97.7	ND	ND	97.7
Diuron	ug/L	1.600	1.600	0.013	1.600	1.600	0.014	1.600	1.600	0.015
Endrin	ug/L	0.002	0.002	0.000	0.002	0.002	0.000	0.002	0.002	0.000
Ethyl Parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	mg/L	ND	ND	0.188	ND	ND	0.188	ND	ND	0.188
g-Chlordane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Guthion (Azinphos-methyl)	ug/L	0.005	0.005	0.000	0.005	0.005	0.000	0.005	0.005	0.000
Heptachlor	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Heptachlor + Heptachlor epoxide	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Heptachlor epoxide	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Hexachlorobenzene	ug/L	0.007	0.007	0.000	0.007	0.007	0.000	0.007	0.007	0.000
Hexachlorobutadiene	ug/L	0.009	0.009	0.000	0.009	0.009	0.000	0.009	0.009	0.000
Hexachloroethane	ug/L	1.000	1.000	0.008	1.000	1.000	0.009	1.000	1.000	0.009
Lindane	ug/L	0.010	0.010	0.000	0.010	0.010	0.000	0.010	0.010	0.000
m/p-Cresol	ug/L	1.000	1.000	0.008	1.000	1.000	0.009	1.000	1.000	0.009
Malathion	ug/L	0.100	0.100	0.001	0.100	0.100	0.001	0.100	0.100	0.001
Mercury (Hg)	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methoxychlor	ug/L	0.040	0.040	0.000	0.040	0.040	0.000	0.040	0.040	0.000
Methyl Ethyl Ketone (2-Butanone)	ug/L	400.000	400.000	3.348	400.000	400.000	3.600	400.000	400.000	3.703
Methyl parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride(Dichloromethane)	ug/L	**100.000**	**100.000**	0.837	**100.000**	**100.000**	0.900	**100.000**	**100.000**	0.926
Metolachlor	ug/L	3.000	3.000	0.025	3.000	3.000	0.027	3.000	3.000	0.028
Metribuzin (Sencor)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	ND	ND	6.812	ND	ND	6.808	ND	ND	6.806
Nitrate + Nitrite (N)	mg/L	ND	ND	7.016	ND	ND	7.011	ND	ND	7.010
Nitrite (N)	mg/L	ND	ND	0.202	ND	ND	0.202	ND	ND	0.202
Nitrobenzene	ug/L	0.020	0.020	0.000	0.020	0.020	0.000	0.020	0.020	0.000
N-Nitrosodimethylamine	ng/L	15000	15000	126	15000	15000	135	15000	15000	139
NTA	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT + p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Cresol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octa CDD	pg/L	ND	ND	6.713	ND	ND	6.709	ND	ND	6.707

Table B: Estimated Mixing Concentrations, Low Flow Conditions (7Q20)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Octa CDF	pg/L	ND	ND	1.487	ND	ND	1.487	ND	ND	1.486
p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Paraquat	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	ug/L	**10.000**	**10.000**	0.084	**10.000**	**10.000**	0.090	**10.000**	**10.000**	0.093
Temephos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Terbufos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ug/L	**50.000**	**50.000**	0.419	**50.000**	**50.000**	0.450	**50.000**	**50.000**	0.463
Toluene	ug/L	0.800	0.800	0.007	0.800	0.800	0.007	0.800	0.800	0.007
Total Arsenic (As)	ug/L	5.000	5.000	0.042	5.000	5.000	0.045	5.000	5.000	0.046
Total Barium (Ba)	ug/L	ND	ND	43.6	ND	ND	43.6	ND	ND	43.6
Total Boron (B)	ug/L	200.0	200.0	27.5	200.0	200.0	27.6	200.0	200.0	27.6
Total Cadmium (Cd)	ug/L	**0.500**	**0.500**	0.004	**0.500**	**0.500**	0.004	**0.500**	**0.500**	0.005
Total Chromium (Cr)	ug/L	1.000	1.000	0.008	1.000	1.000	0.009	1.000	1.000	0.009
Total Cyanide (CN)	mg/L	**5.000**	**5.000**	0.042	**5.000**	**5.000**	0.045	**5.000**	**5.000**	0.046
Total Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Lead (Pb)	ug/L	5.000	5.000	1.529	5.000	5.000	1.531	5.000	5.000	1.532
Total PCB	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Total Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium (Se)	ug/L	**100.00**	**100.00**	0.84	**100.00**	**100.00**	0.90	**100.00**	**100.00**	0.93
Total Silver (Ag)	ug/L	0.100	0.100	0.001	0.100	0.100	0.001	0.100	0.100	0.001
Total Suspended Solids	mg/L	ND	ND	13.288	ND	ND	13.279	ND	ND	13.276
Total Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Uranium (U)	ug/L	5.000	5.000	0.994	5.000	5.000	0.996	5.000	5.000	0.997
Toxaphene	ug/L	0.008	0.008	0.000	0.008	0.008	0.000	0.008	0.008	0.000
Triallate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	**20.000**	**20.000**	0.167	**20.000**	**20.000**	0.180	**20.000**	**20.000**	0.185
Vinyl Chloride	ug/L	**600.00**	**600.00**	**5.02**	**600.00**	**600.00**	**5.40**	**600.00**	**600.00**	**5.55**
Total phosphorus	mg/L	0.020	0.020	**0.033**	0.020	0.020	**0.033**	0.020	0.020	**0.033**
Aluminum	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/L	0.300	0.300	0.003	0.300	0.300	0.003	0.300	0.300	0.003
Copper (Cu)	mg/L	**0.005**	**0.005**	0.000	**0.005**	**0.005**	0.000	**0.005**	**0.005**	0.000
Nickel (Ni)	mg/L	0.025	0.025	0.000	0.025	0.025	0.000	0.025	0.025	0.000
Zinc (Zn)	mg/L	**0.020**	**0.020**	0.000	**0.020**	**0.020**	0.000	**0.020**	**0.020**	0.000

Exceedance of PWQO

Exceedance of CCME

Exceedance of ODWQS

Exceedance of more than one water quality guideline

Table C1: Estimated Mixing Concentrations, Average Flow Conditions (Minimum Pond Effluent Concentrations)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
1,1-Dichloroethylene	ug/L	2.162	2.533	0.032	2.417	2.839	0.034	2.610	3.084	0.035
1,2,3,4,6,7,8-Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	0.140	0.161	0.002	0.155	0.180	0.002	0.167	0.195	0.002
1,2-Dichloroethane	ug/L	**5.38**	**6.32**	0.08	**6.02**	**7.09**	0.08	**6.50**	**7.70**	0.09
1,4-Dichlorobenzene	ug/L	0.222	0.256	0.003	0.247	0.286	0.003	0.266	0.311	0.004
2,3,4,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
2,3,4,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/L	0.968	1.137	0.014	1.083	1.275	0.015	1.170	1.386	0.016
2,4,6-Trichlorophenol	ug/L	0.968	1.137	0.014	1.083	1.275	0.015	1.170	1.386	0.016
2,4-D	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	0.011	0.013	0.000	0.012	0.014	0.000	0.013	0.015	0.000
2,4-Dinitrotoluene	ug/L	0.215	0.253	0.003	0.241	0.283	0.003	0.260	0.308	0.003
a-Chlordane	ug/L	0.003	0.004	0.000	0.004	0.004	0.000	0.004	0.005	0.000
Aldicarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin + Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine + Desethyl-atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bendiocarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/L	**5.376**	**6.318**	0.078	**6.018**	**7.085**	0.084	**6.502**	**7.700**	0.087
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoxynil	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	ug/L	0.011	0.013	0.000	0.012	0.014	0.000	0.013	0.015	0.000
Carbofuran	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ug/L	0.005	0.003	0.000	0.005	0.002	0.000	0.004	0.002	0.000
Chlordane (Total)	ug/L	0.003	0.004	0.000	0.004	0.004	0.000	0.004	0.005	0.000
Chlorobenzene	ug/L	0.815	0.952	0.012	0.910	1.066	0.013	0.982	1.158	0.013
Chloroform	ug/L	0.004	0.002	0.000	0.004	0.002	0.000	0.003	0.002	0.000
Chlorpyrifos (Dursban)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cyanazine (Bladex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT+ Metabolites	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Des-ethyl atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ug/L	0.004	0.005	0.000	0.005	0.006	0.000	0.005	0.006	0.000
Dicamba	ug/L	**10.752**	**12.636**	**0.157**	**12.036**	**14.169**	**0.169**	**13.003**	**15.400**	**0.174**
Diclofop-methyl	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dimethoate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diquat	ug/L	0.027	0.032	0.000	0.030	0.035	0.000	0.033	0.038	0.000
Dissolved Chloride (Cl-)	mg/L	37.7	44.6	98.4	37.7	44.3	98.4	37.6	44.1	98.4
Diuron	ug/L	0.086	0.101	0.001	0.096	0.113	0.001	0.104	0.123	0.001
Endrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ethyl Parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	mg/L	**0.127**	**0.138**	**0.190**	**0.127**	**0.137**	**0.190**	**0.126**	**0.136**	**0.190**
g-Chlordane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Guthion (Azinphos-methyl)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor + Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Hexachlorobutadiene	ug/L	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Hexachloroethane	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
Lindane	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
m/p-Cresol	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
Malathion	ug/L	0.005	0.006	0.000	0.006	0.007	0.000	0.007	0.008	0.000
Mercury (Hg)	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methoxychlor	ug/L	0.002	0.003	0.000	0.002	0.003	0.000	0.003	0.003	0.000
Methyl Ethyl Ketone (2-Butanone)	ug/L	21.503	25.272	0.314	24.072	28.339	0.338	26.006	30.799	0.347
Methyl parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride(Dichloromethane)	ug/L	5.388	6.324	0.079	6.029	7.090	0.085	6.512	7.705	0.087
Metolachlor	ug/L	0.161	0.190	0.002	0.181	0.213	0.003	0.195	0.231	0.003
Metribuzin (Sencor)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	9.171	9.415	6.862	9.152	9.355	6.862	9.120	9.298	6.862
Nitrate + Nitrite (N)	mg/L	9.188	9.432	7.067	9.168	9.373	7.067	9.135	9.315	7.067
Nitrite (N)	mg/L	0.023	0.020	**0.204**	0.022	0.020	**0.204**	0.022	0.020	**0.204**
Nitrobenzene	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.000
N-Nitrosodimethylamine	ng/L	**806**	**948**	**12**	**903**	**1063**	**13**	**975**	**1155**	**13**
NTA	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT + p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Cresol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octa CDD	pg/L	1.275	1.312	6.761	1.275	1.304	6.761	1.271	1.297	6.761

Table C1: Estimated Mixing Concentrations, Average Flow Conditions (Minimum Pond Effluent Concentrations)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Octa CDF	pg/L	ND	ND	1.498	ND	ND	1.498	ND	ND	1.498
p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Paraquat	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	ug/L	**0.538**	**0.632**	0.008	**0.602**	**0.708**	0.008	**0.650**	**0.770**	0.009
Temephos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Terbufos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ug/L	2.709	3.169	0.040	3.027	3.551	0.042	3.268	3.858	0.044
Toluene	ug/L	0.043	0.051	0.001	0.048	0.057	0.001	0.052	0.062	0.001
Total Arsenic (As)	ug/L	0.508	0.427	0.007	0.505	0.451	0.007	0.517	0.478	0.007
Total Barium (Ba)	ug/L	31.2	35.1	43.9	31.1	34.8	43.9	31.0	34.6	43.9
Total Boron (B)	ug/L	32.7	31.2	26.2	32.8	32.2	26.2	33.3	33.2	26.2
Total Cadmium (Cd)	ug/L	0.056	0.045	0.001	0.055	0.047	0.001	0.056	0.050	0.001
Total Chromium (Cr)	ug/L	0.599	0.317	0.009	0.526	0.292	0.007	0.503	0.289	0.007
Total Cyanide (CN)	mg/L	**0.269**	**0.316**	0.004	**0.301**	**0.354**	0.004	**0.325**	**0.385**	0.004
Total Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Lead (Pb)	ug/L	0.541	2.011	1.506	0.534	2.025	1.505	0.544	2.041	1.505
Total PCB	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium (Se)	ug/L	**5.54**	**6.40**	0.08	**6.16**	**7.15**	0.09	**6.64**	**7.76**	0.09
Total Silver (Ag)	ug/L	0.014	0.010	0.000	0.014	0.011	0.000	0.014	0.011	0.000
Total Suspended Solids	mg/L	2.680	5.011	13.387	2.618	4.959	13.387	2.590	4.923	13.387
Total Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Uranium (U)	ug/L	2.168	2.976	0.963	2.199	2.999	0.963	2.218	3.014	0.963
Toxaphene	ug/L	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.001	0.000
Triallate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	1.083	1.267	0.016	1.210	1.420	0.017	1.307	1.543	0.017
Vinyl Chloride	ug/L	**32.26**	**37.91**	0.47	**36.11**	**42.51**	0.51	**39.02**	**46.20**	0.52
Total phosphorus	mg/L	0.012	0.013	**0.033**	0.011	0.012	**0.033**	0.011	0.012	**0.033**
Aluminum	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Iron	mg/L	0.034	0.027	0.000	0.033	0.028	0.000	0.033	0.030	0.000
Copper (Cu)	mg/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)	mg/L	0.002	0.002	0.000	0.002	0.002	0.000	0.002	0.002	0.000
Zinc (Zn)	mg/L	0.003	0.002	0.000	0.003	0.002	0.000	0.003	0.002	0.000

Exceedance of PWQO

Exceedance of CCME

Exceedance of ODWQS

Exceedance of more than one water quality guideline

Table C2: Estimated Mixing Concentrations, Average Flow Conditions (Maximum Pond Effluent Concentrations)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
1,1-Dichloroethylene	ug/L	2.175	2.539	0.032	2.429	2.844	0.034	2.621	3.090	0.035
1,2,3,4,6,7,8-Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	0.155	0.168	0.002	0.168	0.186	0.002	0.179	0.201	0.002
1,2-Dichloroethane	ug/L	**5.40**	**6.33**	0.08	**6.04**	**7.09**	0.08	**6.52**	**7.71**	0.09
1,4-Dichlorobenzene	ug/L	0.236	0.262	0.003	0.259	0.292	0.004	0.277	0.316	0.004
2,3,4,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
2,3,4,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/L	0.968	1.137	0.014	1.083	1.275	0.015	1.170	1.386	0.016
2,4,6-Trichlorophenol	ug/L	0.968	1.137	0.014	1.083	1.275	0.015	1.170	1.386	0.016
2,4-D	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	0.011	0.013	0.000	0.012	0.014	0.000	0.013	0.015	0.000
2,4-Dinitrotoluene	ug/L	0.215	0.253	0.003	0.241	0.283	0.003	0.260	0.308	0.003
a-Chlordane	ug/L	0.003	0.004	0.000	0.004	0.004	0.000	0.004	0.005	0.000
Aldicarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin + Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine + Desethyl-atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bendiocarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/L	**5.376**	**6.318**	0.078	**6.018**	**7.085**	0.084	**6.502**	**7.700**	0.087
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoxynil	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	ug/L	0.011	0.013	0.000	0.012	0.014	0.000	0.013	0.015	0.000
Carbofuran	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ug/L	0.021	0.010	0.000	0.018	0.009	0.000	0.017	0.008	0.000
Chlordane (Total)	ug/L	0.003	0.004	0.000	0.004	0.004	0.000	0.004	0.005	0.000
Chlorobenzene	ug/L	0.827	0.957	0.012	0.921	1.071	0.013	0.992	1.163	0.013
Chloroform	ug/L	0.025	0.012	0.000	0.021	0.010	0.000	0.020	0.010	0.000
Chlorpyrifos (Dursban)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cyanazine (Bladex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT+ Metabolites	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Des-ethyl atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ug/L	0.004	0.005	0.000	0.005	0.006	0.000	0.005	0.006	0.000
Dicamba	ug/L	**10.752**	**12.636**	**0.157**	**12.036**	**14.169**	**0.169**	**13.003**	**15.400**	**0.174**
Diclofop-methyl	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dimethoate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diquat	ug/L	0.027	0.032	0.000	0.030	0.035	0.000	0.033	0.038	0.000
Dissolved Chloride (Cl-)	mg/L	51.0	50.8	98.6	49.0	49.7	98.6	48.3	49.3	98.6
Diuron	ug/L	0.086	0.101	0.001	0.096	0.113	0.001	0.104	0.123	0.001
Endrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ethyl Parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	mg/L	**0.127**	**0.138**	**0.190**	**0.127**	**0.137**	**0.190**	**0.126**	**0.136**	**0.190**
g-Chlordane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Guthion (Azinphos-methyl)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor + Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Hexachlorobutadiene	ug/L	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Hexachloroethane	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
Lindane	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
m/p-Cresol	ug/L	0.054	0.063	0.001	0.060	0.071	0.001	0.065	0.077	0.001
Malathion	ug/L	0.005	0.006	0.000	0.006	0.007	0.000	0.007	0.008	0.000
Mercury (Hg)	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methoxychlor	ug/L	0.002	0.003	0.000	0.002	0.003	0.000	0.003	0.003	0.000
Methyl Ethyl Ketone (2-Butanone)	ug/L	21.503	25.272	0.314	24.072	28.339	0.338	26.006	30.799	0.347
Methyl parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride(Dichloromethane)	ug/L	5.543	6.396	0.081	6.161	7.153	0.086	6.636	7.765	0.089
Metolachlor	ug/L	0.161	0.190	0.002	0.181	0.213	0.003	0.195	0.231	0.003
Metribuzin (Sencor)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	9.335	9.491	6.864	9.292	9.422	6.864	9.251	9.362	6.864
Nitrate + Nitrite (N)	mg/L	9.386	9.524	7.070	9.337	9.453	7.069	9.294	9.392	7.069
Nitrite (N)	mg/L	0.057	0.036	**0.204**	0.051	0.033	**0.204**	0.049	0.033	**0.204**
Nitrobenzene	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.000
N-Nitrosodimethylamine	ng/L	**806**	**948**	**12**	**903**	**1063**	**13**	**975**	**1155**	**13**
NTA	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT + p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Cresol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octa CDD	pg/L	1.275	1.312	6.761	1.275	1.304	6.761	1.271	1.297	6.761

Table C2: Estimated Mixing Concentrations, Average Flow Conditions (Maximum Pond Effluent Concentrations)										
Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Octa CDF	pg/L	ND	ND	1.498	ND	ND	1.498	ND	ND	1.498
p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Paraquat	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	ug/L	**0.538**	**0.632**	0.008	**0.602**	**0.708**	0.008	**0.650**	**0.770**	0.009
Temephos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Terbufos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ug/L	2.693	3.161	0.039	3.013	3.544	0.042	3.255	3.852	0.043
Toluene	ug/L	0.043	0.051	0.001	0.048	0.057	0.001	0.052	0.062	0.001
Total Arsenic (As)	ug/L	2.364	1.291	0.034	2.092	1.205	0.029	2.010	1.199	0.027
Total Barium (Ba)	ug/L	35.4	37.0	44.0	34.7	36.5	44.0	34.4	36.2	44.0
Total Boron (B)	ug/L	83.0	54.6	27.0	75.8	52.6	26.8	73.7	52.7	26.8
Total Cadmium (Cd)	ug/L	**0.446**	**0.227**	0.007	**0.388**	**0.206**	0.005	**0.369**	**0.201**	0.005
Total Chromium (Cr)	ug/L	**2.149**	**1.039**	0.031	**1.851**	0.922	0.026	**1.750**	0.891	0.023
Total Cyanide (CN)	mg/L	**0.269**	**0.316**	0.004	**0.301**	**0.354**	0.004	**0.325**	**0.385**	0.004
Total Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Lead (Pb)	ug/L	1.107	2.275	1.514	1.017	2.254	1.512	0.999	2.261	1.511
Total PCB	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium (Se)	ug/L	**9.57**	**8.27**	0.14	**9.60**	**8.79**	0.13	**9.87**	**9.33**	0.13
Total Silver (Ag)	ug/L	**0.424**	**0.201**	0.006	**0.364**	**0.177**	0.005	**0.343**	**0.171**	0.005
Total Suspended Solids	mg/L	53.385	28.618	14.127	45.968	25.553	13.995	43.362	24.626	13.932
Total Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Uranium (U)	ug/L	2.168	2.976	0.963	2.199	2.999	0.963	2.218	3.014	0.963
Toxaphene	ug/L	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.001	0.000
Triallate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	1.096	1.273	0.016	1.222	1.425	0.017	1.317	1.548	0.018
Vinyl Chloride	ug/L	**32.28**	**37.92**	0.47	**36.13**	**42.52**	0.51	**39.03**	**46.21**	0.52
Total phosphorus	mg/L	**0.031**	**0.021**	**0.033**	**0.028**	**0.020**	**0.033**	**0.027**	0.020	**0.033**
Aluminum	mg/L	0.009	0.004	0.000	0.008	0.004	0.000	0.007	0.004	0.000
Iron	mg/L	**0.687**	**0.331**	0.010	**0.591**	0.294	0.008	**0.559**	0.284	0.007
Copper (Cu)	mg/L	0.002	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)	mg/L	0.002	0.002	0.000	0.002	0.002	0.000	0.002	0.002	0.000
Zinc (Zn)	mg/L	**0.018**	**0.009**	0.000	**0.016**	**0.008**	0.000	**0.015**	**0.008**	0.000

Exceedance of PWQO

Exceedance of CCME

Exceedance of ODWQS

Exceedance of more than one water quality guideline

Table D1: Estimated Mixing Concentrations, High Flow Conditions (2 yr event) (Minimum Pond Effluent Concentrations)										
Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
1,1-Dichloroethylene	ug/L	0.085	0.082	0.003	0.090	0.090	0.003	0.103	0.109	0.003
1,2,3,4,6,7,8-Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	0.022	0.014	0.000	0.023	0.015	0.000	0.026	0.018	0.000
1,2-Dichloroethane	ug/L	0.13	0.16	0.01	0.14	0.18	0.01	0.16	0.22	0.01
1,4-Dichlorobenzene	ug/L	0.028	0.018	0.000	0.029	0.019	0.000	0.033	0.024	0.000
2,3,4,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
2,3,4,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/L	0.021	0.028	0.001	0.023	0.031	0.001	0.026	0.038	0.001
2,4,6-Trichlorophenol	ug/L	0.021	0.028	0.001	0.023	0.031	0.001	0.026	0.038	0.001
2,4-D	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2,4-Dinitrotoluene	ug/L	0.005	0.006	0.000	0.005	0.007	0.000	0.006	0.008	0.000
a-Chlordane	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aldicarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin + Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine + Desethyl-atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bendiocarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/L	0.116	0.157	0.006	0.126	0.173	0.006	0.143	0.210	0.007
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoxynil	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Carbofuran	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ug/L	0.018	0.009	0.000	0.018	0.010	0.000	0.021	0.012	0.000
Chlordane (Total)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chlorobenzene	ug/L	0.045	0.038	0.001	0.047	0.041	0.001	0.054	0.050	0.001
Chloroform	ug/L	0.014	0.007	0.000	0.014	0.007	0.000	0.016	0.009	0.000
Chlorpyrifos (Dursban)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cyanazine (Bladex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT+ Metabolites	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Des-ethyl atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dicamba	ug/L	0.233	0.314	0.013	0.253	0.346	0.013	0.287	0.421	0.013
Diclofop-methyl	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dimethoate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diquat	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Dissolved Chloride (Cl-)	mg/L	36.2	45.3	98.5	36.0	45.1	98.5	35.1	44.3	98.5
Diuron	ug/L	0.002	0.003	0.000	0.002	0.003	0.000	0.002	0.003	0.000
Endrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ethyl Parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	mg/L	0.121	0.139	0.190	0.120	0.139	0.190	0.117	0.136	0.190
g-Chlordane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Guthion (Azinphos-methyl)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor + Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobutadiene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachloroethane	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
Lindane	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
m/p-Cresol	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
Malathion	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mercury (Hg)	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methoxychlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methyl Ethyl Ketone (2-Butanone)	ug/L	0.465	0.628	0.025	0.506	0.691	0.025	0.573	0.841	0.026
Methyl parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride(Dichloromethane)	ug/L	0.157	0.178	0.007	0.168	0.195	0.007	0.192	0.237	0.007
Metolachlor	ug/L	0.003	0.005	0.000	0.004	0.005	0.000	0.004	0.006	0.000
Metribuzin (Sencor)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	8.985	9.652	6.865	8.958	9.626	6.865	8.784	9.494	6.865
Nitrate + Nitrite (N)	mg/L	9.021	9.680	7.070	8.994	9.654	7.070	8.825	9.526	7.070
Nitrite (N)	mg/L	0.042	0.031	0.204	0.042	0.031	0.204	0.046	0.034	0.204
Nitrobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N-Nitrosodimethylamine	ng/L	17	24	1	19	26	1	22	32	1
NTA	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT + p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Cresol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octa CDD	pg/L	1.216	1.327	6.763	1.211	1.322	6.763	1.178	1.298	6.763

Table D1: Estimated Mixing Concentrations, High Flow Conditions (2 yr event) (Minimum Pond Effluent Concentrations)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Octa CDF	pg/L	ND	ND	1.498	ND	ND	1.498	ND	ND	1.498
p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Paraquat	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	ug/L	0.012	0.016	0.001	0.013	0.017	0.001	0.014	0.021	0.001
Temephos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Terbufos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ug/L	0.126	0.114	0.004	0.133	0.123	0.004	0.153	0.150	0.004
Toluene	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.000
Total Arsenic (As)	ug/L	0.785	0.409	0.006	0.805	0.428	0.006	0.936	0.524	0.006
Total Barium (Ba)	ug/L	30.7	36.0	44.0	30.6	35.9	44.0	30.0	35.4	44.0
Total Boron (B)	ug/L	40.5	29.2	26.2	41.2	29.8	26.2	45.4	33.0	26.2
Total Cadmium (Cd)	ug/L	**0.096**	0.050	0.001	**0.099**	0.052	0.001	**0.115**	0.064	0.001
Total Chromium (Cr)	ug/L	**1.777**	0.916	0.014	**1.823**	0.957	0.012	**2.120**	**1.173**	0.012
Total Cyanide (CN)	mg/L	0.006	0.008	0.000	0.006	0.009	0.000	0.007	0.011	0.000
Total Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Lead (Pb)	ug/L	0.894	2.052	1.505	0.917	2.068	1.505	1.067	2.148	1.505
Total PCB	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium (Se)	ug/L	0.66	0.44	0.01	0.69	0.47	0.01	0.80	0.57	0.01
Total Silver (Ag)	ug/L	0.029	0.015	0.000	0.030	0.016	0.000	0.034	0.019	0.000
Total Suspended Solids	mg/L	3.522	5.576	13.396	3.548	5.590	13.396	3.719	5.667	13.396
Total Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Uranium (U)	ug/L	1.816	2.699	0.959	1.809	2.690	0.959	1.762	2.643	0.959
Toxaphene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Triallate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	0.049	0.045	0.001	0.052	0.049	0.001	0.060	0.059	0.001
Vinyl Chloride	ug/L	0.73	0.96	0.04	0.79	**1.05**	0.04	0.89	**1.28**	0.04
Total phosphorus	mg/L	0.016	0.014	**0.033**	0.016	0.015	**0.033**	0.017	0.015	**0.033**
Aluminum	mg/L	0.001	0.001	0.000	0.001	0.001	0.000	0.002	0.001	0.000
Iron	mg/L	0.057	0.030	0.000	0.059	0.031	0.000	0.068	0.038	0.000
Copper (Cu)	mg/L	0.001	0.001	0.000	0.001	0.001	0.000	0.002	0.001	0.000
Nickel (Ni)	mg/L	0.002	0.001	0.000	0.002	0.001	0.000	0.003	0.002	0.000
Zinc (Zn)	mg/L	0.007	0.004	0.000	**0.007**	0.004	0.000	**0.008**	0.005	0.000

Exceedance of PWQO

Exceedance of CCME

Exceedance of ODWQS

Exceedance of more than one water quality guideline

Table D2: Estimated Mixing Concentrations, High Flow Conditions (2 yr event) (Maximum Pond Effluent Concentrations)										
Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
1,1-Dichloroethylene	ug/L	0.128	0.105	0.003	0.135	0.113	0.003	0.155	0.138	0.003
1,2,3,4,6,7,8-Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	0.071	0.039	0.001	0.073	0.041	0.001	0.085	0.050	0.001
1,2-Dichloroethane	ug/L	0.18	0.19	0.01	0.20	0.21	0.01	0.22	0.26	0.01
1,4-Dichlorobenzene	ug/L	0.073	0.041	0.001	0.075	0.044	0.001	0.087	0.053	0.001
2,3,4,6,7,8-Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
2,3,4,7,8-Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/L	0.021	0.028	0.001	0.023	0.031	0.001	0.026	0.038	0.001
2,4,6-Trichlorophenol	ug/L	0.021	0.028	0.001	0.023	0.031	0.001	0.026	0.038	0.001
2,4-D	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2,4-Dinitrotoluene	ug/L	0.005	0.006	0.000	0.005	0.007	0.000	0.006	0.008	0.000
a-Chlordane	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aldicarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin + Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine + Desethyl-atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bendiocarb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ug/L	0.116	0.157	0.006	0.126	0.173	0.006	0.143	0.210	0.007
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoxynil	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Carbofuran	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ug/L	0.068	0.035	0.001	0.070	0.037	0.000	0.081	0.045	0.000
Chlordane (Total)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chlorobenzene	ug/L	0.086	0.059	0.001	0.089	0.063	0.001	0.103	0.077	0.001
Chloroform	ug/L	0.082	0.042	0.001	0.084	0.044	0.001	0.098	0.054	0.001
Chlorpyrifos (Dursban)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cyanazine (Bladex)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDT+ Metabolites	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Des-ethyl atrazine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dicamba	ug/L	0.233	0.314	0.013	0.253	0.346	0.013	0.287	0.421	0.013
Diclofop-methyl	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dimethoate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diquat	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
Dissolved Chloride (Cl-)	mg/L	79.6	67.6	98.8	80.5	68.4	98.8	86.9	72.9	98.8
Diuron	ug/L	0.002	0.003	0.000	0.002	0.003	0.000	0.002	0.003	0.000
Endrin	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ethyl Parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	mg/L	0.121	0.139	0.190	0.120	0.139	0.190	0.117	0.136	0.190
g-Chlordane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Guthion (Azinphos-methyl)	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor + Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Heptachlor epoxide	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachlorobutadiene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hexachloroethane	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
Lindane	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
m/p-Cresol	ug/L	0.001	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.000
Malathion	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mercury (Hg)	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methoxychlor	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methyl Ethyl Ketone (2-Butanone)	ug/L	0.465	0.628	0.025	0.506	0.691	0.025	0.573	0.841	0.026
Methyl parathion	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride(Dichloromethane)	ug/L	0.663	0.438	0.011	0.687	0.467	0.010	0.795	0.571	0.010
Metolachlor	ug/L	0.003	0.005	0.000	0.004	0.005	0.000	0.004	0.006	0.000
Metribuzin (Sencor)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (N)	mg/L	9.519	9.927	6.869	9.506	9.913	6.869	9.421	9.846	6.869
Nitrate + Nitrite (N)	mg/L	9.665	10.011	7.075	9.654	10.000	7.075	9.593	9.950	7.075
Nitrite (N)	mg/L	0.151	0.087	0.205	0.154	0.090	0.205	0.177	0.106	0.205
Nitrobenzene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N-Nitrosodimethylamine	ng/L	17	24	1	19	26	1	22	32	1
NTA	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o,p-DDT + p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Cresol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Octa CDD	pg/L	1.216	1.327	6.763	1.211	1.322	6.763	1.178	1.298	6.763

Table D2: Estimated Mixing Concentrations, High Flow Conditions (2 yr event) (Maximum Pond Effluent Concentrations)

Constituent	Units	Operational (2011-2040)			Post-Operational 1 (2041-2070)			Post-Operational 2 (2071-2100)		
		SW1a	SW2	SW6	SW1a	SW2	SW6	SW1a	SW2	SW6
Octa CDF	pg/L	ND	ND	1.498	ND	ND	1.498	ND	ND	1.498
p,p-DDT	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Paraquat	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	ug/L	0.012	0.016	0.001	0.013	0.017	0.001	0.014	0.021	0.001
Temephos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Terbufos	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ug/L	0.073	0.086	0.003	0.079	0.094	0.003	0.090	0.115	0.003
Toluene	ug/L	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.000
Total Arsenic (As)	ug/L	**6.838**	3.524	0.052	**7.013**	3.684	0.047	**8.157**	4.513	0.047
Total Barium (Ba)	ug/L	44.3	43.0	44.1	44.6	43.2	44.1	46.3	44.4	44.1
Total Boron (B)	ug/L	**204.5**	113.6	27.4	**209.3**	118.1	27.3	**241.0**	141.0	27.3
Total Cadmium (Cd)	ug/L	**1.367**	**0.704**	0.010	**1.402**	**0.736**	0.009	**1.631**	**0.901**	0.009
Total Chromium (Cr)	ug/L	**6.833**	**3.517**	0.052	**7.008**	**3.677**	0.047	**8.151**	**4.504**	0.047
Total Cyanide (CN)	mg/L	0.006	0.008	0.000	0.006	0.009	0.000	0.007	0.011	0.000
Total Hepta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hepta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Hexa CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Lead (Pb)	ug/L	2.739	3.001	1.520	2.809	3.060	1.518	3.267	3.364	1.518
Total PCB	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Penta CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Penta CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium (Se)	ug/L	**13.78**	**7.19**	0.11	**14.14**	**7.52**	0.10	**16.44**	**9.21**	0.10
Total Silver (Ag)	ug/L	**1.367**	**0.703**	0.010	**1.402**	**0.735**	0.009	**1.630**	**0.901**	0.009
Total Suspended Solids	mg/L	168.856	90.656	14.657	173.116	94.536	14.534	200.946	114.618	14.531
Total Tetra CDD	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Tetra CDF	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Uranium (U)	ug/L	1.816	2.699	0.959	1.809	2.690	0.959	1.762	2.643	0.959
Toxaphene	ug/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Triallate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	0.092	0.067	0.002	0.095	0.071	0.002	0.110	0.087	0.002
Vinyl Chloride	ug/L	0.77	0.98	0.04	0.83	**1.07**	0.04	0.94	**1.31**	0.04
Total phosphorus	mg/L	**0.077**	**0.046**	**0.033**	**0.079**	**0.048**	**0.033**	**0.091**	**0.056**	**0.033**
Aluminum	mg/L	0.030	0.015	0.000	0.031	0.016	0.000	0.036	0.020	0.000
Iron	mg/L	**2.187**	**1.126**	0.017	**2.243**	**1.177**	0.015	**2.608**	**1.441**	0.015
Copper (Cu)	mg/L	**0.004**	**0.002**	0.000	**0.004**	**0.002**	0.000	**0.005**	**0.003**	0.000
Nickel (Ni)	mg/L	0.003	0.002	0.000	0.004	0.002	0.000	0.004	0.002	0.000
Zinc (Zn)	mg/L	**0.055**	**0.028**	0.000	**0.056**	**0.029**	0.000	**0.065**	**0.036**	0.000

Exceedance of PWQO

Exceedance of CCME

Exceedance of ODWQS

Exceedance of more than one water quality guideline

APPENDIX F

Design of Stormwater Management Ponds for the Proposed Southwestern Landfill at Carmeuse Quarry in the Township of Zorra

GOLDER

DRAFT

TECHNICAL MEMORANDUM

DATE June 11, 2019 **Project No.** 1664706

TO Walker Environmental

FROM Kevin MacKenzie **EMAIL** Kevin_MacKenzie@golder.com

STORMWATER MANAGEMENT POND DESIGN FOR THE PROPOSED SOUTHWESTERN LANDFILL AT CARMEUSE INGERSOLL QUARRY

1.0 INTRODUCTION AND BACKGROUND

Walker Environmental Group Inc. (WEG) is proposing to develop a landfill in part of the existing Carmeuse Ingersoll Quarry in Ingersoll, Ontario. Golder was retained by WEG to develop a stormwater management plan for the proposed southwestern landfill on the existing quarry site (the site). This technical memo provides an overview of the pond design for the proposed southwestern landfill. It is important to note that the conclusions within this memo may be subject to change upon finalization of the landfill design.

The Stormwater Management Ponds for the proposed landfill will discharge into the Patterson-Robbins Drain Complex (also known as Cemetery Creek), which flows south to the Thames River along the western border of the site.

This design has been prepared as a proof-of-concept with information known by Golder to-date, and is subject to change upon review and detail design of the site in later project phases.

1.1 Background information

The following background information was used in this stormwater management design:

- Flows estimated using a hydrological model for the Patterson-Robbins Drain (Golder 2019a).
- Intensity Duration Frequency (IDF) data from Environment Canada (EC) London CS Weather Station (Climate ID 6144478). This station was selected for it’s length of record and proximity to the study area.
- The Stormwater Management (SWM) Planning and Design Manual (MOE 2003).
- Ministry of Natural Resources and Forestry (MNRF) Climate Change Research Report 44 (MNRF 2015).
- IDF Climate Change (IDF-CC) tool from Western University (2018) (Western University 2018).
- Facility Characteristics Assumptions, March 5, 2019 (Walker 2019).
- Top of Cover Plan (Draft) (Golder, April 23, 2019), developed concurrently with Golder geotechnical landfill design team members.

2.0 SITE CONDITIONS

2.1 Pre-Development

While no information was available on the pre-development conditions of the site, it has been assumed that the initial land use, prior to development of the Carmeuse Quarry, was similar to the surrounding land uses, which are primarily agricultural. For modelling purposes, the pre-development site has been considered agricultural land with a slope similar to the adjacent agricultural properties. Under Pre-Development conditions, the site was modelled with North and South catchments, in order to properly compare to the post-development conditions, described in Section 2.2, below. This pre-development case assumes that all drainage over the proposed landfill area drained towards the Patterson-Robbins Drain prior to quarry excavation.

2.2 Existing Conditions

The site is currently the location of active quarry operations, with the landfill being proposed on the south-west portion of the quarry. No drainage from the existing quarry contributes to the Patterson-Robbins Drain. Runoff from and into the quarry is collected in sumps and discharged into either the West Quarry Pond or to the Thames River, both of which are located south of the site. The existing conditions and "do nothing"/ baseline scenario were not modelled since there are currently no significant contributions to the Patterson-Robbins Drain from the site. The current design contemplates a pre-development scenario prior to quarry development (assuming the land use to be agricultural). In addition, this report considers the potential effects of climate change on the storm events used to size the stormwater ponds.

2.3 Post-Development Conditions

Post-Development Conditions were developed for the final proposed landfill based on planned land use and landfill grading information as described in Section 1.1.

From these sources, a variety of site details were gathered and used to create a Post-Development landfill model. This information includes key site details listed below:

- A final landfill cover with 4.8% slope and 258 mm of annual infiltration through the cover;
- A 10 m wide access road surrounding the perimeter of the landfill area;
- Two proposed stormwater management ponds located at the north and south extents of the site, identified as the North and South ponds, respectively; and,
- Ground elevations along the base of the final landfill cover design.

3.0 OBJECTIVES

3.1 Quality Control

The North and South ponds have been designed with the following main objectives in mind:

- Size the ponds to achieve "Enhanced" water quality protection level (80% long term average suspended solids removal) as per Table 3.2 in the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (2003).

- Size low flow orifices to draw down the extended detention in at least 24 hours to allow for adequate settling of suspended solids.

3.2 Quantity Control

Matching post- to pre- development flows in the Patterson-Robbins Drain was not considered a feasible mitigation target for this site, as there are currently no contributions from the site to the Patterson-Robbins Drain, and there is no information available to confirm historical drainage patterns. Considering this, the general objectives of this stormwater management design were as follows:

- Minimize the post-development peak discharge increase in the receiving watercourse to the largest extent feasible;
- At a minimum, match post-development site flows to modelled pre-development site flows at the pond outlet locations; and,
- As a climate change consideration, the ponds must be able to pass the Post-Closure 1 Climate Change Scenario (2041-2071) 100 year 24 hour storm in order to ensure the ponds will not fail under higher climate change flows. The 100 year 24 hour flow under the Post-Closure 1 Scenario is the highest peak flow and largest volume of climate-change adjusted IDF flows considered, and hence, represents a bounding case. Further details on the Climate Change Storms are included in Section 4.2, below.

3.3 Preliminary Ditch Design and Grading

Conceptual ditch sizing and grading was completed in order to confirm compatibility with the grading design. The pond outlet locations have been proposed based on the available grades and land uses surrounding the site.

4.0 SITE MODELLING

A hydrological model was developed using the US Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modelling System (HEC-HMS) in order to estimate runoff flow rates and volumes from the landfill area. Additionally, HEC-HMS was used as a tool to aid in sizing the North and South Ponds.

4.1 Site Inputs

The site was split into six (6) separate catchments in order to determine flow requirements for the drainage ditches which convey runoff to the stormwater management ponds (see Section 5.4). These catchments were applied to both the pre- and post-development models for comparison purposes. The following table describes major inputs in the pre- and post- development HEC-HMS models.

Table 1: Major HEC-HMS Inputs for Pre- and Post-Development Landfill Models

Catchment*	Area (ha)	Impervious Percent		SCS Curve Number		
		Pre-Development	Post-Development	Pre-Development	Post-Development	Hurricane Hazel
SB-South	16.05	0.00%	10.55%	71	82	92
SB-West	17.50	0.00%	3.69%	71	82	92
SB-East	14.10	0.00%	3.93%	71	82	92
NB-West	9.70	0.00%	4.04%	71	82	92
NB-East	8.39	0.00%	12.75%	71	82	92
NB-North	10.18	0.00%	19.69%	71	82	92
Total (South pond)	**47.64**	**0.00%**	**6.07%**	**-**	**-**	**-**
Total (North Pond)	**28.28**	**0.00%**	**12.26%**	**-**	**-**	**-**
Total Catchment Area	**75.92**	**0%**	**8.4%**	**-**	**-**	**-**

* North Basin (NB) refers to areas draining to the North Pond. South Basin (SB) refers to areas draining to the South Pond. Each Pond catchment was split up based on landfill cover geometry, for modelling and ditch sizing purposes. See Figure 1 for a conceptual layout of the North and South Pond catchments.
* The North and South Basins were separated into smaller catchments in order to confirm sizing for the constituent ditches for each section.

4.2 Design Storms

IDF Curves for the 2 to 100 year, 24 hour Chicago distribution storms were developed using IDF exponents and coefficients from the EC London CS Station (Climate ID 6144478). Additionally, the Hurricane hazel and 4 hour, 25 mm Chicago distribution storms were used in the model to examine runoff rates in high and low volume events, respectively.

4.2.1 Climate Change Considerations

For the purposes of Environmental Assessment (EA), there have been three major climate change periods examined: Operational (2011-2040), Post-Operational 1 (2041-2070), and Post-Operational 2 (2071-2100). The outlet structures for this pond were designed to pass the Post-Operational 1 (2041-2070) 100 year 24 hour storm, obtained from the IDF-CC tool (University of Western Ontario 2018) under climate change scenario RCP 4.5 (MNRF 2015). This storm provided the largest volume and peak rainfall of all storms in the climate change scenarios and was selected as the climate change test storm for the pond design.

5.0 PRELIMINARY STORMWATER MANAGEMENT PLAN

5.1 Runoff Modelling Results

The following table shows peak runoff rates from the site. The post development flows in this case represent the unmitigated runoff rates from the landfill cover, which will be the flow rates entering the ponds

Table 2: Runoff Rates from the Pre-Development and Post-Development Site

Storm Event*	Pre-Development Peak Flow Rate (m^3/s)		Post-Development Peak Flow Rate (m^3/s)	
	South Basin**	North Basin**	South Pond	North Pond
Chicago 4 hour, 25 mm	0.47	0.27	1.26	0.86
2 yr	1.40	0.81	2.85	1.73
5 yr	2.35	1.36	4.52	2.70
10 yr	3.07	1.78	5.70	3.38
25 yr	4.07	2.35	7.28	4.29
50 yr	4.84	2.78	8.44	4.96
100 yr	5.65	3.25	9.65	5.66
Regional (Hurricane Hazel)	6.74	3.98	6.91	4.10

* Storm event duration is 24 hours with the exception of the Chicago and Hurricane Hazel events.
** For the purposes of this table, South and North Basin represent the collection point for the north and south catchments under a pre-development scenario

5.2 Proposed Ponds

5.2.1 Proposed Pond Design

The proposed ponds have been developed according to MOE (now Ministry of the Environment, Conservation and Parks (MECP)) design criteria included in the MOE Stormwater Management Planning and Design Manual (March 2003). Refer to Table 3 below for pond dimensions and Table 4 for design storm outflows. The ponds have been designed using hydrological modelling outputs as described in Section 4.0, and are intended to mitigate flows from the 2 to100 year storms, and pass the Regional and Post-Operational 1 (2041-2070) Climate Change 100 year event without overtopping the berms.

As Described in Section 3.0, there are no specific water quantity objectives applicable for the ponds, as there are currently no contributions from the site to the Patterson-Robbins Drain. As such, the ponds have been designed to minimize flow increases to the extent feasible for the design storms, resulting in considerably lower peak outflows at the ponds than the modelled pre-development scenario. The limiting factors on the pond sizing were based on the physical space available for the ponds.

The North Pond has been designed as a rectangular pond with two forebays, one on the east side (Forebay 2) and one on the west side (Forebay 1) of the pond. The East forebay is separated from the main pond by a roadway crossing that is required for landfill site access and will be connected to the main pool by culverts underneath the roadway crossing. The pond will discharge from the South side of the main pool, approximately at the mid-point of the pond, into a pipe which will discharge westwards into the Patterson-Robbins Drain. Refer to Section 5.5 for details on the proposed discharge pathway. The North Pond has the capacity to mitigate up to the 100 year event with 1.5 meters of active storage and can pass the regional flood event using an additional 0.3 m of active storage. An additional 0.3 m of freeboard beyond the regional storm event water level is available in order to reduce the risk of overtopping the berms. Refer to Figure 2 for the conceptual North Pond design layout.

The South Pond has been designed as a triangular pond with a bermed forebay in the north-east corner. It has the capacity to mitigate up to the 100 year event with 2 meters of active storage and can pass the regional flood event with an additional 0.3 m of active storage depth. An additional 0.3 m of freeboard beyond the regional storm event water level is available in order to reduce the risk of overtopping the berms. Refer to Figure 3 for the conceptual South Pond design layout.

Both ponds have been modelled with adequate permanent pool and extended detention volumes to provide "Enhanced" protection levels, according to Table 3.2 in the MOE Stormwater Management Planning and Design Manual (MOE 2003). These volumes have been determined based on an estimated imperviousness of 12% of the catchment contributing to the North Pond and 6% of the catchment area contributing to the South pond. Table 3, below, shows the permanent pool and extended detention sizes for both ponds. The extended detention drawdown for both ponds is over 24 hours.

Table 3: Permanent Pool and Extended Detention Volumes for the North and South Ponds

Pool element	South pond		North Pond	
	Required*	Provided	Required*	Provided
Permanent Pool Volume (m^3)	3,220	10,200	2,350	5,580
Extended Detention (m^3)	1,910	2,190	1,130	1,150

*Required Permanent Pool and Extended Detention Volumes determined based on Table 3.2 in the MOE Stormwater Management Planning and Design Manual (2003).

Table 4, below, shows key pond sizing information. Refer to Figures 2 and 3 for conceptual pond design layout.

Table 4: North and South Pond Key Dimensions

Parameter	Units	South Pond			North Pond			
		Forebay	Main pool	Total	Forebay1	Main pool	Forebay 2	Total
Length*	m	-		191.0	300.6		57.6	388.2
Width*	m	-		120.0	35.0		35.0	70.0
Footprint**	m^2	-		11,460	10,520		2,020	12,540
Permanent Pool Volume	m^3	1,120	9,090	10,210	660	4,260	660	5,580

Parameter	Units	South Pond			North Pond			
		Forebay	Main pool	Total	Forebay1	Main pool	Forebay 2	Total
Extended Detention volume	m^3	-		2,190	150	860	150	1,160
100 yr Active Storage Volume	m^3	-		17,900	-			11,540
Regional Active Storage Volume	m^3	-		21,130	-			14,570
Top of Freeboard Active Storage Volume	m^3	-		24490	-			17830
Permanent Pool Depth	m	1.5	2.0	-	1.5	1.5	1.5	-
Permanent Pool Elevation	masl	-		277.70	-			287.50
100 year Active Storage Depth	m	-		2.00	-			1.50
100-year Active Storage Elevation	masl	-		279.70	-			289.00
Regional Active Storage Depth	m	-		0.30	-			0.30
Regional Active Storage Elevation	masl	-		280.00	-			289.30
Freeboard Depth	m	-		0.30	-			0.30
Top of Freeboard Elevation	masl	-		280.30	-			289.60

*For the South Pond, Length is considered North-South freeboard length, and Width is considered the east-west freeboard length. Total Length for the North Pond includes a 30 m road width.
** Pond footprint is considered the area at the top freeboard
*** North Pond total length includes the 30 m wide roadway footprint allotted between the Forebay 2 (East Forebay) and the main pond

5.2.2 Peak Outflow Rates from the Proposed Ponds

Peak outflow rates for various design storms can be found in Table 5, below. It is important to note that the post-development scenario significantly lowers peak flows for the 2 to 100 year events in comparison to both the pre-development and post-development runoff models.

Table 5: North and South Pond Outlet Peak Flows for Modelled Pre-Development and Post-Development Mitigated flows

Storm Event	Pre-Development Peak Discharge (m^3/s)		Post-Development (Mitigated) Peak Discharge (m^3/s)	
	South Catchment Area	North Catchment Area	South pond	North Pond
4 hour 25 mm Event (Chicago Distribution)	0.47	0.27	0.06	0.04
2 yr	1.40	0.81	0.34	0.22
5 yr	2.35	1.36	0.76	0.45
10 yr	3.07	1.78	1.08	0.64
25 yr	4.07	2.35	1.46	0.88
50 yr	4.84	2.78	1.69	0.93
100 yr	5.65	3.25	2.71	0.95
Regional (Hazel)	6.74	3.98	6.77	3.95

5.3 Climate Change

For the purposes of the Environmental Assessment (EA), there have been three major climate change periods examined: Operational (2011-2040), Post-Operational 1 (2041-2070), and Post-Operational 2 (2071-2100). The major aspects of the pond design were compared to the expected changes from climate change in order to determine if the pond design can adequately contain the expected changes under climate change.

The minimum required permanent pool and extended detention volumes of the ponds were sized based on the MOE design criteria included in the MOE Stormwater Management Planning and Design Manual (March 2003) contained in Table 3.2, which does not contain guidance on climate change modifications. The MOE Design Manual for water quality is based on the percent of impervious area of a catchment and not based on a specific storm event. Extended detention and permanent pool sizes are based on requirements for "enhanced" treatment (80% long term TSS). The extended detention will continue to drain within 24 hours to meet the settling criteria. The low flow orifices of the ponds have been designed to treat smaller storm events (< 2yr) and can adequately minimize quality and quantity effects of smaller events moving under future climate change predictions.

The spillways for both the North and the South Ponds have been designed to minimize the potential of overtopping the berm during the regional event (Hurricane Hazel) while maintaining 30 cm of freeboard. This provides adequate protection against berm settling and allows even larger events to potentially be contained. The designs of the North and South Ponds are capable of passing the worst-case climate change storm, which is the Post-Operational 1 (2041-2070) 100 year 24 hour storm. This storm was obtained from the IDF-CC tool (Western

University 2018) under climate change scenario RCP 4.5 (MNRF 2015). This storm provided the largest volume and peak rainfall intensity of all storms in the climate change scenarios and was selected as the climate change test storm for the pond design. Both ponds are able to pass this storm through activation of the spillway, while still maintaining 30 cm of freeboard. This ensures that the pond is capable of passing increased storm intensities with climate change.

In terms of minimizing quantity effects on the Patterson-Robbins Drain, the current pond design is intended to minimize peak flows for 2 to 100 year return storms, which includes minimizing the outflow significantly below pre-development flow for all cases. Under climate change, this will likely still be the case, as the ponds will operate within the existing 2 to 100 year return period range in a similar manner. This includes smaller storms under climate change. Under larger climate-change storms where the spillway will be activated, such as the climate change adjusted 100 year storm, it is possible that peak-matching effects may not be possible, however there will still be a significant reduction in peak flows compared to an unmitigated scenario.

5.4 Preliminary Ditch Grading

Ground elevations provided by internal Golder teams have been used to develop a preliminary grading plan for the North and South catchment drainage collection system. The drainage ditches will run around the perimeter of the final landfill cover, collecting drainage off the cover and the buffer area. Table 6, below, shows these grades with reference to grading points in Figure 1.

Table 6: Grading Summary

Grading Point*	Ground Surface Elevation (masl)	Ditch Bottom Elevation (masl)
EB	291.90	291.54
WB	292.04	291.40
N1**	290.50	289.24
N2	290.50	289.35
N3	291.25	290.85
N4**	282.00	281.50
S1	284.00	283.50
S2	280.00	279.30
S3**	291.90	291.54

* Grading Point locations are shown on Figure 1
** N1, N2, and S3 are the inlets to the pond forebays

5.5 Proposed Discharge Pathways

The North Pond is proposed to discharge by pipe into the Patterson-Robbins Drain near the southwest corner of the Road 64 and 35th Line intersection, located near the north-west corner of the site. This discharge pathway would require the crossing of 35th Line. The spillway for the North Pond is proposed to discharge from the western forebay off the site. Refer to Figure 1 for the proposed layout of the pond discharge.

The South Pond is proposed to discharge south off the site, cross the railway, flow west for approximately 650 m through a proposed drainage ditch on the south side of the railway, and enter the Patterson-Robbins Drain near the north-west corner of the West Quarry pond, just south of the Patterson-Robbins Drain railway crossing. The Spillway discharge is proposed to follow a similar pathway to the Patterson-Robbins Drain. This discharge pathway is subject to neighbouring land access agreements. Refer to Figure 1 for the proposed layout of the pond discharge.

5.6 Contributions to the Patterson-Robbins Drain

With reference to Figure 1, the North Pond and South pond will discharge to the Patterson-Robbins Drain at two different locations. Modelled peak flows for the 2 to 100 year design storms in the Patterson-Robbins Drain (Golder 2019a) have been compared to the post-development flows at the points of confluence of the Patterson-Robbins Drain and the discharge stream from the North Pond and South Pond, points SW2 and SW1a respectively. Refer to Figure 1 for locations.

Table 7: Comparison of Existing Patterson-Robbins Drain flows with the addition of mitigated site contributions

Storm	Modelled Existing Patterson-Robbins Drain Peak Flows (m^3/s)*		Patterson-Robbins Drain Peak Flows with Managed Stormwater Pond Outflow (m^3/s)**	
	SW2 (North)	SW1a (South)	SW2 (North)	SW1a (South)
2 yr	3.4	4.4	3.6	4.9
5 yr	7.7	10.2	8.0	11.1
10 yr	10.8	14.3	11.1	15.5
25 yr	14.9	19.8	15.3	21.3
50 yr	18.0	24.0	18.4	25.6
100 yr	21.4	28.5	21.9	30.3

* Note: Existing Patterson-Robbins Drain flows are from the Patterson-Robbins Drain Hydrological Model, as described in the Hydrological Modelling Report (Golder 2019a).
**The timing of peak flows from the site and the Patterson-Robbins Drain catchment are offset in relation to one another, resulting in minimal peak flow increase
***These peak flows do not include contributions from the proposed leachate treatment plant as described in the Water Quality Assessment (Golder 2019b).

6.0 SUMMARY AND CONCLUSIONS

The following conclusions have been made based on our proposed design of the Stormwater Management Ponds.

- Both the North and South Ponds minimize peak flows below the modelled pre-development runoff rates in order to minimize the site impact on peak flows in the Patterson-Robbins Drain.
- Both the North and South Ponds have been designed to meet “Enhanced” level protection (80% long term suspended solids removal) as described in Table 3.2 in the MOE Stormwater Management Planning and Design Manual (MOE 2003).
- The current design contemplates a pre-development scenario prior to quarry development (assuming the land use to be agricultural). Current land use does not drain to the Patterson-Robbins Drain and therefore is not a useful baseline in comparing the mitigation of peak flows directed to the watercourse.
- The ponds are capable of passing the 100 year 24 hr storm under the Post-Operational 1 (2041-2070) climate change scenario, which is the highest volume and peak flow of all Climate Change IDF curves analyzed in this EA.

DRAFT ***DRAFT***

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Principal, Water Resources Engineer

JS/MK/KMM/mp

Attachments: Figure 1: Proposed Stormwater Management Layout - Proposed Southwestern Landfill – Carmeuse Ingersoll Quarry

Figure 2: North Pond Plan View And Details

Figure 3: South Pond Plan View And Details

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Facility Characteristics Assumptions, Southwestern Landfill Environmental Assessment. Walker Environmental Group Inc. March 5, 2019 (Walker 2019).

McDermid, J., S. Fera and A. Hogg. Climate Change Projections for Ontario: An Updated Synthesis for Policymakers and Planners. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontario. Climate Change Research Report CCRR-44. 2015 (MNRF 2015).

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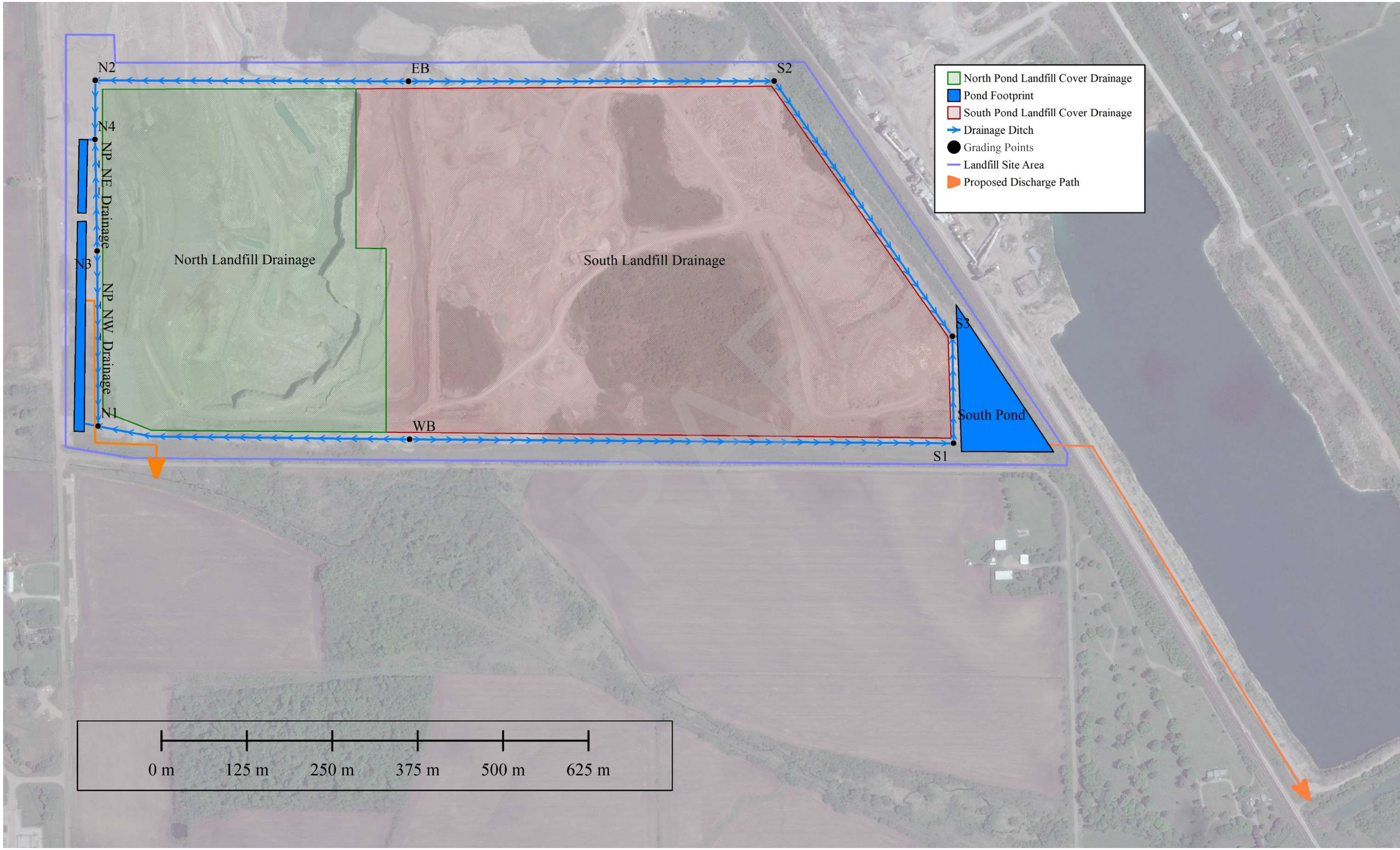
Simonovic, P., Et al. Computerized Tool for the Development of Intensity-Duration-Frequency Curves under Climate Change – Version 3.5. Western University. 2018. www.idf-cc-uwo.ca (Western University 2018).

FIGURES

Proposed Stormwater Management Layout - Proposed Southwestern Landfill – Carmeuse Ingersoll Quarry | Figure 1



Notes:

- Grading Points N4 and S4 represent the inlets to the North and South Ponds, respectively
- This drawing is for demonstration purposes only. It is not drawn to scale and is not intended for design or construction purposes.

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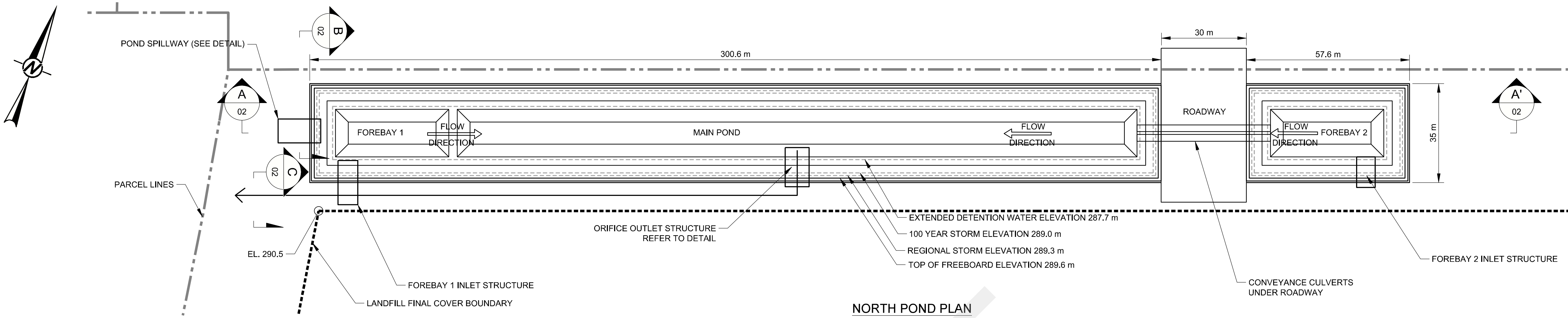
Date: 25-Apr-2019

Project:1664706

Drawn By: JSaunders



NORTH POND PLAN

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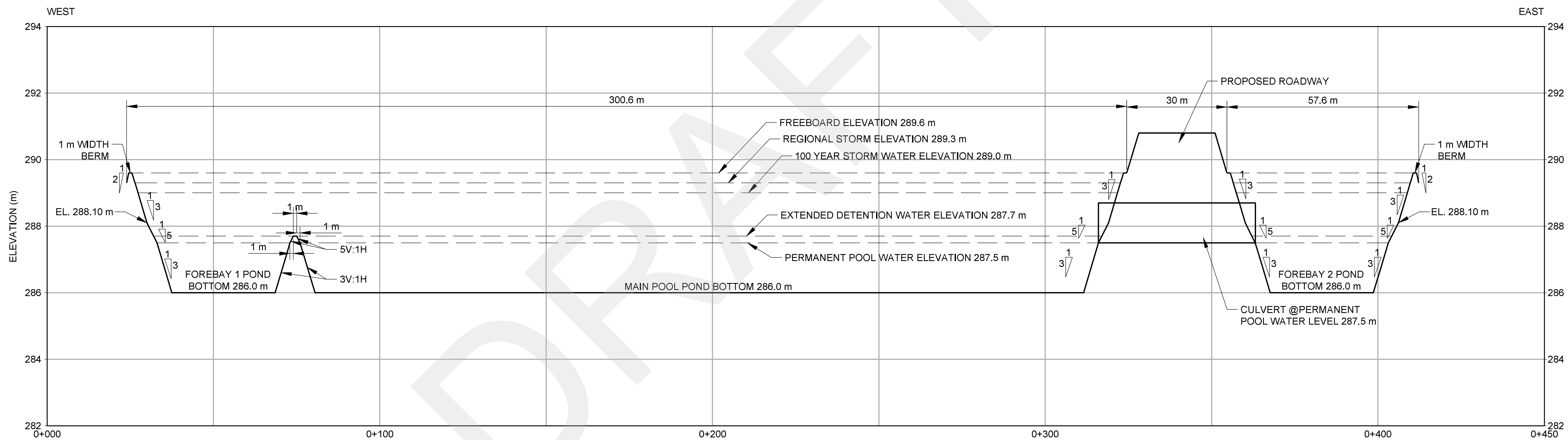

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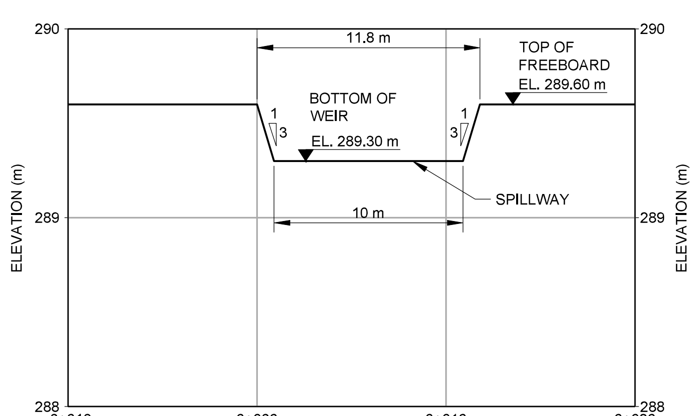

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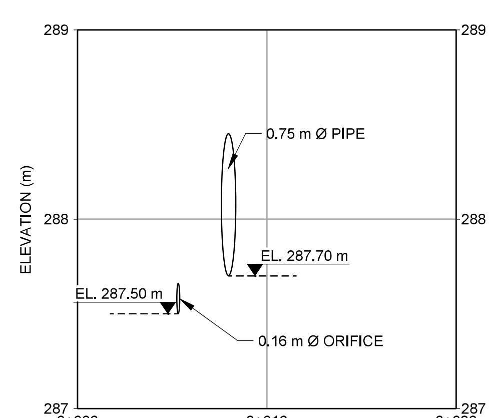

POND OUTLET DETAIL C-C'

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NOT FOR CONSTRUCTION

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CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
WALKER SOUTHWESTERN LANDFILL

TITLE
NORTH POND PLAN VIEW AND DETAILS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-17
DESIGNED	JS
PREPARED	AZ
REVIEWED	CD
APPROVED	MK

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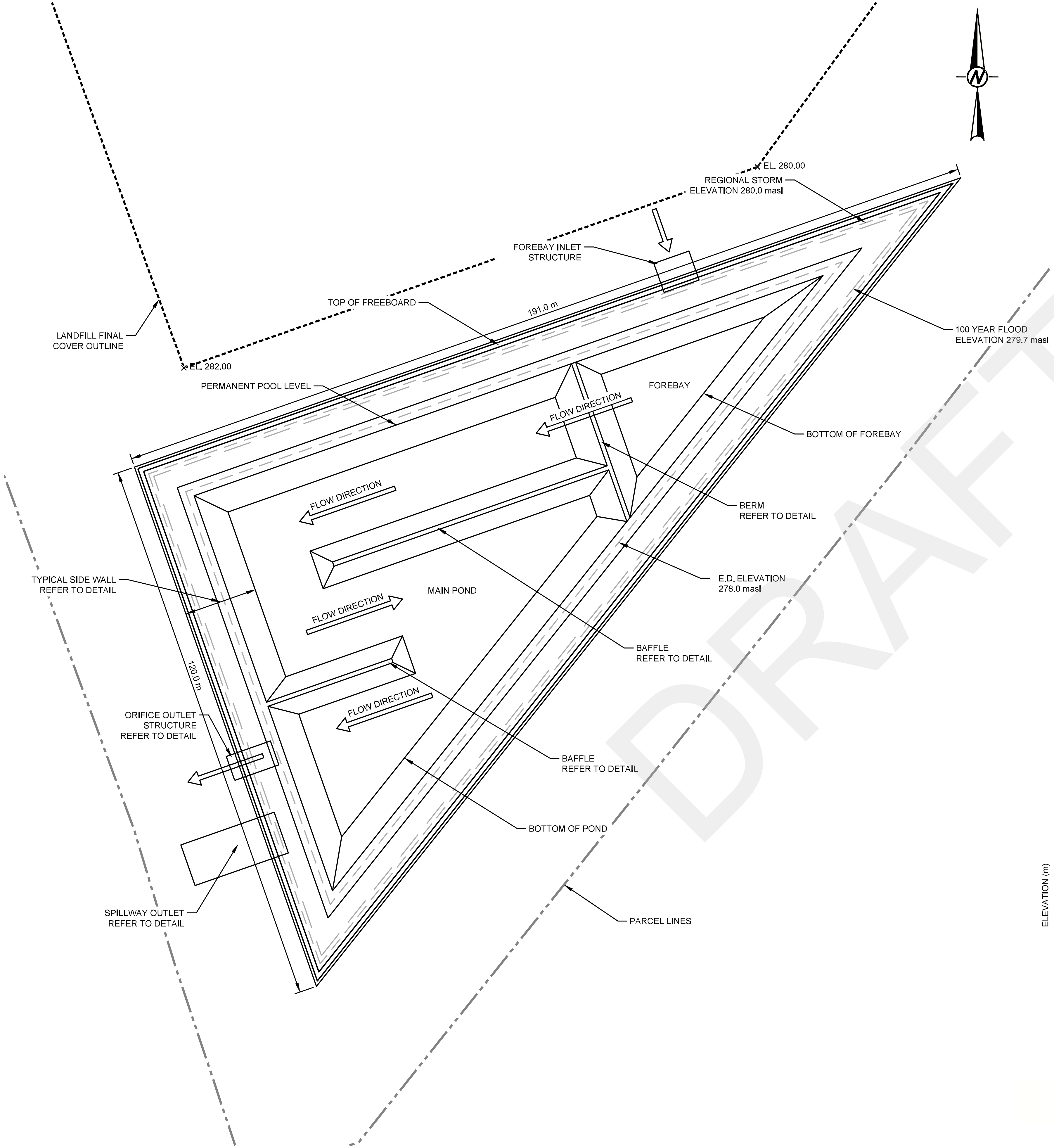

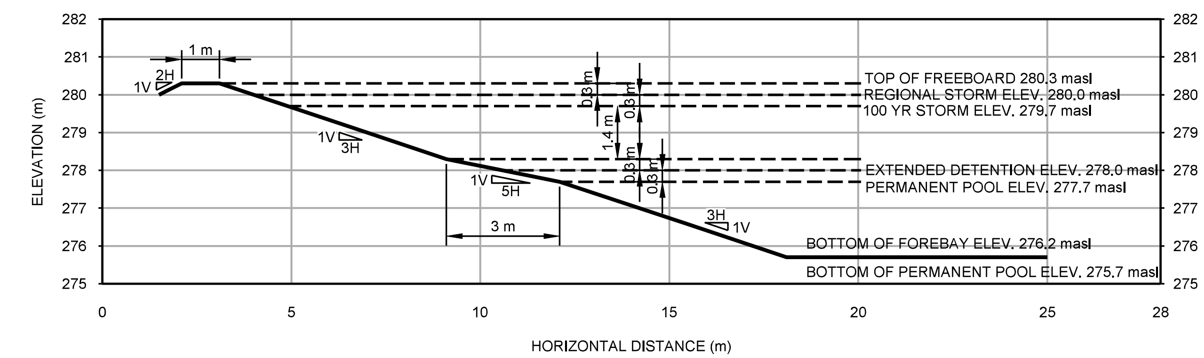

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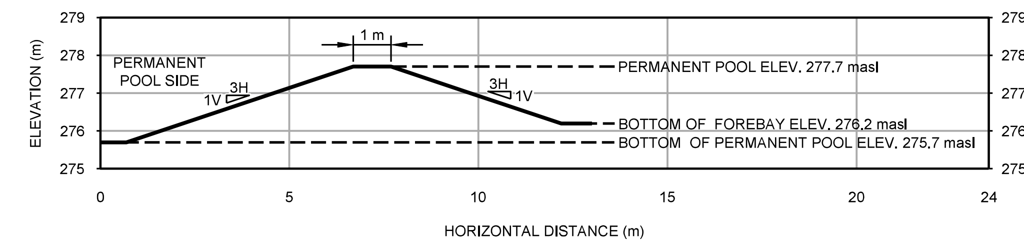

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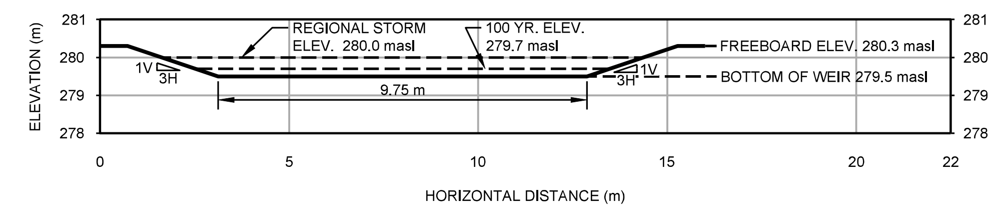

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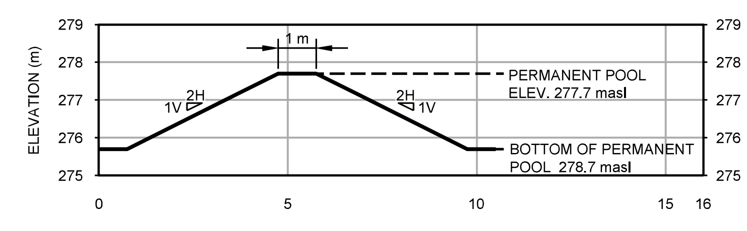

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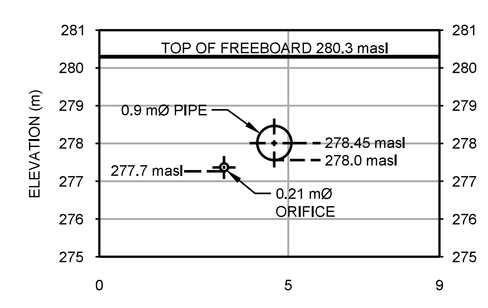

ORIFICE OUTLET DETAIL
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CLIENT
WALKER ENVIRONMENTAL GROUP INC.

PROJECT
WALKER SOUTHWESTERN LANDFILL

TITLE
SOUTH POND PLAN VIEW AND DETAILS

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APPROVED	MK

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