# Appendix A

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# EIR Terms of Reference

# Appendix A-1

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## Interim EIR/FSS Submission Details

**Sixth Oak Inc.**
**Interim EIR/FSS Addendum Submission Details**
**November 2021**

**Goal** – establish the limit of development for the HDSB in order to advance their design

**Content:**

- Introduction – standard information provided in all EIRs

- Natural Heritage System Framework – standard information provided in all EIRs

- Core Areas
  - general description of vegetation communities (Fall 2021 ELC)
  - description of Core 6 boundary delineation (wetlands + 30m, woodland + 10m, 200m wide northern Core limit from western property line)
  - description of Cores 7 and 8 in so far as it is necessary to assist with understanding the LPAs and PSWs in Core 7
  - PSW catchment areas and locations where mitigation measures may be necessary to address flows entering or exiting the Core (specific mitigation measures to be provided in final EIR Addendum)
  - Provide preliminary understanding of whether trail alignment will necessitate tree removal and, if so, include a commitment to consult with MECP and evaluate for SWH if necessary
  - Outline of spring/summer 2022 fieldwork that will be conducted to complete the characterization (i.e., breeding bird surveys, potentially bats); it was agreed that amphibian surveys were not required

- Linkage Preserve Areas
  - review NOCSS to determine whether any background available to explain start and end points of LPA between Core 8 and 8
  - provide rationale for width and location of LPA

- Geology and Hydrogeology
  - Physiography, topography, drainage, climate, geology
  - Summary of monitoring well data collection to date
  - Identification of any gaps in monitoring data
  - Outline of 2022 monitoring to complete the hydrogeological characterization of the site (if necessary)

- Land Use
  - Description of proposed plan
  - Trail planning (include discussion of trail location as it relates to the SWM pond, potential for tree removal)

- Grading, Drainage and Stormwater Management

  - Build upon the information provided in the UWMC Addendum to confirm SWM pond size and design
  - Preliminary Grading Plan

- Confirm that the trail adjacent to the SWM pond can be accommodated, especially on the north side of the pond
- Provide a drainage strategy for Burnhamthorpe Road; advise if there are any changes required to the existing Sixth Line drainage strategy

- Wastewater and Water Servicing
  - Preliminary details pertaining to wastewater and water servicing

- Roads
  - Details pertaining to the Sixth Line ROW; road allowance design; sidewalk details

- Monitoring Program
  - Identify the OPA 272 and NOCSS monitoring requirements; detailed monitoring recommendations to be included in final report

- Summary of Recommendations
  - identify commitments/additional information that will be included in the final report; this additional information is not anticipated to have any affect on the limit of development but may be related to items such as: 2022 terrestrial or hydrogeological fieldwork; feature based water balance and mitigation measures; monitoring requirements; etc.
  - identify detailed design requirements

**Format** – proposed format is somewhere between a Technical Brief and a full Addendum; will include the content as outlined above; interim report will ultimately be incorporated into an EIR Addendum the format of which can be determined at a later date.

# RE: Sixth Oak UWMC EIR Addendum

Laura Schreiner <lschreiner@hrca.on.ca>

Tue 1/25/2022 5:28 PM

To: Jennifer Lawrence <jennifer@jlplanning.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>; Kristina Parker <kristina.parker@oakville.ca>; George Golding <george.golding@oakville.ca>

Cc: David Faye <davidfaye.associates@gmail.com>; Piotr Szponar <pszponar@randengineering.ca>

Hi Jennifer,

My apologies for the delay in getting back to you on this.

First, as I'm not sure I ever formally responded to the plotting of PSW 83 confirming its 30 m regulatory allowance falls within the Core 6 and Linkage boundary: thanks. This confirms it's fully within the NHS and no adjustment to the NHS boundary should be needed.

Second, regarding the "Interim Report Goal Content Format" document you sent on November 19, 2021: thanks. We reviewed and have the following comments:

- *Linkage Preserve Areas:* Bullet 1 should be revised to Core 6 and Core 8 (assuming this was just a typo). The linkage from Core 6 to Core 7 should also be discussed.
- *Geology and Hydrogeology:* Depending on the wetland catchments, wetland water balance information may be required in this section.
- *Grading, Drainage and Stormwater Management:* Depending on the wetland catchment and water balance results, information on getting water to the wetlands might be needed in this section.

Thirdly, regarding your email below dated December 14, 2021: Thank you for clarifying the process you hope to take on this file. While I understand that the school board's timelines are a driving force on this file, and that it's a priority to all to expedite the building of the school, CH won't be able to confirm whether we can provide draft plan conditions based on the "interim" EIR/FSS document; we'll need to actually review at least one submission of it to be better able to answer that question. I believe it would need to contain all the technical information we normally see in order to consider an EIR/FSS sufficiently complete for draft plan approval. Until we review the first submission I can't really confirm whether the scope will be sufficient for that purpose. Based on your Interim Report outline, it certainly sounds as though it will contain sufficient information for a first review, so we will review it when it comes in and see. We can give you an update at that point, when we provide our first set of comments.

Thanks,
Laura

**Laura Schreiner (she/her), M.Sc. (Planning)**
Environmental Planner

**Conservation Halton**
2596 Britannia Road West, Burlington, ON L7P 0G3
905.336.1158 ext. 2266 | Fax 905.336.6684 | lschreiner@hrca.on.ca
conservationhalton.ca

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**From:** Jennifer Lawrence <jennifer@jlplanning.ca>
**Sent:** January 4, 2022 10:52 AM
**To:** Laura Schreiner <lschreiner@hrca.on.ca>; Rita Juliao <rita.juliao@oakville.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Piotr Szponar <pszponar@randengineering.ca>
**Subject:** Re: Sixth Oak UWMC EIR Addendum

Good Morning Rita and Laura and Happy New Year!

I hope you both had a wonderful holiday and break from work!

I wanted to follow-up on the submission that we made after the November NOARM, outlining the proposed content of the Interim Sixth Oak UWM1 Addendum. In order to meet the School Board's timeline, we are going to have to submit the report within the next week or so and I was hoping to have your input on the content prior to the submission. Please let me know if there is any additional information that I could provide that would be helpful.

Thanks,

Jennifer

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**From:** Jennifer Lawrence <jennifer@jlplanning.ca>
**Sent:** Tuesday, December 14, 2021 10:04 AM
**To:** Laura Schreiner <lschreiner@hrca.on.ca>; Rita Juliao <rita.juliao@oakville.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Piotr Szponar <pszponar@randengineering.ca>
**Subject:** Re: Sixth Oak UWMC EIR Addendum

Hi Laura,

The complete EIR/FSS Addendum will be submitted once the spring/summer fieldwork is completed in 2022. In order to meet the School Board's timeline, it is my understanding that discussions have taken place with Oakville planning staff and that the goal would be a June 2022 Council approval and the Planning Director's draft approval with conditions issued soon after the Council approval. Based on that timeline, the agencies will not likely have the final EIR/FSS Addendum prior to draft plan approval however, you will have received the interim Addendum (which will address all items that could have a bearing on the limit of development) and, if needed, a second submission of the interim Addendum to address any questions. The final Addendum would likely need to be a condition of draft plan approval to be provided prior to registration.

I hope that helps but please let me know if you would like to discuss it further.

Thanks,

Jennifer

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**From:** Laura Schreiner <lschreiner@hrca.on.ca>
**Sent:** Friday, December 10, 2021 10:56 AM
**To:** Jennifer Lawrence <jennifer@jlplanning.ca>; Rita Juliao <rita.juliao@oakville.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Piotr Szponar <pszponar@randengineering.ca>
**Subject:** RE: Sixth Oak UWMC EIR Addendum

Hi Jennifer,

Thanks for this. Forgive me if I'm slow on the uptake on this one, but a follow up question: I understand your proposal for the interim EIR/FSS submission and appreciate that it would build on the existing Addendum #1. When are you proposing that the complete EIR/FSS Addendum would be submitted? Would it be part of a second submission, prior to draft plan approval, or are you proposing after draft plan approval but prior to registration?

Regarding the Core 6 northern border, I'll be touching base with the team on Monday and will get back to you shortly after.

Thanks,
Laura

**Laura Schreiner** **(she/her), M.Sc. (Planning)**
Environmental Planner

**Conservation Halton**
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*Click here to learn about Conservation Halton's new strategic plan.*

*Conservation Halton's Administration Office is currently closed to the public due to COVID-19. For more information and updates on Conservation Halton's planning and permitting services, please visit https://conservationhalton.ca/planning-permits.*

**From:** Jennifer Lawrence <jennifer@jlplanning.ca>
**Sent:** November 30, 2021 3:33 PM
**To:** Rita Juliao <rita.juliao@oakville.ca>; Laura Schreiner <lschreiner@hrca.on.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Piotr Szponar <pszponar@randengineering.ca>
**Subject:** Re: Sixth Oak UWMC EIR Addendum

Hi Rita,

You are correct, the content, as outlined in the document titled 'Interim EIR/FSS Addendum Submission Details', is intended to outline the information that will be included in the first submission of the EIR Addendum. We are calling it an Interim EIR Addendum since we know we won't have all of the information normally available in an EIR (i.e., such as post-development water balance) however, in order to meet the School Board's timeline, we have included those items in the Interim Report that either (a) are readily available from existing studies, or (b) could have an impact on the establishment of the limit of development.

The headings of each bullet point are taken directly from the current UWM1 Addendum. Our intention would be to utilize as much of the existing information as possible from the UWM1 Addendum plus the inclusion of specific details related to the Sixth Oak lands such as Core boundary stakings, etc. that could have an impact on the limit of development. Please let me know if a quick phone call with you and Laura would be helpful.

Jennifer

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**From:** Rita Juliao <rita.juliao@oakville.ca>
**Sent:** Monday, November 29, 2021 3:42 PM
**To:** Jennifer Lawrence <jennifer@jlplanning.ca>; Laura Schreiner <lschreiner@hrca.on.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Vito Cavallo <vcavallo@randengineering.ca>; Piotr Szponar <pszponar@randengineering.ca>; Rick Hubbard <rickhubbard@savanta.ca>; Christopher Zoladeski <ecosystem.r.m@gmail.com>; Dwight Smikle <dwight.smikle@rjburnside.com>
**Subject:** RE: Sixth Oak UWMC EIR Addendum

Hi Jennifer,

Laura and I met briefly on Friday to discuss the materials put forward following our meeting on November 19th. We have a few items we would like to follow-up on internally but in the meantime, perhaps you wouldn't mind clarifying the approach that would be helpful. Is your plan to submit an interim EIR/FSS with the scope provided per the document titled *"Interim EIR/FSS Addendum Submission Details"* as a first submission to support the complete planning application? If not, please provide the first submission scope.

If you have any questions, please let me know.
Thanks,
Rita

**Rita Juliao, P. Eng.**
**Water Resource Engineer**
**Transportation and Engineering**
Town of Oakville | 905-845-6601, ext.3025 | f: 905-338-4414 | www.oakville.ca

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**From:** Jennifer Lawrence <jennifer@jlplanning.ca>
**Sent:** November 19, 2021 3:57 PM
**To:** Rita Juliao <rita.juliao@oakville.ca>; Laura Schreiner <lschreiner@hrca.on.ca>; Pasquini-Smith, Alexsandria <Alex.Pasquini-Smith@halton.ca>
**Cc:** David Faye <davidfaye.associates@gmail.com>; Vito Cavallo <vcavallo@randengineering.ca>; Piotr Szponar <pszponar@randengineering.ca>; Rick Hubbard <rickhubbard@savanta.ca>; Christopher Zoladeski <ecosystem.r.m@gmail.com>; Dwight Smikle <dwight.smikle@rjburnside.com>
**Subject:** Sixth Oak UWMC EIR Addendum



Hi Rita, Laura and Alexsandria,

Thank you again for meeting with us to discuss the interim UWMC EIR Addendum in support of the HDSB site at the northwest corner of Sixth Line and Burnhamthorpe. I have attached a draft of the meeting minutes as well as a summary of the Goal, Content and Format of the proposed interim report for your review and comment. As mentioned, in order to meet the School Board's schedule, the Study Team is aiming for a submission of this interim report by the end of 2021. As such, if you could please provide your comments at your earliest convenience, that would help to ensure that the report contains the material that you need in order to inform the limit of development.

Have a great weekend,

Jennifer

**Jennifer Lawrence, MCIP, RPP**
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# Appendix A-2

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# North Oakville EIR/FSS Terms of Reference

**TOWN OF OAKVILLE**

# NORTH OAKVILLE
# ENVIRONMENTAL IMPLEMENTATION REPORT and
# FUNCTIONAL SERVICING STUDY

## *TERMS OF REFERENCE*

***REVISED – MAY 2013***

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**FIGURES:**

# NORTH OAKVILLE ENVIRONMENTAL IMPLEMENTATION REPORT AND FUNCTIONAL SERVICING STUDY TERMS OF REFERENCE

## 1.0 INTRODUCTION

### 1.1 Background

The North Oakville Creeks Subwatershed Study, including addenda (NOCSS) provides the Management Strategy for the North Oakville Secondary Plan area. The limits of this area are illustrated in Figure 1.1.1, and include the lands north of Dundas Street to the Highway 407 corridor and from Tremaine Road east to Ninth Line. The Management Strategy and associated North Oakville Secondary Plan provide direction for land development within the North Oakville lands.

Integral to these documents is the goal of preserving a sustainable Natural Heritage System (NHS) for maintaining landscape diversity within an urban context. In accordance with this goal, the NOCSS was completed, providing recommendations with respect to the management approach for natural heritage/open space and stream systems. There are certain lands, including watercourses, that are restricted from development and others that have specified limitations or constraints. The Management Strategy and associated North Oakville Secondary Plan also outline requirements with regard to stormwater management, land use policies and servicing.

The NOCSS is divided into four sections, which follow the four phases of a subwatershed management approach:

i) Characterization
ii) Analysis
iii) Management Strategy
iv) Implementation

The Management Strategy for North Oakville is outlined in the last two NOCSS sections: Management Report and Implementation. In the Implementation Report, the processes to be followed as well as implementation details are outlined including the need for an Environmental Implementation Report (EIR) and a Functional Servicing Study (FSS) in support of future Draft Plans of subdivision (Draft Plans). A general overview of the planning/implementation framework is illustrated in Figure 1.1.2, which indicates how the EIR/FSS fits within this process.

### 1.2 Purpose

The purpose of the EIR is to characterize and analyse the natural heritage features and functions and to determine and address the potential impacts of a proposed development application, including servicing requirements, on the NHS. The purpose of the FSS is to identify servicing requirements related to sanitary, water, stormwater, roads and site grading.

Further, the purpose of both the EIR and FSS is to provide a link between the Management Report, Implementation Report, the Secondary Plan, and the Draft Plan submissions for future development applications.

It is recognized that the approach to servicing will, in large part, be guided by conditions within the NHS, including cores, linkages and stream corridors. In addition, the characteristics of these areas may require

the use of measures to protect the function of the NHS from impacts (i.e., prevention of changes to the surface water and groundwater systems to maintain flows to the NHS). As a result, the EIR and FSS must be integrated and may be produced as a joint document.

It is intended that this document provides the Terms of Reference for completion of an EIR and FSS. The EIR/FSS document sets out the study requirements and obligations, including monitoring, for works installed in the secondary plan area, including the NHS. These are the obligation of the landowner proponent who proposes the development or proposes to install the works. In some cases, the Town or the Region may be the proponent of certain works in the secondary plan area or in the NHS. In this latter instance, the study requirements and obligations, including monitoring, are the proponent Town's or the proponent Region's as the case may be and the obligations are not the landowner's obligation.

The preparation of an EIR/FSS is to assist in the development of a Draft Plan. It is to ensure that the requirements of the Subwatershed Strategy and Secondary Plan are met and that the site characteristics are understood in sufficient detail to provide the information necessary for processing of the Draft Plan and to provide conditions of approval. These studies also will support agencies' approvals.

If the Draft Plan does not conform to the Secondary Plan, other planning approvals may be required.

The objectives to be fulfilled by the EIR and FSS are to:

- Demonstrate how the subwatershed requirements set out in the NOCSS Management Report (including targets), the Implementation Report, and Secondary Plan are being fulfilled in all proposed Draft Plans;
- Provide sufficient level of conceptual design to ensure that the various components of NHS and infrastructure can be implemented as envisaged in the NOCSS and Secondary Plan and to ensure that the Draft Plans are consistent with this conceptual design;
- Ensure servicing requirements as determined in the FSS for the areas external to the Draft Plan are adequate;
- Identify details regarding any potential development constraints or conflicts and how they are to be resolved;
- Provide any further implementation details as needed;
- Streamline the Draft Plan approval process; and,
- Facilitate the development of Draft Plan conditions.

The EIR/FSS Terms of Reference are broken down into sections to discuss the overall approach, and details of the studies needed, including monitoring.


NORTH OAKVILLE CREEKS SUBWATERSHED STUDY

TSH engineers architects planners · PARISH geomorphic · Natural Resource Solutions Inc. Aquatic, Terrestrial and Wetland Biologists · Donald G. Weatherbe Associates · Morrison Environmental Limited Groundwater Consultants · Environmental Water Resources Group Ltd.

OAKVILLE

0 500 1,000

Meters

August 2006

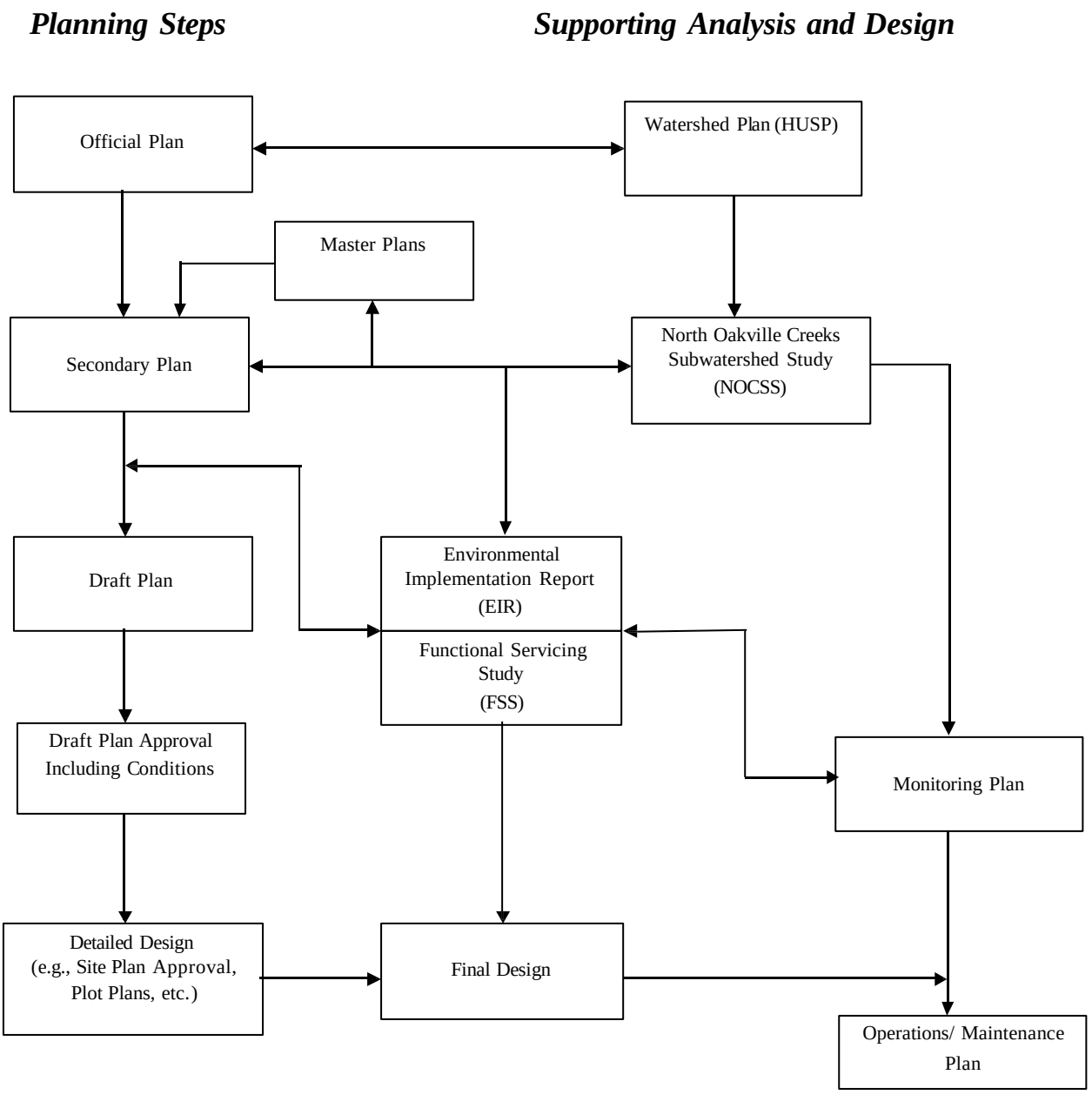
**Legend** Road
Watercourse
Secondary Plan Boundary
EIR Nodes
EIR Subcatchments

# EIR Subcatchment Plan

Figure 1.1.1

**Figure 1.1.2**

**OVERVIEW OF SUBWATERSHED PLANNING IMPLEM ENTATION FRAMEWORK**



# 2.0 APPROACH

## 2.1 Overview

The EIR/FSS is to demonstrate how the proposed development will meet the requirements set out in the Management Strategy and Secondary Plan. To do this, comprehensive technical analyses and design concepts will be necessary as part of the EIR/FSS. It is the intention of these Terms of Reference to indicate how the analyses, design concepts and related reports are to be prepared.

## 2.2 Agencies

It is intended that the EIR/FSS, and subsequent Draft Plans, will be reviewed by the following agencies as related to their respective jurisdictions:

Town of Oakville
Region of Halton
Conservation Halton

The above noted agencies will be the primary contact groups for the EIR/FSS submissions. Depending upon the conditions related to the EIR subcatchment area, it may be decided by one or more of the agencies, primarily Conservation Halton and the Town of Oakville, that input and approval will be needed from the Ministry of Natural Resources (MNR) and/or Department of Fisheries and Oceans (DFO). This input will be coordinated by the Town and Conservation Halton. It is understood that proponents can liaise with the agencies as necessary as part of this process. Input from DFO is anticipated in the review of conceptual and final design on any sections of streams where fish habitat compensation is required.

## 2.3 Study Areas

It is intended that the EIR be carried out on a subcatchment basis, which forms the study area for the EIR. The EIR subcatchments are illustrated on Figure 1.1.1. The study area for the FSS will focus on the proposed development area for the intended Draft Plans (referred to as "proposed development area" in subsequent sections of this document). It is recognized that consideration will likely be required beyond the FSS study area to ensure that servicing can be provided for neighbouring areas.

Each EIR/FSS will be evaluated to ensure that the flows outletting from each area are managed in a manner that will properly protect the receiving stream(s), in accordance with the NOCSS Management Strategy. Carrying out the EIR based on the specified subcatchments will address the following:

Preservation of drainage areas to the various stream branches within the subwatersheds; and,
Provide for meeting target flows, water quality and erosion targets for the various receiving points along the streams.

In some cases, the study area for the NHS system (cores and linkages, and streams) may extend beyond the subcatchment, as discussed in Sections 3.2 and 3.3.

It is recognized that the EIR subcatchment areas do not correspond to land ownership boundaries and that it may be difficult to ensure the cooperation of landowners to carry out an EIR/FSS within the specific

study subcatchment. Every effort should be made to facilitate cooperation between landowners to carry out the EIR/FSS within the EIR subcatchment. If more than one landowner within an EIR subcatchment is active in the EIR/FSS process, only one EIR study will be permitted (i.e., no concurrent EIR studies for the same area). Subsequent development in the EIR subcatchment area will require the preparation of a separate FSS and an update of the EIR, to conform to the findings and recommendations of all previous EIR/FSS studies. In the event that this concurrent joint report cannot be accomplished, it is recognized that consideration will be given to permitting a modified approach. In that event, certain conditions will need to be met to ensure that the requirements of the Management Strategy and Secondary Plan are met and that any proposed development does not place any undue restrictions on other lands within the EIR subcatchment area not included in the study.

Various scenarios could arise where the proposed development (Draft Plan areas of participating owners) does not correspond to the EIR subcatchment area boundary. Anticipated scenarios and the approach that should be used for each are outlined in the following items. These are presented as examples and do not include all potential scenarios:

i) The proposed development is in the upstream portion of the EIR subcatchment.
   EIR/FSS will need to indicate how land will be serviced on an interim and final basis;
   If the existing receiving watercourse is used as an outlet, assumptions as to the final outlet conditions are to be indicated. The submission must demonstrate how drainage from upstream lands including stormwater management systems, will be conveyed to a suitable outlet without placing undue restrictions on the serviceability of adjacent lands;
   If a proposed stormwater management (SWM) facility is downstream of the proposed development, an interim facility may be provided, with a long-term approach indicated, in the event that a permanent facility is not constructed;
   If stream modifications extend beyond the limits of the proposed development area (e.g., lowering or relocations), they also must be addressed conceptually;
   Conceptual design of trunk services within the EIR subcatchment must be prepared, including appropriate allowances for connections to areas external to the Draft Plan and/or EIR subcatchment, demonstrating servicing viability without placing undue restrictions on external areas (e.g., considering sewer depths and grading); and,
   Street and land use patterns outside of the proposed Draft Plan are to be provided as per the Secondary Plan with input from the Town of Oakville.

ii) The proposed development is in the downstream portion of the EIR subcatchment.
   EIR/FSS will need to indicate how land will be serviced/graded on an interim and final basis;
   If SWM facility is located in the proposed development area and is to service the upstream portion of the subcatchment, the facility is to be sized for the entire upper subcatchment, based on the land use from the Secondary Plan with input from the Town of Oakville;
   If stream modifications extend beyond the limits of the proposed development area (e.g., lowering or relocations), they also must be addressed conceptually;
   Conceptual design of trunk services within the EIR subcatchment are to be prepared, including appropriate allowances for connections to areas external to the Draft Plan and/or EIR subcatchment, demonstrating servicing viability without placing undue restrictions on external areas (e.g., considering sewer depths and grading); and,
   Street and land use patterns outside of the proposed Draft Plan are to be provided as per the Secondary Plan, with input from the Town of Oakville.

iii) The proposed development is within the majority of the EIR subcatchment with minor portions outside.

Consideration will be given to minor adjustments in subcatchment boundaries with the conditions that the adjustments would not put undue restrictions on the servicing of adjacent subcatchments and demonstrate no negative impacts to flooding, erosion and the NHS; and,

If no change in subcatchment boundary is proposed, consideration is to be given to how development in the adjacent subcatchment is to be serviced. Conceptual drainage patterns are to be developed and profiles generated to ensure that the area can be serviced.

## 3.0 STUDY REQUIREMENTS

Studies are required for the EIR/FSS in the areas of:

Land Use
Cores and Linkages
Stream Systems, Fish, and Fish Habitat
Grading, Drainage and SWM
Hydrogeology
Sanitary, Water, Roads
Trails

The specific study requirements are outlined in the following sections.

### 3.1 Land Use

The proposed land use, road patterns and servicing layout are to be provided through the EIR/FSS submission. The EIR/FSS submission should reflect the Secondary Plan land uses. Further land use details will be provided in the corresponding Draft Plans. If the EIR subcatchment extends beyond a particular Draft Plan, land use details in those areas must reflect the Secondary Plan, with input from the Town of Oakville.

The land use map for the portions of the EIR subcatchment area that are outside the limits of the Draft Plan will include details for the following to demonstrate the Draft Plan context with regard to the rest of the subcatchment:

Land use designations
Natural heritage system (cores, linkages and stream corridors)
Major roads
Major services
SWM Blocks
Trails

Planning input to the EIR/FSS is needed to demonstrate the logical coordination of land uses, road connections and open space linkages and features for the Draft Plan(s), lands extending beyond the limits of the Draft Plan(s), and potentially beyond the limits of EIR subcatchment area.

## 3.2 Cores and Linkages

### *3.2.1 Introduction*

The following section summarizes the study requirements for cores and linkages in the EIR/FSS. The NOCSS and current approaches to natural heritage planning strongly recommend that certain study components be completed at a larger ecologically based study area than the proposed development area (i.e. the EIR subcatchment boundaries or beyond). On the other hand, certain impact assessments require details that are only available at the Draft Plan level of detail. As such, the following discussion of the Terms of Reference is divided into two components.

Study components that must be completed at the EIR subcatchment area level or beyond: This level of study is required since many ecological processes and features extend beyond the limits of a single Draft Plan and require analysis based on ecological study boundaries in order to understand the factors that drive the sustainability of the ecosystem; and

Study components that require Draft Plan level of detail in order to be completed: This level of study focuses on detailing the potential impacts of proposed land use changes on the natural features and functions. As such, details regarding the proposed undertaking must be available in order to understand the sources of, and potential mitigation of, potential impacts.

In cases where an entire EIR subcatchment area is covered by participating landowners, the two levels of detail can be integrated. In cases where a Draft Plan(s) for only a portion of the lands within a particular EIR subcatchment area is being advanced, it is critical that proponents have regard for the varying levels of detail at each level.

### *3.2.2 Cores*

**EIR Subcatchment Area Level of Detail:**

Confirm limits of EIR subcatchment and FSS study area based on overlap of Draft Plan(s) with subcatchments, extent of cores, especially those that extend beyond subcatchment boundary (for linkages see below);

Delineate core boundaries based on NOCSS and present the boundaries on recent aerial photographs;

Assemble background information on natural environment features and functions within the core(s) from the NOCSS and other secondary sources, including features, functions and management recommendations;

Conduct preliminary field review of features to confirm limits and character of vegetation communities (e.g. using recent aerial photographs); and,

Identify any effect of other works (i.e. road crossings, servicing, SWM, trails, etc.) and associated requirements related to cores and linkages.

**Draft Plan Level of Detail:**

Complete appropriate seasonal field surveys of the limits of woodlands, wetlands and other habitats associated with the core(s), generally within 50m of vegetation community boundaries that define the limit of the core;

Apply the buffers to the natural features based on the NOCSS recommendations, to define the boundaries of the core;

Stake and survey the boundaries of core areas including limit of buffers based on guidance provided in NOCSS;

These staked core boundaries are to be confirmed in the field by staff of Conservation Halton, Town of Oakville and Ministry of Natural Resources (at the discretion of Conservation Halton);

Identify limits of grading adjacent to a core, and assess the impacts of any grading adjacent to the core(s), and detail mitigative measures and/or management recommendations, where needed;

Detail the proposed drainage characteristics of lands adjacent to core and assess any impacts associated with drainage to the natural features, functions and management recommendations;

Detail stormwater management facilities proposed adjacent to the core(s) and assess the impacts of construction and operation of the stormwater management facility on core features, functions and management recommendations;

Where a SWM pond is permitted* within a core, stake and survey the limit of stormwater management pond block overlap with the core boundary (as per NOCSS). This is to be reviewed in the field by agencies as noted above, and the impacts of construction and operation of the stormwater management facility on core features, functions and management recommendations assessed;

Identify all services, utilities etc. proposed to be located adjacent to or within cores and assess the potential impacts* of these facilities on core features and functions;

In cases where a core is crossed by a road installed by a proponent, provide information respecting the road characteristics and identify potential impacts to features and functions within the core, (including delineation of features) and protective measures;

Detail location, type and size of crossing structures from a wildlife movement (ecopassage) perspective;

Detail any restoration measures within the core that may be triggered by proponent proposals to encroach into cores (road crossings, SWM);

Detail mitigative measures and assess potential residual impacts of proponent works within the cores and any proponent grading or works adjacent to the cores. Provide evidence that alternative methods and measures for minimizing impacts have been considered; and,

Develop a plan for monitoring the mitigative measures noted above, based on liaison with agency staff (Conservation Halton, Town of Oakville).

** See 'Field Survey Requirements' detailed within 'Trails' section of this document.*

### *3.2.3 Linkages*

**EIR Subcatchment Area Level of Detail:**

Confirm limits of EIR subcatchment and FSS study area based on the overlap of Draft Plan(s) with subcatchments, and extent of linkages (i.e. identify cases in which linkages extend beyond limits of subcatchment and include these areas within study);

Delineate linkage areas based on NOCSS and present the boundaries on recent aerial photographs;

Assemble background information on natural environment features within linkages from NOCSS and other secondary sources;

Conduct a preliminary field review of features to confirm limits and character of vegetation communities within linkages (e.g. using recent aerial photographs);

Review stream corridor assessment to ensure that any proposed proponent modifications to stream corridors (locations, widths, etc.) that may influence linkages are identified;
Show linkage limits in conjunction with conceptual subcatchment- level stream corridor on plans.

**Draft Plan Level of Detail:**

Delineate and describe any natural features (e.g., hedgerows, wetlands, etc.) that are to be incorporated into the linkage, and stake and survey as necessary;
Identify means by which these features will be protected during development/construction process;
Identify the boundaries of linkage areas, and confirm them in the field with staff of Conservation Halton, Town of Oakville and Ministry of Natural Resources (at the discretion of Conservation Halton);
Identify limits of grading, and assess any impacts of re-grading within linkage and adjacent to the protected features within linkage;
Detail the drainage characteristics of lands adjacent to natural features within linkages to be retained (if any), and assess any impacts associated with drainage to the natural features;
In cases where a linkage is crossed by a road(s) installed by a proponent, detail the road characteristics and identify potential impacts to features within the linkage (if any) including delineation of features and protective measures, detail location, type and size of crossing structures from a wildlife movement (ecopassage ) perspective;
Identify the limit to which a stormwater management pond overlaps with linkage boundary (as per NOCSS), to be reviewed in the field by agencies as noted above;
In linkages which include stream corridors, it may be necessary to stake and survey the linkage (and the SWM pond overlap) at this time;
Detail any restoration/naturalization measures within the linkage whenn proponent intrusion has occurred.
Detail mitigative measures and assess potential residual impacts of proponent works/intrusions; and,
Develop a monitoring plan of the mitigative measures noted above, based on liaison with agency staff (Conservation Halton, Town of Oakville).

## 3.3 Stream Systems, Fish Habitat and Fish Communities

### *3.3.1 Introduction*

The Natural Heritage System for North Oakville includes protection and enhancement of high and medium constraint streams, which are identified as red and blue streams respectively in the Secondary Plan. This approach identified the "provision of a corridor system for streams that have been identified as having environmental characteristics or watershed functions that require protection and/or enhancement to meet the watershed goals and objectives" (NOCSS, Management Report Section 6.3.2).

The stream corridors identified in the NOCSS and Secondary Plan were developed using the concept of riparian corridor identification. The classification was based upon the stream characteristics and related processes considering the role of adjacent lands. This approach then identified the streams to be protected as well as the width of neighbouring lands, or corridor widths that need to be protected. This classification was developed in conjunction with the Department of Fisheries and Oceans and

Conservation Halton, who conducted field surveys with representatives of the Town of Oakville subwatershed team.

The corridors have been identified in the Management Strategy and Secondary Plan as well as the conceptual width requirements. It is the intent that the corridor widths of the red and blue streams, and the end points of the reach delineations are to be refined as part of the EIR/FSS study. The factors to be considered in the refinement of the stream systems and corridor widths include:

Regulatory floodplain;
Fluvial geomorphologic requirements;
Stable slope top of bank;
Fish and fish habitat protection requirements;
Preservation of hydrogeologic functions;
Edge of any identified terrestrial features;
Hydrologic Features "A"; and
Setback and buffer requirements.

The following sections present a summary of the EIR/FSS study requirements for the development of North Oakville with respect to the streams component of the NHS.

### *3.3.2 Existing Conditions and Constraint Mapping*

The following tasks must be undertaken by the proponent in order to fulfill the requirements of the EIR/FSS:

Describe the proposed land use change and associated servicing issues;
Confirm limits of EIR subcatchment area based on the NOCSS;
Assemble and review all relevant materials pertaining to the stream system of the NHS including the Secondary Plan and NOCSS and other studies;
Compile existing conditions and constraints (from existing data) and display on recent aerial photographs to delineate the stream system of the NHS; and,
Review and summarize factors leading to the identification of the corridor constraint level from a natural heritage perspective.

### *3.3.3 Detailed Studies*

The following sections summarize the detailed study requirements for:

Corridor Width Delineation
Fish and Fish Habitat
Stream Modification and Rehabilitation

#### *3.3.3.1 Corridor Width Delineation*

Through the NOCSS, stream corridor widths were developed on a broad scale and, as such, are subject to refinement during the EIR/FSS stage. **Figures 6.3.15a, 6.3.15b** and **6.3.15c** in the Management Report of

NOCSS and an Appendix of the Secondary Plan provide illustrations clarifying the stream corridor delineation process. The corridor is defined considering the factors outlined in Section 3.3.1.

Specifically, the following tasks must be completed by the proponent in order to fulfill the EIR/FSS requirements:

**a) Geomorphology:**

Confirm delineation and potential refinement of stream reaches as outlined in the NOCSS;
On a reach basis, conduct an historic evaluation of changes in land use and channel configuration over time utilizing a series of historic aerial photographs or mapping that extend from the earliest (i.e., 1930's to 1950's) to most recent coverage available;
Based on the results of the historic evaluation, quantify the 100-year erosion rate on a reach basis;
Delineate meander belt width on a reach basis, following Belt *Width Delineation Procedures* (PARISH Geomorphic Ltd., 2004). It should be noted that factors affecting the ultimate stream corridor width include degree of channel confinement, type of valley system (i.e., major or minor valley), channel position relative to the valley wall and proposed servicing modifications;
As per **Figures 6.3.15a** and **6.3.15b**, apply the 100-year erosion rate to each side of the belt width as a factor of safety (in lieu of an historic evaluation, a factor of safety represents 10% of the meander belt width on each side (total of 20%) or as determined through a 100-year erosion rate of channel bends that define the belt width); and,
Perform field investigations, including rapid geomorphic assessment, to confirm desktop analysis, with respect to the 100-year erosion rate and meander belt width on a reach-by-reach basis.

**b) Regulatory Floodplain**

The floodplain will be defined for all medium and high constraints streams, which are identified as red and blue streams respectively in the Secondary Plan;
The floodplain calculations shall be based on the applicable Provincial Technical Guidelines (i.e., Technical Guide – River & Stream Systems: Erosion Hazard Limit, Ministry of Natural Resources & Watershed Science Centre, 2002). It is intended that the Regulatory Floodplain would be determined through this process. Further the calculations should include consideration of:

- Flow rates based on Regional Storm (existing or future land use, as appropriate (see Section 3.4.4)) or 100-year flood event, whichever is greater;
- Stream corridor hydraulic properties (i.e. roughness), based on existing and planned ultimate conditions;
- Where alteration of any existing floodplains is proposed, demonstrate the preservation of floodplain stage-storage -discharge in accordance with directions in the NOCSS; and
- Field surveys to provide cross-sections and an invert profile to provide for updated regulatory flood lines to Conservation Halton specifications.

A full range of return period flood levels will be calculated for the purpose of maintenance of riparian storage calculations, SWM facility and outlet design, etc.

**c) Geotechnical**

As per **Figure 6.3.15a** and in fulfillment of Conservation Halton's *Policies, Procedures and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (2006), a site specific study must be completed to determine the toe erosion allowance on a reach basis for confined river systems;

As per **Figure 6.3.15a** and in fulfillment of Conservation Halton's *Policies, Procedures and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (2006), a geotechnical stable slope assessment must be completed to determine the 'stable slope top of bank' in a confined setting. The stable slope line is to be drawn from the limit of the toe allowance;

As per **Figure 6.3.15b**, if a stream within an unconfined corridor will be lowered for servicing such that the valley depth becomes greater than or equal to 2 metres, then geotechnical stable slope design must be incorporated (refer to **Figure 6.3.15a**);

The physical (or geographical) 'top of bank' of valley features greater than or equal to 2 metres in height, will be established in the field in conjunction with Conservation Halton and Town of Oakville staff, and the applicant. The top of bank, as staked in the field, will represent the limit of the physical top of bank. When staking the limit of the physical top of bank, staff of Conservation Halton will require that the applicant's surveyor be in attendance during the site walk; and,

Based on the results of the geotechnical stable slope assessment, identify the greater of the 'stable slope top of bank' and the 'physical top of bank'.

**d) Fish Habitat Setback**

Identify any relevant fish habitat setbacks, on a reach basis. These setbacks are to be based on the fisheries buffers recommended in the NOCSS Management Report, and as confirmed through the studies outlined in Section 3.3.3.2;

With respect to Species at Risk, fish habitat setbacks will be identified on a reach basis with reference to NOCSS, and through discussions with relevant agencies; and,

As per **Figures 6.3.15a** and **6.3.15b**, these fish habitat setbacks are to be applied to the bankfull channel, or unless otherwise specified in the NOCSS Management Report.

**e) Valleylands Setback**

Determine the nature of the valley setting (major or minor) on a reach basis. Major valley system refers to the Sixteen Mile Creek valley system, and the balance of the valley systems in North Oakville are minor systems;

In confined river systems, a 15 metre setback must be applied to the stable slope top of bank for major valley systems and a 7.5 metre setback must be applied to the stable slope top of bank for minor valley systems;

In unconfined river systems, a 15 metre setback must be applied on both sides of the meander belt allowance for major valley systems and a 7.5 metre setback must be applied on both sides of the meander belt allowance for minor valley systems; and

In some cases, the Regulatory Floodline may define the corridor width. Floodplain modifications (subject to the approval of Conservation Halton) may alter the location of the floodline in which case the setback would be applied to the altered floodline.

It should be noted that, as per **Figure 6.3.15c**, the final corridor width determined on a reach basis for confined river systems represents the greater of the meander belt width plus factor of safety plus major/minor valley system setback OR the stable slope top of bank plus toe erosion allowance plus major/minor valley system setback. If servicing modifications are proposed within the identified land use change, the proponent must be cognizant of the implications of channel deepening which may result in a reclassification of degree of stream confinement.

**f) Forested Stands within Stream Corridors**

The presence of forested stands within stream corridors was not used as a factor directly affecting stream corridor widths in the NOCSS. However, preservation of forested stands within stream corridors is generally preferred, and recommendations were provided in the NOCSS for forest preservation within stream corridors. For the purposes of an EIR/FSS, the following tasks must be completed:

Use a combination of aerial photographs, ground-truthing, and ELC mapping to determine the extent of forested cover within potential stream corridor(s) (as defined by other factors discussed in this section of the Terms of Reference);
Identify the characteristics of forested stands and their relationship to the stream corridor (including potential implications, if any, on stream corridor width/location); and,
Identify forested stands within the stream corridor(s) and measures to be used to protect and/or manage them as appropriate.

### *3.3.3.2 Fish and Fish Habitats*

**Introduction:**

The following section summarizes the study requirements for fish and fish habitats in the EIR/FSS. An assessment of fish habitat throughout the EIR subcatchment area will be required. This will provide the context and ensure that connectivity to fish habitats throughout the subcatchment are understood and addressed as required by DFO. On the other hand, certain impact assessments require details that are only available at the Draft Plan level of detail, especially those associated with proposed stream modifications. As such, the following discussion of the Terms of Reference is divided into three components.

Study components that must be completed at the EIR subcatchment area level or beyond: This level of study is required to assess fish habitats that extend beyond the limits of a single Draft Plan and require analyses based on subcatchment boundaries in order to understand the factors that drive the sustainability of the aquatic ecosystem;
Study components that require Draft Plan level of detail in order to be completed: This level of study focuses on detailing the potential impacts of proposed land use changes on the fish habitats. As such, details regarding the proposed undertaking must be available in order to understand the sources of, and potential mitigation of, potential impacts; and,
Study components that focus on cases of proposed modifications to streams.

**EIR Subcatchment Area Level of Detail***:*

Carry out the work necessary to refine, map and describe stream reaches on an EIR subcatchment area basis to compare this mapping to mapping done for the NOCSS Characterization Report, and present findings on recent aerial photographs to determine any changes to channel alignment or location relative to the NOCSS;

Assemble background information on fish and fish habitats from the NOCSS and other secondary sources;

Conduct a preliminary field review (e.g. using recent aerial photographs) of aquatic habitat factors leading to the classification of aquatic habitat (i.e., critical, important, marginal) as defined in the NOCSS and confirm the aquatic habitat designation of each stream on a reach basis;

Identify reaches with critical, important or marginal aquatic habitat targeted for rehabilitation measures (to identify compensation opportunities); and,

Compile aquatic habitat management recommendations on a reach basis as identified in the Management Strategy.

**Draft Plan Level of Detail:**

Prepare detailed habitat mapping for all streams that contain fish habitat, which potentially may be impacted by the proposed development (e.g., road crossings, SWM outfalls, compensation reaches, trails, etc.). Confirm location and map important habitat structure including in-stream vegetation, boulders, undercut banks, riffles, pools, runs, and woody debris;

Identify any habitat features supporting critical life stages of fish or other aquatic biota and describe potential impacts to this habitat. Indicate how impacts to these critical habitats will be mitigated so as not to affect the form or function of these habitats;

Additional fish sampling may be necessary to fill information gaps, as determined in consultation with Conservation Halton;

Detail the proposed drainage characteristics of lands adjacent to fish habitats and assess any impacts associated with drainage ;

Detail proposed works (e.g., stormwater management facilities, road crossings, grading, trails, etc.) adjacent to the fish habitats and assess/predict the impacts of construction and operation of the works, considering channel length and form, riparian buffers, flow volume and duration, water quality and water temperature;

Detail mitigative measures and assess potential residual impacts of any works in or adjacent to fish habitats. Provide evidence that alternative methods and measures for minimizing impacts have been considered; and,

Identify buffers from stream reaches for use in identifying stream corridor widths (see Section 3.3.3.1 d).

**Modified Stream Reaches:**

Complete fish and fish habitat studies required for proposed stream modifications (see Section 3.3.3.3 below).

### *3.3.3.3 Stream Modification/Rehabilitation Measures*

Stream rehabilitation opportunities have been identified in the Management Strategy and are illustrated in **Figure 6.3.13 ( NOCSS)**. **Section 6.3.4.2 (Table 6.3.4)** of the Management Report identifies enhancement recommendations for stream rehabilitation and **Section 6.3.4.6** (**NOCSS)** outlines considerations for stream relocation.

Stream modification may occur under circumstances such as the following:

Stream reach rehabilitation
Stream reach relocation and/or lowering
Road, trail and infrastructure crossings
Construction of SWM outfalls

It should be noted that authorization by the DFO will be required for any watercourse alteration resulting in a Harmful Alteration, Disruption or Destruction (HADD) of fish habitat and may be required for rehabilitation and for elimination of some low constraint streams. Consultation with DFO, in conjunction with Conservation Halton is required.

Where modifications are proposed by a proponent for medium constraint streams, it will be necessary to demonstrate that the newly constructed stream will maintain and where possible enhance existing channel form, function and aquatic habitat. The established riparian corridor width must also be maintained on a reach basis. Reconstructed channels should incorporate "natural channel design" elements and should transition effectively with downstream receiving waters. Specifically, the following requirements must be fulfilled as part of the EIR/FSS:

Perform 'rapid' field assessments to determine channel sensitivity and identify dominant processes (e.g., aggradation, widening, planform adjustment). During this assessment any existing erosion sites or infrastructure will be mapped and evaluated for rehabilitation or removal;
Conduct a detailed field investigation of the reach requiring modification or an appropriate reference reach (channel relocation) in order to determine existing aquatic habitat features, stream geometry and channel morphology;
Confirm the extent of all fish habitat with DFO during preparation of the EIR/FSS;
Prepare a fish habitat compensation plan that clearly demonstrates how modified reaches will achieve a net gain in fish habitat and meet the 'no net loss in fish habitat productivity' as required by Section 35(2) of the Fisheries Act;
Illustrate the extent of any features supporting critical life stages of fish or other aquatic biota and clearly demonstrate how the proposed compensation will replace the form and function of this habitat;
Quantify existing aquatic habitat features (e.g., number and linear extent of pools, riffles, runs) for use in ensuring that the proposed compensation plan adequately replaces the type and extent of existing habitats;
Use a combination of aerial photographs, ground-truthing, and ELC mapping to determine the extent of wetland cover for each Hydrologic Feature 'A';
Identify the form and function of each Hydrologic Feature 'A' and document its ecological and hydrologic relationship to the watercourse (e.g., does the feature represent an online pond or wetland);
Identify how the ecological and hydrological relationships of the Hydrologic Feature 'A' is considered in the proposed stream modification;
Develop preliminary design concepts based on the principles of "natural channel design";

Review hydraulic modeling to confirm 2-year flow conditions, regulatory flood levels and any potential impacts of modifications on regulatory floodlines;
Based on the foregoing, identify the recommended modification to the watercourse in the form of conceptual drawings;
Clearly demonstrate how the proposed modification measures meet the management recommendations identified in the Management Strategy;
Consider construction approach and timing of conceptual design; and
Identify and detail mitigation requirements related to road crossings.

Design submission requirements will be specified by the review agencies and generally will include the following:

Plans and elevations;
Restoration details including conceptual landscape plans, planform, profile, cross-sections and typical treatments;
Erosion and sediment control requirements;
Design brief; and
Monitoring Plan for proponent modifications, including any DFO requirements.

## 3.4 Grading, Drainage, Stormwater Management

### *3.4.1 Introduction*

A major element of the EIR/FSS involves the development of a preliminary grading, stormwater servicing and stormwater management plans. This is to address the overall serviceability of the lands, to determine the grading required to service the lands, and to ensure integration with neighbouring lands, cores, linkages and receiving watercourses.

### *3.4.2 Topography and Grading*

The following additional work will be needed to upgrade existing information and provide the additional details required to develop grading and servicing plans:

Topographic mapping that meets Town of Oakville and Conservation Halton requirements, if any;
Detailed survey information is to be obtained for any proposed watercourse crossings, core or linkage crossings for services, including roadways; and
Collection of field information to further delineate and quantify topographic depressions as identified in the NOCSS study.

### *3.4.3 Preliminary Grading and Drainage Plan*

Use updated topographic mapping and survey work to refine the EIR subcatchment boundaries; Prepare a preliminary grading plan for the proposed development area, and a conceptual grading plan for the EIR subcatchment as necessary, to ensure servicing functionality. It is recognized that the level of detail for the EIR subcatchment will be more conceptual than within the proposed development area;

A drainage and servicing plan for the EIR subcatchment area is to be developed identifying the storm drainage network, including conceptual designs of storm trunk sizes and profiles, SWM facilities (see Section 3.4.5) and the major and minor system;
Potential conflicts with the ability to protect the NHS are to be identified and mitigation proposed. Examples include:

- Any increase or decrease in drainage area to a NHS feature. It is intended that existing drainage characteristics (e.g., flow volumes, form and location) are maintained. Some minor flexibility in this may be possible provided that the feature and its functions are protected;
- Change in grades adjacent to a NHS feature that could impact surface drainage or groundwater conditions;
- Location of underground services adjacent to a NHS feature that would influence groundwater levels and impact the feature (i.e., wetland).
- Details on proposed drainage features with NHS areas designed with the purpose of protecting, maintaining and augmenting the natural hydrological regime of the NHS. All proposed (or required) drainage features must also be shown on the plan(s), including the extent of grading associated with the drainage feature. The location of these works should be considered during the staking process. If this drainage feature is associated with a proposed trail system refer to Section3.7 for further requirements.

Grading and servicing details in support of stream lowering and/or relocation to be undertaken by a proponent are to be provided.
Lowering of existing culverts at Dundas Street may need to be considered. The lowering of red streams is not permitted; however, this may apply to blue streams and any other crossings. If proposed by a proponent, details of any lowering are to be provided, as detailed in Section 3.3.3.3; and,
A conceptual approach to erosion and sediment control is to be provided to the satisfaction of the Town.

### *3.4.4 Water Resources-Related Analyses*

Analysis and/or modeling are required for the following components:

Hydrology and SWM facility analyses:
- Water quantity
- Water quality and water balance
- Erosion control
- Topographic depressions

Development or refinement of floodline mapping (see Section 3.3.3.1 b)
Flow analysis for drainage system design (sewer sizing in accordance with municipal standards)

Guidance to the analysis required to address the hydrology and SWM facility analyses is presented in the following subsections.

**a) Water Quantity**

*Hydrology Modeling*

The approach to modeling for hydrology related to SWM sizing for flood and erosion control is to be determined in consultation with the Town of Oakville and Conservation Halton, as an initial step in the EIR/FSS. Consideration of impacts to existing downstream online facilities will need to be addressed in the EIR/FSS. It is intended that flexibility be provided in the selection of a modeling approach; however, the approach is to follow commonly accepted practices.

The modeling of predevelopment conditions to establish unit flow rate targets for quantity (flood) control (2-year through Regional Storm flows) purposes has been completed as part of NOCSS. Further modeling of predevelopment conditions is not required for this purpose. SWM ponds are to be sized to meet unit flow rate targets.

*Regional Storm Control*

The NOCSS recommends that stormwater management targets include control of the peak flow to predevelopment levels for the 2-year to 100-year return period events and the Regional Storm. With the exception of Joshua's Creek, where control of the Regional Storm event is required, future land use development applicants may carry out an investigation of the potential increase to flood risk to confirm if Regional Storm controls are necessary. Existing stream crossings and online control structures should be field verified by the proponent and reflected in the modeling as part of the Regional storm control analysis. This analysis is to include the increase in risk to life as well as the potential for flood risk to private, Municipal, Regional, Provincial and Federal property under Regional Storm conditions. If the study finds, and the Town and Conservation Halton concur in that finding, that no increase in risk occurs to downstream landowners or public uses, the Town in conjunction with Conservation Halton will conclude, subject to consideration of any other relevant factor within their respective mandates, that control at the Regional Storm level is not required. Evaluation of risk may include, but is not limited to:

All development within North Oakville for the watershed under consideration;
The potential increase in flood risk for the entire downstream watercourse to its outlet at Sixteen Mile Creek;
The examination of potential increase to flood risk related to the:

- Potential increase in flood elevations;
- Potential increase in flood velocities;
- Potential for the foregoing increases to adversely affect all landowners including individuals, municipal agencies, provincial agencies (MTO, MOE, etc.) and federal agencies;
- Potential for the foregoing increases to adversely affect all land uses including road crossings, private access road, parks, storm sewer outlets, etc.; and,
- Potential for the implementation of mitigation measures to address any increase in risk as an alternative to the requirements to control Regional Storm flows.

It is understood that not all increases in flood velocity or flood elevation will necessarily lead to an increase in risk.

The final approach with respect to this issue may have a significant impact on the SWM quantity related results for the EIR/FSS.

If it is determined, by the Town of Oakville, in conjunction with Conservation Halton, that it is not necessary to control peak flow rates, under Regional Storm conditions, to pre-development levels, then post development flow rates for the Regional Storm will need to be calculated through modeling as part of this study. These flow rates will then be used to determine flood elevations and associated flood lines for regulatory purposes. The modeling will be carried out to the satisfaction of the Town of Oakville and Conservation Halton.

**b) Water Quality and Water Balance**

The NOCSS recommends meeting MOE's Enhanced Level of protection (Level 1) for phosphorus control and fishery protection in sizing stormwater management facilities for water quality control. It is an objective of the Town that there be no-net increase in phosphorus loadings as a result of development. This objective will be met with the use of enhanced Level SWM ponds and as a result, there is no requirement to further analyze phosphorus loadings during development approvals.

The NOCSS also recommends the use of a hierarchy of stormwater controls with preference for source control (site level), then conveyance system control, followed by end-of-pipe control. In addition, where feasible, the use of infiltration measures, including the diversion of drainage to pervious surfaces as well as designed infiltration facilities, surface retention , and storage is encouraged, to help maintain pre-development water balance conditions (see also Section 3.5 Hydrogeology). The implementation of the foregoing would be subject to best efforts to meet water balance objectives, including reduced runoff volumes and maintenance of groundwater levels, and the hierarchy of SWM controls. The examples presented in NOCSS Appendix AA – Test Catchment Design Case and Appendix LL – Analysis of Treatment-Train Design for Water Quality Control reflect both the hierarchy of measures (treatment-train approach) and the use of infiltration measures in the design.

Should the proponent wish to further analyze SWM pond sizing to account for the use of a variety of SWM measures (i.e., potential to reduce pond sizes), the above noted appendices present procedures for the following cases:

In the case where Enhanced Level water quality ponds are to be used, calculations to support a reduced level of imperviousness will be acceptable as a basis for sizing the water quality pond where source or conveyance controls also are used to provide surface storage/retention or infiltration in permanent locations;

In the case where an Enhanced Level water quality SWM pond is not proposed but rather a combination of source, conveyance system, and/or end-of-pipe facilities are proposed, then calculations of the combined efficiencies of the facilities should be carried out to support the design, with a view to achieve a combined performance of 80% TSS removal and/or 65% TP removal, as required by an Enhanced Level of protection; and,

For serviced lands with a drainage area of less than 5ha, where the size of drainage area limits the feasibility of end-of-pipe facilities for SWM, the use of lot and/or conveyance type of SWM measures will be needed to meet SWM requirements. It is recognized that it may be difficult to meet the enhanced level of SWM needed to provide for the water quality control target. In that event, it must be demonstrated that every reasonable effort has been made to provide an approach that would meet the water quality target. If it is agreed by the Town of Oakville and Conservation Halton that enhanced level of control cannot be provided for in the serviced area, it must be demonstrated that the enhanced level of control, as well as other SWM targets are being met within the overall EIR subcatchment area that contains this particular serviced area.

### c) Erosion Control SWM Facility Sizing

In order to ensure that the receiving channels will not experience higher than normal rates of erosion, a threshold flow needs to be incorporated into the design of each SWM facility. Analysis in support of SWM facility sizing must include erosion threshold analysis and continuous hydrologic modeling to ensure that appropriate extended detention storage is provided.

Erosion thresholds were broadly characterized in **Section 5.8 (Table 5.8.5)** of the NOCSS Analysis Report. A more detailed determination of erosion thresholds is required at the EIR/FSS stage. These thresholds are meant to be integrated into a stormwater management system design in such a manner that existing channel erosion or aggradation is not exacerbated. Specifically, the following requirements must be fulfilled as part of the EIR/FSS:

Confirm reach delineation work completed for the NOCSS using best available mapping and aerial photography;

Determine if erosion thresholds previously identified in the NOCSS apply to the EIR subcatchment area;

Confirm the location of SWM ponds within and downstream of the identified EIR subcatchment area;

Conduct rapid geomorphic assessments on a reach basis to verify desktop analyses and identify areas most susceptible to erosion;

Perform detailed field investigation(s) along the most geomorphologically sensitive reach(es) to quantify channel geometry and identify active geomorphic processes;

Apply multiple analytical methods (e.g. critical shear, stream power and permissible velocity models) to the field data in order to calculate an erosion threshold in terms of the point at which sustained flows will tend to entrain and transport sediment using data collected during the detailed field investigation(s);

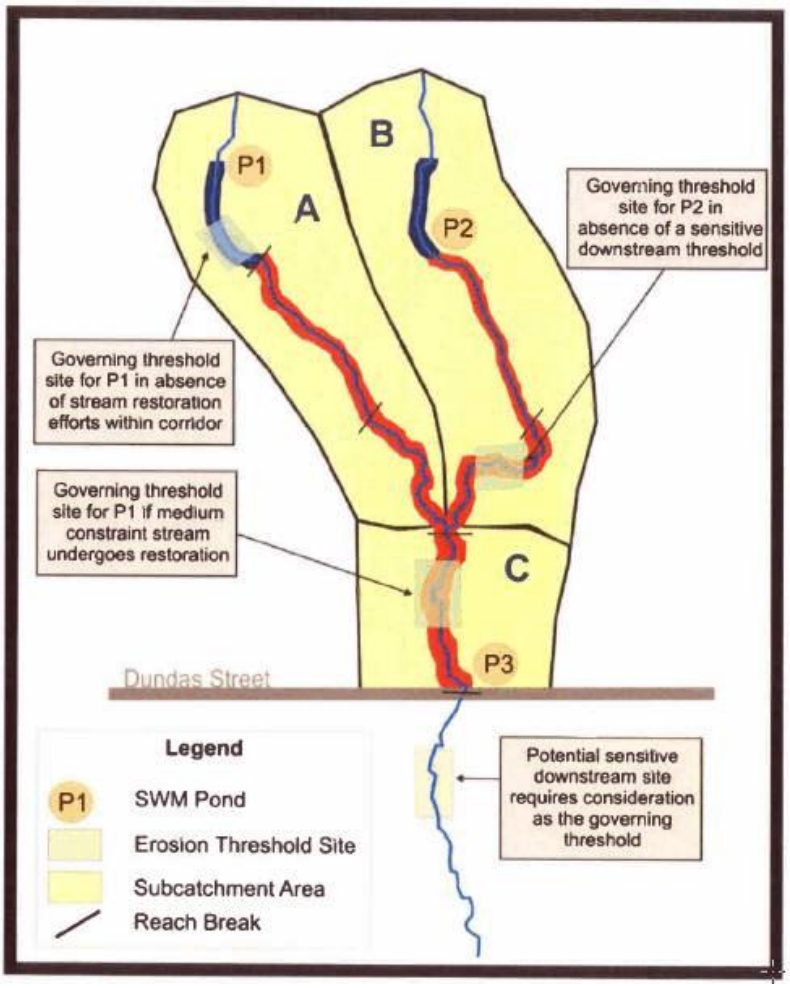
Select an appropriate defining threshold based on model convergence and compatibility with indicators of active processes (e.g., widening and entrenchment) as identified through the field investigation;

Perform an analysis of pre and post development conditions using a continuous hydrologic model on a subcatchment area basis to identify erosion control sizing for SWM facilities. Specifically, the frequency and duration of time (expressed as hours) that the erosive threshold flow is exceeded, in the pre-development condition, is to be matched in the post-development condition (i.e., results are within approximately 5% of the pre-development conditions. Before a 5% increase is accepted, work needs to be completed as to the likely effects and implications of this nominal increase to determine whether further mitigation, modeling refinement or monitoring is warranted); and,

Clearly illustrate how the proposed development scenario meets erosion control criteria as established in the NOCSS.

It should be noted that, while the erosion threshold assessment is conducted on a single subcatchment area basis, the proponent must be aware that areas downstream need to be considered when selecting the most sensitive reach, as depicted in Figure 3.4.1.

***Figure 3.4.1: A Hypothetical Example Illustrating Relevant Erosion Threshold Procedures in the Context of Subcatchment Areas***




**Note:** The most sensitive reach for SWM P1 is highlighted in the shaded area downstream of the pond. However, an assessment of downstream reaches beyond the subcatchment boundary is required in order to ensure that no additional impacts are created. Moreover, if restoration of the medium constraint stream is anticipated, then an analysis of downstream reaches would be required to determine the governing threshold for SWM P1. As discussed in the previous text, the governing threshold could be located downstream of Dundas Street (beyond the boundary of the EIR Subcatchments), depending on the relative sensitivity of stream conditions. In this example, the shaded area in Subcatchment A would govern as the most sensitive reach for SWM P1. Also, in the event that the shaded area downstream of SWM P1 was so unstable that erosion threshold targets could not be met, this reach could be restored and enhanced and the threshold for Subcatchment C then would apply.

**d) Topographic Depressions**

In North Oakville, there are a number of topographic depression areas that are poorly drained. The characteristics of this topography have an impact on the response characteristics of the area during precipitation and runoff events. Consequently, NOCSS requires, as part of the EIR/FSS, that the storage within the topographic depressions be refined and checked against the storage within proposed SWM ponds in the EIR subcatchment area to verify that the SWM pond storage accounts for the depression storage. Thus, the SWM ponds volume must be equal to or greater than the original depression storage volume.

In general, the NOCSS hydrologic model incorporates depression storage to establish unit area target flow rates. The calculation and comparison of depression storage to SWM storage is intended as a check to ensure that the existing condition peak flow rates do not increase as a result of land development. The principle behind this approach is to ensure that the hydrologic analysis and SWM approach reflects the existing site conditions that include a number of topographic depressions, and the natural depression storage is maintained in the SWM system.

This approach is not to include artificially created storage such as that created by embankments or dug facilities. Although the topographic depressions are illustrated in NOCSS, referred to as pits, ponds and depressions, the existing mapping does not provide for accurate delineation of these depressions.

The more detailed mapping and other relevant investigations of the EIR/FSS are to be used to confirm the existence, nature (natural or artificial), and storage volume of these depressions.

To ensure that the storage volume of the depression storage areas is maintained, the calculated depression volume is to be compared to the SWM pond volume of the proposed SWM facility within the same subcatchment drainage area. If the depression storage volume is less than or equal to the SWM facility volume, no additional analysis or change to the SWM facility design is required. In the event that depression storage is greater than the SWM facility volumes, the SWM facility volume (as noted in the following points) is to be adjusted to be equal to the depression storage volume.

Calculations and volume comparisons shall be done as follows:

2-year event: Calculate the 2-year depression storage volume and compare this volume to the water quality (extended detention and permanent pool) volume in the SWM facility.

100-year event or Regional Storm (whichever is applicable): Calculate the 100-year or Regional Storm depression storage volume and compare it to the total storage volume (permanent and active storage) in the SWM facility (up to 100-year or Regional Storm event).

### *3.4.5 SWM Plan*

A SWM plan is to be developed as part of the EIR/FSS to demonstrate how the targets as specified in the Management Strategy are to be met. It is intended that SWM is to be provided through a combination of "Best Management Practices" (BMP), which may range from at-source controls to end-of-pipe solutions. The preliminary location of SWM ponds is illustrated in the Management Strategy; however, flexibility on the final location is anticipated.

In developing the overall SWM Plan, a treatment train approach is to be applied in evaluating the effectiveness of BMPs. Consultation with the Town of Oakville and Conservation Halton will be required in the selection of measures and their effectiveness.

The use of BMP s for stormwater management (in addition to SWM ponds) can reduce the size of the ponds. The measures are to be evaluated in their ability to retain water on-site and thereby maintain existing condition water balance where feasible based on site soil conditions, and protect water quality in relation to the NOCSS recommendations (i.e. phosphorus control, temperature control, suspended solids reduction).

Preliminary design details for the SWM ponds will be required as part of the EIR/FSS including:

SWM pond block sizing, including preliminary grades, design water levels (pond and receiving body outlet), storage volumes and maintenance access provisions;
Cross-section details;
Pond profile including inlet and outlet;
Landscaping provisions as per Conservation Halton guidelines; and
Monitoring plan to the satisfaction of the Town.

## 3.5 Hydrogeology

### *3.5.1 Introduction*

The NOCSS prepared in support of the Secondary Plan for the North Oakville area included recommendations for more detailed hydrogeological investigations as part of the EIR/FSS in support of proposed Draft Plans.

The purpose of the detailed hydrogeological study is to characterize existing hydrogeological conditions, quantify potential groundwater-related impacts and determine the need for, and nature of, any mitigation measures required to protect the hydrogeological features and functions within the EIR subcatchment area.

### *3.5.2 Technical Requirements*

The EIR must address the entire EIR subcatchment area within which the proposed development area is located. Therefore, in addition to site investigations specific to the proposed development area, it may be necessary to secure access to adjacent properties or road allowances to investigate areas of the EIR subcatchment area outside the proposed development area.

The level of detail must be sufficient to support submission of Draft Plans of subdivision. The methodology to complete the study requirements is at the discretion of the consultant, but must conform to generally accepted groundwater engineering and hydrogeologic practices.

Boreholes and groundwater observation wells must be distributed such that the groundwater conditions are defined for the proposed development area and the EIR subcatchment area. Any specific on-site features are to be investigated.

**a) Geology and Hydrogeology**

Provide an overview of the regional geological setting;

Drill boreholes to determine the site-specific geology (stratigraphy and depth to bedrock). The number of boreholes will depend upon the sizes of the EIR subcatchment area and the proposed development area, the background data available, and the geological complexity of the area;

Collect soil samples from each borehole and test for grain-size to characterize the soil types and to assist in determining soil hydraulic conductivity;

Relate the local geological data to the regional geological setting;

Establish a network of groundwater observation wells to determine the depth to the water table and vertical and horizontal groundwater gradients;

The number of monitoring wells to be installed will depend upon the EIR subcatchment area and the proposed development area sizes, the complexity of drainage, the number of environmental features, the locations of groundwater divides, and the background data available. Where available, existing observation wells may be used;

Survey all monitoring locations for coordinates and geodetic elevation;

Map the groundwater flow conditions (including vertical and horizontal flow components);

Conduct bail-down, slug, or other appropriate field tests to confirm well function and assess the hydrogeological characteristics of stratigraphic units (e.g. *in situ* hydraulic conductivity);

Provide estimates of groundwater flux;

Monitor groundwater levels in all observation wells (data included in the EIR/FSS should be related to the regional groundwater elevation data and be sufficient to document the response of the shallow groundwater to climatic conditions throughout the year). A minimum of one water table observation well should be equipped with a data-logger to continuously record water levels. The data must be corrected for barometric response;

Monitor surface water baseflows (non-storm event flows; minimum of 3 days post precipitation event) upstream and downstream in all identified watercourses. These data will be used to assist in establishing the groundwater contribution to stream flow and infiltration as part of the water balance assessment;

Collect a sufficient number of groundwater and surface water samples for laboratory analysis of major ion chemistry to establish the background water quality across the area. These data will be used to assist in the assessment of groundwater/surface water interactions and to establish baseline pre-development conditions;

Map groundwater discharge areas and identify any areas along stream corridors for recharge/discharge function protection; and,

Complete a water balance analysis to determine the pre-development (based on existing conditions) and post-development (based on the proposed land use plan) interflow and deep recharge volumes. The water balance should utilize the longest and most continuous local daily climate data and a soil-moisture balance approach (e.g., Thornthwaite and Mather) with daily or monthly calculations reported on an average annual basis. Surface water flow data should be used to validate the existing conditions water balance where possible.

**b) Requirements for Proposed Development Plan**

Determine the infiltration deficit (pre to post development) for the proposed development area and the EIR subcatchment area;

Identify hydrogeological opportunities and constraints to maintaining the water balance (i.e., to reduce the infiltration deficit);

Identify the type, location and size of infiltration or storage measures that may be feasible for use based on the site specific geological and hydrogeological conditions;

Evaluate opportunities for augmenting groundwater infiltration through appropriate and practical Best Management Practices (e.g., as outlined in the MOE Stormwater Management Planning and Design Manual 2003) to balance, or at least in part, make up the post-development infiltration deficit;

If pre-development infiltration cannot be maintained, predict the impact of this change on the flows in local streams and on the local water table and recommend mitigation measures as required;

Identify areas where hydrogeological conditions may affect construction (e.g., high water table, requirements for dewatering, etc.), and recommend control and mitigation measures, if warranted; and,

Evaluate the potential for impacts from proposed underground services on shallow groundwater conditions adjacent to cores, linkages and stream corridors. If the potential for negative impact exists, mitigative measures are to be recommended.

### 3.6 Sanitary, Water, Roads

Analyses and details must be provided for the servicing of a specific development application. In addition, it will be necessary to provide conceptual designs of trunk services within the EIR subcatchment (conceptually only in areas not part of the proposed development area; FSS level of detail in the proposed development area) including appropriate connections to external areas, demonstrating servicing viability without placing undue restrictions on external areas (e.g., considering sewer depths and grading). Sufficient analysis is necessary to ensure that external lands can be serviced to meet Town and Region standards.

The FSS will build upon and implement, as applicable, recommendations of the Master Servicing Plan for the North Oakville East area, prepared as background to the Secondary Plan, and any applicable Master Servicing Plans prepared by the Region of Halton. The following tasks are to be undertaken.

Compile information from the NOCSS and the Secondary Plan specific to the proposed development area including design criteria, environmental designations, road locations and design levels, etc. and undertake an information gap analysis to determine additional information needs, if any;

Review detailed information on the proposed land uses of the development application, with respect to population, housing form, road pattern, open space components, and hard surfaces to provide input to engineering analysis;

Complete a sanitary servicing assessment to:

- determine the servicing requirements based on future system wastewater flows;
- recommend a preferred sanitary servicing option considering external and internal Infrastructure, and potential phasing;
- provide interim servicing solutions where feasible;
- assess site specific infrastructure locations and designs for crossings of streams, linkages and cores;
- make recommendations on preferred crossing locations, construction practices, and mitigative measures to minimize impacts to the NHS; and,
- determine consistency with Region of Halton Master Servicing Plan and explain differences;

Complete a water servicing assessment to:

- determine the servicing requirements based on future system demands;
- identify a preferred water servicing option considering external and internal infrastructure, pressure districts and potential phasing;
- assess site specific infrastructure locations and designs for crossings of streams, linkages and cores;
- make recommendations on preferred crossing locations, construction practices, and mitigative measures to minimize impacts to the NHS; and,
- determine consistency with Region of Halton Master Servicing Plan and explain differences.

Complete a road design assessment to:

- compile the road design requirements and road locations as identified in the Master Servicing Plan and the Secondary Plan;
- identify local road system within the proposed development area;
- assess site specific road locations and designs for crossings of streams, linkages and cores; and,
- make recommendations on preferred crossing locations and configurations, road design standards, and mitigative measures to minimize impacts to the NHS (e.g., ecopassages).

## 3.7 Trails

The following section summarizes the study requirements for Trails in the EIR/FSS. The purpose of these studies is to identify the potential impacts to the NHS and proposed associated mitigation. In general, the level of detail required at the EIR stage will result in a plan that includes the approximate centerline of trail with options in areas where issues have been identified.

Trail types and locations have been generally described in the Master Trails Plan for North Oakville. Through this plan 3 types of trails have been recognized: multi-use, major and minor. Multi-use trails are all located within road right-of-ways (r.o.w.'s). Major trails are 2.4m wide seasonal trails that are generally located in the NHS along the periphery or buffers of core areas, linkages, or are within stream corridors. Minor trails are 1 – 2m wide seasonal trails that are generally found within the core areas. Preference should be given to using existing and proposed road crossings for trails. Where trails will have any footprint impact within the NHS, the following is required.

### *3.7.1 Trails <u>exclusively</u> in buffer areas that are active agricultural areas at the time of study*

Trail sections that are exclusively located within buffers that are active agricultural lands (row crops) must undertake Species at Risk (SAR) screening and complete appropriate seasonal field surveys. This would include the review of all associated species lists from NOCSS, as the status of some species has changed since NOCSS such that they are now species of conservation concern.
For example, Eastern Meadowlark and Bobolink are both listed as Threatened species and Redside Dace as an Endangered species, all of which are regulated including their habitat by the Endangered Species Act (2007).

All hazard trees within striking distance of the proposed trail must be identified and felled as a part of trail construction. These trees should be dropped so that they fall out of the natural area and into the buffer where they can create unique micro-habitats for plants and wildlife while minimizing damage to vegetation within the core natural area. A plan identifying hazard trees will be a condition of draft approval for review and approval prior to any tree removals occurring.

### *3.7.2 Trails in natural areas or crossing streams*

Trail sections in natural areas including cultural thicket and meadow communities or crossing stream corridors must have appropriate field surveys done including the following as applicable:

- Review of all associated species lists from NOCSS, as the status of some species has changed since NOCSS such that they are now species of conservation concern.
- Ecological Land Classification (ELC) – All vegetation communities that are traversed need to be mapped and described according to the ELC. This includes generating a complete vegetation species list for each polygon. In this way appropriate mitigations such as avoidance can be made for any species of conservation concern including regionally significant species.
- SAR risk screening (NHIC database, Aurora District MNR and Conservation Halton data requests)- this screening will identify the need for any species specific field surveys and associated design requirements.Significant Wildlife Habitat (SWH) screening using the Ecoregion 7E Criterion Schedule (OMNR 2012) - this screening will identify the need for any specific field surveys.
- Complete Appropriate seasonal field surveys using approved protocols.
- 
- The Draft Guidance for Development Activities in Redside Dace Habitat (OMNR 2011) should be referred to where trail development is to occur within the buffer area of Redside Dace habitat (watercourse meander plus 30 m).
- 
- Prior to site walk, a certified arborist will have walked the proposed trail alignment and flagged any significant trees greater than 10 cm diameter-at-breast height (DBH) within 5 m of either side. Each of these trees will be assessed by a Certified Arborist to document species, size, health and general hazard rating. Trees recommended for preservation will then be surveyed and mapped during time of formal site walk (preliminary trail stake-out).
- Significant flora, wildlife habitat or desirable vegetation to be retained and avoided during trail construction should be surveyed and shown on the plan.

Detailed design submission requirements will be specified by the review agencies and Conditions of Draft Plan approval will generally include the following:

- Hydraulic impacts to the flood plain of any culvert crossings must be assessed and shall have no negative impacts to the lot lines.
- Where trails cross red streams only span structures are to be considered.
- Where feasible, crossings of watercourses are generally recommended to span three times the bankfull channel width of the watercourse.
- Blue streams can be crossed using either a span or a culvert (preferably open bottom) in combination with terrestrial eco-passages.

### *3.7.3 Trail Siting*

The final trail location is to be determined in the field with Conservation Halton and Town of Oakville staff. The trail should generally be in the location identified by the Trails Master Plan unless an alternate location is identified as an outcome of site level surveys. For example, a stream crossing could be moved to take advantage of an existing agricultural crossing, or to an alternate location which provides for installation on a straight section of stream.

The field fitting of the final location completed with Town and agency staff must be informed by the ELC and required field surveys for wildlife as described above. This will ensure that any new constraints that are

identified through these surveys are considered in the final trail location and or that appropriate mitigations are identified. As such, the supporting materials should be received and reviewed by Town and Agency staff prior to completing the site visit. Trail siting field visits will be booked between May 1st and October 31st.

During the site walk with Town and agency staff, all natural features that factor into the final location will be identified for pick-up by surveyors to be shown on the plan. This will include all trees, and other vegetation or habitat features that are to be retained and protected during trail construction as per above. During this site walk, the trail centerline will be staked for survey to be shown on the plan.

If new drainage features are proposed within NHS areas, they should be designed with the purpose of protecting, maintaining, and augmenting the natural hydrological regime of the NHS. All proposed (or required) drainage features must also be shown on the plan(s), including the extent of grading associated with the drainage feature. The location of these works should be considered during the site walk and factor into the siting of the trail in terms of minimizing overall impacts to natural area. All trails should be sited as far as possible from the Natural Heritage Feature.

Detailed design submission requirements will be specified by the review agencies and Conditions of Draft Plan approval will generally include the following:

Plans and elevations;
Restoration details including proposed landscape plans, plan-form, profile, cross-sections and typical treatments;
Tree Preservation Plan details for all surveyed trees including existing health and protection measures, including hazard trees proposed for removal
Requirement to adhere to the Town's Trail Construction guidelines and/or
Best management practices for trails installations;
Specific construction timing criteria to minimize impact to natural
environment;
Erosion and sediment control requirements;
Design brief;
Monitoring Plan for planting establishment, and
Permits and associated technical studies as required by Conservation Halton for work within regulated areas

## 4.0 MONITORING

It will be necessary to detail environmental monitoring requirements as part of the EIR/FSS, in support of Draft Plans of subdivision, in accordance with applicable directions in NOCSS. As prescribed through NOCSS, the landowners are required to undertake operation, maintenance and monitoring in accordance with the Town of Oakville standards and North Oakville Monitoring Guidelines. Baseline monitoring is required prior to any development activity and as such consideration of this component of the monitoring program will coincide with EIR timing.

## 5.0 REPORTING REQUIREMENTS

A detailed report is to be prepared integrating the analysis, findings and recommendations covered in the study Terms of Reference.

# Appendix B

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## Natural Heritage System

# Appendix B-1

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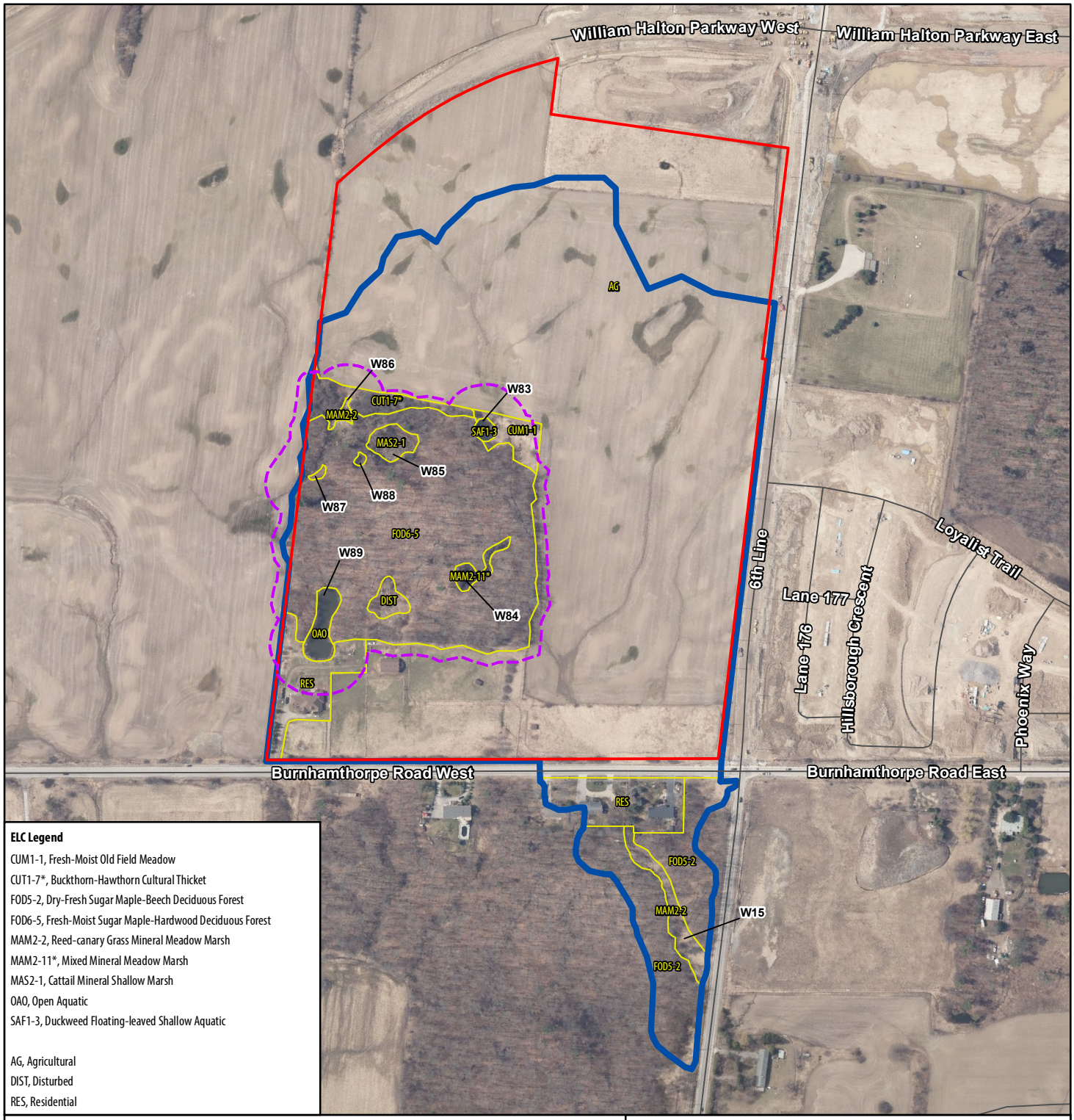
## Figures




**ELC Legend**

CUM1-1, Fresh-Moist Old Field Meadow
CUT1-7*, Buckthorn-Hawthorn Cultural Thicket
FOD5-2, Dry-Fresh Sugar Maple-Beech Deciduous Forest
FOD6-5, Fresh-Moist Sugar Maple-Hardwood Deciduous Forest
MAM2-2, Reed-canary Grass Mineral Meadow Marsh
MAM2-11*, Mixed Mineral Meadow Marsh
MAS2-1, Cattail Mineral Shallow Marsh
OAO, Open Aquatic
SAF1-3, Duckweed Floating-leaved Shallow Aquatic

AG, Agricultural
DIST, Disturbed
RES, Residential

## Legend

- Subject Lands
- Core 6
- Road
- Ecological Land Classification
- EIR Subcatchment Boundary
- **W83** PSW Polygon

N

0 25 50 100 m

SCALE 1:5,000

ENVIRONMENTAL IMPLEMENTATION REPORT AND FUNCTIONAL SERVICING STUDY ADDENDUM
SIXTH OAK INC.

BURNSIDE
RAND ENGINEERING CORPORATION
SAVANTA A GEI Company
JENNIFER LAWRENCE & ASSOCIATES

**UPPER WEST MORRISON CREEK UWM1**

Figure B1-1
Ecological Land Classification

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# Appendix B-2

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## Tables

# Table B2-1

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| | | | | | | | | | | | |
| **Dryopteridaceae** | | **Wood Fern Family** | | | | | | | | | |
| *Dryopteris carthusiana* | *Dryopteris spinulosa* | Spinulose Wood Fern | 5 | -2 | | S5 | | | G5 | X | (Vill.) H.P. Fuchs |
| *Onoclea sensibilis* | | Sensitive Fern | 4 | -3 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Equisetaceae** | | **Horsetail Family** | | | | | | | | | |
| *Equisetum hyemale ssp. affine* | | Scouring-rush | 2 | -2 | | S5 | | | G5T5 | X | L. |
| | | | | | | | | | | | |
| **Thelypteridaceae** | | **Marsh Fern Family** | | | | | | | | | |
| *Thelypteris palustris* | *Dryopteris thelypteris* | Marsh Fern | 5 | -4 | | S5 | | | G5 | X | Schott |
| | | | | | | | | | | | |
| **Cupressaceae** | | **Cedar Family** | | | | | | | | | |
| *Thuja occidentalis* | | Eastern White Cedar | 4 | -3 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Pinaceae** | | **Pine Family** | | | | | | | | | |
| *Picea abies* | | Norway Spruce | | 5 | -1 | SNA | | | G5 | X | (L.) Karsten |
| *Picea glauca* | | White Spruce | 6 | 3 | | S5 | | | G5 | U | (Moench) Voss |
| *Pinus strobus* | | Eastern White Pine | 4 | 3 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Aceraceae** | | **Maple Family** | | | | | | | | | |
| *Acer negundo* | | Manitoba Maple | 0 | -2 | | S5 | | | G5 | X | L. |
| *Acer rubrum* | | Red Maple | 4 | 0 | | S5 | | | G5 | X | L. |
| *Acer saccharinum* | | Silver Maple | 5 | -3 | | S5 | | | G5 | X | L. |
| *Acer saccharum ssp. saccharum* | | Sugar Maple | 4 | 3 | | S5 | | | G5T5 | X | Marshall |
| | | | | | | | | | | | |
| **Anacardiaceae** | | **Sumac or Cashew Family** | | | | | | | | | |
| *Rhus typhina* | | Staghorn Sumac | 1 | 5 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Apiaceae** | | **Carrot or Parsley Family** | | | | | | | | | |
| *Daucus carota* | | Wild Carrot | | 5 | -2 | SNA | | | GNR | X | L. |
| *Sium suave* | | Hemlock Water-parsnip | 4 | -5 | | S5 | | | G5 | X | Walter |
| | | | | | | | | | | | |
| **Aquifoliaceae** | | **Holly Family** | | | | | | | | | |
| *Ilex verticillata* | | Winterberry | 5 | -4 | | S5 | | | G5 | X | (L.) A. Gray |
| | | | | | | | | | | | |
| **Asclepiadaceae** | | **Milkweed Family** | | | | | | | | | |
| *Asclepias syriaca* | | Common Milkweed | 0 | 5 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Asteraceae** | | **Composite or Aster Family** | | | | | | | | | |
| *Ambrosia artemisiifolia* | | Annual Ragweed | 0 | 3 | | S5 | | | G5 | X | L. |
| *Arctium lappa* | | Greater Burdock | | | | SNA | | | GNR | X | L. |
| *Bidens frondosa* | | Devil's Beggarticks | 3 | -3 | | S5 | | | G5 | X | L. |
| *Cichorium intybus* | | Chicory | | 5 | -1 | SNA | | | GNR | X | L. |
| *Cirsium arvense* | | Canada Thistle | | 3 | -1 | SNA | | | GNR | X | (L.) Scop. |
| *Cirsium vulgare* | | Bull Thistle | | 4 | -1 | SNA | | | GNR | X | (Savi) Ten. |
| *Conyza canadensis* | | Horseweed | 0 | 1 | | S5 | | | G5 | X | (L.) Cronquist |
| *Erigeron strigosus* | | Daisy Fleabane | 0 | 1 | | S5 | | | G5 | X | Muhlenb. ex Willd. |

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| *Eurybia macrophylla* | *Aster macrophyllus* | Large-leaved Aster | 5 | 5 | | S5 | | | G5 | X | L. |
| *Euthamia graminifolia* | *Solidago graminifolia* | Grass-leaved Goldenrod | 2 | -2 | | S5 | | | G5 | X | (L.) Nutt. |
| *Inula helenium* | | Elecampane Flower | | 5 | -2 | SNA | | | GNR | X | L. |
| *Solidago altissima* | | Tall Goldenrod | 1 | 3 | | S5 | | | G5 | X | L. |
| *Solidago gigantea* | | Smooth Goldenrod | 4 | -3 | | S5 | | | G5 | U | Aiton |
| *Symphyotrichum lanceolatum ssp. lanceolatum* | *Aster lanceolatus ssp. la* | Tall White Aster | 3 | -3 | | S5 | | | G5T5 | X | Willd. |
| *Symphyotrichum lateriflorum* | *Aster lateriflorus* | Starved Aster | 3 | -2 | | S5 | | | G5 | X | (L.) Britton |
| *Symphyotrichum novae-angliae* | *Aster novae-angliae* | New England Aster | 2 | -3 | | S5 | | | G5 | X | L. |
| *Taraxacum officinale* | | Common Dandelion | | 3 | -2 | SNA | | | G5 | X | G. Weber |
| | | | | | | | | | | | |
| **Berberidaceae** | | **Barberry Family** | | | | | | | | | |
| *Berberis thunbergii* | | Japanese Barberry | | 4 | -3 | SNA | | | GNR | X | DC. |
| | | | | | | | | | | | |
| **Betulaceae** | | **Birch Family** | | | | | | | | | |
| *Carpinus caroliniana* | | Blue-beech | 6 | 0 | | S5 | | | G5 | X | Walter |
| *Ostrya virginiana* | | Eastern Hop-hornbeam | 4 | 4 | | S5 | | | G5 | X | (Miller) K. Koch |
| | | | | | | | | | | | |
| **Brassicaceae** | | **Mustard Family** | | | | | | | | | |
| *Alliaria petiolata* | *Alliaria officinalis* | Garlic Mustard | | 0 | -3 | SNA | | | GNR | X | (M. Bieb.) Cavara & Grande |
| | | | | | | | | | | | |
| **Caprifoliaceae** | | **Honeysuckle Family** | | | | | | | | | |
| *Lonicera dioica* | | Mountain Honeysuckle | 5 | 3 | | S5 | | | G5 | X | L. |
| *Lonicera tatarica* | | Tartarian Honeysuckle | | 3 | -3 | SNA | | | GNR | X | L. |
| *Viburnum acerifolium* | | Maple-leaf Viburnum | 6 | 5 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Celastraceae** | | **Staff-tree Family** | | | | | | | | | |
| *Euonymus obovatus* | | Running Strawberry-bush | 6 | 5 | | S5 | | | G5 | X | Nutt. |
| | | | | | | | | | | | |
| **Cornaceae** | | **Dogwood Family** | | | | | | | | | |
| *Cornus sericea* | *Cornus stolonifera* | Red-osier Dogwood | 2 | -3 | | S5 | | | G5 | X | Michx. |
| | | | | | | | | | | | |
| **Dipsacaceae** | | **Teasel Family** | | | | | | | | | |
| *Dipsacus fullonum* | *Dipsacus sylvestris* | Fuller's Teasel | | 5 | -1 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Fabaceae** | | **Pea Family** | | | | | | | | | |
| *Lotus corniculatus* | | Bird's-foot Trefoil | | 1 | -2 | SNA | | | GNR | X | L. |
| *Trifolium hybridum* | | Alsike Clover | | 1 | -1 | SNA | | | GNR | X | L. |
| *Trifolium pratense* | | Red Clover | | 2 | -2 | SNA | | | GNR | X | L. |
| *Vicia cracca* | | Tufted Vetch | | 5 | -1 | SNA | | | GNR | X | L. |
| *Vicia sativa* | *Vicia angustifolia* | Spring Vetch | | 4 | -1 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Fagaceae** | | **Beech Family** | | | | | | | | | |
| *Fagus grandifolia* | | American Beech | 6 | 3 | | S4 | | | G5 | X | Ehrh. |
| *Quercus macrocarpa* | | Bur Oak | 5 | 1 | | S5 | | | G5 | X | Michx. |
| *Quercus rubra* | | Northern Red Oak | 6 | 3 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| **Geraniaceae** | | **Geranium Family** | | | | | | | | | |
| *Geranium maculatum* | | Wild Crane's-bill | 6 | 3 | | S5 | | | G5 | X | L. |
| *Geranium robertianum* | | Herb-robert | | 5 | -2 | SNA | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Grossulariaceae** | | **Currant Family** | | | | | | | | | |
| *Ribes rubrum* | | Northern Red Currant | | 5 | -2 | SNA | | | G4G5 | X | L. |
| | | | | | | | | | | | |
| **Juglandaceae** | | **Walnut Family** | | | | | | | | | |
| *Carya ovata* | | Shagbark Hickory | 6 | 3 | | S5 | | | G5 | X | (Miller) K. Koch |
| | | | | | | | | | | | |
| **Lamiaceae** | | **Mint Family** | | | | | | | | | |
| *Lycopus uniflorus* | | Northern Bugleweed | 5 | -5 | | S5 | | | G5 | X | Michx. |
| | | | | | | | | | | | |
| **Lythraceae** | | **Loosestrife Family** | | | | | | | | | |
| *Lythrum salicaria* | | Purple Loosestrife | | -5 | -3 | SNA | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Malvaceae** | | **Mallow Family** | | | | | | | | | |
| *Abutilon theophrasti* | | Velvet-leaf | | 4 | -1 | SNA | | | GNR | X | Medik. |
| *Malva neglecta* | | Dwarf Cheeseweed | | 5 | -1 | SNA | | | GNR | X | Wallr. |
| | | | | | | | | | | | |
| **Moraceae** | | **Mulberry Family** | | | | | | | | | |
| *Morus alba* | | White Mulberry | | 0 | -3 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Oleaceae** | | **Olive Family** | | | | | | | | | |
| *Fraxinus americana* | | White Ash | 4 | 3 | | S4? | | | G5 | X | L. |
| *Syringa vulgaris* | | Common Lilac | | 5 | -2 | SNA | | | GNR | X | L. |
| *Epilobium ciliatum* ssp. *ciliatum* | | Hairy Willow-herb | 3 | 3 | | S5 | | | G5T5 | X | Raf. |
| | | | | | | | | | | | |
| **Orobanchaceae** | | **Broom-rape Family** | | | | | | | | | |
| *Epifagus virginiana* | | Beech-drops | 6 | 5 | | S5 | | | G5 | X | (L.) Barton |
| | | | | | | | | | | | |
| **Plantaginaceae** | | **Plantain Family** | | | | | | | | | |
| *Plantago major* | | Common Plantain | | -1 | -1 | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Polygonaceae** | | **Smartweed Family** | | | | | | | | | |
| *Persicaria pensylvanica* | *Polygonum pensylvanicu* | Pennsylvania Smartweed | 3 | -4 | | S5 | | | G5 | U | L. |
| *Rumex crispus* | | Curly Dock | | -1 | -2 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Ranunculaceae** | | **Buttercup Family** | | | | | | | | | |
| *Ranunculus acris* | | Tall Buttercup | | | -2 | SNA | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Rhamnaceae** | | **Buckthorn Family** | | | | | | | | | |
| *Rhamnus cathartica* | | Common Buckthorn | | 3 | -3 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Rosaceae** | | **Rose Family** | | | | | | | | | |
| *Crataegus species* | | Hawthorn species | | | | | | | | | |

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| *Fragaria virginiana* | | Virginia Strawberry | 2 | 1 | | S5 | | | G5 | X | Miller |
| *Geum aleppicum* | | Yellow Avens | 2 | -1 | | S5 | | | G5 | X | Jacq. |
| *Geum canadense* | | White Avens | 3 | 0 | | S5 | | | G5 | X | Jacq. |
| *Geum laciniatum* | | Rough Avens | | -3 | | S4 | | | G5 | X | Murray |
| *Malus pumila* | | Common Apple | | 5 | -1 | SNA | | | G5 | X | Miller |
| *Potentilla recta* | | Sulphur Cinquefoil | | 5 | -2 | SNA | | | GNR | X | L. |
| *Prunus serotina* | | Black Cherry | 3 | 3 | | S5 | | | G5 | X | Ehrh. |
| *Prunus virginiana* | | Choke Cherry | 2 | 1 | | S5 | | | G5 | X | L. |
| *Pyrus communis* | | Common Pear | | 5 | -1 | SNA | | | G5 | X | L. |
| *Rosa multiflora* | | Multiflora Rose | | 3 | -3 | SNA | | | GNR | X | Thunb. ex Murray |
| *Rubus allegheniensis* | | Alleghany Blackberry | 2 | 2 | | S5 | | | G5 | X | Porter |
| *Rubus idaeus* ssp. *strigosus* | *Rubus idaeus* ssp. *mela* | Red Raspberry | 0 | -2 | | S5 | | | G5T5 | X | L. |
| | | | | | | | | | | | |
| **Rubiaceae** | | **Madder Family** | | | | | | | | | |
| *Galium mollugo* | | White Bedstraw | | 5 | -2 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Salicaceae** | | **Willow Family** | | | | | | | | | |
| *Populus deltoides* ssp. *deltoides* | | Eastern Cottonwood | 4 | -1 | | S5 | | | G5T5 | X | Bartram ex Marshall |
| *Populus grandidentata* | | Large-tooth Aspen | 5 | 3 | | S5 | | | G5 | X | Michx. |
| *Populus tremuloides* | | Trembling Aspen | | 0 | | S5 | | | G5 | X | Michx. |
| *Salix amygdaloides* | | Peach-leaved Willow | 6 | -3 | | S5 | | | G5 | X | Anderss. |
| *Salix interior* | *Salix exigua* | Sandbar Willow | 3 | -5 | | S5 | | | GNR | X | Nutt. |
| | | | | | | | | | | | |
| **Scrophulariaceae** | | **Figwort Family** | | | | | | | | | |
| *Verbascum thapsus* | | Common Mullein | | 5 | -2 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Solanaceae** | | **Nightshade Family** | | | | | | | | | |
| *Solanum dulcamara* | | Climbing Nightshade | | 0 | -2 | SNA | | | GNR | X | L. |
| | | | | | | | | | | | |
| **Tiliaceae** | | **Linden Family** | | | | | | | | | |
| *Tilia americana* | | American Basswood | 4 | 3 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Ulmaceae** | | **Elm Family** | | | | | | | | | |
| *Ulmus americana* | | White Elm | 3 | -2 | | S5 | | | G5? | X | L. |
| | | | | | | | | | | | |
| **Verbenaceae** | | **Vervain Family** | | | | | | | | | |
| *Verbena hastata* | | Blue Vervain | 4 | -4 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Vitaceae** | | **Grape Family** | | | | | | | | | |
| *Vitis riparia* | | Riverbank Grape | 0 | -2 | | S5 | | | G5 | X | Michx. |
| | | | | | | | | | | | |
| **Cyperaceae** | | **Sedge Family** | | | | | | | | | |
| *Carex comosa* | | Bristly Sedge | 5 | -5 | | S5 | | | G5 | X | Boott |
| *Carex lupulina* | | Hop Sedge | 6 | -5 | | S5 | | | G5 | | Muhlenb. ex Willd. |
| *Carex pensylvanica* | | Pennsylvania Sedge | 5 | 5 | | S5 | | | G5 | X | Lam. |
| *Carex tuckermanii* | | Tuckerman's Sedge | 7 | -5 | | S4 | | | G4 | U | Dewey |

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| *Scirpus cyperinus* | | Wool-grass | 4 | -5 | | S5 | | | G5 | X | (L.) Kunth |
| | | | | | | | | | | | |
| **Lemnaceae** | | **Duckweed Family** | | | | | | | | | |
| *Lemna minor* | | Lesser Duckweed | 2 | -5 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Orchidaceae** | | **Orchid Family** | | | | | | | | | |
| *Epipactis helleborine* | | Common Helleborine | | 5 | -2 | SNA | | | GNR | X | (L.) Crantz |
| | | | | | | | | | | | |
| **Poaceae** | | **Grass Family** | | | | | | | | | |
| *Bromus inermis* | | Awnless Brome | | 5 | -3 | SNA | | | G5TNR | X | Leyss. |
| *Dactylis glomerata* | | Orchard Grass | | 3 | -1 | SNA | | | GNR | X | L. |
| *Glyceria grandis* | | Tall Manna Grass | 5 | -5 | | S4S5 | | | G5 | X | S. Watson |
| *Glyceria striata* | | Fowl Meadow Grass | 3 | -5 | | S5 | | | G5 | X | (Lam.) A. Hitchc. |
| *Phalaris arundinacea* | | Reed Canary Grass | 0 | -4 | | S5 | | | G5 | X | L. |
| | | | | | | | | | | | |
| **Typhaceae** | | **Cattail Family** | | | | | | | | | |
| *Typha latifolia* | | Broad-leaved Cattail | 3 | -5 | | S5 | | | G5 | X | L. |
| *Typha x glauca* | | Glaucous Cattail | 3 | -5 | | SNA | | | GNA | X | Godron |
| | | | | | | | | | | | |
| STATISTICS | | | | | | | | | | | |
| | | | | | | | | | | | |
| Species Richness | | | | | | | | | | | |
| Total Number of Species: | | 108 | | | | | | | | | |
| Native Species: | | 70 | 65% | | | | | | | | |
| Exotic Species | | 38 | 35% | | | | | | | | |
| | | | | | | | | | | | |
| S1-S3 Species | | 0 | 0% | | | | | | | | |
| S4 Species | | 5 | 7% | | | | | | | | |
| S5 Species | | 65 | 93% | | | | | | | | |
| | | | | | | | | | | | |
| Floristic Quality Indices | | | | | | | | | | | |
| Mean Co-efficient of Conservatism (CC) | | 3.6 | | | | | | | | | |
| CC 0 - 3 lowest sensitivity | | 30 | 45% | | | | | | | | |
| CC 4 - 6 moderate sensitivity | | 36 | 54% | | | | | | | | |
| CC 7 - 8 high sensitivity | | 1 | 1% | | | | | | | | |
| CC 9 - 10 highest sensitivity | | 0 | 0% | | | | | | | | |
| Floristic Quality Index (FQI) | | 29 | | | | | | | | | |
| | | | | | | | | | | | |
| Weedy and Invasive Species | | | | | | | | | | | |
| Mean Weediness Index | | -1.8 | | | | | | | | | |
| -1 low potential invasiveness | | 14 | 38% | | | | | | | | |
| -2 moderate potential invasiveness | | 15 | 41% | | | | | | | | |
| -3 high potential invasivenss | | 8 | 22% | | | | | | | | |
| | | | | | | | | | | | |
| Wetland Species | | | | | | | | | | | |
| Mean Wetness Index | | 0.8 | | | | | | | | | |
| upland | | 24 | 23% | | | | | | | | |
| facultative upland | | 28 | 27% | | | | | | | | |

| Latin Name | Latin Synonym | Common Name | Coefficient of Conservatism | Wetness Index | Weediness Index | Provincial Status S-Rank | OMNR Status | COSEWIC Status | Global Status G-Rank | Local Status Halton | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Crins et al., 2006 | |
| facultative | | 18 | 17% | | | | | | | | |
| facultative wetland | | 23 | 22% | | | | | | | | |
| obligate wetland | | 12 | 11% | | | | | | | | |

# Appendix C

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# Hydrogeology

# Appendix C-1

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# MECP Well Records

# Water Well Records

Wednesday, December 15, 2021

12:02:38 PM

| TOWNSHIP CON LOT | UTM | DATE CNTR | CASING DIA | WATER | PUMP TEST | WELL USE | SCREEN | WELL | FORMATION |
|---|---|---|---|---|---|---|---|---|---|
| MILTON TOWN (TRAFALG | 17 600657 4815875 W | 2014/05 7247 | 2 | | | MT | 0030 5 | 7225279 (Z179652) A156004 | BRWN LOAM TILL LOOS 0002 RED TILL DNSE 0035 |
| MILTON TOWN (TRAFALG DS N 02 015 | 17 600684 4816918 W | 7147 | | | | | | 7270202 (C33994) P | |
| OAKVILLE TOWN | 17 600684 4816918 W | 2008/09 6809 | | | | MT | | 7114867 (Z82816) A073763 | BRWN LOAM 0001 GREY CLAY SILT TILL 0025 RED CLAY SAND TILL 0030 |
| OAKVILLE TOWN | 17 601029 4816843 W | 2001/12 1129 | 2 | FR 0042 | | NU | 0039 10 | 2809621 (54201) | BLCK LOAM 0001 BRWN SILT CLAY DNSE 0013 GREY CLAY SILT DNSE 0029 GREY SILT CLAY STNS 0042 GREY FSND LYRD 0049 |
| OAKVILLE TOWN | 17 600880 4815855 W | 2005/08 6809 | 2 | | | | 0020 10 | 2810342 (Z33984) A023191 | BLCK LOAM 0001 BRWN TILL 0025 RED SHLE 0030 |
| OAKVILLE TOWN | 17 601694 4816130 W | 2007/11 6809 | 2 | | ///: | MO | | 7054130 (Z69295) A062231 | BRWN SILT TILL HARD 0011 RED SHLE 0035 |
| OAKVILLE TOWN | 17 601252 4816350 W | 2008/09 6809 | | | | MT | 0030 5 | 7114832 (M02966) A075394 | BRWN LOAM 0001 BRWN CLAY SAND SILT 0015 GREY CLAY SILT 0033 GREY CLAY SAND WBRG 0035 |
| OAKVILLE TOWN | 17 600736 4815679 W | 2019/03 7556 | | | | DO | | 7332573 (Z291461) A251116 | |
| OAKVILLE TOWN | 17 601604 4815794 W | 2008/09 6809 | | | | MT | | 7114870 (Z82815) A073764 | BRWN LOAM 0001 RED CLAY SILT TILL 0017 RED SHLE 0022 |
| OAKVILLE TOWN | 17 601177 4815564 W | 2014/06 7247 | 2 | | | MT | 0010 5 | 7238402 (Z198514) A161591 | BRWN LOAM LOOS 0000 BRWN CLAY SLTY GRVL 0003 BRWN CLAY SLTY SAND 0016 |
| OAKVILLE TOWN | 17 601308 4816301 W | 2015/03 7472 | 2.04 | | | MO | 0027 8 | 7239285 (Z208545) A179681 | BRWN FILL MSND LOOS 0000 GREY SILT CLAY PCKD 0035 |
| OAKVILLE TOWN | 17 601585 4816013 W | 2015/03 7472 | 0.75 | | | MO | 0020 5 | 7239286 (Z208546) A179682 | BRWN FILL MSND LOOS 0000 GREY SILT CLAY PCKD 0025 |
| OAKVILLE TOWN | 17 601811 4815882 W | 2015/02 7241 | 2 | | | MO | 0012 8 | 7239775 (Z206202) A179489 | BRWN SILT CLAY DNSE 0013 RED SHLE WBRG 0020 |
| OAKVILLE TOWN | 17 601818 4815873 W | 2015/02 7241 | 2 | | | MO | 0013 7 | 7239776 (Z206201) A179490 | BRWN SILT CLAY DNSE 0013 RED SHLE 0020 |

| TOWNSHIP CON LOT | UTM | DATE CNTR | CASING DIA | WATER | PUMP TEST | WELL USE | SCREEN | WELL | FORMATION |
|---|---|---|---|---|---|---|---|---|---|
| OAKVILLE TOWN | 17 601808 4815859 W | 2015/02 7241 | 2 | | | MO | 0013 7 | 7239777 (Z182980) A179491 | BRWN SAND CLAY DNSE 0013 RED SHLE 0020 |
| OAKVILLE TOWN | 17 600925 4816994 W | 2016/04 7360 | 2 | | | MO | 0035 5 | 7279985 (Z251766) A194043 | FILL 0005 SILT CLAY 0010 TILL HARD 0025 BRWN SILT CLAY 0030 BRWN SILT CLAY 0040 |
| OAKVILLE TOWN | 17 600991 4817071 W | 2016/04 7360 | 2 | | | MO | 0025 5 | 7279988 (Z251767) A201919 | FILL 0005 SILT CLAY 0010 SILT CLAY 0015 SILT CLAY 0020 HARD 0025 0030 |
| OAKVILLE TOWN | 17 600890 4816946 W | 2016/04 7360 | 2 | 0040 | | MO | 0035 5 | 7279986 (Z251768) A193999 | FILL 0005 SILT CLAY 0020 FILL HARD 0025 FILL HARD 0030 SILT CLAY 0035 CLAY 0040 |
| OAKVILLE TOWN | 17 600737 4815681 W | 2019/05 7556 | | | | | | 7336939 (Z291506) A P | |
| OAKVILLE TOWN | 17 601611 4815769 W | 6875 | 1 | | ///: | | | 7332975 (Z303779) A256552 A | |
| OAKVILLE TOWN | 17 601130 4815858 W | 2018/02 7626 | | | | | | 7310640 (C39454) A241571 P | |
| OAKVILLE TOWN | 17 601401 4816277 W | 2018/06 7360 | 2 | | | MO | 0010 10 | 7314706 (Z283975) A245676 | BRWN FILL 0005 RED SILT TILL 0020 |
| OAKVILLE TOWN | 17 601424 4816435 W | 2018/06 7360 | 2 | UT | | MO | 0010 10 | 7314699 (Z283976) A245714 | GRVL 0005 SILT SAND CLAY 0020 |
| OAKVILLE TOWN | 17 601485 4816444 W | 2018/06 7360 | 2 | UT | | MO | 0010 10 | 7314698 (Z293688) A245713 | GRVL 0005 SILT SAND CLAY 0020 |
| OAKVILLE TOWN 01 017 | 17 600985 4815798 W | 2008/05 7219 | 36 | | | NU | | 7105450 (Z92426) A071845 A | |
| OAKVILLE TOWN 01 017 | 17 600923 4815793 W | 2008/05 7219 | 36 | | 2///: | NU | | 7105448 (Z92424) A071864 A | |
| OAKVILLE TOWN 01 017 | 17 600967 4815752 W | 2008/05 7219 | 43.9 | | 2///: | NU | | 7105449 (Z92425) A071865 A | |
| OAKVILLE TOWN 017 | 17 600666 4815888 W | 2006/09 3349 | 6.25 | | | | | 2810671 (Z71494) A | |
| OAKVILLE TOWN DS N 01 015 | 17 601689 4816128 W | 2017/05 7523 | 2 | | | | | 7287979 (Z254645) A | |

| TOWNSHIP CON LOT | UTM | DATE CNTR | CASING DIA | WATER | PUMP TEST | WELL USE | SCREEN | WELL | FORMATION |
|---|---|---|---|---|---|---|---|---|---|
| OAKVILLE TOWN DS N 01 015 | 17 601447 4816200 W | 1967/10 1307 | 30 | FR 0026 | 12//2/: | DO | | 2802122 () | BRWN LOAM MSND 0020 RED SHLE 0026 |
| OAKVILLE TOWN DS N 01 015 | 17 601430 4816524 W | 1965/01 4602 | 6 6 | FR 0043 | 21/56/1/2:0 | DO | | 2802120 () | YLLW CLAY 0013 GREY CLAY 0038 GREY CLAY GRVL 0040 RED SHLE 0056 |
| OAKVILLE TOWN DS N 01 015 | 17 601475 4816577 W | 1963/10 4602 | 6 6 | FR 0049 | 18/49/5/1:0 | DO | | 2802119 () | BRWN CLAY 0016 GREY CLAY 0045 RED SHLE 0052 |
| OAKVILLE TOWN DS N 01 015 | 17 601694 4816128 W | 2017/05 7523 | 2 | | | | | 7287980 (Z254655) A062231 A | |
| OAKVILLE TOWN DS N 01 015 | 17 601802 4815885 W | 2017/05 7523 | 2 | | | | | 7287981 (Z254646) A179491 A | |
| OAKVILLE TOWN DS N 01 015 | 17 601803 4815853 W | 2017/05 7523 | 5.07 | | | | | 7287982 (Z254644) A179489 A | |
| OAKVILLE TOWN DS N 01 015 | 17 601804 4815855 W | 2017/05 7523 | 2 | | | | | 7287983 (Z254643) A179490 A | |
| OAKVILLE TOWN DS N 01 015 | 17 601412 4816233 W | 2018/02 7626 | | | | | | 7310639 (C40302) A241573 P | |
| OAKVILLE TOWN DS N 01 015 | 17 601834 4815893 W | 3349 | 60 | | | | | 7199037 (Z143857) A | |
| OAKVILLE TOWN DS N 01 015 | 17 601439 4816379 W | 1967/01 1308 | 30 | FR 0037 | 20/35/1/1:0 | DO | | 2802121 () | LOAM 0002 BRWN CLAY 0019 BLUE CLAY 0029 RED HPAN 0035 RED SHLE 0037 |
| OAKVILLE TOWN DS N 01 016 | 17 601085 4815958 W | 2012/07 7219 | 48 | | 4///: | NU | | 7190548 (Z157307) A127179 A | |
| OAKVILLE TOWN DS N 01 016 | 17 601229 4816259 W | 1961/09 5417 | 6 6 | FR 0060 | 12/53/2/0:45 | DO | | 2802130 () | BRWN CLAY 0014 GREY CLAY 0033 GREY CLAY GRVL 0039 RED SHLE 0063 |
| OAKVILLE TOWN DS N 01 016 | 17 601074 4816067 W | 1957/06 4838 | 6 6 | FR 0039 FR 0060 FR 0061 | 7/50/4/2:0 | DO | | 2802127 () | LOAM 0004 CLAY 0020 CLAY GRVL 0034 RED SHLE 0063 |
| OAKVILLE TOWN DS N 01 016 | 17 601146 4816171 W | 1956/11 1642 | 6 6 | FR 0055 | 9/50/0/0:30 | DO | | 2802126 () | CLAY 0010 MSND CLAY 0035 RED SHLE 0058 |
| OAKVILLE TOWN DS N 01 016 | 17 601215 4816203 W | 1970/02 4602 | 6 | FR 0051 FR 0063 | 21/71/1/3:0 | DO | | 2803321 () | BRWN CLAY 0017 GREY CLAY 0037 RED CLAY GRVL 0041 RED SHLE 0074 |
| OAKVILLE TOWN DS N 01 016 | 17 601193 4816163 W | 2011/05 1663 | 6.61 | UT | | NU | | 7166442 (Z123021) A | |
| OAKVILLE TOWN DS N 01 016 | 17 601617 4815825 W | 1993/09 1660 | 6 6 | FR 0056 | 16/49/10/1:0 | DO | | 2808261 (74890) | BRWN CLAY 0014 RED CLAY 0017 RED SHLE 0060 |

| TOWNSHIP CON LOT | UTM | DATE CNTR | CASING DIA | WATER | PUMP TEST | WELL USE | SCREEN | WELL | FORMATION |
|---|---|---|---|---|---|---|---|---|---|
| OAKVILLE TOWN DS N 01 016 | 17 601215 4816243 W | 1969/11 1307 | 30 | FR 0052 | 25/50/1/1:0 | DO | | 2803265 () | BRWN CLAY 0011 RED CLAY 0038 RED SHLE 0052 |
| OAKVILLE TOWN DS N 01 017 | 17 600805 4815693 W | 1968/11 3637 | 30 | FR 0017 FR 0030 | 4///: | DO | | 2802898 () | LOAM 0002 BRWN CLAY 0026 RED SHLE 0033 |
| OAKVILLE TOWN DS N 01 017 | 17 600810 4815679 W | 1965/11 4602 | 6 6 | FR 0035 FR 0049 | 14/52/2/1:0 | DO | | 2802131 () | YLLW CLAY 0017 GREY CLAY 0027 RED SHLE 0052 |
| OAKVILLE TOWN DS N 01 017 | 17 600806 4815641 W | 1967/03 1612 | 6 6 | FR 0053 | 13/56/1/2:0 | DO | | 2802135 () | LOAM 0001 BRWN CLAY 0031 RED SHLE 0056 |
| OAKVILLE TOWN DS N 01 017 | 17 600810 4815696 W | 1960/06 5417 | 6 6 | FR 0058 | 7/51/2/1:0 | DO | | 2802134 () | BRWN LOAM 0001 BRWN CLAY 0014 GREY CLAY 0019 GREY CLAY GRVL STNS 0025 GREY CLAY 0029 RED SHLE 0061 |
| OAKVILLE TOWN DS N 02 015 | 17 600599 4816984 W | 1996/05 1663 | 36 | | | NU | | 2808524 (159757) A | PRDG 0008 |
| OAKVILLE TOWN DS N 02 015 | 17 600993 4816672 W | 1996/01 1737 | | | | NU | | 2808465 (146321) A | PRDG 0027 |
| OAKVILLE TOWN DS N 02 016 | 17 600666 4816643 W | 1959/09 2904 | 6 6 | FR 0072 | 32/74/1/2:0 | ST DO | | 2802210 () | PRDG 0038 GREY CLAY MSND 0050 RED SHLE 0074 |
| OAKVILLE TOWN DS N 02 016 | 17 600695 4816663 W | 1970/07 3637 | 30 | FR 0040 FR 0062 | 17///: | ST | | 2803462 () | BRWN CLAY LOAM 0001 BRWN CLAY 0014 GREY CLAY GRVL 0016 BLUE CLAY MSND 0030 BRWN CLAY 0034 GREY CLAY 0036 BRWN MSND 0055 RED SHLE 0064 |
| OAKVILLE TOWN DS N 02 016 | 17 600936 4816072 W | 1988/06 1660 | 6 6 | FR 0068 | 21/65/8/1:0 | DO | | 2807205 (16473) | BRWN CLAY SOFT 0020 GREY CLAY SAND MSND 0037 RED SHLE HARD 0076 |
| OAKVILLE TOWN DS N 02 017 | 17 600748 4815685 W | 1960/10 5417 | 6 6 | FR 0043 FR 0056 | 18/50/5/0:30 | DO | | 2802211 () | BRWN CLAY 0016 GREY CLAY 0039 RED SHLE 0060 |
| OAKVILLE TOWN DS N 02 017 | 17 600710 4815829 W | 1962/09 5417 | 6 6 | FR 0054 | 19/50/2/0:45 | DO | | 2802212 () | BRWN CLAY 0019 GREY CLAY 0039 RED SHLE 0060 |
| OAKVILLE TOWN DS N 02 017 | 17 600619 4815919 W | 1988/09 1660 | 6 6 | FR 0044 | 21/63/4/1:0 | DO | | 2807204 (43007) | BLCK LOAM 0001 BRWN CLAY 0027 GREY CLAY SAND 0035 GRVL HARD 0042 RED SHLE SOFT 0048 RED SHLE HARD 0068 |

TOWNSHIP CON LOT UTM DATE CNTR CASING DIA WATER PUMP TEST WELL USE SCREEN WELL FORMATION

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL ( AUDIT # ) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

## 1. Core Material and Descriptive terms

| Code | Description | Code | Description | Code | Description | Code | Description | Code | Description |
|---|---|---|---|---|---|---|---|---|---|
| BLDR | BOULDERS | FCRD | FRACTURED | IRFM | IRON FORMATION | PORS | POROUS | SOFT | SOFT |
| BSLT | BASALT | FGRD | FINE-GRAINED | LIMY | LIMY | PRDG | PREVIOUSLY DUG | SPST | SOAPSTONE |
| CGRD | COARSE-GRAINED | FGVL | FINE GRAVEL | LMSN | LIMESTONE | PRDR | PREV. DRILLED | STKY | STICKY |
| CGVL | COARSE GRAVEL | FILL | FILL | LOAM | TOPSOIL | QRTZ | QUARTZITE | STNS | STONES |
| CHRT | CHERT | FLDS | FELDSPAR | LOOS | LOOSE | QSND | QUICKSAND | STNY | STONEY |
| CLAY | CLAY | FLNT | FLINT | LTCL | LIGHT-COLOURED | QTZ | QUARTZ | THIK | THICK |
| CLN | CLEAN | FOSS | FOSILIFEROUS | LYRD | LAYERED | ROCK | ROCK | THIN | THIN |
| CLYY | CLAYEY | FSND | FINE SAND | MARL | MARL | SAND | SAND | TILL | TILL |
| CMTD | CEMENTED | GNIS | GNEISS | MGRD | MEDIUM-GRAINED | SHLE | SHALE | UNKN | UNKNOWN TYPE |
| CONG | CONGLOMERATE | GRNT | GRANITE | MGVL | MEDIUM GRAVEL | SHLY | SHALY | VERY | VERY |
| CRYS | CRYSTALLINE | GRSN | GREENSTONE | MRBL | MARBLE | SHRP | SHARP | WBRG | WATER-BEARING |
| CSND | COARSE SAND | GRVL | GRAVEL | MSND | MEDIUM SAND | SHST | SCHIST | WDFR | WOOD FRAGMENTS |
| DKCL | DARK-COLOURED | GRWK | GREYWACKE | MUCK | MUCK | SILT | SILT | WTHD | WEATHERED |
| DLMT | DOLOMITE | GVLY | GRAVELLY | OBDN | OVERBURDEN | SLTE | SLATE | | |
| DNSE | DENSE | GYPS | GYPSUM | PCKD | PACKED | SLTY | SILTY | | |
| DRTY | DIRTY | HARD | HARD | PEAT | PEAT | SNDS | SANDSTONE | | |
| DRY | DRY | HPAN | HARDPAN | PGVL | PEA GRAVEL | SNDY | SANDYOAPSTONE | | |

## 2. Core Color

| Code | Description |
|---|---|
| WHIT | WHITE |
| GREY | GREY |
| BLUE | BLUE |
| GREN | GREEN |
| YLLW | YELLOW |
| BRWN | BROWN |
| RED | RED |
| BLCK | BLACK |
| BLGY | BLUE-GREY |

## 3. Well Use

| Code | Description | Code | Description |
|---|---|---|---|
| DO | Domestic | OT | Other |
| ST | Livestock | TH | Test Hole |
| IR | Irrigation | DE | Dewatering |
| IN | Industrial | MO | Monitoring |
| CO | Commercial | MT | Monitoring TestHole |
| MN | Municipal | | |
| PS | Public | | |
| AC | Cooling And A/C | | |
| NU | Not Used | | |

## 4. Water Detail

| Code | Description | Code | Description |
|---|---|---|---|
| FR | Fresh | GS | Gas |
| SA | Salty | IR | Iron |
| SU | Sulphur | | |
| MN | Mineral | | |
| UK | Unknown | | |

# Appendix C-2

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## Monitoring Wells and Borehole Logs

# LANDTEK LIMITED

**BH/MW 1**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Elev. Depth | Sample No. | Sample Type | Test Data |
|---|---|---|---|---|
| Ground Surface | 193.5 | | | stick up = 0.92 m |
| ±300 mm of topsoil | 0.0 | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, stiff, moist | | 1 | SS | |
| 0.3 m to 0.6 m: trace rootlets | | | | |
| 1.0 m to 5.5 m: hard | | 2 | SS | |
| | | 3 | SS | |
| | | 4 | SS | |
| | | 5 | SS | |
| 4.5 m to 6.5 m: grey | | 6 | SS | |
| 5.5 m to 6.5 m: stiff | | 7 | SS | |
| | 187.0 | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | 6.5 | | | |

SPT "N" Value: 13, 32, 35, 30, 34, 30, 11

Soil Moisture (%): 18, 12, 12, 12, 11, 10, 20

GWL: WL = 3.7 m Feb. 6, 2021

Monitor Details: bentonite backfill to ground level; sand backfill to 2.7 m; 3.0 m; 3.0 m of slotted 50 mm dia. PVC pipe; 6.0 m

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process
3. Water level reading: WL at 3.7 m depth on February 6, 2021

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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# LANDTEK LIMITED

**BH 2**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 192.0 | | | | | | | | |
| ±250 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, stiff, moist | | | 1 | SS | | 8 | 16 | | | |
| 1.0 m to 2.4 m: very stiff | | | 2 | SS | | 21 | 13 | | | |
| | | | 3 | SS | | 23 | 12 | | | |
| 2.4 m to 4.5 m: hard | | | 4 | SS | | 34 | 11 | | | |
| | | | 5 | SS | | 38 | 12 | | | |
| 4.5 m to 6.5 m: grey, very stiff | | | 6 | SS | | 16 | 10 | | | |
| | | | 7 | SS | | 18 | 11 | | | |
| | | 185.5 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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**BH 3**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 190.5 | | | | | | | | |
| ±250 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, stiff, moist | | | 1 | SS | | 8 | 23 | | | |
| 1.0 m to 3.0 m: very stiff | | | 2 | SS | | 22 | 12 | | | |
| | | | 3 | SS | | 22 | 13 | | | |
| 3.0 m to 4.5 m: hard | | | 4 | SS | | 38 | 11 | | | |
| 3.5 m to 6.5 m: grey | | | | | | | | | | |
| 4.0 m to 6.5 m: very stiff | | | 5 | SS | | 18 | 10 | | | |
| 5.6 m to 6.5 m: wet | | | 6 | SS | | 19 | 14 | | | |
| | | 184.0 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

Scale (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0

SPT "N" Value: 0, 25, 50, 75, 100

Soil Moisture (%): 0, 25, 50

**Notes:**
1. On completion, borehole open to 6.0 m
2. Wet soils encountered below 5.6 m during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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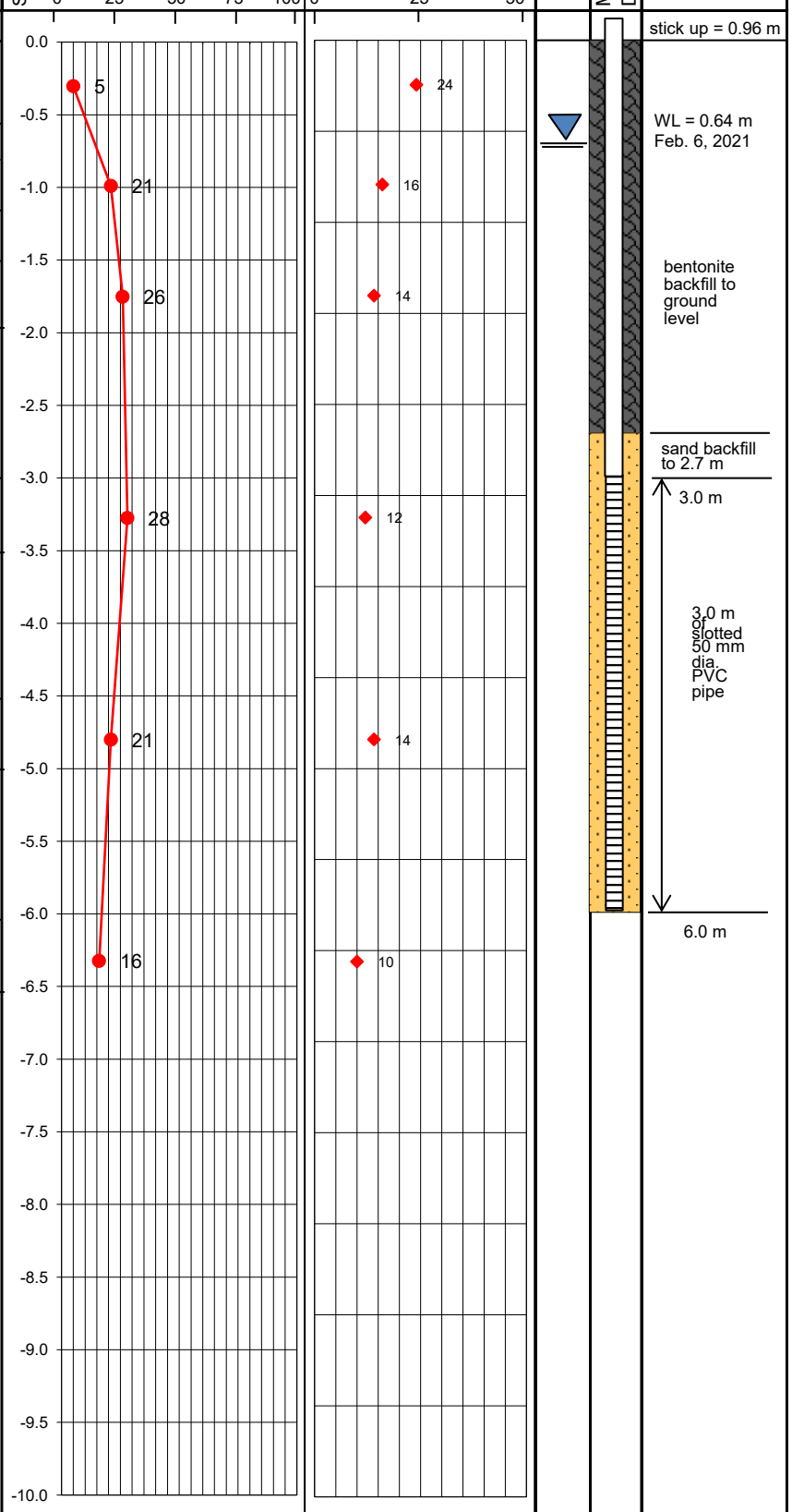
# LANDTEK LIMITED

**BH/MW 4**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Elev. Depth | Samples No. | Type | Test Data |
|---|---|---|---|---|
| Ground Surface | 191.8 | | | stick up = 0.96 m |
| ±300 mm of topsoil | 0.0 | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | 1 | SS | WL = 0.64 m Feb. 6, 2021 |
| 1.0 m to 6.5 m: very stiff | | 2 | SS | bentonite backfill to ground level |
| | | 3 | SS | sand backfill to 2.7 m |
| | | 4 | SS | 3.0 m |
| | | 5 | SS | 3.0 m of slotted 50 mm dia. PVC pipe |
| 5.0 m to 6.5 m: grey | | 6 | SS | 6.0 m |
| | 185.3 | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | 6.5 | | | |




**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process
3. Water level reading: WL at 0.64 m depth on February 6, 2021

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity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# LANDTEK LIMITED

**BH 5**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. / Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 193.5 | | | | | | | | |
| ±300 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist<br>0.3 m to 0.6 m: trace rootlets<br>1.0 m to 4.5 m: very stiff | | | 1 | SS | | 5 | 20 | | | |
| | | | 2 | SS | | 26 | 13 | | | |
| | | | 3 | SS | | 17 | 12 | | | |
| 4.5 m to 6.5 m: grey, stiff | | | 4 | SS | | 11 | 12 | | | |
| | | | 5 | SS | | 14 | 13 | | | |
| | | 187.0 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50

Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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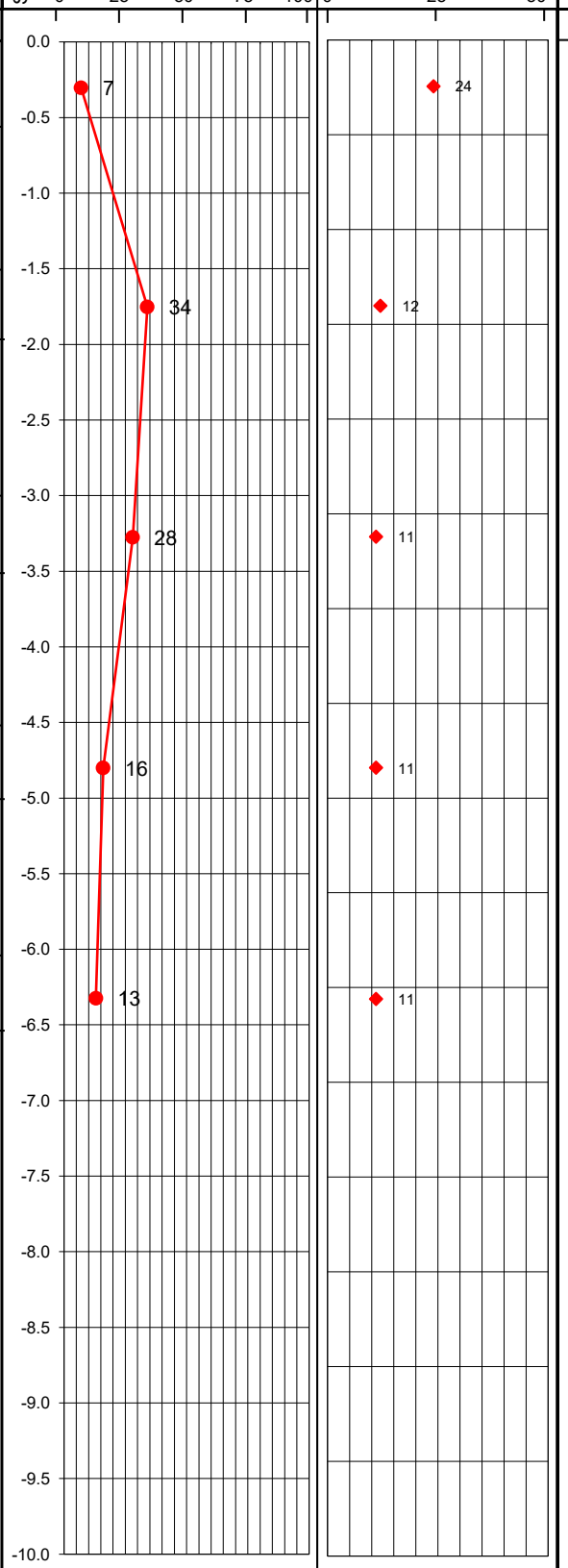
# LANDTEK LIMITED

**BH 6**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 192.8 | | | | | | | | |
| ±330 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm moist<br>0.3 m to 0.6 m: trace rootlets<br>1.0 m to 5.0 m: very stiff to hard | | | 1 | SS | | 7 | 24 | | | |
| | | | 2 | SS | | 34 | 12 | | | |
| 3.0 m to 6.5 m: grey | | | 3 | SS | | 28 | 11 | | | |
| | | | 4 | SS | | 16 | 11 | | | |
| 5.0 m to 6.5 m: stiff | | | 5 | SS | | 13 | 11 | | | |
| | | 186.3 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |




**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity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# LANDTEK LIMITED

**BH 7**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 191.5 | | | | | | | | |
| ±360 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm moist<br>0.3 m to 0.6 m: trace rootlets<br>1.0 m to 3.5 m: very stiff to hard | | | 1 | SS | | 6 | 20 | | | |
| | | | 2 | SS | | 35 | 13 | | | |
| 3.0 m to 6.5 m: grey | | | 3 | SS | | 16 | 12 | | | |
| 4.5 m to 6.5 m: stiff | | | 4 | SS | | 11 | 12 | | | |
| | | 185.0 | 5 | SS | | 12 | 13 | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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**BH 8**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 21, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 190.8 | | | | | | | | |
| ±360 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | | 1 | SS | | 5 | 22 | | | |
| 0.4 m to 0.6 m: trace rootlets | | | | | | | | | | |
| 1.0 m to 4.0 m: very stiff to hard | | | 2 | SS | | 17 | 13 | | | |
| | | | | | | | | | | |
| | | | 3 | SS | | 31 | 13 | | | |
| | | | | | | | | | | |
| | | | 4 | SS | | 17 | 11 | | | |
| 4.0 m to 6.5 m: grey, stiff | | | | | | | | | | |
| | | | 5 | SS | | 14 | 12 | | | |
| | | | | | | | | | | |
| | | | 6 | SS | | 9 | 13 | | | |
| | | 184.3 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

SPT "N" Value: 0 25 50 75 100

Soil Moisture (%): 0 25 50

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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# LANDTEK LIMITED

**BH 9**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 190.0 | | | | | | | | |
| ±410 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist<br>0.4 m to 0.6 m: trace rootlets<br>1.0 m to 4.0 m: hard | | | 1 | SS | | 6 | 21 | | | |
| | | | 2 | SS | | 33 | 14 | | | |
| | | | 3 | SS | | 45 | 12 | | | |
| 4.0 m to 6.5 m: grey, stiff | | | 4 | SS | | 15 | 11 | | | |
| | | | 5 | SS | | 16 | 13 | | | |
| | | 183.5 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50

Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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**BH/MW 10**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Elev. Depth | Sample No. | Sample Type | SPT "N" Value | Soil Moisture (%) | Test Data |
|---|---|---|---|---|---|---|
| Ground Surface | 189.5 | | | | | stick up = 0.92 m |
| ±430 mm of topsoil | 0.0 | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | 1 | SS | 6 | 21 | WL = 0.54 m Feb. 6, 2021 |
| 0.4 m to 0.8 m: trace rootlets | | | | | | |
| 1.0 m to 4.0 m: hard | | 2 | SS | 33 | 13 | bentonite backfill to ground level |
| | | 3 | SS | 35 | 14 | sand backfill to 2.7 m; 3.0 m |
| 4.0 m to 6.5 m: very stiff | | 4 | SS | 24 | 13 | 3.0 m of slotted 50 mm dia. PVC pipe |
| 5.0 m to 6.5 m: grey | | 5 | SS | 17 | 11 | |
| | 182.2 | | | | | 6.0 m |
| **END OF BOREHOLE AT TARGET DEPTH** | 6.5 | | | | | |

SPT "N" Value: Scale (m) 0.0 to -10.0; 0 25 50 75 100

Soil Moisture (%): 0 25 50

GWL

Monitor Details

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process
3. Water level reading: WL at 0.54 m depth on February 6, 2021

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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# LANDTEK LIMITED

**BH 11**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 187.0 | | | | | | | | |
| ±330 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | | 1 | SS | | 5 | 20 | | | |
| 0.3 m to 0.6 m: trace rootlets | | | | | | | | | | |
| 1.0 m to 4.0 m: hard | | | 2 | SS | | 39 | 13 | | | |
| 3.0 m to 6.5 m: grey | | | 3 | SS | | 41 | 12 | | | |
| 4.0 m to 6.5 m: very stiff | | | 4 | SS | | 16 | 12 | | | |
| | | 180.5 | 5 | SS | | 15 | 14 | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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# LANDTEK LIMITED

**BH 12**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 187.0 | | | | | | | | |
| ±380 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, stiff, moist | | | 1 | SS | | 5 | 21 | | | |
| 0.4 m to 0.6 m: trace rootlets | | | | | | | | | | |
| 1.0 m to 3.0 m: very stiff | | | 2 | SS | | 18 | 13 | | | |
| | | | | | | | | | | |
| | | | 3 | SS | | 22 | 11 | | | |
| 3.0 m to 4.0 m: hard | | | 4 | SS | | 49 | 13 | | | |
| 4.0 m to 6.5 m: grey, very stiff | | | 5 | SS | | 16 | 12 | | | |
| | | | | | | | | | | |
| | | | 6 | SS | | 19 | 13 | | | |
| | | 180.5 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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# LANDTEK LIMITED

**BH 13**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) | SPT "N" Value | Soil Moisture (%) | GWL | Monitor Details | Test Data |
|---|---|---|---|---|---|---|---|---|---|---|
| Ground Surface | | 186.5 | | | | | | | | |
| ±360 mm of topsoil | | 0.0 | | | | | | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | | 1 | SS | | 3 | 22 | | | |
| 0.4 m to 0.6 m: trace rootlets | | | | | | | | | | |
| 1.0 m to 4.0 m: hard | | | 2 | SS | | 32 | 12 | | | |
| | | | 3 | SS | | 37 | 14 | | | |
| 4.0 m to 6.5 m: grey, very stiff | | | 4 | SS | | 18 | 10 | | | |
| | | | 5 | SS | | 18 | 13 | | | |
| | | 180.0 | | | | | | | | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | | | | | | |

Scale (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0

SPT "N" Value: 0, 25, 50, 75, 100

Soil Moisture (%): 0, 25, 50

**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


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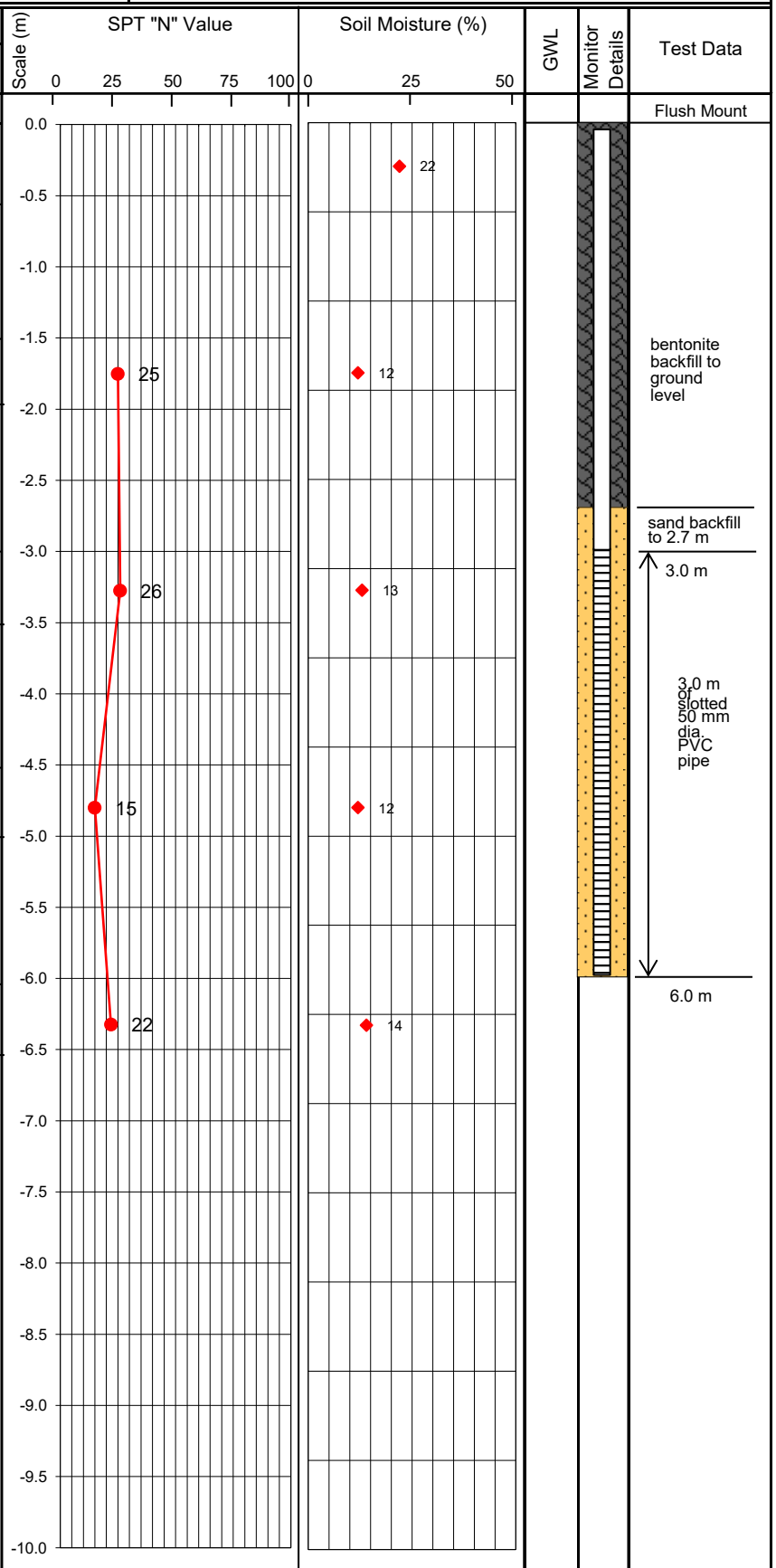
# LANDTEK LIMITED

**BH/MW 14**

| | | | |
|---|---|---|---|
| Project No.: | 20381 | Drill Date: | December 22, 2020 |
| Project: | Geotechnical Investigation | Drill Method: | [ x ] solid stem [ ] hollow stem [ ] vibratory |
| Location: | 103 Burnhamthorpe Road West, Oakville, Ontario | Datum: | Geodetic |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Test Data |
|---|---|---|---|---|---|
| Ground Surface | | 186.2 | | | Flush Mount |
| ±360 mm of topsoil | | 0.0 | | | |
| **SILTY CLAY TILL:** trace gravel, trace red shale, trace iron staining, brown, firm, moist | | | 1 | AUG | |
| 0.4 m to 0.8 m: trace rootlets | | | | | |
| 1.0 m to 6.5 m: very stiff | | | 2 | SS | |
| | | | 3 | SS | |
| 4.0 m to 6.5 m: grey | | | 4 | SS | |
| | | 179.7 | 5 | SS | |
| **END OF BOREHOLE AT TARGET DEPTH** | | 6.5 | | | |




**Notes:**
1. On completion, borehole open to 6.0 m
2. Groundwater was not encountered during the drilling process
3. Water level reading: Monitoring well inaccessible on February 6, 2021

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity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# LOG OF DRILLING OPERATIONS

**MW4s**



| | | |
|---|---|---|
| Client: **Star Oak Developments Limited** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **C. Dinulescu** |
| Project No.: **PTN15522.0** | Location: **North Oakville East** | Ground (m amsl): **187.5** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **9/16/2008** | Static Water Level (m amsl): **185.1** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **9/16/2008** | Sand Pack (m amsl): **184.5 - 182.3** |

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description (Surface Elevation (m): 187.50) | Strat. Plot | Elev. / Depth (m) | | SAMPLE Num. | Type | Int. | N.Val. | Depth Scale (ft) | Depth Scale (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL | | 187.25 / 0.25 | bentonite seal | | SS | | 36 | | |
| | 1.0 | Clayey with some silt, trace organics. Light brown, soft and damp. | | | | | SS | | >100 | | 1.0 |
| 5.0 | | CLAYEY SILT TILL | | | | | | | | 5.0 | |
| | 2.0 | Trace fine sand and pebbles and cobbles (<2.5 cm diam., subangular to subrounded). Light brown, firm to stiff, damp, trace iron stainings. | | | | | SS | | 80 | | 2.0 |
| | | | | | | | SS | | >100 | | |
| 10.0 | 3.0 | At 4.50 m, becomes grey and soft to firm. | | | | | SS | | >100 | 10.0 | 3.0 |
| | 4.0 | | | | PVC screen silica sand pack | | | | | | 4.0 |
| 15.0 | | | | | | | SS | | 73 | 15.0 | |
| | 5.0 | | | 182.32 / 5.18 | 5.18 | | | | | | 5.0 |

Prepared By: **CD** Checked By: **JT** Date Prepared: **10/29/2008**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- Water found @ time of drilling
- Static Water Level - 10/23/2008

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**MW4d**

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BURNSIDE



| | | |
|---|---|---|
| Client: **Star Oak Developments Limited** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **C. Dinulescu** |
| Project No.: **PTN15522.0** | Location: **North Oakville East** | Ground (m amsl): **187.5** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **9/15/2008** | Static Water Level (m amsl): **181.4** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **9/15/2008** | Sand Pack (m amsl): **179.3 - 176.8** |

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. Depth (m) | SAMPLE Num. | Type | Int. | N.Val. |
|---|---|---|---|---|---|---|---|---|
| | | Surface Elevation (m): **187.50** | | | | | | |
| | | TOPSOIL | | 187.25 / 0.25 | | SS | | 36 |
| | 1.0 | Clayey with some silt, trace organics. Light brown, soft and damp. | | | | SS | | >100 |
| 5.0 | | CLAYEY SILT TILL | | | | SS | | 80 |
| | 2.0 | Trace fine sand and pebbles and cobbles (<2.5 cm diam., subangular to subrounded). Light brown, firm to stiff, damp, trace iron stainings. | | | | SS | | >100 |
| 10.0 | 3.0 | At 4.50 m, becomes grey and soft to firm. | | | | SS | | >100 |
| | 4.0 | At 6 m, damp to moist and reddish-grey. | | | | | | |
| 15.0 | | At 9 m, soft and moist. | | | | SS | | 73 |
| | 5.0 | | | | | | | |
| 20.0 | 6.0 | | | | | SS | | 52 |
| | 7.0 | | | | | | | |
| 25.0 | 8.0 | | | | | SS | | 74 |
| | 9.0 | | | | | | | |
| 30.0 | 10.0 | | | | | SS | | 62 |
| | | | | | | SS | | 80 |
| 35.0 | | | | 176.83 / 10.67 | | | | |

bentonite seal

PVC screen
silica sand pack

10.67

Prepared By: **CD** Checked By: **JT** Date Prepared: **10/29/2008**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- Water found @ time of drilling
- Static Water Level - 10/23/2008

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

BHLOG GUELPH P:\GINT\PROJECTS\P\PTN15522.0- STAR OAK-WEST MORRISON.GPJ TEMPLATE.GDT 2/3/09

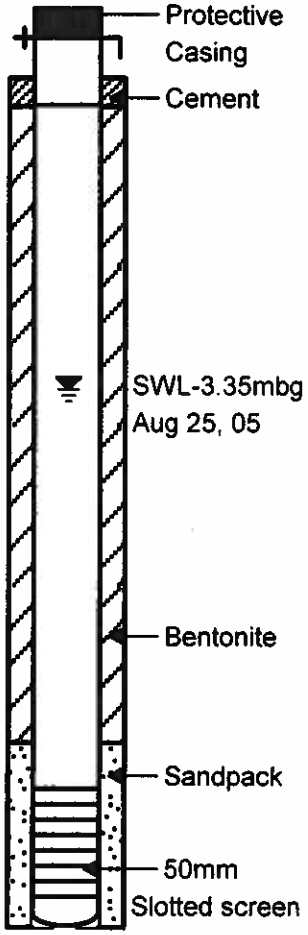
BEATTY & ASSOCIATES

# Borehole Log: SGGC1 (SGGC)

***Project No:*** 431-051
***Client:*** Mattamy Homes
***Location:*** Oakville
***Static Water Level:*** 179.15masl

***Estimated Ground Elevation:*** 182.5masl
***Top of Casing:*** 183.28 masl
***Logged By:*** CC
***Drill Date:*** Aug 15, 2005

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (masl) | Number | Type | N-Value (1ft; 1ft) | Well Completion Details |
| 0.00 | | Ground Surface | 182.50 | | | | |
| | | ***Top Soil:*** Sandy silt, brown, trace clay, trace organics. | | 1 | SS | | |
| 1.00 | | ***Clayey Silt Till:*** Redish-brown, very stiff, dry, trace iron staining. | | 2 | SS | 48; 80 | |
| 2.00 | | Grey at 4.10m. | | | | | |
| 3.00 | | | | 3 | SS | 78; >100 | |
| 4.00 | | | 177.93 | | | | |
| 5.00 | | ***Sandy Silt Till:*** Grey, stiff to hard, dry, trace clay, trace pebbles. | | 4 | SS | 38; 43 | |
| 6.00 | | | | 5 | SS | 100; 100 | |
| 7.00 | | | | | | | |
| 8.00 | | | | 6 | SS | 100; 100 | |
| 9.00 | | | 173.36 | | | | |
| | | ***Shale:*** Contact with red shale, very hard, dry, at 9.14m. | | 7 | SS | | |
| 10.00 | | End of Log | | | | | |
| 11.00 | | | | | | | |




***Drill Method:*** Hollow Stem Auger

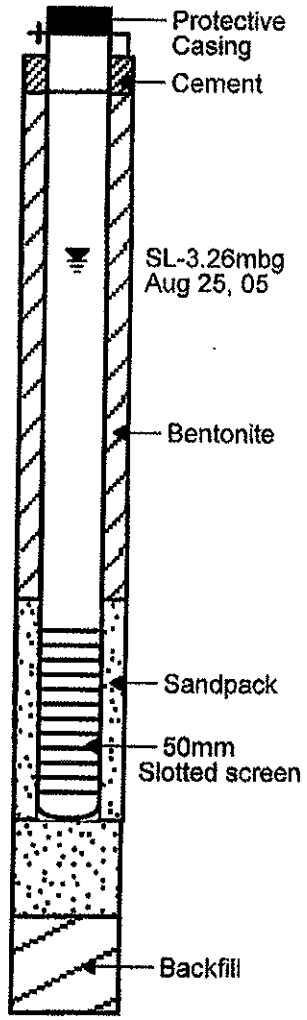
BEATTY & ASSOCIATES

# Borehole Log: SGGC2 (SGGC)

***Project No:*** 431-051
***Client:*** Mattamy Homes
***Location:*** Oakville
***Static Water Level:*** 184.74masl

***Estimated Ground Elevation:*** 188masl
***Top of Casing:*** 188.8 masl
***Logged By:*** CC
***Drill Date:*** Aug 15, 2005

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description (DRAFT) | Elevation (masl) | Number | Type | N-Value (1ft; 1ft) | Well Completion Details |
| 0.00 | | Ground Surface | 188.00 | | | | |
| | | ***Top Soil:*** Sandy silt, brown, trace clay, trace boulders. | | 1 | SS | | |
| 1.00 | | | | | | | |
| 2.00 | | ***Clayey Silt Till:*** Redish- brown, very stiff, dry, trace iron staining, trace pebbles, high plasticity. | | 2 | SS | 50; 79 | |
| 3.00 | | At 4.57m, soft, moist. | | 3 | SS | 57; 78 | |
| 4.00 | | | | | | | |
| 5.00 | | Grey-brown at 7.62m depth. | | 4 | SS | 28; 37 | |
| 6.00 | | At 10.66m, becomes redish- brown. | | 5 | SS | 18; 31 | |
| 7.00 | | Very stiff to hard, starting with 12.2m depth. | | | | | |
| 8.00 | | | | 6 | SS | 16; 22 | |
| 9.00 | | | | 7 | SS | 8; 18 | |
| 10.00 | | | | | | | |
| 11.00 | | | | 8 | SS | 14; 25 | |
| 12.00 | | | | | | | |
| 13.00 | | | | 9 | SS | 65; >100 | |
| 14.00 | | | | 10 | SS | >100 | |
| 15.00 | | | 172.76 | | | | |
| 16.00 | | End of Log | | 11 | SS | >100 | |




***Drill Method:*** Hollow Stem Auger

***Sheet*** 1 of 1

Beatty & Associates

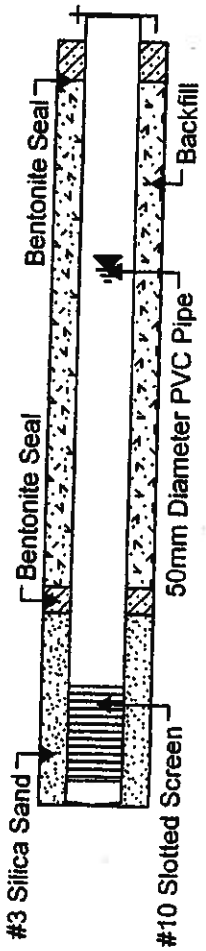
# Borehole Log: BA-1s

***Project No.*** 317-012
***Client*** North Oakville Management Inc.
***Location:*** North Oakville
***Logged By:*** Kurt Stamm

***Ground Elevation:*** 191.8 masl
***Top of Casing:*** 192.5 masl
***Water Level Elevation:*** 186.3 masl

| Depth (m) | Description | Elevation (masl) | Sample Number | Sample Type | N-Value |
|---|---|---|---|---|---|
| 0 | Ground Surface | 192.6 / 191.8 | | | |
| 0–1.5 | ***Topsoil*** medium, firm, brown, moist, some rootlets, trace clay, some sand | 190.3 | 1 | | |
| 1.5–13 | ***Silty Sand Till*** fine, firm, brown, damp, trace gravel, trace pebbles<br>***Clayey Silt Till*** stiff to hard, reddish brown, damp, trace sand, trace pebbles, trace gravel | | 2, 3, 4, 5, 6, 7, 8 | | |
| 13–18 | ***Silty Sand Till*** fine, hard, grey, damp, trace pebbles, trace gravel | 178.4 | 9, 10, 11, 12 | | |
| 18 | End of Log | 173.5 | | | |

Well Completion Details




***Drill Method:*** Hollow Stem Auger
***Drill Date:*** June 3, 2002

***Sample Interval:*** Auger
***Sheet:*** 1 of 1

Beatty & Associates

# Borehole Log: BA-1d

***Project No.*** 317-012
***Client*** North Oakville Management Inc.
***Location:*** North Oakville
***Logged By:*** Kurt Stamm

***Ground Elevation:*** 191.5 masl
***Top of Casing:*** 192.2 masl
***Water Level Elevation:*** 186.0 masl

| Depth (m) | Description | Elevation (masl) | Sample Number | Sample Type | N-Vaule |
|---|---|---|---|---|---|
| 0 | Ground Surface | 192.3 / 191.5 | | | |
| 0–1 | ***Topsoil*** medium, firm, brown, moist, some rootlets, trace clay, some sand | 190.4 | 1 | | |
| 1–4 | ***Silty Sand Till*** fine, firm, brown, damp, trace gravel, trace pebbles | | 2, 3 | | |
| 4–13 | ***Clayey SiltTill*** stiff to hard, reddish brown, damp, trace sand, trace pebbles, trace gravel | 178.1 | 4, 5, 6, 7, 8, 9 | | |
| 13–19 | ***Silty Sand Till*** fine, hard, grey, damp, trace pebbles, trace gravel<br>turning red and moist at 18.2m | 172.0 | 10, 11, 12, 13 | | |
| 19–24 | ***Shale*** hard, red, damp, some fractures present along bedding planes | 167.1 | 14, 15, 16 | | |
| 24 | End of Log | | | | |

Well Completion Details: Backfill; Bentonite Seal; Grout; 50mm Diameter PVC Pipe; #3 Silica Sand; Bentonite Seal; #10 Slotted Screen

***Drill Method:*** Hollow Stem Auger
***Drill Date:*** June 12, 2002

***Sample Interval:*** Continuous
***Sheet:*** 1 of 1

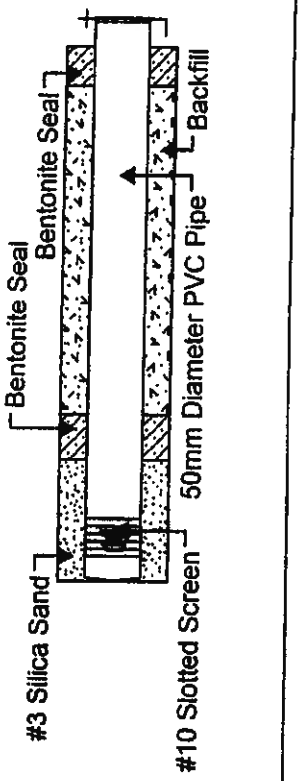
Beatty & Associates

# Borehole Log: BA 2s

***Project No.*** 317-012
***Client*** North Oakville Management Inc.
***Location:*** North Oakville
***Logged By:*** Kurt Stamm

***Ground Elevation:*** 190.4 masl
***Top of Casing:*** 191.2 masl
***Water Level Elevation:*** 178.5 masl

| Depth (m) | Symbol | Description | Elevation (masl) | SAMPLE Number | SAMPLE Type | SAMPLE N-Vaule | Well Completion Details |
|---|---|---|---|---|---|---|---|
| | | | 191.2 | | | | |
| 0 | | Ground Surface | 190.4 | | | | |
| 0–1 | | ***Topsoil*** medium, soft, brown, damp, some rootlets | | 1 | | | |
| 1–3 | | ***Clayey Silt Till*** stiff to hard, reddish brown, damp to moist, trace sand, trace gravel, trace pebbles | | 2 | | | |
| 3–6 | | becoming grey at 10m | | 3 | | | |
| 6–8 | | becoming very moist at 12.4m | | 4 | | | |
| 8–12 | | | | 5 | | | |
| | | | | 6 | | | |
| | | | | 7 | | | |
| | | | | 8 | | | |
| 12–13 | | | 177.6 | 9 | | | |
| 13 | | End of Log | | | | | |




***Drill Method:*** Hollow Stem Auger
***Drill Date:*** May 28, 2002

***Sample Interval:*** Auger
***Sheet:*** 1 of 1

Beatty & Associates

# Borehole Log: BA 2d

***Project No.*** 317-012
***Client*** North Oakville Management Inc.
***Location:*** North Oakville
***Logged By:*** Kurt Stamm

***Ground Elevation:*** 190.7 masl
***Top of Casing:*** 191.5 masl
***Water Level Elevation:*** 178.8 masl

| Depth (m) | Symbol | Description | Elevation (masl) | Number | Type | N-Value |
|---|---|---|---|---|---|---|
| 0 | | Ground Surface | 191.5 / 190.7 | | | |
| 0–1 | | ***Topsoil*** medium, soft, brown, damp, some rootlets | | 1 | | |
| 1–10 | | ***Clayey Silt Till*** stiff to hard, reddish brown, damp to moist, trace sand, trace gravel, trace pebbles; becoming grey at 10m; becoming very moist at 12.4m | | 2–11 | | |
| 16–17 | | ***Silty Sand Till*** fine, hard, grey, very moist to wet, trace gravel, trace pebbles | 173.9 | 12–14 | | |
| 19–20 | | ***Shale*** hard, red with grey bands about 3cm to 7cm thick, moist, some fractures along bedding planes | 170.9 | 15–18 | | |
| 26 | | End of Log | 164.8 | | | |

Well Completion Details: Grout; Bentonite Seal; 50mm Diameter PVC Pipe; Bentonite Seal; #10 Slotted Screen; #3 Silica Sand

***Drill Method:*** Hollow Stem Auger
***Drill Date:*** June 3, 2002

***Sample Interval:*** Continuous
***Sheet:*** 1 of 1

Beatty & Associates

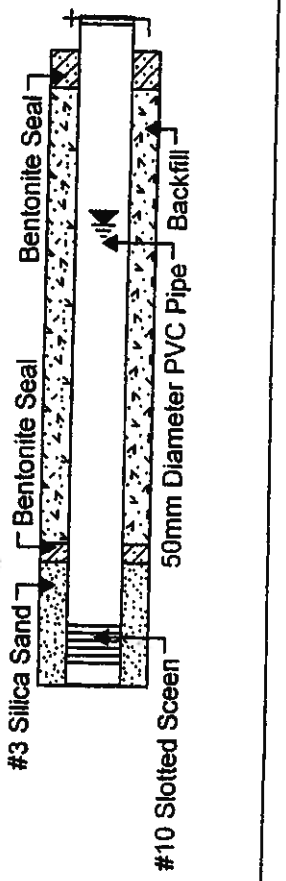
# Borehole Log: BA-3

***Project No.*** 317-012
***Client*** North Oakville Management Inc.
***Location:*** North Oakville
***Logged By:*** Kurt Stamm

***Ground Elevation:*** 187.6 masl
***Top of Casing:*** 188.5 masl
***Water Level Elevation:*** 178.4 masl

| Depth (m) | Description | Elevation (masl) | Sample Number | Sample Type | N-Vaule |
|---|---|---|---|---|---|
| | | 188.5 | | | |
| 0 | Ground Surface | 187.6 | | | |
| 1 | ***Topsoil*** medium, soft, brown, damp, some rootlets | 186.1 | 1 | | 7 |
| 2 | | | 2 | | 41 |
| 3 | ***Sandy Silt Till*** fine to medium, firm to stiff, brown, damp, trace pebbles, trace gravel, trace rootlets | | 3 | | 43 |
| 4 | | | 4 | | 58 |
| 5 | ***Clayey Silt Till*** stiff to hard, reddish brown, damp, trace sand, trace gravel, trace pebbles | | 5 | | 50 |
| 6 | | | 6 | | 25 |
| 7 | | | 7 | | 29 |
| 8 | becoming purple/grey at 4m | | 8 | | 19 |
| 9 | | | 9 | | 21 |
| 10 | 2 cm sand till seam present at 10.6m | | 10 | | 24 |
| 11 | | | 11 | | 31 |
| 12 | becoming moist at 10.6m | | 12 | | 34 |
| 13 | | 174.6 | 13 | | 27 |
| 14 | ***Sandy Silt Till*** fine, hard, grey, very moist to wet, some gravel, trace clay, trace pebbles | | 14 | | 25 |
| 15 | | | 15 | | 67 |
| 16 | | | 16 | | 42 |
| 17 | | | 17 | | 50-3 |
| 18 | | | 18 | | 50-5 |
| 19 | | | 19 | | 100-6 |
| 20 | | 172.4 | 20 | | 100-3 |
| 21 | 7 cm sand and gravel seam present at 13.7m | | | | |
| 22 | End of Log | | | | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |
| 26 | | | | | |
| 27 | | | | | |
| 28 | | | | | |

Well Completion Details




***Drill Method:*** Hollow Stem Auger
***Drill Date:*** May 27, 2002

***Sample Interval:*** 0.7m
***Sheet:*** 1 of 1

# LOG OF DRILLING OPERATIONS

**UCW6**

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **189.2** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **1/29/2018** | Static Water Level Depth (m): **0.15** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **1/29/2018** | Sand Pack Depth (m) : **4.72-6.92** |

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description (Surface Elevation (m): 189.20) | Strat. Plot | Elev. Depth (m) | | SAMPLE Num. | Type | Int. | N.Val. |
|---|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown, damp. | | 188.95<br>0.25 | | 1a<br>1b | SS<br>SS | | 5<br>7 |
| 5.0 | 1.0 | SILT Clayey<br>Brown-grey, very stiff to hard, damp, trace sand, some gravel, medium plasticity, grey mottling, weathered red shale fragments. Subangular gravel (<4cm in diameter) increased with depth. | | | | 3 | SS | | 20 |
| | 2.0 | | | | | 4 | SS | | 26 |
| | | | | | bentonite seal | 5 | SS | | 28 |
| 10.0 | 3.0 | | | | | | | | |
| | 4.0 | | | 185.24<br>3.96 | | 6 | SS | | 60 |
| 15.0 | | CLAY Silty (TILL)<br>Grey, very stiff, damp, trace sand and gravel, medium to high plasticity, weathered green shale fragments.<br>Sand inclusion at 4.72m. | | | | 7 | SS | | 25 |
| | 5.0 | | | | | 8 | SS | | 17 |
| | | | | | silica sand pack | | | | |
| 20.0 | 6.0 | | | | well screen | 9 | SS | | 20 |
| | | | | 182.27<br>6.93 | 6.92 | | | | |

| Depth Scale (ft) | Depth Scale (m) |
|---|---|
| 5.0 | 1.0 |
| 10.0 | 3.0 |
| 15.0 | 5.0 |
| 20.0 | 6.0 |

Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **2/12/2018**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- Water found @ time of drilling
- Static Water Level - 2/28/2018

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**UKW5d**

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **182.0** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **1/26/2018** | Static Water Level Depth (m): **2.29** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **1/26/2018** | Sand Pack Depth (m) : **6.65-8.47** |

Surface Elevation (m): **182.00**

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. Depth (m) |
|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown , damp. | | 181.75<br>0.25 |
| | | SILT Clayey<br>Grey- brown, very stiff to hard, damp, trace sand, some gravel, medium plasticity, grey mottling, weathered red shale fragments.<br>Subangular gravel (<4cm in diameter) increased with depth.<br>Narrow (~4cm) sand layer at 1.60m. | | |
| | | SAND Gravelly<br>Brown, very dense, wet, trace silt, and weathered shale fragments.<br>Gravel is fine (<3 cm diameter), subangular to subrounded and well graded. | | 178.31<br>3.69 |
| | | CLAY Silty (TILL)<br>Brown-red, hard, wet, medium plasticity, weathered red shale fragments. | | 175.22<br>6.78 |
| | | SHALE<br>Hard, red, green. | | 173.16<br>8.84<br>173.01<br>8.99 |

bentonite seal

silica sand pack

well screen

8.47

| SAMPLE Num. | Type | Int. | N.Val. |
|---|---|---|---|
| 1a | SS | | 4 |
| 1b | SS | | 11 |
| 2 | SS | | 21 |
| 3 | SS | | 29 |
| 4 | SS | | 27 |
| 5a | SS | | 72 |
| 5b | SS | | 72 |
| 6 | SS | | >72/12" |
| 7 | SS | | >72/12" |
| 8 | SS | | >52/6" |
| 9 | SS | | >52/6" |
| 10 | SS | | >63/6" |
| 11 | SS | | >70/6" |

Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **2/12/2018**

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LEGEND
- Water found @ time of drilling
- Static Water Level - 2/28/2018

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**UKW5s**

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **182.0** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **1/26/2018** | Static Water Level Depth (m): **2.37** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **1/26/2018** | Sand Pack Depth (m) : **3.43-4.93** |

Surface Elevation (m): **182.00**

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. Depth (m) | Sample Num. | Sample Type | Sample Int. | Sample N.Val. |
|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown , damp. | | 181.75<br>0.25 | 1a | SS | | 4 |
| | | SILT Clayey<br>Grey- brown, medium to stiff, damp, trace sand, some gravel, medium plasticity, grey mottling, weathered red shale fragments. Subangular gravel (<4cm in diameter) increased with depth. | | | 1b | SS | | 11 |
| | 1.0 | | | | 2 | SS | | 21 |
| 5.0 | | Narrow (~4cm) sand layer at 1.60m. | | | 3 | SS | | 29 |
| | 2.0 | | | | | | | |
| | | | | | 4 | SS | | 27 |
| 10.0 | 3.0 | | | | | | | |
| | | SAND Gravelly<br>Brown, very dense, wet, trace silt, and weathered shale fragments. Gravel is fine (<3 cm diameter), subangular to subrounded and well graded. | | 178.31<br>3.69 | 5a | SS | | 72 |
| | 4.0 | | | | 5b | SS | | 72 |
| 15.0 | | | | | | | | |
| | | | | | 6 | SS | | >72/12" |
| | | | | 175.22<br>6.78 | | | | |

bentonite seal
silica sand pack
well screen
4.93

Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **2/12/2018**

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LEGEND
▼ Water found @ time of drilling
▽ Static Water Level - 2/28/2018

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
AC Auger Cutting
CS Continuous
RC Rock Core
SS Split Spoon
AR Air Rotary
WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**UHW1**

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M.** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **182.9** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **6/9/2017** | Static Water Level Depth (m): **0.43** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **6/9/2017** | Sand Pack Depth (m) : **3.65-4.57** |

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. / Depth (m) | Sample Num. | Sample Type | Sample Int. | Sample N.Val. |
|---|---|---|---|---|---|---|---|---|
| | | Surface Elevation (m): **182.90** | | | | | | |
| | | TOPSOIL<br>Dark brown, clayey, rootlets. | | 182.78<br>0.12 | 1a | SS | | 2 |
| | | SILT Clayey and Sandy (Till)<br>Brown, moist, hard, trace gravel (<2 cm diameter, subangular to subrounded), medium plasticity, iron staining. | | | 1b | SS | | 5 |
| 5.0 | 1.0 | | | | 2 | SS | | 16 |
| | 2.0 | Dry, crumbling, sand inclusions from about 1 m. | | | 3 | SS | | 26 |
| | | | | | 4 | SS | | 38 |
| 10.0 | 3.0 | Brown and grey mottling from about 3.5 m; occasional weathered shale. | | | 5 | SS | | 48 |
| | 4.0 | Turns grey at about 4 m. | | | 6 | SS | | 30 |
| 15.0 | 5.0 | | | 177.72<br>5.18 | 7 | SS | | 31 |


Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **10/4/2017**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level -

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE AC Auger Cutting; SS Split Spoon; CS Continuous; AR Air Rotary; RC Rock Core; WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**UHW2**

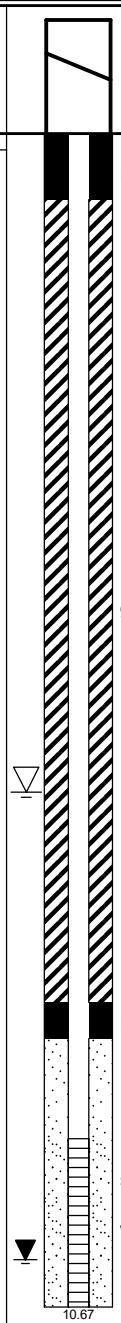
R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M.** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **191.1** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **6/7/2017** | Static Water Level Depth (m): **5.99** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **6/7/2017** | Sand Pack Depth (m) : **8.23-10.67** |

Surface Elevation (m): **191.10**

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. Depth (m) | Sample Num. | Sample Type | Sample Int. | Sample N.Val. |
|---|---|---|---|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown, silty. | | 190.95<br>0.15 | 1a | SS | | 3 |
| | | | | | 1b | SS | | 4 |
| | | SILT Clayey and Sandy (Till)<br>Brown, hard, damp to moist, trace gravel (< 1 cm diameter, subangular to subrounded), mottling with grey clay, occasional silt inclusions, medium plasticity. | | | 2 | SS | | 19 |
| 5.0 | 1.0 | | | | 3 | SS | | 32 |
| | 2.0 | Larger gravel with depth - < 4 cm diameter between 1.5 to 2.3 m | | | 4 | SS | | 33 |
| 10.0 | 3.0 | At 2.97 m - 18 cm layer of silt (brown, soft to firm, moist, some sand, some clay, trace fine gravel). | | | 5 | SS | | 36 |
| | 4.0 | Turns grey at 4.7 m. | | | | | | |
| 15.0 | 5.0 | | | | 6 | SS | | 25 |
| 20.0 | 6.0 | | | | 7 | SS | | 20 |
| 25.0 | 7.0 | | | | | | | |
| | 8.0 | | | | 8 | SS | | 17 |
| 30.0 | 9.0 | | | | 9 | SS | | 19 |
| | 10.0 | | | | | | | |
| 35.0 | 11.0 | | | 179.82<br>11.28 | 10 | SS | | 19 |




Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **10/4/2017**

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LEGEND
- Water found @ time of drilling
- Static Water Level - 7/28/2018

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

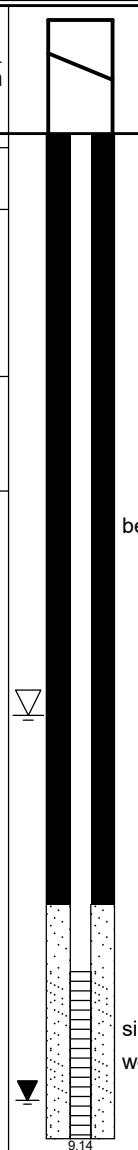
**UHW4**

R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M.** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **190.9** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **6/8/2017** | Static Water Level Depth (m): **5.29** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **5/31/2017** | Sand Pack Depth (m) : **7.01-9.14** |

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description (Surface Elevation (m): **190.90**) | Strat. Plot | Elev. Depth (m) |
|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown loam. | | 190.77<br>0.13 |
| | | SILT Clayey<br>Brown, soft, damp, trace sand, trace fine gravel. | | 190.21<br>0.69 |
| 5.0 | 1.0 | SILT Clayey (Till)<br>Brown, stiff, dry, crumbling, some sand, trace gravel (<2 cm diameter, subangular to subrounded), medium plasticity, trace weathered rocks, occasional sand inclusions. | | 188.69<br>2.21 |
| 10.0 | 2.0 | SILT Sandy (Till)<br>Brown, hard, dry, crumbling, some clay, trace gravel (<3 cm diameter, subangular to subrounded), occasional cobbles.<br><br>More clay with depth. | | 187.65<br>3.25 |
| 15.0 | 3.0 | SILT Clayey (Till)<br>Brown, hard, dry, some mottling, some sand, trace gravel (<3 cm diameter, subangular to subrounded), iron staining, sand inclusions, medium plasticity. | | |
| 20.0 | 4.0 | Turns grey at about 4.7 m. | | |
| 25.0 | 5.0 | From about 4.7 m - damp, soft to firm. | | |
| 30.0 | 6.0 | From about 6 m, mottling with brown-red clayey silt. | | |
| | 7.0 | More clay with depth. | | |
| | 8.0 | | | |
| | 9.0 | | | 181.15<br>9.75 |




| SAMPLE Num. | Type | Int. | N.Val. |
|---|---|---|---|
| 1a | SS | ☒ | 1 |
| 1b | SS | ☒ | 4 |
| 2 | SS | ☒ | 25 |
| 3 | SS | ☒ | 34 |
| 4 | SS | ☒ | 39 |
| 5 | SS | ☒ | 42 |
| 6 | SS | ☒ | 15 |
| 7 | SS | ☒ | 15 |
| 8 | SS | ☒ | 14 |
| 9 | SS | ☒ | 7 |

Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **10/4/2017**

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LEGEND
▼ Water found @ time of drilling
▽ Static Water Level - 7/28/2018

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
AC Auger Cutting
CS Continuous
RC Rock Core
SS Split Spoon
AR Air Rotary
WC Wash Cuttings

# LOG OF DRILLING OPERATIONS

**UHW5**

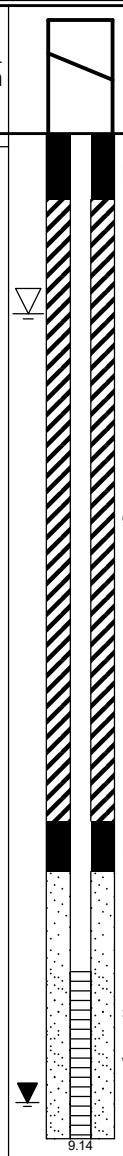
R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477



| | | |
|---|---|---|
| Client: **Jennifer Lawrence and Associates Inc.** | Project Name: **Upper West Morrison Creek EIR** | Logged by: **M.M.** |
| Project No.: **300040365.0000** | Location: **Oakville, ON** | Ground (m amsl): **188.8** |
| Drilling Co.: **Lantech Drilling Services Inc.** | Date Started: **6/7/2017** | Static Water Level Depth (m): **1.64** |
| Drilling Method: **Hollow Stem Auger** | Date Completed: **6/7/2017** | Sand Pack Depth (m) : **6.70-9.14** |

Surface Elevation (m): **188.80**

| Depth Scale (ft) | Depth Scale (m) | Stratigraphic Description | Strat. Plot | Elev. Depth (m) |
|---|---|---|---|---|
| | | TOPSOIL<br>Dark brown loam. | | 188.68<br>0.12 |
| 5.0 | 1.0 | SILT Clayey and Sandy (Till)<br>Brown, very stiff to hard, damp, trace fine sand, trace gravel (< 2 cm diameter, subangular to subrounded), medium plasticity, occasional iron staining. | | |
| 10.0 | 2.0 | Soft to firm and sandy silt inclusions from 4.5 m to 7.62 m. | | |
| 15.0 | 3.0 | Turns grey at about 5.10 m. | | |
| 20.0 | 4.0 | Silty sand inclusions from 7.6 m. | | |
| 25.0 | 5.0 | | | |
| 30.0 | 6.0 | | | |
| 35.0 | 7.0 | | | 178.13<br>10.67 |




| Num. | Type | Int. | N.Val. |
|---|---|---|---|
| 1a | SS | | 5 |
| 1b | SS | | 13 |
| 2 | SS | | 21 |
| 3 | SS | | 31 |
| 4 | SS | | 28 |
| 5 | SS | | 26 |
| 6 | SS | | 13 |
| 7 | SS | | 16 |
| 8 | SS | | 18 |
| 9 | SS | | 25 |

Prepared By: **M.M** Checked By: **D.S.** Date Prepared: **10/4/2017**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level - 7/28/2018

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE AC Auger Cutting; SS Split Spoon; CS Continuous; AR Air Rotary; RC Rock Core; WC Wash Cuttings

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# LOG OF BOREHOLE BH20-1



PROJECT: Preliminary Geotechnical Investigation- EMGO III
CLIENT: Emgo III Corporation
PROJECT LOCATION: 3483 Sixth Line, Oakville, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4816191.499 E 601500.756

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150mm
Date: Mar/04/2020

REF. NO.: 20-020-100
ENCL NO.: 2

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | BLOWS "N" 0.3 m | GROUND WATER CONDITIONS | ELEVATION | METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 180.1 | | | | | | | | |
| 179.9 0.2 | **TOPSOIL:** 200mm | | | | | | 180 | |
| 179.3 | **FILL:** clayey silt, trace topsoil/ organics, brown, wet, firm (weathered/ disturbed native) | | 1 | SS | 6 | | | |
| 0.8 | **CLAYEY SILT TO SILTY CLAY TILL:** sandy, trace gravel, occasional cobble/boulder, brown to greyish brown, moist, very stiff to hard | | 2 | SS | 27 | | Bentonite | |
| | | | 3 | SS | 28 | | 178 | |
| 177.5 | | | 4 | SS | 90/ 300mm | | W. L. 177.5 m Mar 05, 2020 | |
| 2.6 | **SANDY SILT TO SILTY SAND TILL:** trace to some clay, trace gravel, occasional cobble/boulder, greyish brown, wet, very dense | | 5 | SS | 89/ 280mm | | 177 | |
| | | | | | | | 176 Filter Pack | |
| | | | 6 | SS | 50/ 25mm | | Slotted Pipe | 6 47 42 5 |
| 174.0 | | | | | | | 175 | |
| 6.1 | **SHALE BEDROCK:** weathered, reddish brown | | 7 | SS | 50/ 100mm | | 174 | |
| 172.4 | | | | | | | 173 | |
| 7.7 | **END OF BOREHOLE:** Notes: 1) 50mm dia. monitoring well installed upon completion. 2) Water level Reading: Date: Mar 05, 2020 Water Level (mbgl): 2.6 | | 8 | SS | 50/ 25mm | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT $w_P$ | NATURAL MOISTURE CONTENT $w$ | LIQUID LIMIT $w_L$
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

DS SOIL LOG 20-020-100.GPJ DS.GDT 3/13/20

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

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# LOG OF BOREHOLE BH20-4



PROJECT: Preliminary Geotechnical Investigation- EMGO III
CLIENT: Emgo III Corporation
PROJECT LOCATION: 3483 Sixth Line, Oakville, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4816270.693 E 601638.402

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150mm
Date: Mar/05/2020

REF. NO.: 20-020-100
ENCL NO.: 5

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | BLOWS "N" 0.3 m | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 182.6 | | | | | | | | | | | | |
| 182.5 / 0.1 | **TOPSOIL:** 250mm | | | | | | | | | | | |
| 181.8 / 0.8 | **FILL:** silty clay, trace topsoil/rootlets, brown, very moist, stiff (weathered/ disturbed native) | | 1 | SS | 8 | | 182 | | ○ | | | |
| 1 | **CLAYEY SILT TO SILTY CLAY TILL:** sandy, trace gravel, occasional cobble/boulder & sand seams, brown, moist, hard | | 2 | SS | 30 | ▽ | W. L. 181.8 m Mar 05, 2020 | | ○ | | | |
| 2 | | | 3 | SS | 38 | | 181 Bentonite | | ○ | | | |
| | reddish brown below 2.3m | | 4 | SS | 56 | | | | ○ | | | |
| 179.5 / 3.1 | **SANDY SILT TILL:** trace clay, trace gravel, brown, wet, very dense | | 5 | SS | 74/ 280mm | | 180 | | ○ | | | |
| 4 | | | | | | | 179 | | | | | |
| 5 | | | 6 | SS | 50/ 125mm | | 178 | | ○ | | | |
| 176.9 / 5.7 | **SILT:** some sand, trace clay, trace gravel, grey, wet, very dense (till-like) | | | | | | 177 Filter Pack | | | | | |
| 6 | | | 7 | SS | 50/ 75mm | | Slotted Pipe 176 | | ○ | | | 1 10 84 5 |
| 7 | | | | | | | | | | | | |
| 174.9 / 7.7 | **END OF BOREHOLE:** Notes: 1) 50mm dia. monitoring well installed upon completion. 2) Water level Reading: Date: Mar 10, 2020 Water Level (mbgl): 0.8 | | 8 | SS | 50/ 75mm | | 175 | | ○ | | | |

DS SOIL LOG 20-020-100.GPJ DS.GDT 3/13/20

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

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# LOG OF BOREHOLE BH20-6



PROJECT: Preliminary Geotechnical Investigation- EMGO III
CLIENT: Emgo III Corporation
PROJECT LOCATION: 3483 Sixth Line, Oakville, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4816399.019 E 601644.742

**DRILLING DATA**
Method: Hollow Stem Auger
Diameter: 150mm
Date: Feb/14/2020

REF. NO.: 20-020-100
ENCL NO.: 7

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | BLOWS 0.3 m "N" | GROUND WATER CONDITIONS | ELEVATION |
|---|---|---|---|---|---|---|---|
| 184.6 | | | | | | | |
| 184.5 0.1 | **TOPSOIL:** 300mm<br>**FILL:** clayey silt, brown, moist, firm (weathered/ disturbed native) | | 1 | SS | 5 | | |
| 183.8 0.8 | **CLAYEY SILT TO SILTY CLAY TILL:** sandy, trace gravel, sand seams, brown, moist, very stiff to hard | | 2 | SS | 16 | | 184 |
| | | | 3 | SS | 37 | | 183 |
| 181.5 3.1 | **SANDY SILT TILL:** trace clay, trace gravel, occasional cobble/ boulder, sand seams, brown to grey, wet, very dense | | 4 | SS | 31 | | 182 |
| | | | 5 | SS | 50/ 75mm | | 181 |
| | | | 6 | SS | 89/ 290mm | | 180 |
| 178.2 | | | 7 | SS | 50/ 125mm | | 179 |
| 6.4 | **END OF BOREHOLE:** | | | | | | |

Notes:
1) 50mm dia. monitoring well installed upon completion.
2) Water level Reading:

| Date: | Water Level (mbgl): |
|---|---|
| Mar 05, 2020 | 0.8 |

W. L. 183.8 m
Mar 05, 2020
Bentonite
Filter Pack
Slotted Pipe

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT $w_P$ | NATURAL MOISTURE CONTENT $w$ | LIQUID LIMIT $w_L$
WATER CONTENT (%)
10 20 30

| POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|
| 44 | | |
| >225 | | |
| >225 | | 7 25 50 18 |
| | | |
| | | |
| | | 3 28 64 5 |

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-020-100.GPJ DS.GDT 3/13/20

# Appendix C-3

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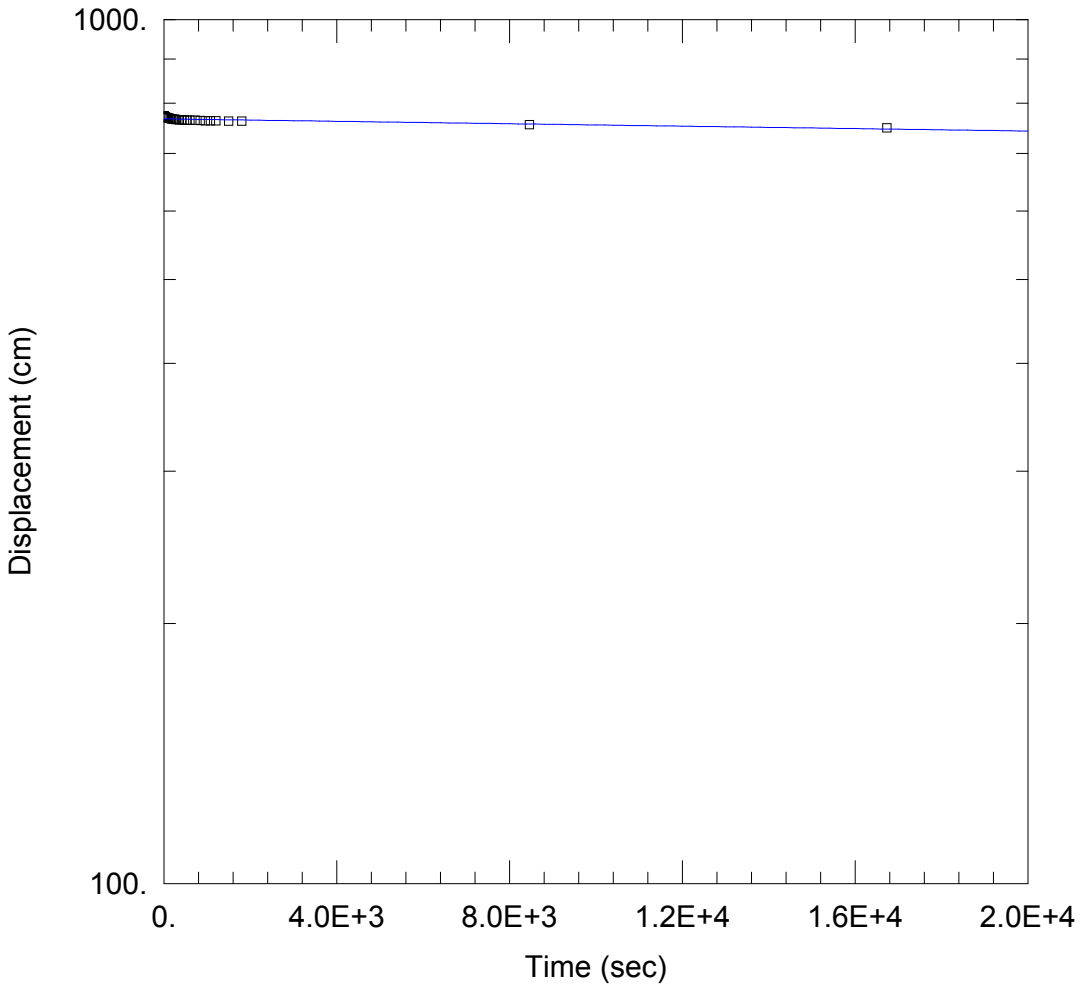
## Hydraulic Conductivity Testing




## HYDRAULIC CONDUCTIVITY TEST AT BA2S-SCREENED IN CLAYEY SILT TILL

### PROJECT INFORMATION

Company: R.J. Burnside
Project: 300040365
Location: Oakville, ON
Test Well: BA2s
Test Date: May 8, 2018

### AQUIFER DATA

Saturated Thickness: 985. cm
Anisotropy Ratio (Kz/Kr): 1.

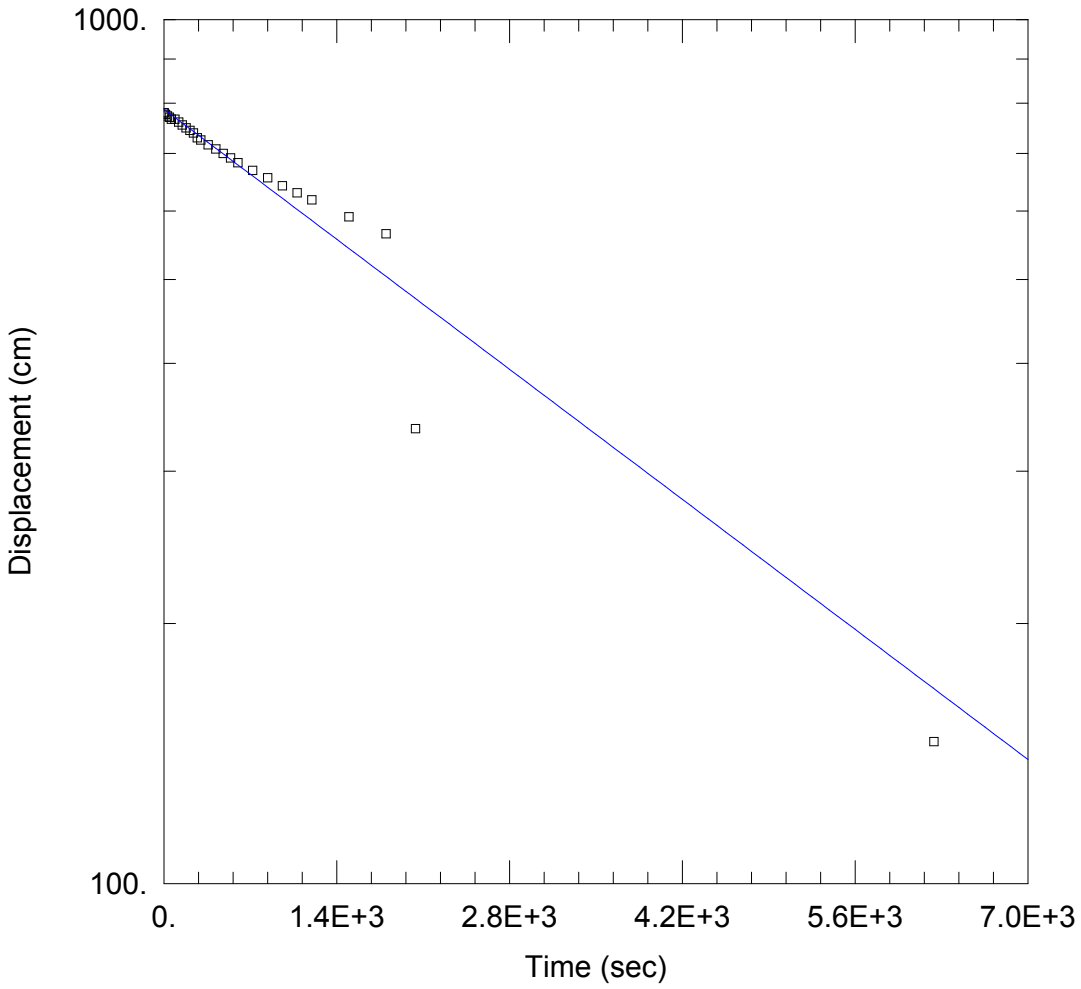
### WELL DATA (BA2s)

Initial Displacement: 774. cm
Total Well Penetration Depth: 985. cm
Casing Radius: 2.54 cm
Static Water Column Height: 985. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

### SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.266E-7 cm/sec
y0 = 767.3 cm

Figure C-3-1




## HYDRAULIC CONDUCTIVITY TEST AT BA3-SCREENED IN SANDY SILT TILL

### PROJECT INFORMATION

Company: R.J. Burnside
Project: 300040365
Location: Oakville, ON
Test Well: BA3
Test Date: May 8, 2018

### AQUIFER DATA

Saturated Thickness: 1103. cm
Anisotropy Ratio (Kz/Kr): 1.

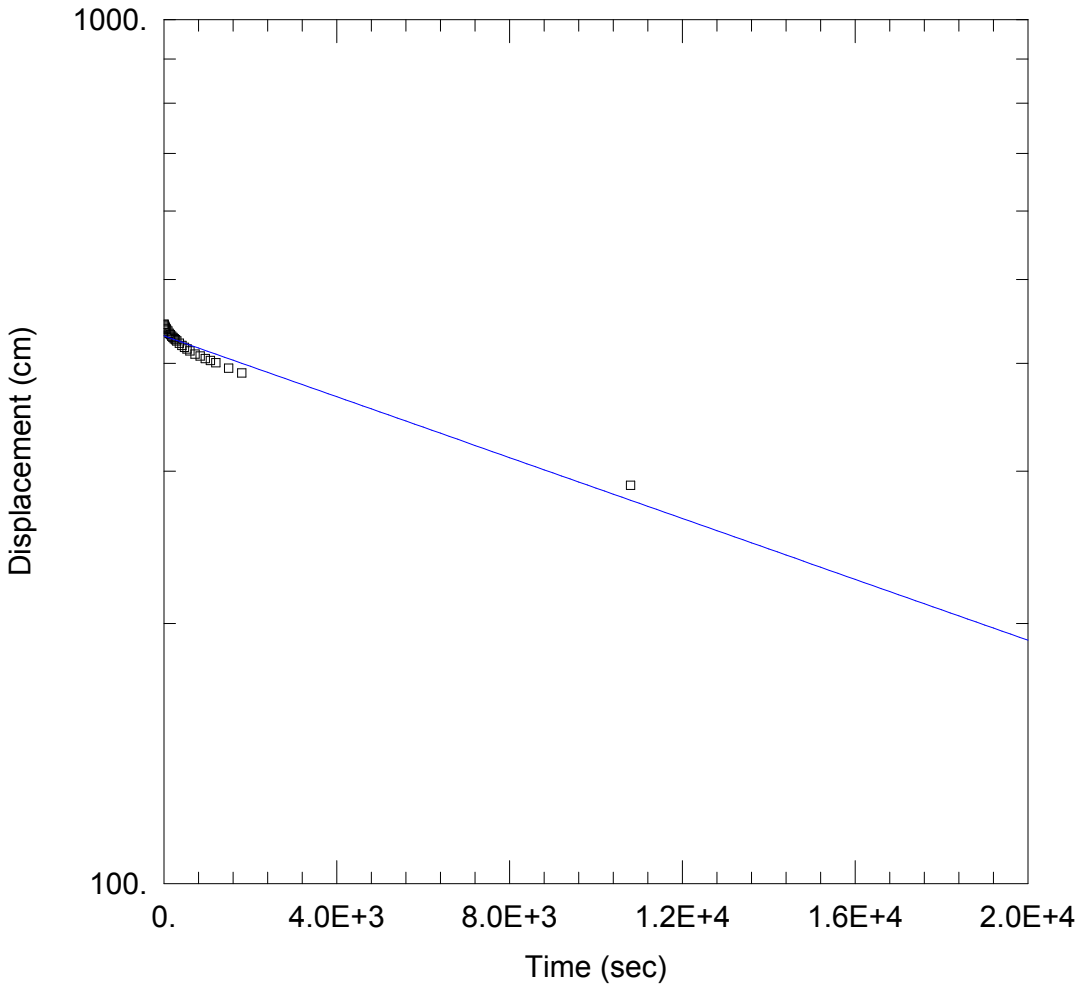
### WELL DATA (New Well)

Initial Displacement: 780. cm
Total Well Penetration Depth: 1103. cm
Casing Radius: 2.54 cm
Static Water Column Height: 1103. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

### SOLUTION

Aquifer Model: Unconfined
K = 1.937E-5 cm/sec
Solution Method: Hvorslev
y0 = 787.3 cm

Figure C-3-2




## HYDRAULIC CONDUCTIVITY TEST AT UCW6- SCREENED IN CLAY SILTY (TILL)

### PROJECT INFORMATION

Company: R.J. Burnside
Project: 300040365
Location: Oakville, ON
Test Well: UCW6
Test Date: May 9, 2018

### AQUIFER DATA

Saturated Thickness: 668. cm
Anisotropy Ratio (Kz/Kr): 1.

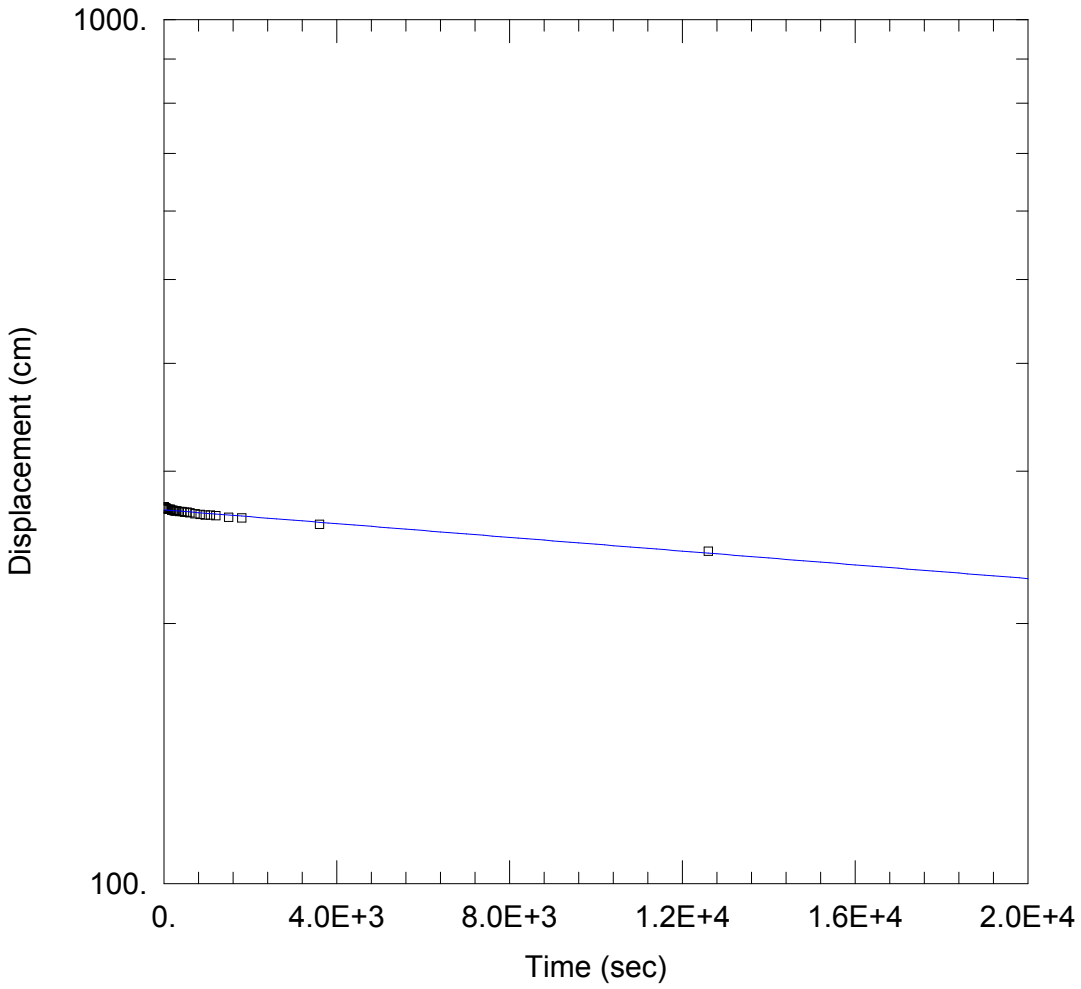
### WELL DATA (UCW6)

Initial Displacement: 444. cm
Total Well Penetration Depth: 668. cm
Casing Radius: 2.54 cm
Static Water Column Height: 668. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

### SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.174E-6 cm/sec
y0 = 430.4 cm

Figure C-3-5




HYDRAULIC CONDUCTIVITY TEST AT UHW1- SCREENED IN SILT CLAYEY AND SANDY (TILL)

PROJECT INFORMATION

Company: R.J. Burnside
Project: 300040365
Location: Oakville, ON
Test Well: UHW1
Test Date: May 8, 2018

AQUIFER DATA

Saturated Thickness: 427. cm
Anisotropy Ratio (Kz/Kr): 1.

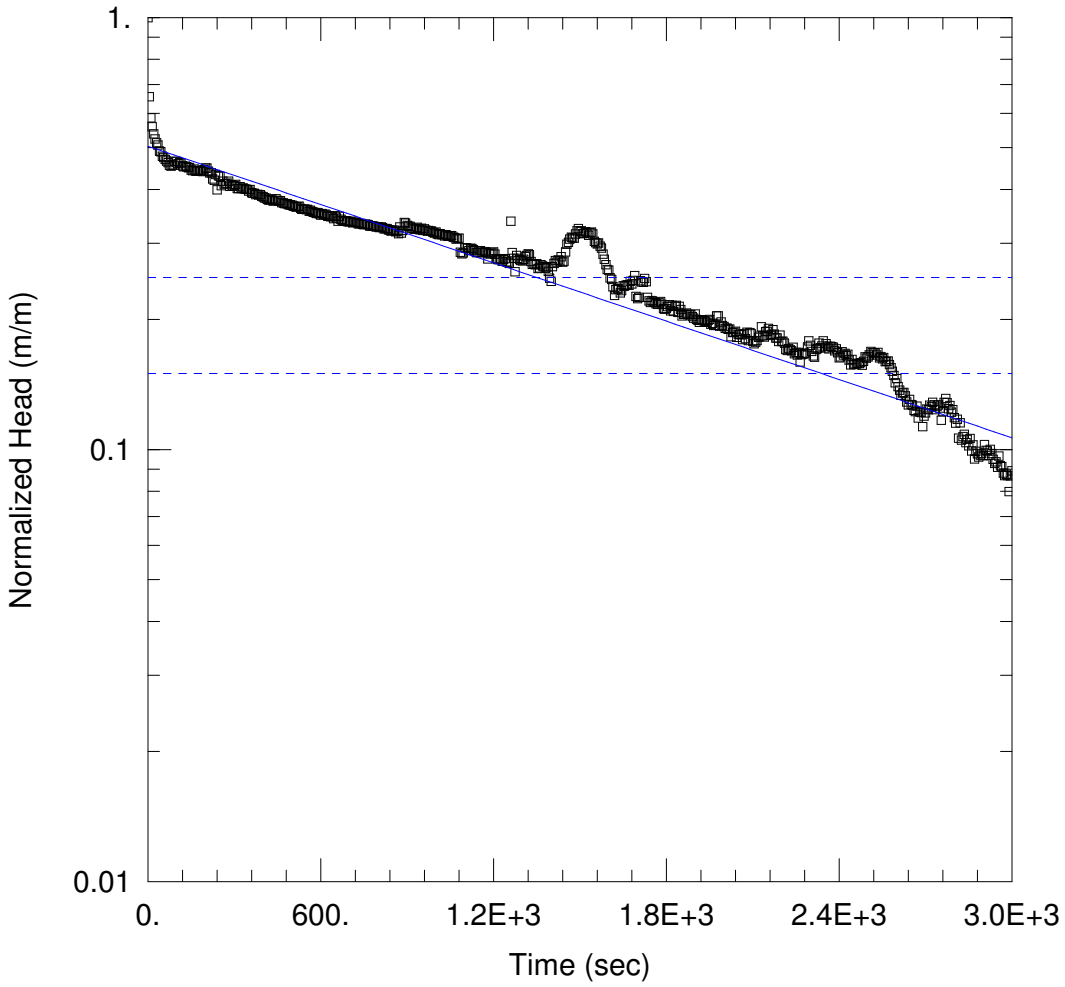
WELL DATA (UHW1)

Initial Displacement: 273. cm
Total Well Penetration Depth: 427. cm
Casing Radius: 2.54 cm
Static Water Column Height: 427. cm
Screen Length: 90. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
K = 1.038E-6 cm/sec
Solution Method: Hvorslev
y0 = 270.7 cm

Figure C-3-7




HDROGEOLOGICAL INVESTIGATION

Data Set: F:\Landtek Slug Tests 2020-21\103 Burnhamthorpe Oakville\AqteSolv\MW1.aqt
Date: 02/17/21 Time: 15:32:21

PROJECT INFORMATION

Company: Landtek Limited
Client: Melrose Investments Inc.
Project: 20382
Location: 103 Burnhamthorpe Rd. West
Test Well: MW1
Test Date: Feb. 6, 2021

AQUIFER DATA

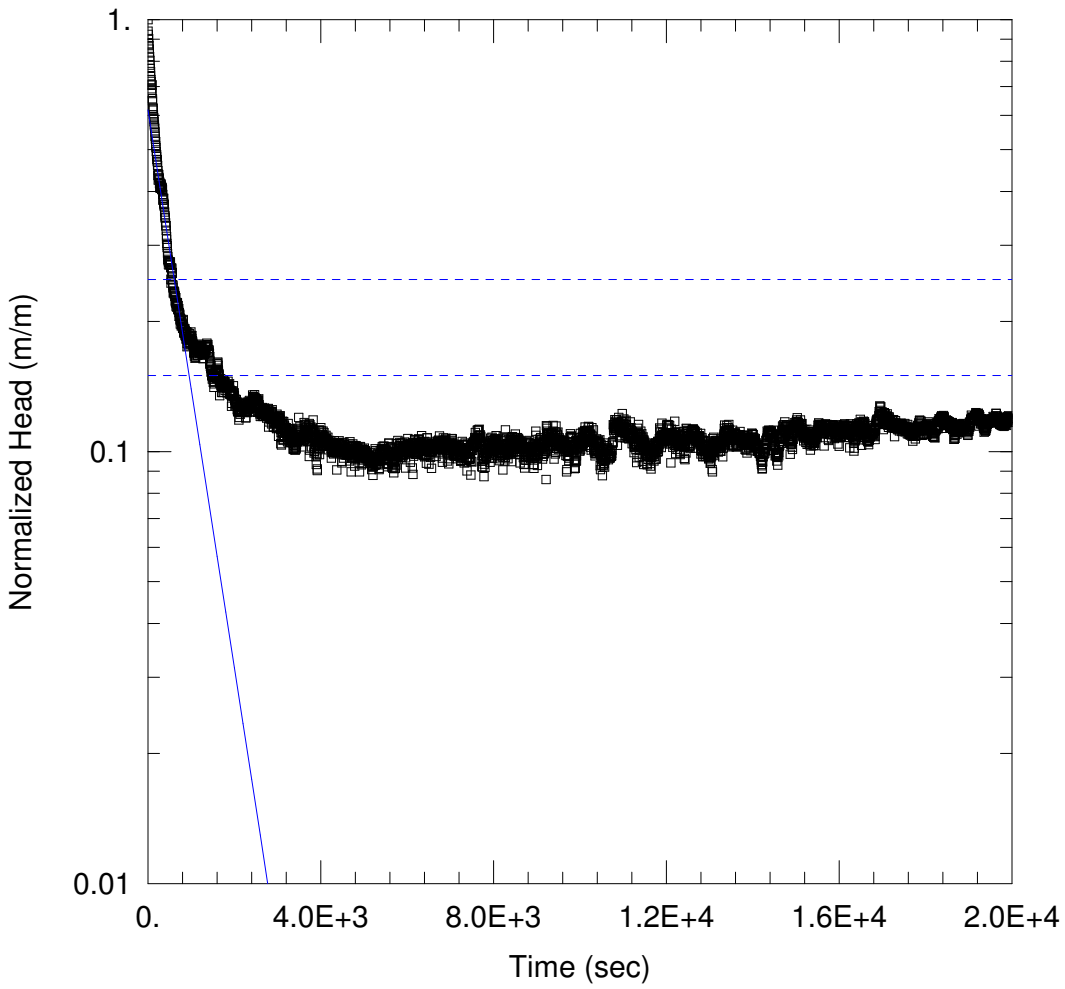
Saturated Thickness: 2.58 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW1)

Initial Displacement: 0.2999 m
Total Well Penetration Depth: 2.58 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.58 m
Screen Length: 2.58 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.432E-7 m/sec
y0 = 0.151 m




HDROGEOLOGICAL INVESTIGATION

Data Set: F:\Landtek Slug Tests 2020-21\103 Burnhamthorpe Oakville\AqteSolv\MW4.aqt
Date: 02/17/21 Time: 15:29:36

PROJECT INFORMATION

Company: Landtek Limited
Client: Melrose Investments Inc.
Project: 20382
Location: 103 Burnhamthorpe Rd. West
Test Well: MW4
Test Date: Feb. 6, 2021

AQUIFER DATA

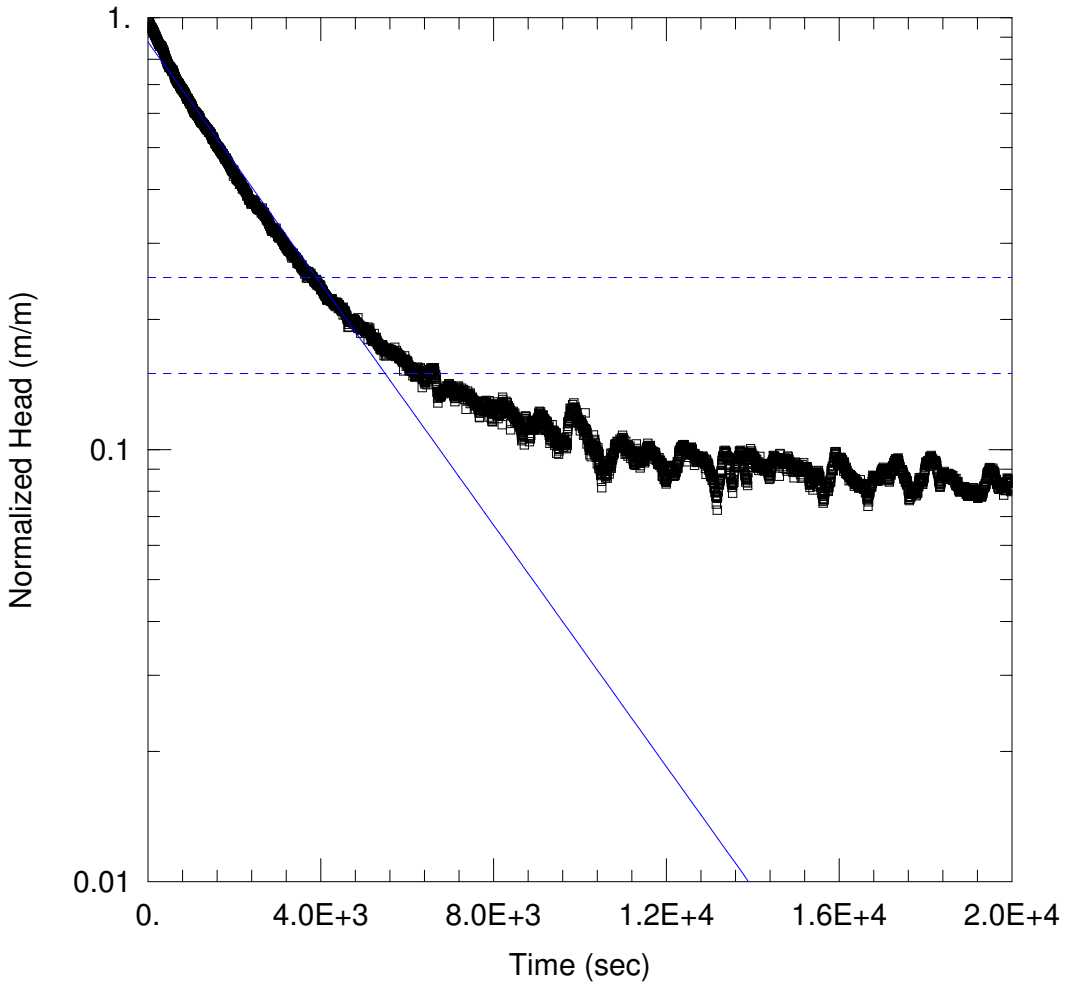
Saturated Thickness: 6.24 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4)

Initial Displacement: 0.443 m
Total Well Penetration Depth: 6.24 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.24 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.736E-7 m/sec
y0 = 0.2736 m




HDROGEOLOGICAL INVESTIGATION

Data Set: F:\Landtek Slug Tests 2020-21\103 Burnhamthorpe Oakville\AqteSolv\MW10.aqt
Date: 02/17/21 Time: 15:31:53

PROJECT INFORMATION

Company: Landtek Limited
Client: Melrose Investments Inc.
Project: 20382
Location: 103 Burnhamthorpe Rd. West
Test Well: MW10
Test Date: Feb. 6, 2021

AQUIFER DATA

Saturated Thickness: 6.12 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.3995 m
Total Well Penetration Depth: 6.12 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.12 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.891E-7 m/sec
y0 = 0.3506 m

# Appendix C-4

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# Groundwater Elevations

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 26-28-Jun-17 | | 17-Aug-17 | | 27-Sep-17 | | 23-25-Oct-17 | | 23-24-Nov-17 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | 2.00 | 190.20 | 2.06 | 190.14 | 2.26 | 189.95 | 2.43 | 189.77 | 2.64 | 189.56 |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | 3.20 | 188.90 | 3.29 | 188.81 | 3.50 | 188.60 | 3.70 | 188.40 | 3.81 | 188.29 |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | 3.49 | 186.06 | 3.62 | 185.93 | 3.84 | 185.71 | 4.01 | 185.54 | 4.10 | 185.45 |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 19-20-Dec-17 | | 25-Jan-18 | | 16-Feb-18 | | 22-Mar-18 | | 25-Apr-18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | 2.85 | 189.35 | 3.10 | 189.10 | 2.92 | 189.28 | 2.55 | 189.65 | 2.25 | 189.95 |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | 3.99 | 188.11 | 4.21 | 187.89 | 4.07 | 188.03 | 3.74 | 188.36 | 3.45 | 188.65 |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | 4.37 | 185.19 | 4.49 | 185.06 | 4.16 | 185.39 | 3.70 | 185.85 | 3.27 | 186.28 |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 8-9-May-18 | | 04-Jun-18 | | 27-Jun-18 | | 31-Jul-18 | | 26-Feb-19 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | 2.17 | 190.03 | 3.87 | 188.33 | 2.64 | 189.56 | 2.16 | 190.04 | 1.56 | 190.64 |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | 3.32 | 188.78 | 3.17 | 188.93 | 3.13 | 188.97 | 3.22 | 188.88 | 2.71 | 189.39 |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | 3.16 | 186.39 | 3.00 | 186.55 | 3.07 | 186.48 | 3.43 | 186.12 | 2.70 | 186.85 |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 17-Apr-19 | | 18-Jun-19 | | 29-Aug-19 | | 28-Oct-19 | | 19-Jun-20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | 1.67 | 190.53 | 1.71 | 190.49 | 1.90 | 190.30 | 2.22 | 189.98 | 1.67 | 190.53 |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | 2.96 | 189.14 | 2.84 | 189.26 | 3.04 | 189.06 | 3.36 | 188.74 | 2.82 | 189.28 |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | 2.77 | 186.78 | 2.69 | 186.86 | 3.09 | 186.46 | 3.45 | 186.10 | 2.58 | 186.97 |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 21-Jan-21 | | 06-Feb-21 | | 17-Mar-21 | | 20-Apr-21 | | 17-May-21 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | - | - | - | - | - | - | - | - | - | - |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | - | - | - | - | - | - | - | - | - | - |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | - | - | - | - | - | - | - | - | - | - |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | 2.26 | 191.24 | 3.70 | 189.80 | 0.64 | 192.86 | 0.25 | 193.25 | 0.65 | 192.85 |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | 2.22 | 189.53 | 0.64 | 191.11 | 0.33 | 191.42 | 0.43 | 191.32 | 0.57 | 191.18 |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | 0.13 | 189.37 | 0.54 | 188.96 | 0.13 | 189.37 | 0.32 | 189.18 | 0.51 | 188.99 |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-1**
**Groundwater Elevations - Observation Wells**

| Well | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 17-Jun-21 | | 22-Jul-21 | | 10-Nov-21 | | 09-Dec-21 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| **BA2s** | **13.60** | **12.80** | **0.80** | **192.2** | - | - | - | - | 2.04 | 190.16 | - | - |
| **BA2d** | **25.90** | **25.32** | **0.58** | **192.1** | - | - | - | - | 3.10 | 189.00 | - | - |
| **BA3** | **14.94** | **14.18** | **0.76** | **189.6** | - | - | - | - | 2.99 | 186.56 | 2.72 | 186.83 |
| ***BH/MW1*** | **6.92** | **6.00** | **0.92** | **193.5** | 1.36 | 192.14 | 0.76 | 192.74 | 0.30 | 193.20 | 0.15 | 193.35 |
| ***BH/MW4*** | **6.96** | **6.00** | **0.96** | **191.8** | 0.65 | 191.10 | 0.45 | 191.30 | 0.39 | 191.36 | 0.21 | 191.54 |
| ***BH/MW10*** | **6.92** | **6.00** | **0.92** | **189.5** | 0.45 | 189.05 | 0.44 | 189.06 | 0.24 | 189.26 | 0.18 | 189.32 |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-2**
**Groundwater Elevations - Piezometers**

| Piezometer | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 10-May-17 | | 26-28-Jun-17 | | 17-Aug-17 | | 27-Sep-17 | | 23-25-Oct-17 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| ***UHPZ1s*** | **1.92** | **1.17** | **0.75** | **188.5** | 0.83 | 187.67 | 0.38 | 188.12 | 0.62 | 187.88 | dry | dry | dry | dry |
| ***UHPZ1d*** | **2.54** | **1.50** | **1.04** | **188.5** | 1.45 | 187.05 | 0.74 | 187.76 | 0.70 | 187.80 | 1.23 | 187.27 | dry | dry |
| **UHPZ2s** | **1.85** | **1.04** | **0.81** | **191.9** | dry | dry | 0.34 | 191.54 | 0.55 | 191.33 | 0.99 | 190.89 | dry | dry |
| **UHPZ2d** | **2.80** | **1.77** | **1.03** | **191.8** | 1.55 | 190.24 | 0.65 | 191.14 | 0.58 | 191.21 | 0.64 | 191.15 | 0.78 | 191.01 |
| ***PZ3s*** | **1.82** | **1.03** | **0.79** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ3d*** | **2.85** | **1.91** | **0.94** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4s*** | **2.24** | **1.45** | **0.79** | **179.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4d*** | **1.82** | **1.12** | **0.70** | **179.0** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-2**
**Groundwater Elevations - Piezometers**

| Piezometer | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 23-24-Nov-17 | | 19-20-Dec-17 | | 25-Jan-18 | | 16-Feb-18 | | 22-Mar-18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| ***UHPZ1s*** | **1.92** | **1.17** | **0.75** | **188.5** | 1.03 | 187.47 | dry | dry | 0.86 | 187.64 | 0.58 | 187.92 | 0.26 | 188.25 |
| ***UHPZ1d*** | **2.54** | **1.50** | **1.04** | **188.5** | 1.47 | 187.03 | dry | dry | 1.47 | 187.03 | 1.31 | 187.19 | 1.02 | 187.48 |
| **UHPZ2s** | **1.85** | **1.04** | **0.81** | **191.9** | dry | dry | dry | dry | 0.64 | 191.24 | 0.40 | 191.48 | 0.28 | 191.60 |
| **UHPZ2d** | **2.80** | **1.77** | **1.03** | **191.8** | 1.04 | 190.75 | 1.27 | 190.52 | 1.44 | 190.35 | 1.13 | 190.66 | 0.93 | 190.86 |
| ***PZ3s*** | **1.82** | **1.03** | **0.79** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ3d*** | **2.85** | **1.91** | **0.94** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4s*** | **2.24** | **1.45** | **0.79** | **179.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4d*** | **1.82** | **1.12** | **0.70** | **179.0** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-2**
**Groundwater Elevations - Piezometers**

| Piezometer | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 25-Apr-18 | | 8-9-May-18 | | 04-Jun-18 | | 27-Jun-18 | | 31-Jul-18 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| ***UHPZ1s*** | **1.92** | **1.17** | **0.75** | **188.5** | 0.11 | 188.39 | 0.05 | 188.45 | 0.08 | 188.42 | 0.22 | 188.28 | 0.54 | 187.96 |
| ***UHPZ1d*** | **2.54** | **1.50** | **1.04** | **188.5** | 0.78 | 187.72 | 0.68 | 187.82 | 0.53 | 187.97 | 0.43 | 188.07 | 0.45 | 188.05 |
| **UHPZ2s** | **1.85** | **1.04** | **0.81** | **191.9** | 0.21 | 191.67 | 0.15 | 191.73 | 0.15 | 191.73 | 0.24 | 191.64 | 0.51 | 191.37 |
| **UHPZ2d** | **2.80** | **1.77** | **1.03** | **191.8** | 0.61 | 191.18 | 0.52 | 191.27 | 0.39 | 191.40 | 0.30 | 191.49 | 0.25 | 191.54 |
| ***PZ3s*** | **1.82** | **1.03** | **0.79** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ3d*** | **2.85** | **1.91** | **0.94** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4s*** | **2.24** | **1.45** | **0.79** | **179.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4d*** | **1.82** | **1.12** | **0.70** | **179.0** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-2**
**Groundwater Elevations - Piezometers**

| Piezometer | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 26-Feb-19 | | 17-Apr-19 | | 18-Jun-19 | | 29-Aug-19 | | 28-Oct-19 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| ***UHPZ1s*** | **1.92** | **1.17** | **0.75** | **188.5** | 0.04 | 188.46 | -0.06 | 188.56 | 0.05 | 188.45 | 0.73 | 187.77 | dry | dry |
| ***UHPZ1d*** | **2.54** | **1.50** | **1.04** | **188.5** | 0.12 | 188.38 | -0.03 | 188.53 | -0.02 | 188.52 | 0.35 | 188.15 | dry | dry |
| **UHPZ2s** | **1.85** | **1.04** | **0.81** | **191.9** | 0.19 | 191.69 | 0.04 | 191.84 | 0.08 | 191.81 | 0.34 | 191.54 | 0.65 | 191.23 |
| **UHPZ2d** | **2.80** | **1.77** | **1.03** | **191.8** | frozen | frozen | -0.08 | 191.87 | -0.25 | 192.04 | -0.20 | 191.99 | 0.02 | 191.77 |
| ***PZ3s*** | **1.82** | **1.03** | **0.79** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ3d*** | **2.85** | **1.91** | **0.94** | **181.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4s*** | **2.24** | **1.45** | **0.79** | **179.0** | - | - | - | - | - | - | - | - | - | - |
| ***PZ4d*** | **1.82** | **1.12** | **0.70** | **179.0** | - | - | - | - | - | - | - | - | - | - |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Table C-4-2**
**Groundwater Elevations - Piezometers**

| Piezometer | Measured Well Depth (mbmp) | Well Depth (mbgl) | Surveyed Casing Stick up (m) | Surveyed Ground Elevation (masl) | 16-Dec-19 | | 02-Apr-20 | | 17-Jun-20 | | 09-Dec-21 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) | Water Level Depth (mbgl) | Estimated Elevation (masl) |
| ***UHPZ1s*** | **1.92** | **1.17** | **0.75** | **188.5** | 0.64 | 187.86 | 0.19 | 188.32 | 0.12 | 188.38 | 0.47 | 188.03 |
| ***UHPZ1d*** | **2.54** | **1.50** | **1.04** | **188.5** | 1.19 | 187.31 | -0.50 | 189.00 | 0.30 | 188.20 | 1.09 | 187.41 |
| **UHPZ2s** | **1.85** | **1.04** | **0.81** | **191.9** | 0.35 | 191.53 | 0.14 | 191.74 | 0.15 | 191.73 | - | - |
| **UHPZ2d** | **2.80** | **1.77** | **1.03** | **191.8** | frozen | frozen | -0.09 | 191.88 | -0.11 | 191.90 | - | - |
| ***PZ3s*** | **1.82** | **1.03** | **0.79** | **181.0** | - | - | - | - | - | - | - | - |
| ***PZ3d*** | **2.85** | **1.91** | **0.94** | **181.0** | - | - | - | - | - | - | 1.52 | 179.48 |
| ***PZ4s*** | **2.24** | **1.45** | **0.79** | **179.0** | - | - | - | - | - | - | 0.71 | 178.29 |
| ***PZ4d*** | **1.82** | **1.12** | **0.70** | **179.0** | - | - | - | - | - | - | frozen | frozen |

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round
"n/a" data unavailable
Italics denotes estimated ground elevation and measured stick up.

**Figure C-4-1**
**Groundwater Elevations**
**BA2s/d: BA2s Screened in Clayey Silt Till**
**BA2d Screened in Shale**

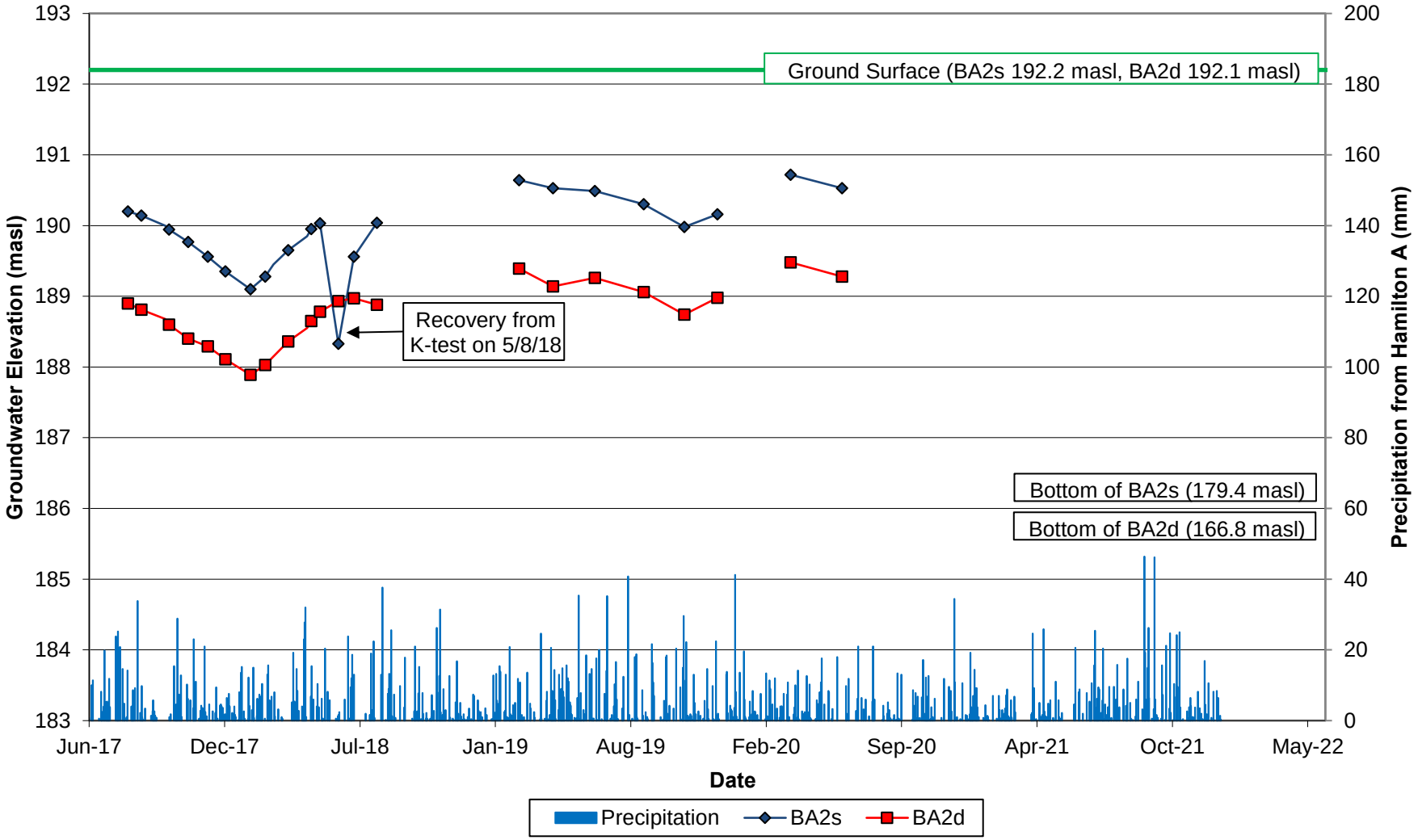


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**Figure C-4-2**
**Groundwater Elevations**
**BA3: Screened in Sandy Silt Till**

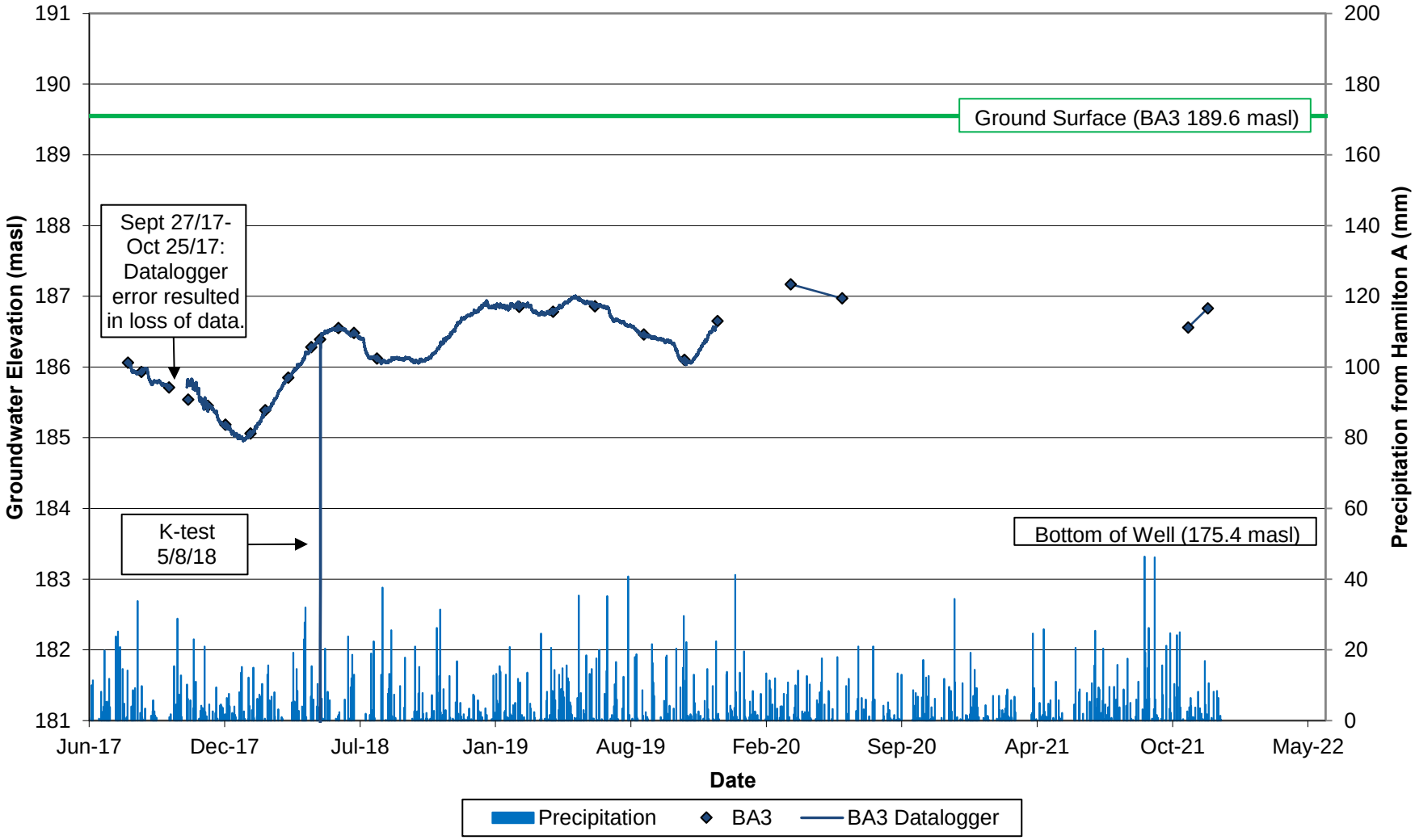


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**Figure C-4-3**
**Groundwater Elevations**
**BH/MW1: Screened in Silty Clay Till**

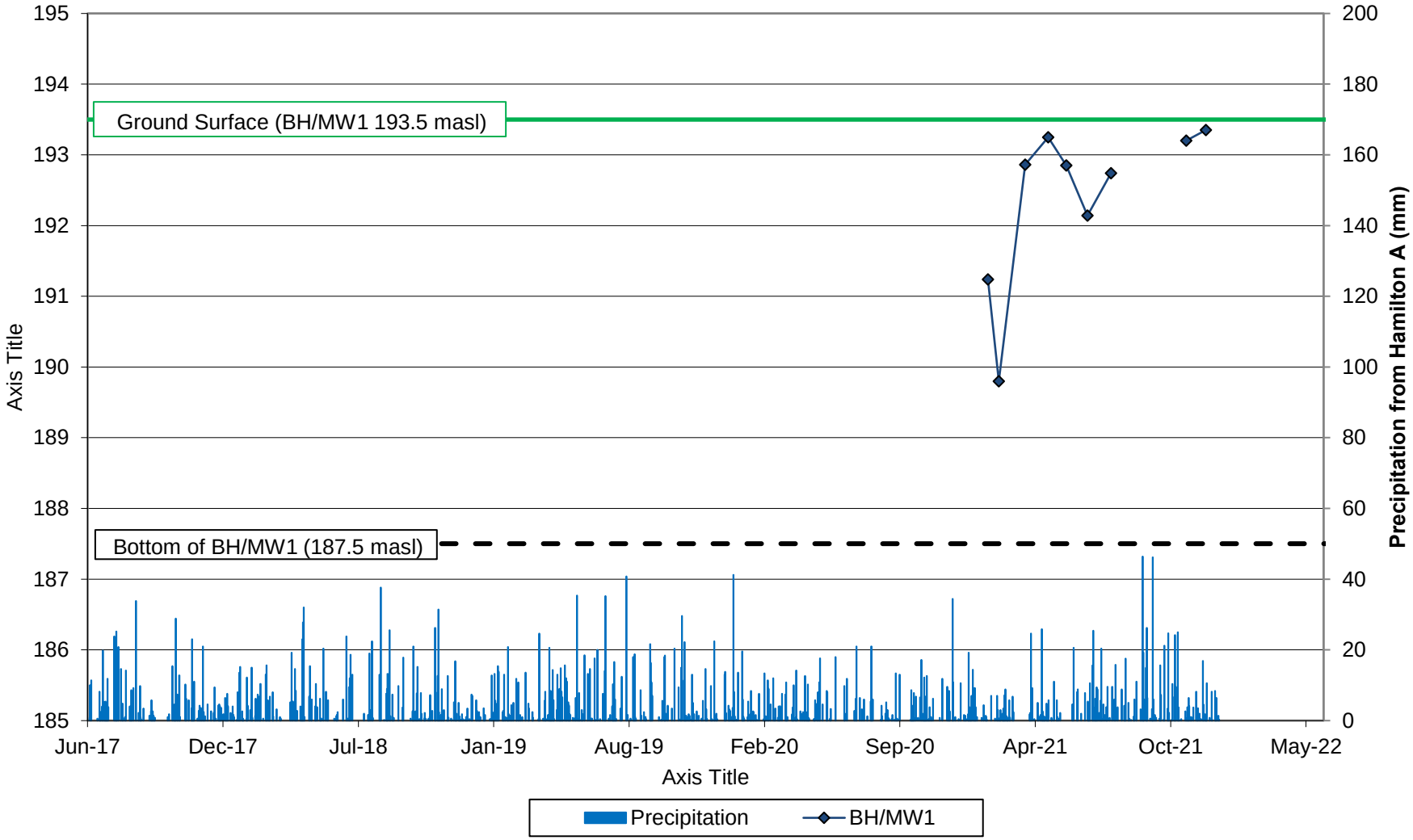


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**Figure C-4-4**
**Groundwater Elevations**
**BH/MW4: Screened in Silty Clay Till**

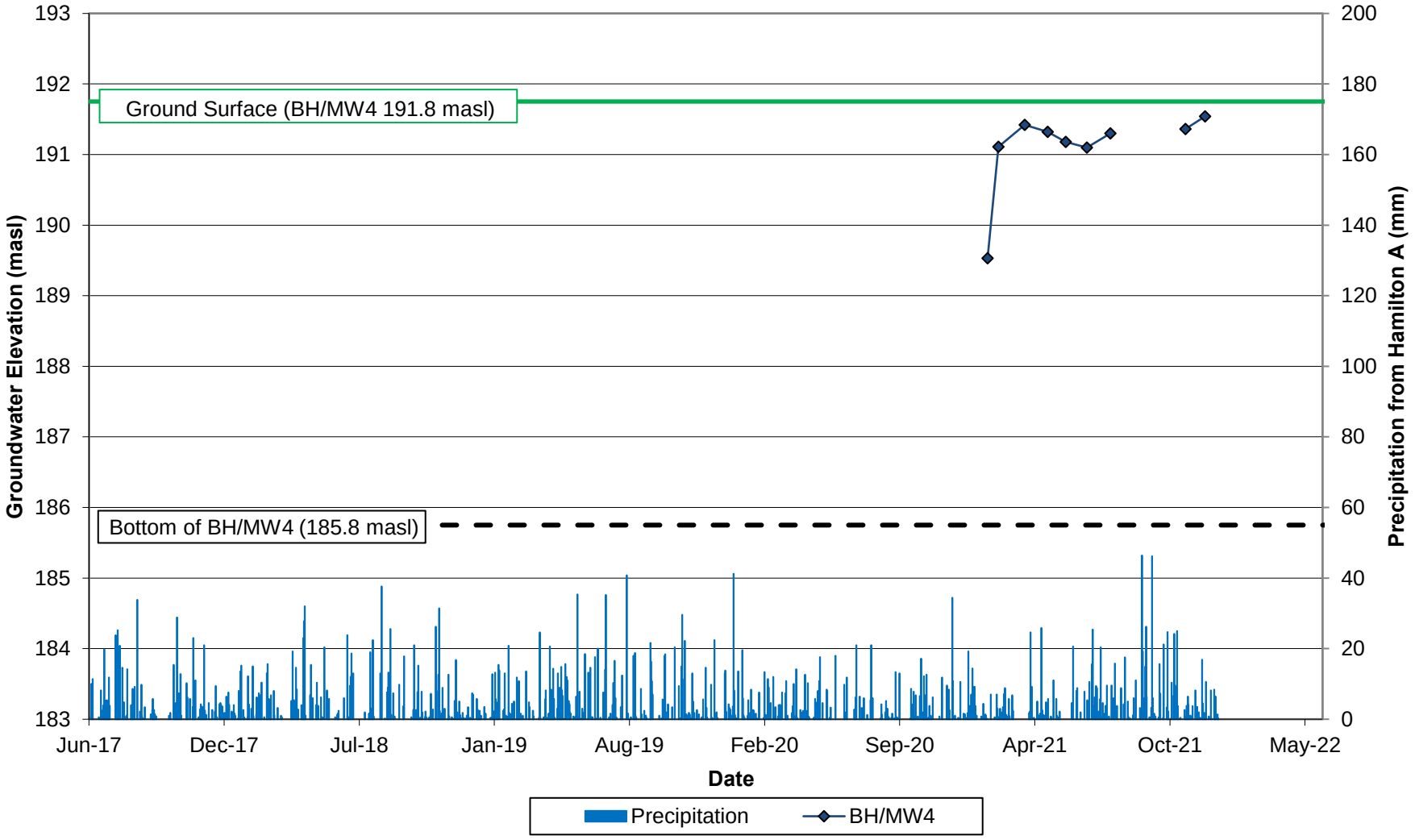


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**Figure C-4-5**
**Groundwater Elevations**
**BH/MW10: Screened in Silty Clay Till**

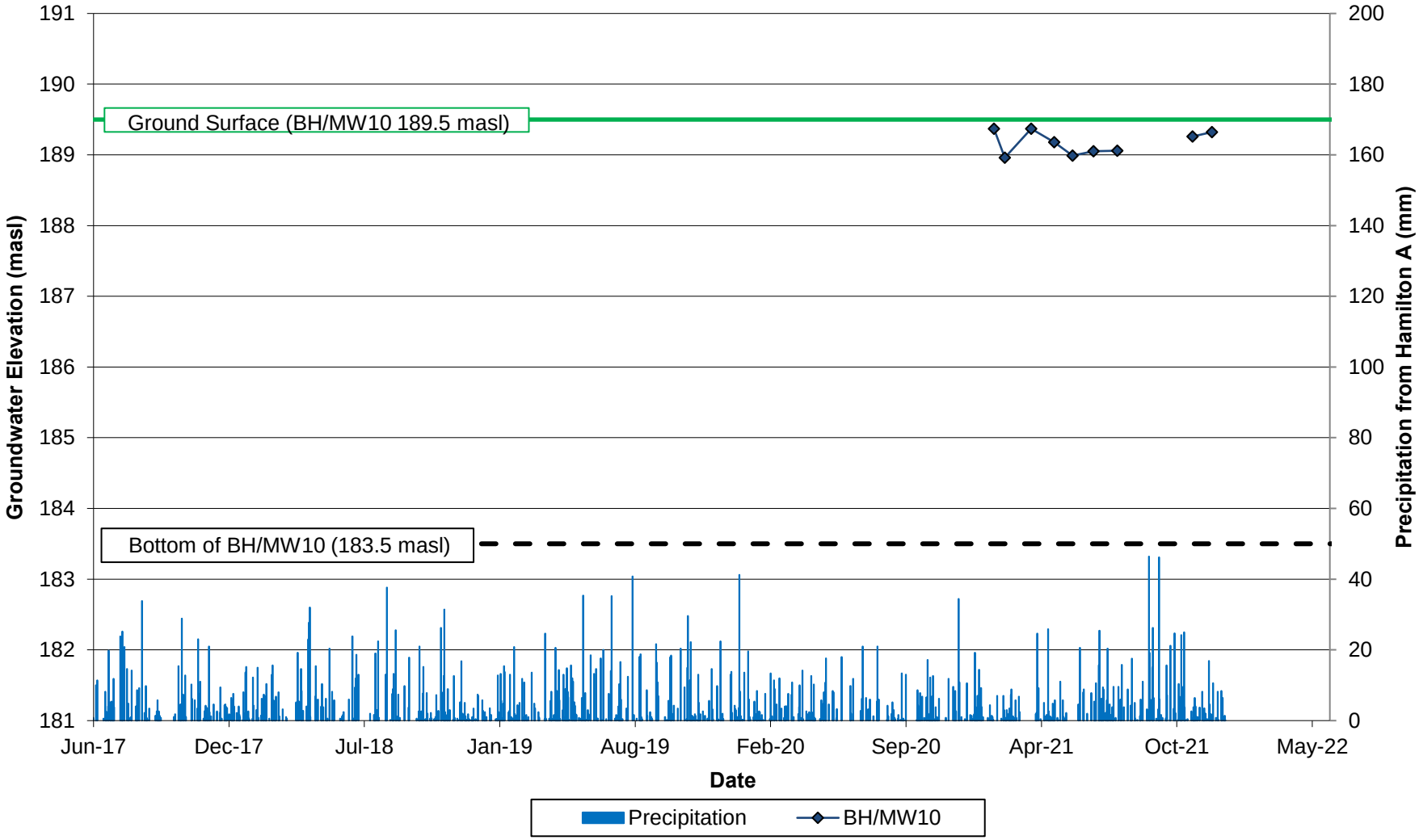


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**Figure C-4-6**
**Groundwater Elevations**
**UHPZ1s/d and UHSG1**

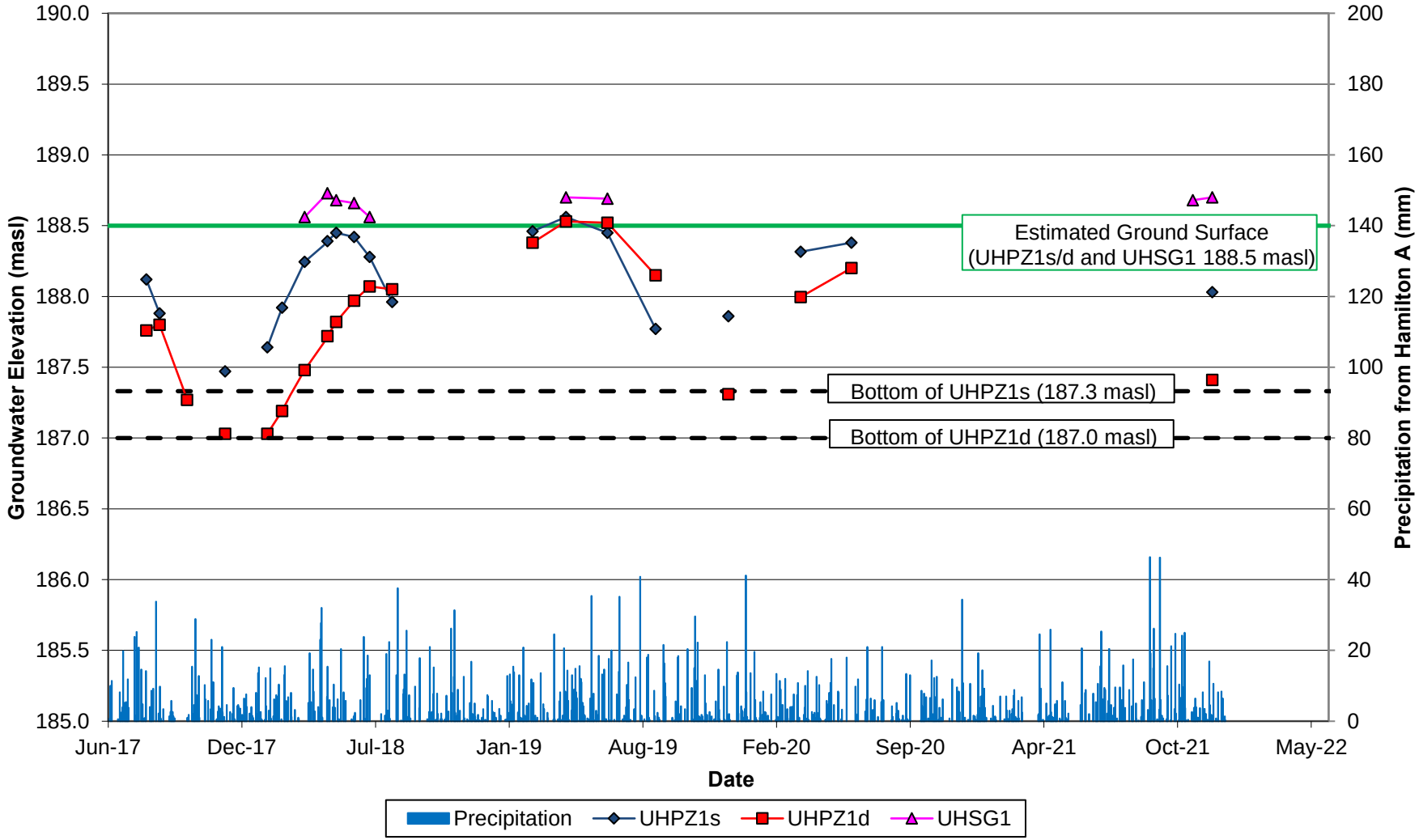


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**Figure C-4-7**
**Groundwater Elevations**
**UHPZ2s/d**

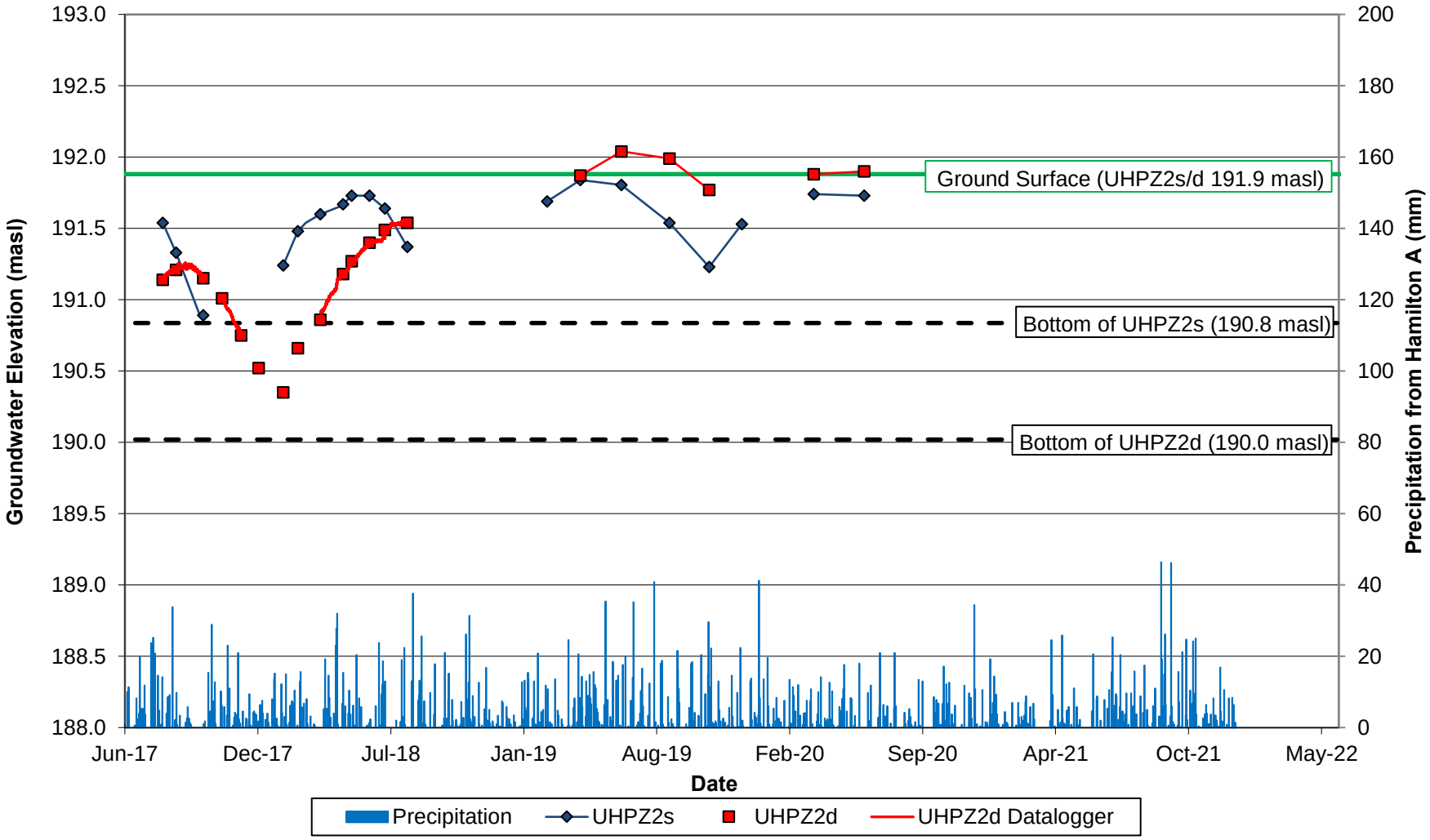


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**Figure C-4-8**
**Groundwater Elevations**
**PZ3s/d and SG3**

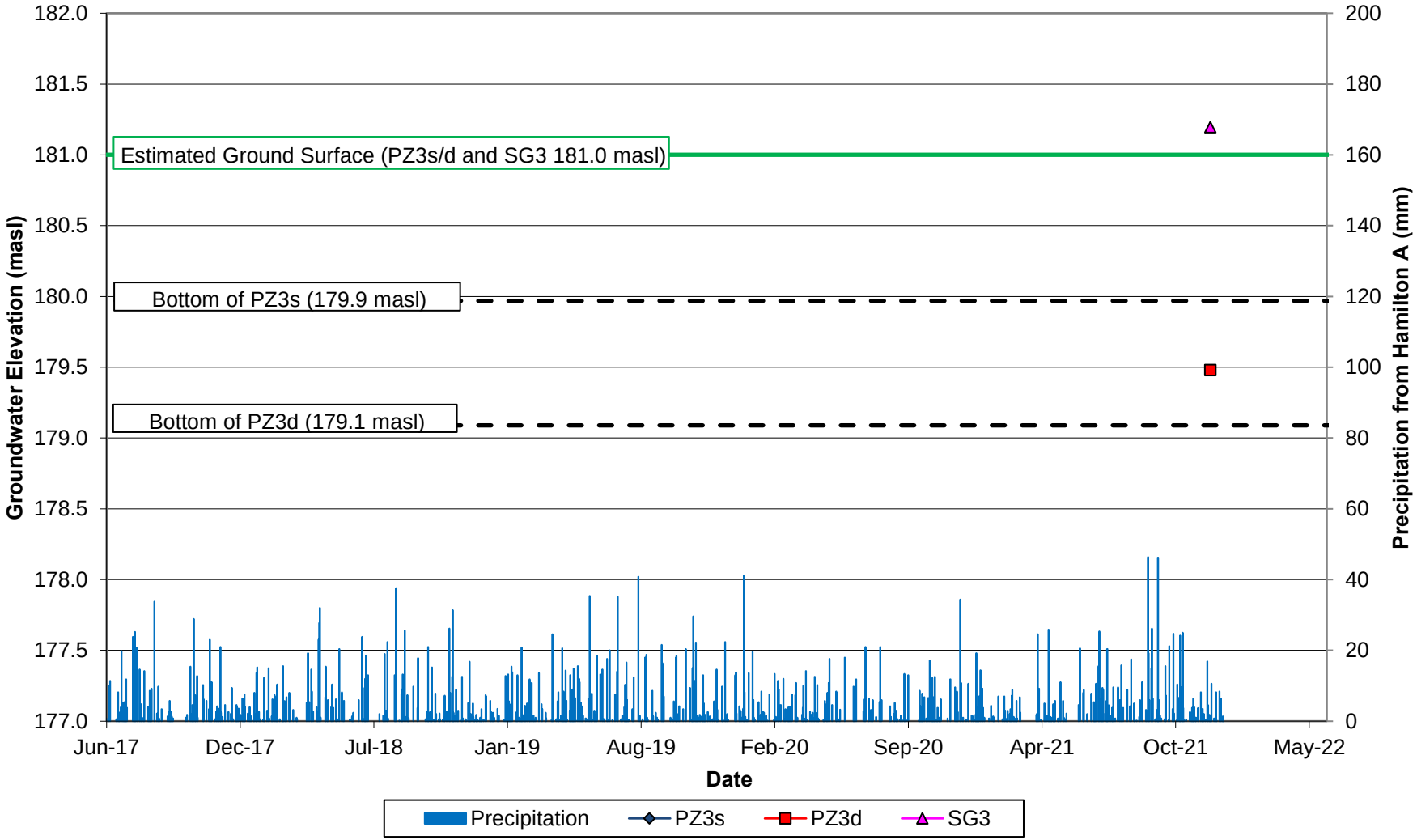


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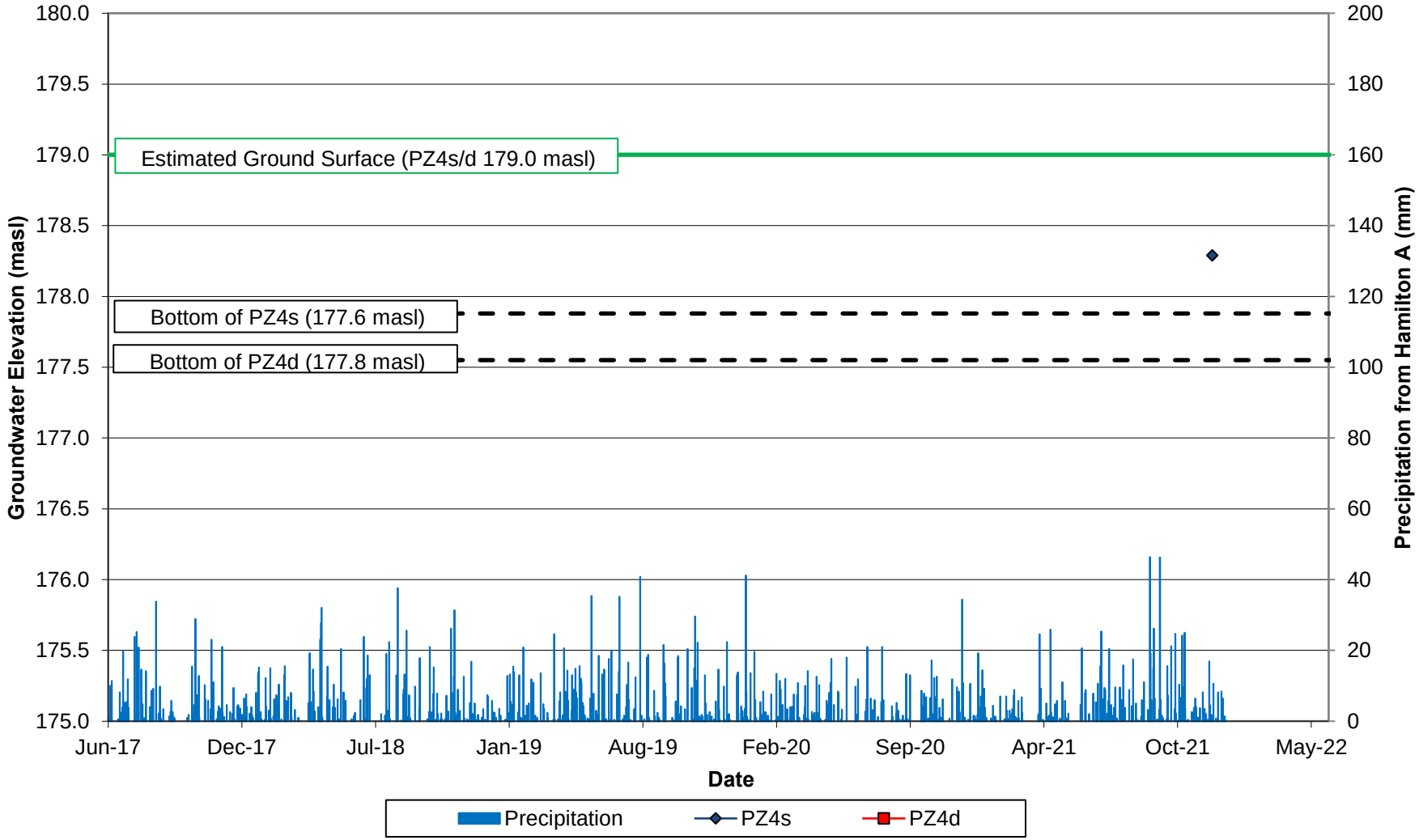
**Figure C-4-9**
**Groundwater Elevations**
**PZ4s/d**

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# Appendix C-5

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# Water Quality

# Table C-5-1

## Groundwater Quality

| **Observation Wells** | | | | | **BA-1s** | **BA-1d** | **BA-2s** | **MW4s** | **MW4d** |
|---|---|---|---|---|---|---|---|---|---|
| **Date** | | | | | 23-Jul-02 | 23-Jul-02 | 23-Jul-02 | 14-Nov-08 | 14-Nov-08 |
| **Parameter** | **RDL** | **MDL*** | **ODWQS** | **Units** | | | | | |
| Electrical Conductivity | 2 | | | µS/cm | 530 | 590 | 910 | 2360 | 2010 |
| pH | | | 6.5-8.5 | | 8.4 | 8.2 | 7.92 | 7.78 | 8.00 |
| pH of saturation | | | | | 7.89 | 7.58 | 7.48 | 6.18 | 6.67 |
| Langelier Saturation Index | | | | | 0.51 | 0.62 | 0.44 | 1.60 | 1.33 |
| Total Dissolved Solids | 20 | | 500 | mg/L | 330 | 390 | **630** | **1700** | **1620** |
| % Difference/ Ion Balance | 0.1 | | | % | - | - | - | 4.90 | 1.60 |
| Alkalinity (as $CaCO^3$) | 5 | 1 | 30-500 | mg/L | 270 | 230 | 150 | 413 | 189 |
| Bicarbonate (as $CaCO^3$) | 5 | 1 | | mg/L | 260 | 230 | 150 | 413 | 189 |
| Carbonate (as $CaCO^3$) | 5 | 1 | | mg/L | 6.2 | 3.4 | 1.2 | <5 | <5 |
| Hydroxide (as $CaCO^3$) | 5 | | | mg/L | - | - | - | <5 | <5 |
| Fluoride | 0.05 | 0.03 | 1.5 | mg/L | 0.52 | 0.36 | 0.31 | 0.06 | 0.12 |
| Chloride | 0.1 | 0.05 | 250 | mg/L | 6.2 | 19 | 7.3 | 210 | 73 |
| Bromide | 0.05 | 0.10 | | mg/L | 0.15 | 0.19 | 0.21 | <0.05 | <0.05 |
| Nitrate (as N) | 0.05 | 0.05 | 10 | mg/L | <0.05 | <0.5 | <0.05 | <0.05 | <0.05 |
| Nitrite (as N) | 0.05 | 0.01 | 1 | mg/L | <0.01 | 0.035 | <0.01 | 0.15 | <0.05 |
| Sulphate | 0.1 | 0.1 | 500 | mg/L | 56 | 97 | 350 | **598** | **840** |
| ortho-Phosphate (as P) | 0.1 | 0.5 | | mg/L | <0.5 | <0.5 | <0.5 | <0.10 | <0.10 |
| Total Phosphorus | 0.05 | 0.06 | | mg/L | <0.5 | <0.5 | <0.5 | 2.37 | 0.13 |
| Ammonia (as N) | 0.02 | 0.02 | | mg/L | 0.59 | 0.77 | 0.46 | 0.04 | 0.23 |
| Total Organic Carbon | 0.5 | 0.2 | | mg/L | 1.3 | 1.8 | 10 | 24.0 | 10.4 |
| Reactive Silica | 0.05 | | | mg/L | - | - | - | 16.5 | 10.9 |
| Colour | 5 | | 5 | TCU | - | - | - | **40** | **32** |
| Turbidity | 0.5 | | 5 | NTU | - | - | - | **9.5** | 2.6 |
| Total Hardness (as $CaCO^3$) | 10 | 1 | 80-100 | mg/L | **180** | **170** | **330** | **1290** | **895** |
| Calcium | 0.05 | 0.2 | | mg/L | 15 | 35 | 71 | 236 | 187 |
| Magnesium | 0.05 | 0.4 | | mg/L | 35 | 19 | 37 | 169 | 104 |
| Iron | 0.01 | 0.01 | 0.30 | mg/L | <0.01 | <0.01 | 0.013 | 0.02 | **2.31** |
| Sodium | 0.05 | 0.1 | 200 | mg/L | 45 | 72 | 64 | 74 | 131 |
| Potassium | 0.05 | 1 | | mg/L | 13 | 7.8 | 15 | 19.4 | 18.8 |
| Aluminum | 0.004 | 0.015 | 0.10 | mg/L | 0.018 | 0.023 | 0.024 | 0.01 | 0.01 |
| Arsenic | 0.003 | 0.005 | 0.025 | mg/L | <0.005 | <0.005 | <0.005 | <0.003 | <0.003 |
| Barium | 0.002 | | 1.00 | mg/L | - | - | - | 0.01 | 0.02 |
| Boron | 0.01 | 0.2 | 5.00 | mg/L | 0.71 | 1.30 | 0.93 | 0.25 | 0.97 |
| Cadmium | 0.002 | 0.0002 | 0.005 | mg/L | <0.0002 | <0.0002 | <0.0002 | <0.0001 | <0.0001 |
| Chromium | 0.003 | 0.002 | 0.05 | mg/L | <0.002 | <0.002 | <0.002 | <0.003 | <0.003 |
| Copper | 0.003 | 0.001 | 1.00 | mg/L | <0.001 | <0.001 | 0.003 | 0.003 | <0.003 |
| Lead | 0.002 | 0.005 | 0.01 | mg/L | <0.005 | <0.005 | <0.005 | <0.002 | <0.002 |
| Manganese | 0.002 | | 0.05 | mg/L | - | - | - | **1.03** | **0.35** |
| Mercury | 0.0001 | | | mg/L | - | - | - | <0.0001 | <0.0001 |
| Molybdenum | 0.002 | 0.040 | | mg/L | <0.04 | <0.04 | 0.054 | 0.02 | 0.04 |
| Nickel | 0.003 | 0.025 | | mg/L | <0.025 | <0.025 | <0.025 | 0.012 | 0.004 |
| Selenium | 0.004 | 0.100 | 0.01 | mg/L | <0.1 | <0.1 | <0.1 | <0.004 | 0.004 |
| Silver | 0.002 | 0.0001 | | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Strontium | 0.005 | | | mg/L | - | - | - | 2.73 | 7.01 |
| Thallium | 0.006 | 0.0003 | | mg/L | <0.0003 | <0.0004 | <0.0005 | <0.0003 | <0.0003 |
| Titanium | 0.002 | | | mg/L | - | - | - | 0.016 | 0.021 |
| Uranium | 0.002 | 0.005 | 0.02 | mg/L | <0.005 | <0.005 | 0.006 | 0.017 | 0.009 |
| Vanadium | 0.002 | 0.006 | | mg/L | <0.006 | <0.006 | <0.006 | 0.002 | <0.002 |
| Zinc | 0.005 | 0.02 | 5 | mg/L | <0.02 | <0.02 | <0.02 | 0.02 | 0.01 |

Notes:

RDL = Reported Detection Limit  MDL* = Method Detection Limit (2002 Samples)

ODWQS = Ontario Drinking Water Quality Standards, Objectives and Guidelines, 2008

Bold indicates exceedence of ODWQS

- data not available

Source of data for 2002 samples - North Oakville East SWS, NOMI, 2004

Source of data for 2008 data - R.J.Burnside and Associates - EIR Studies

# Table C-5-2

## Water Quality
## Field Measurements

| Groundwater Monitoring Location | Date | Temperature (°C) | Conductivity (µS/cm) | Total Dissolved Solids (mg/L) | pH |
|---|---|---|---|---|---|
| MW4d | 14-Nov-08 | 12.33 | 1555 | 1332 | 8.1 |

| Surface Water Monitoring Location | Date | Temperature (°C) | Conductivity (µS/cm) | Total Dissolved Solids (mg/L) | pH |
|---|---|---|---|---|---|
| **Lower West Morrison Creek** | | | | | |
| MW-D3 | 17-Jan-08 | 1.5 | 590 | N/A | 6.4 |
| MW-D3 | 21-Feb-08 | 0.0 | 616 | N/A | 7.6 |
| MW-D3 | 22-Apr-08 | 14.7 | 855 | 695 | 6.4 |
| MW-D3 | 23-May-08 | 11.6 | 957 | 836 | 7.3 |
| MW-D3 | 23-Jun-08 | 16.3 | 604 | 409 | 7.6 |
| MW-D3 | 31-Jul-08 | 20.0 | 965 | 693 | 7.6 |
| MW-D3 | 19-Aug-08 | 17.5 | 428 | 325 | 6.9 |
| MW-D3 | 17-Sep-08 | 13.4 | 734 | 613 | 7.9 |
| MW-D3 | 22-Oct-08 | 10.5 | 1265 | 632 | 7.0 |
| MW-D3 | 20-Nov-08 | 1.9 | 999 | 515 | 6.9 |
| MW-D3 | 15-Apr-09 | 5.4 | 952 | 475 | 7.4 |
| MW-D3 | 15-May-09 | 13.4 | 931 | 711 | 7.0 |
| MW-D3 | 24-Aug-09 | 17.8 | 790 | 400 | 6.9 |
| MW-D3 | 25-May-10 | 15.1 | 1584 | 975 | 7.3 |
| MW-D3 | 22-Nov-10 | 9.3 | 540 | 352 | 8.1 |
| MW-D3 | 22-Nov-11 | 4.6 | 734 | 477 | 8.7 |
| MW-D3 | 8-Feb-12 | 0.8 | 774 | 502 | 9.2 |
| | | | | | |
| MW-S1 | 21-Feb-08 | 0.2 | 593 | N/A | 7.0 |
| MW-S1 | 25-Apr-08 | 7.7 | 1134 | 1102 | 7.0 |
| MW-S1 | 23-May-08 | 15.0 | 1617 | 1265 | 8.3 |
| MW-S1 | 23-Jun-08 | 21.0 | 639 | 449 | 8.2 |
| MW-S1 | 31-Jul-08 | 22.1 | 410 | 282 | 7.8 |
| MW-S1 | 19-Aug-08 | 21.2 | 456 | 319 | 7.2 |
| MW-S1 | 20-Nov-08 | 2.2 | 798 | 400 | 6.9 |
| MW-S1 | 22-Jan-09 | 1.8 | 137 | 84 | 7.4 |
| MW-S1 | 15-Apr-09 | 5.3 | 1084 | 544 | 7.2 |
| MW-S1 | 15-May-09 | 13.4 | 942 | 787 | 7.5 |
| MW-S1 | 24-Aug-09 | 18.6 | 790 | 400 | 7.0 |
| MW-S1 | 22-Nov-10 | 9.1 | 473 | 308 | 8.2 |
| MW-S1 | 22-Nov-11 | 2.6 | 630 | 410 | 8.4 |
| MW-S1 | 8-Feb-12 | 0.2 | 703 | 457 | 9.2 |
| | | | | | |
| MW-S2 | 22-Apr-08 | 23.5 | 926 | 620 | 7.9 |
| MW-S2 | 23-Jun-08 | 22.2 | 607 | 416 | 8.5 |
| MW-S2 | 19-Aug-08 | 22.1 | 455 | 314 | 7.2 |
| MW-S2 | 16-Mar-09 | 10.1 | 583 | 291 | 7.7 |
| MW-S2 | 15-Apr-09 | 4.8 | 856 | 431 | 7.7 |
| | | | | | |

Notes:
N/A - data not available
Surface water quality data was only measured when water was visibly flowing.
Pre 2008 data from North Oakville East SWS, NOMI, 2004.

# Table C-5-2

## Water Quality
## Field Measurements

| Surface Water Monitoring Location | Date | Temperature (°C) | Conductivity (µS/cm) | Total Dissolved Solids (mg/L) | pH |
|---|---|---|---|---|---|
| **Upper West Morrison Creek** | | | | | |
| MW-S3 | 3-May-02 | 8.2 | 500 | N/A | 8.6 |
| MW-S3 | 11-Apr-03 | 15.2 | 800 | N/A | 8.4 |
| MW-S3 | 25-Sep-03 | 15.8 | 400 | N/A | 8.5 |
| MW-S3 | 16-Apr-04 | 13.7 | 500 | N/A | 8.4 |
| MW-S3 | 17-Sep-08 | 16.8 | 930 | 688 | 7.8 |
| MW-S3 | 16-Mar-09 | 7.2 | 950 | 471 | 7.7 |
| MW-S3 | 22-Nov-10 | 9.1 | 592 | 385 | 8.5 |
| | | | | | |
| MW-S4 | 11-Apr-03 | 11.1 | 400 | N/A | 8.2 |
| MW-S4 | 16-Apr-04 | 6.3 | 500 | N/A | 8.2 |
| MW-S4 | 16-Mar-09 | 5.5 | 796 | 393 | 6.9 |
| MW-S5 | 3-May-02 | 8.7 | 400 | N/A | 8.7 |
| MW-S5 | 28-May-02 | 12.3 | 200 | N/A | 8.6 |
| MW-S5 | 11-Apr-03 | 9.3 | 400 | N/A | 8.6 |
| MW-S5 | 25-Sep-03 | 15.1 | 300 | N/A | 8.5 |
| MW-S5 | 16-Apr-04 | 8.2 | 500 | N/A | 8.3 |
| MW-S5 | 16-Mar-09 | 8.4 | 978 | 489 | 7.9 |
| MW-S5 | 15-May-09 | 14.4 | 418 | 341 | 8.2 |
| MW-S5 | 24-Aug-09 | 17.1 | 620 | 310 | 7.2 |
| MW-S5 | 20-Nov-09 | 7.7 | 848 | 554 | 9.4 |
| MW-S5 | 25-May-10 | 23.9 | 427 | 218 | 8.6 |
| MW-S5 | 22-Nov-10 | 9.3 | 669 | 435 | 8.6 |
| MW-S5 | 22-Nov-11 | 9.2 | 373 | 242 | 8.8 |
| MW-S5 | 8-Feb-12 | 0.6 | 677 | 440 | 9.1 |
| | | | | | |
| MW-B1 | 11-Apr-03 | 1.6 | 100 | N/A | 8.6 |
| MW-B1 | 20-Nov-09 | 8.5 | 590 | 383 | 9.3 |
| MW-B2 | 11-Apr-03 | 1.3 | 100 | N/A | 8.6 |
| MW-B2 | 16-Mar-09 | 13.8 | 304 | 152 | 7.7 |
| MW-B3 | 11-Apr-03 | 2.5 | 300 | N/A | 8.6 |
| MW-B3 | 16-Mar-09 | 13.1 | 551 | 273 | 7.9 |
| MW-B4 | 11-Apr-03 | 0.5 | 600 | N/A | 8.3 |
| MW-B5 | 11-Apr-03 | 0.9 | 400 | N/A | 8.4 |
| MW-B5 | 16-Mar-09 | 6.1 | 450 | 225 | 7.5 |
| MW-B5 | 20-Nov-09 | 8.0 | 599 | 389 | 9.2 |
| MW-B5 | 22-Nov-10 | 8.7 | 367 | 239 | 8.5 |
| | | | | | |
| MW-B6 | 3-May-02 | 12.2 | 600 | N/A | 8.3 |
| MW-B6 | 11-Apr-03 | 0.3 | 400 | N/A | 8.5 |
| MW-B6 | 16-Mar-09 | 5.0 | 1001 | 497 | 7.6 |
| MW-B6 | 24-Aug-09 | 19.9 | 1120 | 550 | 7.2 |
| MW-B6 | 20-Nov-09 | 8.1 | 663 | 431 | 9.1 |
| MW-B6 | 22-Nov-10 | 8.5 | 504 | 325 | 8.4 |
| | | | | | |

Notes:
N/A - data not available
Surface water quality data was only measured when water was visibly flowing.
Pre 2008 data from North Oakville East SWS, NOMI, 2004.

# Table C-5-3

## Surface Water Quality

| Watershed | | | | | Upper West Morrison Creek | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Surface Station | | | | | MW-B1 | MW-B6* | MW-B6 | MW-S3* | MW-S5* |
| Date | | | | | 3-Dec-08 | 3-May-02 | 3-Dec-08 | 3-May-02 | 3-May-02 |
| Parameter | RDL | MDL* | PWQO | Units | | | | | |
| Electrical Conductivity | 2 | | | µS/cm | 1400 | 810 | 607 | 650 | 550 |
| pH | | | 6.8-8.5 | | 8.15 | 8.11 | 8.16 | 8.04 | 8.11 |
| pH of saturation | | | | | 7.11 | 7.17 | 6.86 | 7.54 | 7.64 |
| Langelier Saturation Index | | | | | 1.04 | 0.94 | 1.30 | 0.50 | 0.47 |
| Total Dissolved Solids | 20 | - | | mg/L | 768 | 470 | 92 | 360 | 300 |
| % Difference/ Ion Balance | 0.1 | - | | % | 0.2 | - | 4.7 | - | - |
| Alkalinity (as $CaCO^3$) | 5 | 1 | | mg/L | 196 | 250 | 252 | 150 | 140 |
| Bicarbonate (as $CaCO^3$) | 5 | 1 | | mg/L | 196 | 240 | 252 | 150 | 140 |
| Carbonate (as $CaCO^3$) | 5 | 1 | | mg/L | <5 | 3 | <5 | 2 | 2 |
| Hydroxide (as $CaCO^3$) | 5 | - | | mg/L | <5 | - | <5 | - | - |
| Fluoride | 0.05 | 0.03 | | mg/L | 0.14 | 0.18 | <0.05 | 0.31 | 0.37 |
| Chloride | 0.10 | 0.05 | | mg/L | 309 | 66 | 20 | 79 | 65 |
| Bromide | 0.05 | 0.1 | | mg/L | <0.05 | 0.13 | <0.05 | <0.1 | <0.1 |
| Nitrate (as N) | 0.05 | 0.05 | | mg/L | 1.71 | 0.05 | <0.05 | 1.50 | 0.60 |
| Nitrite (as N) | 0.05 | 0.01 | | mg/L | <0.05 | <0.01 | <0.05 | <0.01 | <0.01 |
| Sulphate | 0.10 | 0.10 | | mg/L | 55 | 89 | 51 | 55 | 43 |
| ortho-Phosphate (as P) | 0.10 | 0.50 | | mg/L | <0.10 | <0.5 | <0.10 | <0.5 | <0.5 |
| Total Phosphorus | 0.05 | 0.06 | 0.02 | mg/L | **0.04** | **0.08** | **0.09** | **0.11** | **<0.06** |
| Ammonia (as N) | 0.02 | 0.02 | | mg/L | <0.02 | 0.03 | <0.02 | 0.02 | 0.02 |
| Total Organic Carbon | 0.5 | 0.2 | | mg/L | 8.3 | 9.9 | 16.1 | 6.2 | 4.7 |
| Reactive Silica | 0.05 | | | mg/L | 5.09 | - | 7.32 | - | - |
| Colour | 5 | | | TCU | 40 | - | 65 | - | - |
| Turbidity | 0.5 | | | NTU | 20 | - | 55 | - | - |
| Total Hardness (as $CaCO^3$) | 10 | 1 | | mg/L | 308 | 310 | 320 | 200 | 180 |
| Calcium | 0.05 | 0.2 | | mg/L | 91 | 87 | 87 | 58 | 51 |
| Magnesium | 0.05 | 0.4 | | mg/L | 20 | 23 | 25 | 14 | 12 |
| Iron | 0.01 | 0.01 | 0.30 | mg/L | <0.01 | **0.65** | 0.02 | **0.84** | **0.63** |
| Sodium | 0.05 | 0.1 | 20 | mg/L | **175** | **48** | 15 | **57** | **43** |
| Potassium | 0.05 | 1 | | mg/L | 2.9 | 3.9 | 9.8 | 3.1 | 2.3 |
| Aluminum | 0.004 | 0.015 | 0.075 | mg/L | <0.030 | **0.45** | <0.030 | **0.60** | **0.44** |
| Arsenic | 0.003 | 0.005 | 0.100 | mg/L | <0.003 | <0.005 | <0.003 | <0.005 | <0.005 |
| Barium | 0.002 | | | mg/L | 0.035 | - | 0.031 | - | - |
| Boron | 0.010 | 0.200 | 0.200 | mg/L | 0.010 | <0.2 | 0.028 | <0.2 | <0.2 |
| Cadmium | 0.002 | 0.0002 | 0.0005 | mg/L | <0.0001 | <0.0002 | <0.0001 | <0.0002 | <0.0002 |
| Chromium | 0.003 | 0.002 | 0.001 | mg/L | 0.004 | <0.002 | 0.004 | <0.002 | <0.002 |
| Copper | 0.003 | 0.001 | 0.005 | mg/L | 0.003 | 0.001 | 0.005 | 0.001 | 0.002 |
| Lead | 0.002 | 0.005 | 0.025 | mg/L | <0.001 | <0.005 | <0.001 | <0.005 | <0.005 |
| Manganese | 0.002 | | | mg/L | 0.009 | - | 0.024 | - | - |
| Mercury | 0.0001 | | 0.0002 | mg/L | <0.0001 | - | <0.0001 | - | - |
| Molybdenum | 0.002 | 0.04 | 0.040 | mg/L | <0.001 | <0.04 | <0.001 | <0.04 | <0.04 |
| Nickel | 0.003 | 0.025 | 0.025 | mg/L | <0.003 | <0.025 | <0.003 | <0.025 | <0.025 |
| Selenium | 0.004 | 0.1 | 0.100 | mg/L | <0.004 | <0.1 | <0.004 | <0.1 | <0.1 |
| Silver | 0.002 | 0.0001 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Strontium | 0.005 | | | mg/L | 0.296 | - | 0.305 | - | - |
| Thallium | 0.006 | 0.0003 | 0.0003 | mg/L | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 |
| Titanium | 0.002 | | | mg/L | 0.003 | - | 0.003 | - | - |
| Uranium | 0.002 | 0.005 | 0.005 | mg/L | <0.002 | <0.005 | <0.002 | <0.005 | <0.005 |
| Vanadium | 0.002 | 0.006 | 0.006 | mg/L | 0.003 | <0.006 | 0.002 | <0.006 | <0.006 |
| Zinc | 0.005 | 0.02 | 0.030 | mg/L | <0.005 | <0.02 | <0.005 | <0.02 | <0.02 |

Notes:

- data not available

RDL = Reported Detection Limit (Samples collected in 2008)

MDL = Method Detection Limit (Samples collected in 2002)

PWQO = Provincial Water Quality Objectives

Bold indicates exceedence of PWQO

Source of data for 2002 samples - North Oakville East SWS, NOMI, 2004

# Appendix C-6

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# Water Balance

**Figure C-6-1**
**Total Annual Precipitation**
**1950 - 2021**

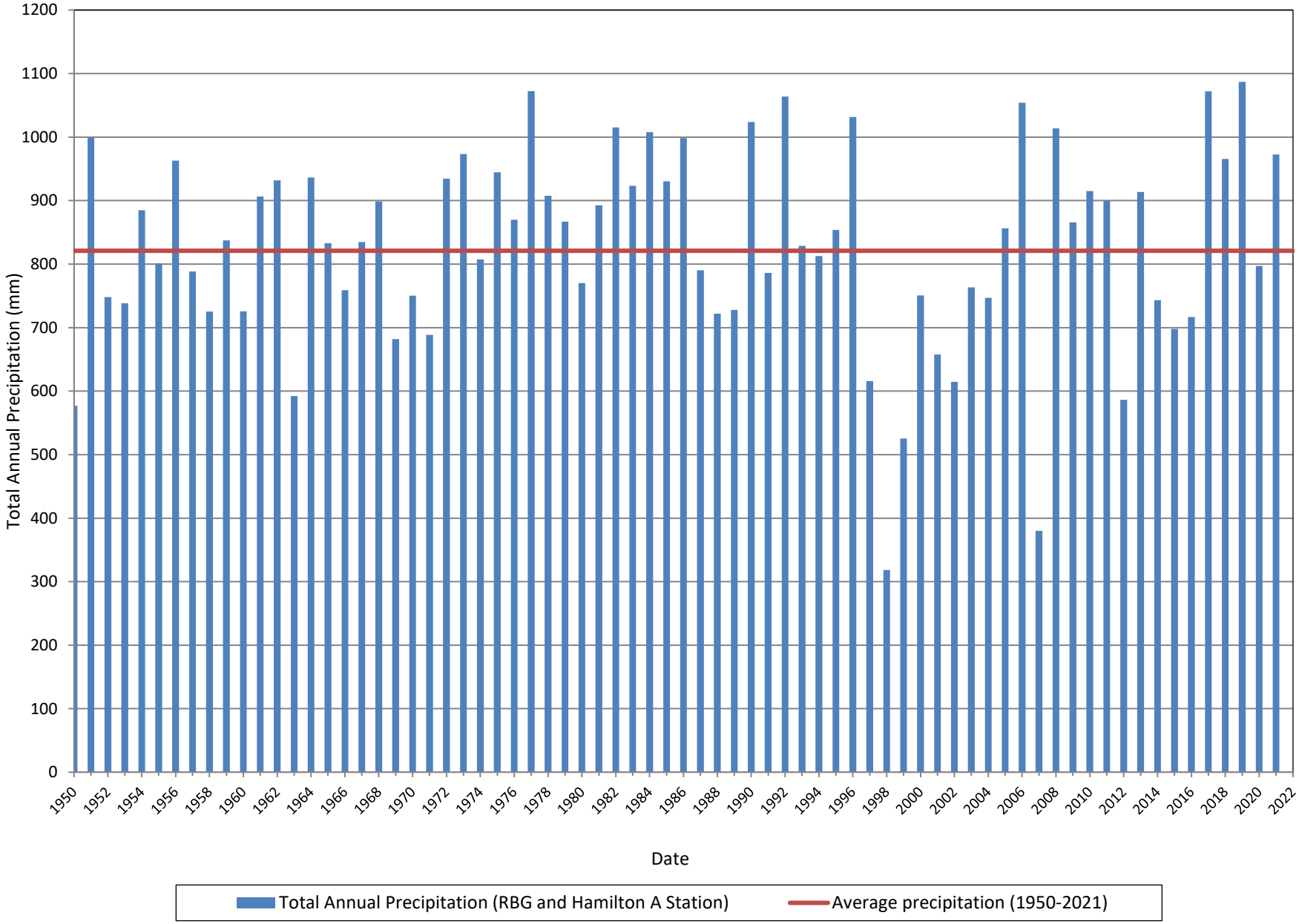
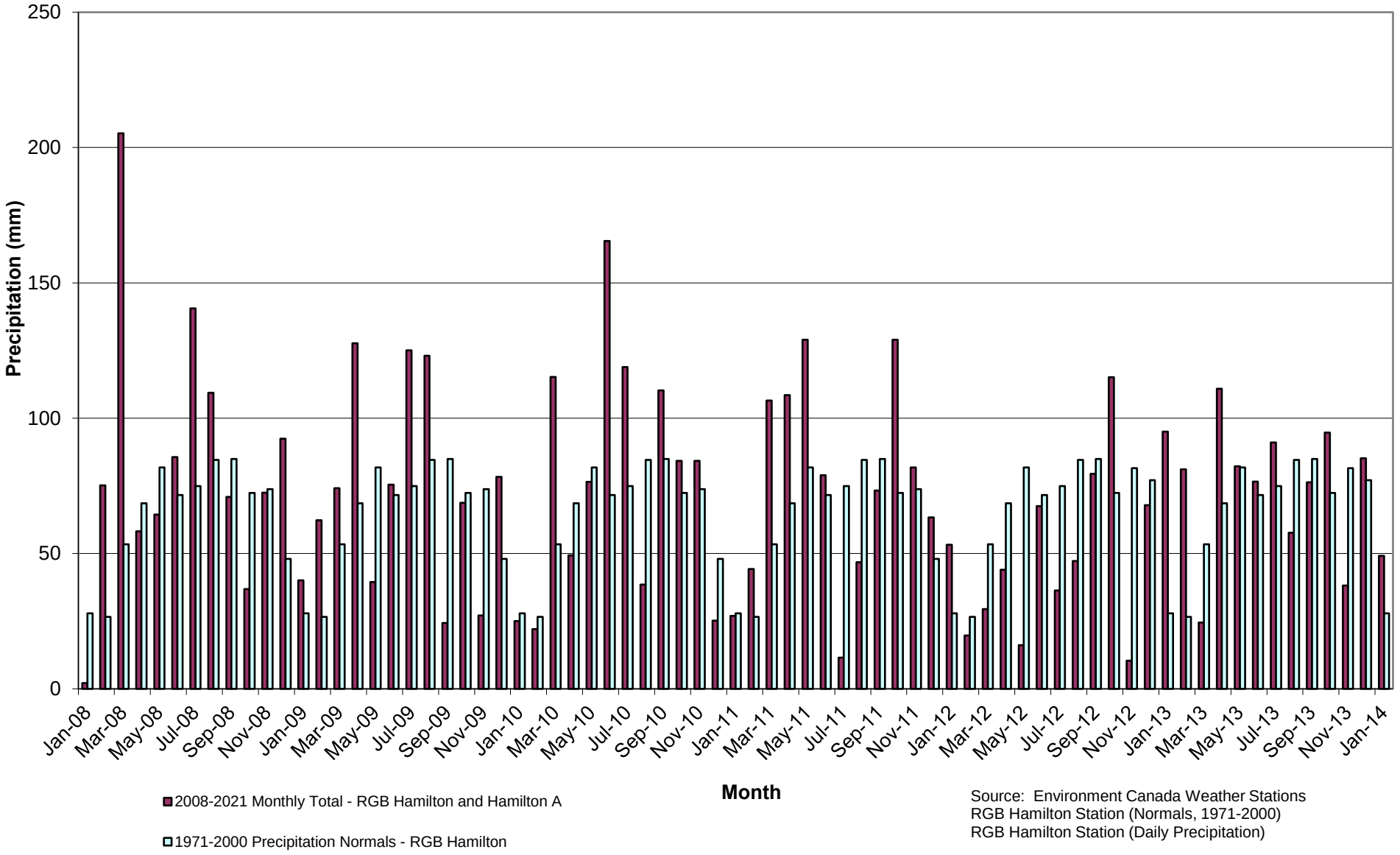
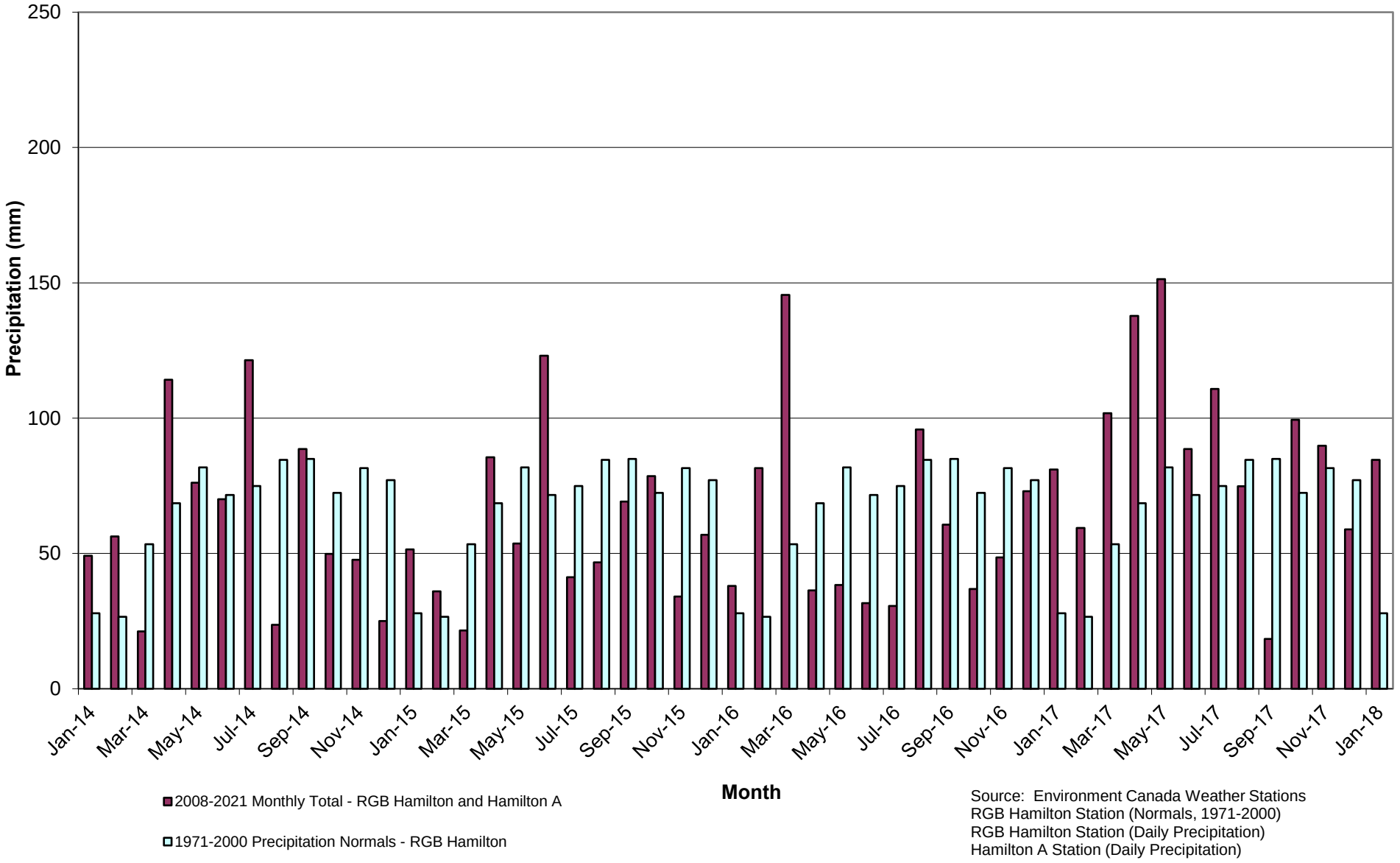


**Figure C-6-2A**
**2008 to 2013 Precipitation and Precipitation Normals**



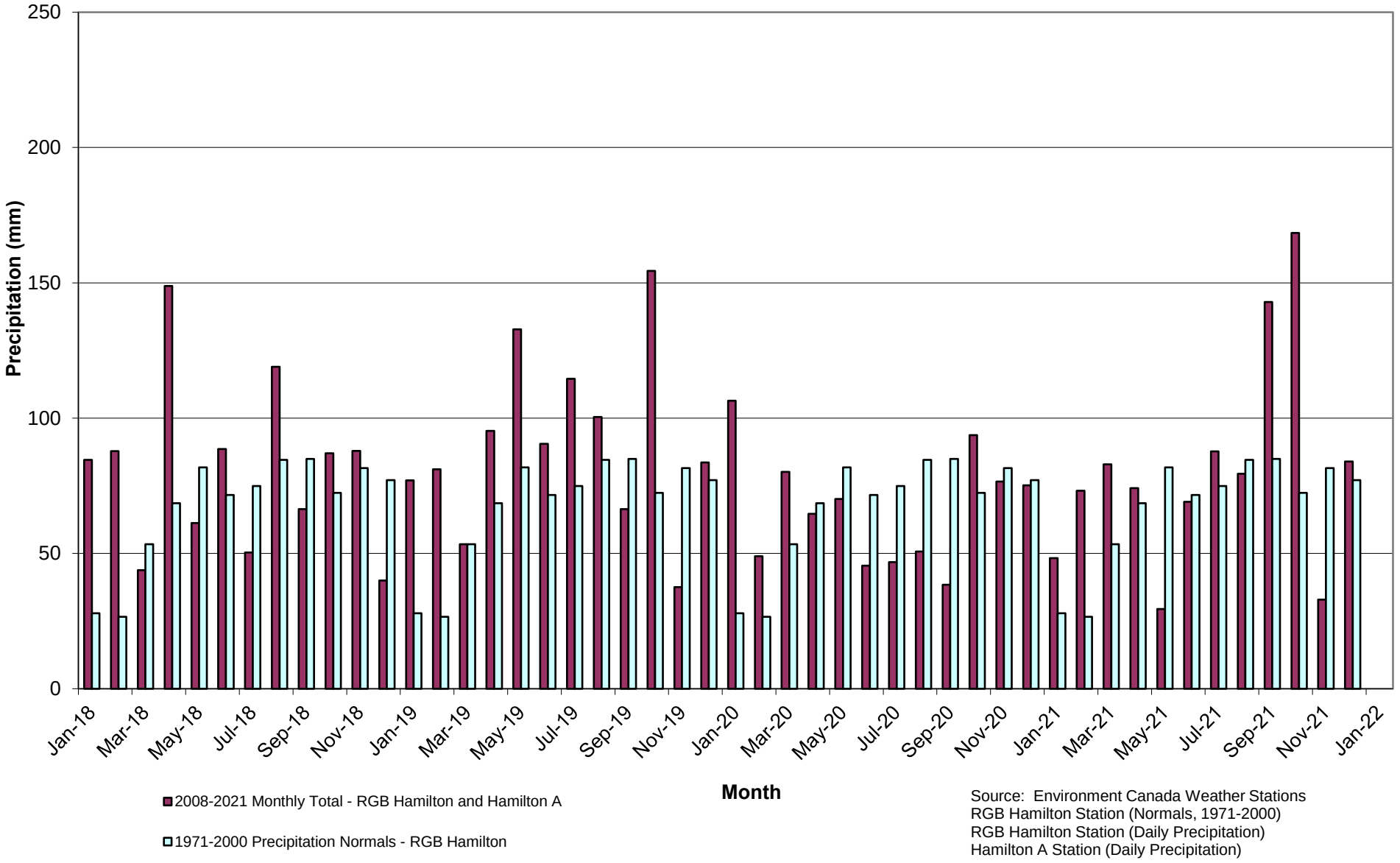

Source: Environment Canada Weather Stations
RGB Hamilton Station (Normals, 1971-2000)
RGB Hamilton Station (Daily Precipitation)

**Figure C-6-2B**
**2008 to 2013 Precipitation and Precipitation Normals**




Source: Environment Canada Weather Stations
RGB Hamilton Station (Normals, 1971-2000)
RGB Hamilton Station (Daily Precipitation)
Hamilton A Station (Daily Precipitation)

**Figure C-6-2C**
**2008 to 2013 Precipitation and Precipitation Normals**




Source: Environment Canada Weather Stations
RGB Hamilton Station (Normals, 1971-2000)
RGB Hamilton Station (Daily Precipitation)
Hamilton A Station (Daily Precipitation)

# TABLE C-6-1

## Water Balance Components
## Based on Thornthwaite's Soil Moisture Balance Approach
## with a Soil Moisture Retention of 100 mm (selected for Short-Rooted Vegetation on Clay Soils)

| **Potential Evapotranspiration Calculation** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** | **YEAR** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Temperature (Degree C) from RBG Hamilton | -4.7 | -3.9 | 0.5 | 7.1 | 13.3 | 18.9 | 22 | 20.9 | 16.3 | 10 | 4.1 | -1.4 | **8.6** |
| Heat index: $i = (t/5)^{1.514}$ | 0.00 | 0.00 | 0.03 | 1.70 | 4.40 | 7.49 | 9.42 | 8.72 | 5.98 | 2.86 | 0.74 | 0.00 | **41.3** |
| Unadjusted Daily Potential Evapotranspiration U (mm) | 0.00 | 0.00 | 1.42 | 29.73 | 61.02 | 91.26 | 108.61 | 102.41 | 77.03 | 44.01 | 15.85 | 0.00 | **531** |
| Adjusting Factor for U (Latitude 43° 16.8'N) | 0.81 | 0.82 | 1.02 | 1.12 | 1.26 | 1.28 | 1.29 | 1.2 | 1.04 | 0.95 | 0.81 | 0.77 | |
| Adjusted Potential Evapotranspiration PET (mm) | 0 | 0 | 1 | 33 | 77 | 117 | 140 | 123 | 80 | 42 | 13 | 0 | **626** |
| | | | | | | | | | | | | | |
| **PRE-DEVELOPMENT WATER BALANCE COMPONENTS** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** | **YEAR** |
| Precipitation (P) from RBG Hamilton 1981-2010 | 56.8 | 57.2 | 63.7 | 73.3 | 85.5 | 72.7 | 82.7 | 89.7 | 80.9 | 71.6 | 91.3 | 71.9 | **897** |
| Potential Evapotranspiration (PET) | 0 | 0 | 1 | 33 | 77 | 117 | 140 | 123 | 80 | 42 | 13 | 0 | **626** |
| P - PET | 57 | 57 | 62 | 40 | 9 | -44 | -57 | -33 | 1 | 30 | 78 | 72 | **271** |
| Change in Soil Moisture Storage | 0 | 0 | 0 | 0 | 0 | -44 | -56 | 0 | 1 | 30 | 69 | 0 | **0** |
| Soil Moisture Storage (max 100 mm) | 100 | 100 | 100 | 100 | 100 | 56 | 0 | 0 | 1 | 31 | 100 | 100 | |
| Actual Evapotranspiration (AET) | 0 | 0 | 1 | 33 | 77 | 117 | 139 | 90 | 80 | 42 | 13 | 0 | **591** |
| Soil Moisture Deficit (max 100 mm) | 0 | 0 | 0 | 0 | 0 | 44 | 100 | 100 | 99 | 69 | 0 | 0 | |
| Water Surplus - available for infiltration or runoff | 57 | 57 | 62 | 40 | 9 | 0 | 0 | 0 | 0 | 0 | 9 | 72 | **306** |
| Potential Infiltration (based on MOE metholodogy*; independent of temperature) | 26 | 26 | 28 | 18 | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 32 | **138** |
| Potential Direct Surface Water Runoff (independent of temperature) | 31 | 31 | 34 | 22 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 40 | **168** |
| Recharge (deep infiltration - assume 50% of I) | 13 | 13 | 14 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 16 | **69** |
| Interflow (indirect runoff - assume 50% of I) | 13 | 13 | 14 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 16 | **69** |
| Total Runoff (direct and indirect components) | 44 | 44 | 48 | 31 | 7 | 0 | 0 | 0 | 0 | 0 | 7 | 56 | **237** |
| | | | | | | | | | | | | | |
| **IMPERVIOUS AREA WATER SURPLUS** | | | | | | | | | | | | | |
| Annual Precipitation (P) | 897 | mm/year | | | | | | | | | | | |
| Potential Evaporation (PE) from impervious areas (assume loss of up to 20%) | 179 | mm/year | | | | | | | | | | | |
| P-PE (surplus available for runoff from impervious areas) | 718 | mm/year | | | | | | | | | | | |

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage for short-rooted vegetation 100 mm

*MOE SWM infiltration calculations (from 2003 Planning & Design Manual)

| | |
|---|---|
| topography - flat land | 0.25 |
| soils - relatively tight silty clay till materials | 0.1 |
| cover - predominantly cultivated land | 0.1 |
| **Infiltration factor** | **0.45** |

# TABLE C-6-2

**Water Balance Components**
**Based on Thornthwaite's Soil Moisture Balance Approach**
**with a Soil Moisture Retention of 200 mm (selected for Deeper-Rooted Vegetation on Clay Soils)**

| **Potential Evapotranspiration Calculation** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** | **YEAR** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Temperature (Degree C) from RBGHamilton | -4.7 | -3.9 | 0.5 | 7.1 | 13.3 | 18.9 | 22 | 20.9 | 16.3 | 10 | 4.1 | -1.4 | **8.6** |
| Heat index: $i = (t/5)^{1.514}$ | 0.00 | 0.00 | 0.03 | 1.70 | 4.40 | 7.49 | 9.42 | 8.72 | 5.98 | 2.86 | 0.74 | 0.00 | **41.3** |
| Unadjusted Daily Potential Evapotranspiration U (mm) | 0.00 | 0.00 | 1.42 | 29.73 | 61.02 | 91.26 | 108.61 | 102.41 | 77.03 | 44.01 | 15.85 | 0.00 | **531** |
| Adjusting Factor for U (Latitude 43° 16.8'N) | 0.81 | 0.82 | 1.02 | 1.12 | 1.26 | 1.28 | 1.29 | 1.2 | 1.04 | 0.95 | 0.81 | 0.77 | |
| Adjusted Potential Evapotranspiration PET (mm) | 0 | 0 | 1 | 33 | 77 | 117 | 140 | 123 | 80 | 42 | 13 | 0 | **626** |
| | | | | | | | | | | | | | |
| **PRE-DEVELOPMENT WATER BALANCE COMPONENTS** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** | **YEAR** |
| Precipitation (P) from RBG Hamilton 1981-2010 | 56.8 | 57.2 | 63.7 | 73.3 | 85.5 | 72.7 | 82.7 | 89.7 | 80.9 | 71.6 | 91.3 | 71.9 | **897** |
| Potential Evapotranspiration (PET) | 0 | 0 | 1 | 33 | 77 | 117 | 140 | 123 | 80 | 42 | 13 | 0 | **626** |
| P - PET | 57 | 57 | 62 | 40 | 9 | -44 | -57 | -33 | 1 | 30 | 78 | 72 | **271** |
| Change in Soil Moisture Storage | 0 | 0 | 0 | 0 | 0 | -44 | -57 | -33 | 1 | 30 | 78 | 26 | **0** |
| Soil Moisture Storage (max 200 mm) | 200 | 200 | 200 | 200 | 200 | 156 | 98 | 65 | 66 | 96 | 174 | 200 | |
| Actual Evapotranspiration (AET) | 0 | 0 | 1 | 33 | 77 | 117 | 140 | 123 | 80 | 42 | 13 | 0 | **626** |
| Soil Moisture Deficit (max 200 mm) | 0 | 0 | 0 | 0 | 0 | 44 | 102 | 135 | 134 | 104 | 26 | 0 | |
| Water Surplus - available for infiltration or runoff | 57 | 57 | 62 | 40 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 46 | **271** |
| Potential Infiltration (based on MOE metholodogy*; independent of temperature) | 26 | 26 | 28 | 18 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | **122** |
| Potential Direct Surface Water Runoff (independent of temperature) | 31 | 31 | 34 | 22 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | **149** |
| Recharge (deep infiltration - assume 50% of I) | 13 | 13 | 14 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | **61** |
| Interflow (indirect runoff - assume 50% of I) | 13 | 13 | 14 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | **61** |
| Total Runoff (direct and indirect components) | 44 | 44 | 48 | 31 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | **210** |
| | | | | | | | | | | | | | |

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage (for deeper-rooted vegetation) 200 mm

*MOE SWM infiltration calculations

| | |
|---|---|
| topography -flat land | 0.25 |
| soils - relatively tight silty clay till materials | 0.1 |
| cover - woodland | 0.2 |
| **Infiltration factor** | **0.55** |

# TABLE C-6-3

**Pre- and Post-Development Water Balance Calculations for Sixth Oak UWM1 Subcatchment Area**
**With No Mitigation or Use of LID Strategies**

| Land Use Description | Approx. Land Area ($m^2$) | Estimated Impervious Coefficient for Land Use | Estimated Impervious Area ($m^2$) | Runoff from Impervious Area* (m/a) | Direct Runoff Volume from Impervious Area ($m^3$/a) | Estimated Pervious Area ($m^2$) | Total Runoff (Direct and Indirect) from Pervious Area* (m/a) | Runoff Volume from Pervious Area ($m^3$/a) | Recharge in Pervious Area* (m/a) | Recharge Volume in Pervious Area ($m^3$/a) | Total Runoff (Direct and Indirect) Volume ($m^3$/a) | Total Recharge Volume ($m^3$/a) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Existing Conditions** | | | | | | | | | | | | |
| Agricultural/Open Space | 135,325 | 0.00 | 0 | 0.718 | 0 | 135,325 | 0.237 | 32,071 | 0.069 | 9,311 | 32,071 | 9,311 |
| Rural Residential | 7,670 | 0.25 | 1,918 | 0.718 | 1,376 | 5,753 | 0.237 | 1,363 | 0.069 | 396 | 2,739 | 396 |
| Burnhamthorpe Road | 2,293 | 0.90 | 2,064 | 0.718 | 1,481 | 229 | 0.237 | 54 | 0.069 | 16 | 1,535 | 16 |
| Core/ NHS | 69,499 | 0.00 | 0 | 0.718 | 0 | 69,499 | 0.210 | 14,601 | 0.061 | 4,239 | 14,601 | 4,239 |
| **TOTAL PRE-DEVELOPMENT** | **214,787** | | **3,981** | | **2,857** | **210,806** | | **48,090** | | **13,962** | **50,947** | **13,962** |
| | | | | | | | | | | | | |
| **Potential Post-Development Conditions with no LID** | | | | | | | | | | | | |
| School | | | | | | | | | | | | |
| Rural Residential | | | | | | | | | | | | |
| SWM Pond | | | | | | | | | | | | |
| Core/ NHS | | | | | | | | | | | | |
| **TOTAL POST-DEVELOPMENT** | | | | | | | | | | | | |
| | | | | | | | | | | % Change from Pre to Post | | |
| | | | | | | | | | | Potential Change | | |

*figures from Tables C-6-1 and C-6-2

Agricultural and rural residential lands are allocated recharge characteristics of short-rooted vegetation.
Wooded areas estimated from aerial photograph

Difference between pre and post recharge volumes (m3/a) **13,962**

# Appendix D

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# Hydraulics and Hydrology

# Appendix D-4

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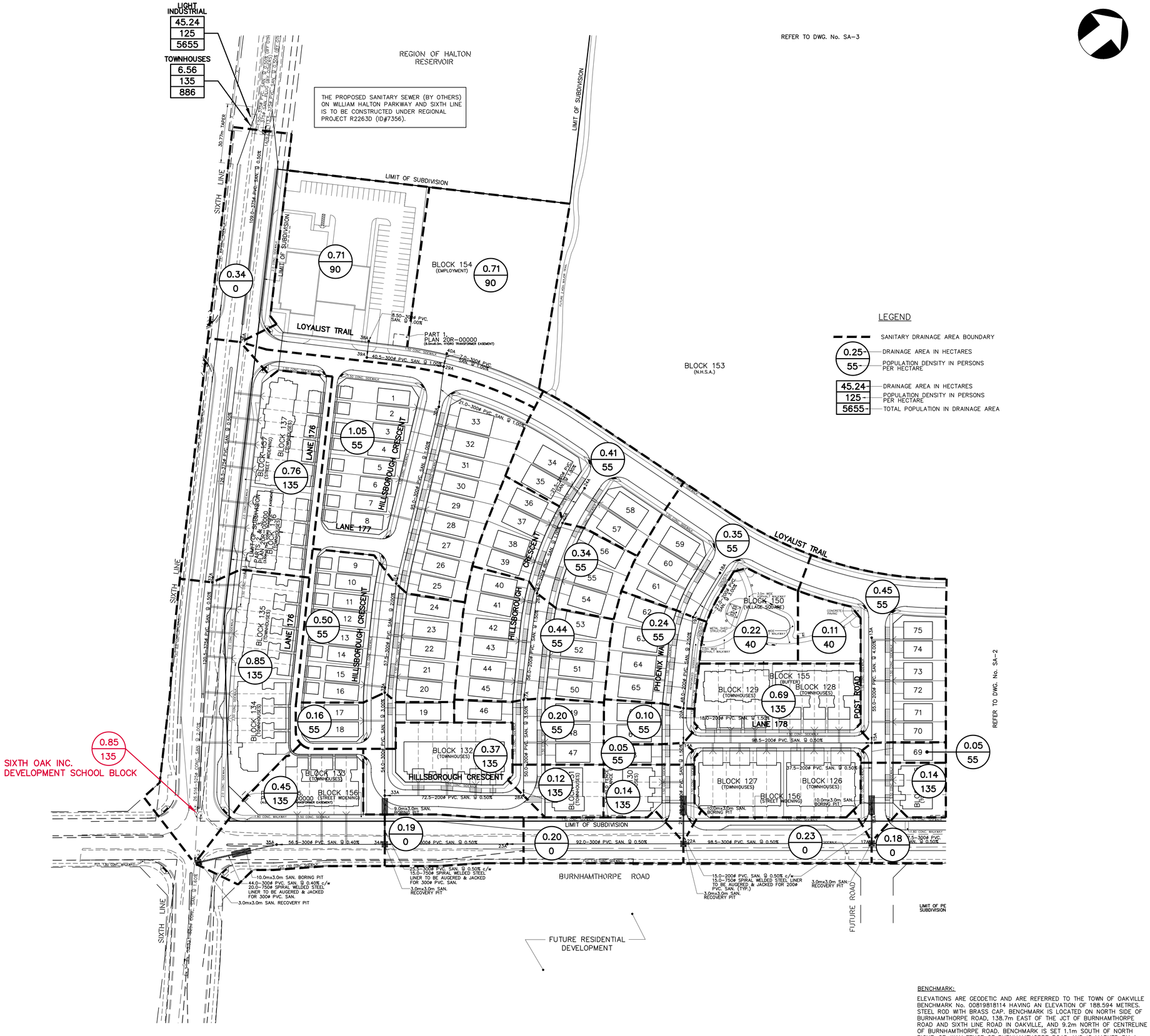
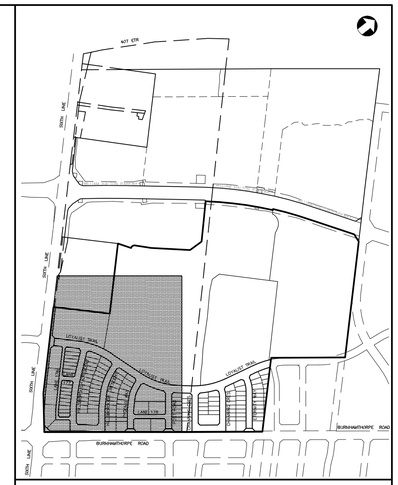
## Sanitary Sewer Calculations




BENCHMARK:

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE TOWN OF OAKVILLE BENCHMARK No. 00819818114 HAVING AN ELEVATION OF 188.594 METRES. STEEL ROD WITH BRASS CAP. BENCHMARK IS LOCATED ON NORTH SIDE OF BURNHAMTHORPE ROAD, 138.7m EAST OF THE JCT OF BURNHAMTHORPE ROAD AND SIXTH LINE ROAD IN OAKVILLE, AND 9.2m NORTH OF CENTRELINE OF BURNHAMTHORPE ROAD. BENCHMARK IS SET 1.1m SOUTH OF NORTH RIGHT-OF-WAY FENCE OF BURNHAMTHORPE ROAD AND IS MARKED BY A STEEL MARKER 46cm EAST OF BENCHMARK.




KEY PLAN SCALE N.T.S.

FOR GENERAL NOTES REFER TO DWG. No. GN-1

| NO. | DATE | BY | REVISION |
|---|---|---|---|
| 9 | JAN. 21, 2022 | P.S. | PROP. SANITARY CONNECTION FOR SIXTH OAK INC. BLK. |
| 8 | MAY 6, 2019 | M.M. | FINAL SUBMISSION |
| 7 | APR. 2, 2019 | M.M. | SIXTH SUBMISSION |
| 6 | FEB. 7, 2019 | M.M. | FIFTH SUBMISSION |
| 5 | NOV. 9, 2018 | M.M. | ISSUED FOR CONSTRUCTION |
| 4 | OCT. 15, 2018 | M.M. | FOURTH SUBMISSION |
| 3 | JUL. 17, 2018 | M.M. | THIRD SUBMISSION |
| 2 | FEB. 9, 2018 | M.M. | SECOND SUBMISSION |
| 1 | MAR. 13, 2017 | M.M. | FIRST SUBMISSION |

| DESIGN | M.M. | CHECKED | V.C. | DATE |
|---|---|---|---|---|
| DRAWN | ACAD | CHECKED | M.M. | MAY 2019 |

SCALE 0 10 20 40 60 80 — 1:1000

STAMP

APPROVALS

MUNICIPAL

APPROVED IN PRINCIPLE SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO TOWN OF OAKVILLE STANDARDS AND SPECIFICATIONS.

SIGNED: _____ DATE: _____
Manager of Development Engineering, Town of Oakville

REGIONAL

DESIGN OF SANITARY AND WATER SERVICES APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON REGION STANDARDS AND SPECIFICATIONS AND LOCATION APPROVAL FROM AREA MUNICIPALITY.

SIGNED: ORIGINAL SIGNED BY RONALD MACKENZIE DATE: NOV. 9, 2018
Legislative & Planning Services Department, Halton Region

CONSULTANT

RAND ENGINEERING CORPORATION
5285 Solar Drive
Mississauga, ON
Canada, L4W 5B8
Tel: 905.625.9500

MUNICIPALITY

THE REGIONAL MUNICIPALITY OF HALTON
TOWN OF OAKVILLE
DEVELOPMENT ENGINEERING

# STAR OAK DEVELOPMENTS LIMITED

# SANITARY DRAINAGE PLAN

24T-13002

| MUNICIPAL FILE NO. | REGIONAL FILE NO. |
|---|---|
| SD-605 | DO-1036 |
| CONTRACT NO. 16987 | SHEET SA-1 |

R:\21\21043\987-SA-01(SAN SCHOOL BLOCK).dwg | Jan 21, 2022 - 4:22pm

# THE REGIONAL MUNICIPALITY OF HALTON

**Project No.:** 16987
**Location:** Star Oak Developments Limited
Town of Oakville

## SANITARY SEWER DESIGN

**Date:** January 5, 2022
**Designed By:** M.Maveal
**Checked By:** V.Cavallo

| Population Densities | | | |
|---|---|---|---|
| | Residential - Low Density | 55 | ppha |
| | Residential - High Density | 135 | ppha |
| | Commercial | 90 | ppha |
| | Industrial / School | 125 | ppha |
| | Park | 40 | ppha |
| | Road Allowance | 0 | ppha |

Ave. Daily per Capita Flow: 275 L/c/d

Inflitration Allowance: 0.286 L/s/ha

PF = $K_{av}\{1+14/(4+P^{1/2})\}$

$K_{av} = A_R + 0.80\,(A_I+A_C)/(A_R+A_I+A_C)$

n = 0.013

| STREET | Manhole | | Length | Tributary Area (Ha) | | | | | | | | Population Tributary | | | | | | | | Average (L/s) | Average (L/s) | Peaking | Max. | Infilt- | Max. | SEWER | | | | | PIPE | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Increment | | | | | | | | Increment | | | | | | | | | | | | | | | | | | | | | |
| | From | To | (m) | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Increment | Total | PF | (L/s) | (L/s) | Expect. (L/s) | Size Dia. (mm) | Slope (%) | Q (L/s) | V (m/s) Full Flow | V (m/s) Actual Flow | Type | Class | |
| LOYALIST TRAIL | 1A | 2A | 32.5 | | | | 4.94 | | | 4.94 | 4.94 | | | | 618 | | | 618 | 618 | 1.965 | 1.965 | 3.140 | 6.172 | 1.413 | 7.585 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| ETERNITY WAY | 2A | 3A | 17.0 | 0.29 | | | | | | 0.29 | 5.23 | 16 | | | | | | 16 | 633 | 0.051 | 2.016 | 3.179 | 6.409 | 1.496 | 7.905 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| ETERNITY WAY | 3A | 4A | 84.0 | 0.68 | | | | | | 0.68 | 5.91 | 37 | | | | | | 37 | 671 | 0.119 | 2.135 | 3.252 | 6.944 | 1.690 | 8.635 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| ETERNITY WAY | 4A | 5A | 30.5 | | 0.23 | | | | | 0.23 | 6.14 | | 31 | | | | | 31 | 702 | 0.099 | 2.234 | 3.267 | 7.299 | 1.756 | 9.055 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| ETERNITY WAY | 5A | 6A | 17.5 | | | | | | | | 6.14 | | | | | | | | 702 | | 2.234 | 3.267 | 7.299 | 1.756 | 9.055 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 6A | 7A | 72.0 | | 0.31 | | | | | 0.31 | 6.45 | | 42 | | | | | 42 | 744 | 0.133 | 2.367 | 3.285 | 7.776 | 1.845 | 9.621 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 7A | 12A | 69.5 | | 0.30 | | | | | 0.30 | 6.75 | | 41 | | | | | 41 | 784 | 0.129 | 2.496 | 3.300 | 8.237 | 1.931 | 10.167 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| CHANNING CRESCENT | 8A | 9A | 93.0 | 0.69 | 0.12 | | | | | 0.81 | 0.81 | 38 | 16 | | | | | 54 | 54 | 0.172 | 0.172 | 4.308 | 0.742 | 0.232 | 0.974 | 200 | 1.50 | 41.9 | 1.29 | 1.24 | PVC | SDR35 | |
| CHANNING CRESCENT | 9A | 11A | 69.5 | | 0.29 | | | | | 0.29 | 1.10 | | 39 | | | | | 39 | 93 | 0.125 | 0.297 | 4.252 | 1.263 | 0.315 | 1.577 | 200 | 2.00 | 48.4 | 1.49 | 1.43 | PVC | SDR35 | |
| CHANNING CRESCENT | 10A | 11A | 81.5 | 0.64 | 0.12 | | | | | 0.76 | 0.76 | 35 | 16 | | | | | 51 | 51 | 0.164 | 0.164 | 4.312 | 0.705 | 0.217 | 0.923 | 200 | 3.00 | 59.3 | 1.83 | 1.75 | PVC | SDR35 | |
| CHANNING CRESCENT | 11A | 12A | 25.0 | | | | | | | | 1.86 | | | | | | | | 145 | | 0.461 | 4.196 | 1.933 | 0.532 | 2.465 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 12A | 17A | 77.5 | | | | | | 0.18 | 0.18 | 8.79 | | | | | | | | 929 | | 2.957 | 3.375 | 9.980 | 2.514 | 12.494 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| POST ROAD | 13A | 15A | 55.0 | 0.45 | | | | 0.11 | | 0.56 | 0.56 | 25 | | | | 4 | | 29 | 29 | 0.093 | 0.093 | 4.186 | 0.388 | 0.160 | 0.548 | 200 | 4.00 | 68.4 | 2.11 | 2.03 | PVC | SDR35 | |
| LANE 178 | 14A | 15A | 98.5 | | 0.69 | | | | | 0.69 | 0.69 | | 93 | | | | | 93 | 93 | 0.296 | 0.296 | 4.252 | 1.261 | 0.197 | 1.458 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| POST ROAD | 15A | 16A | 37.5 | 0.05 | 0.14 | | | | | 0.19 | 1.44 | 3 | 19 | | | | | 22 | 144 | 0.069 | 0.458 | 4.133 | 1.893 | 0.412 | 2.305 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| POST ROAD | 16A | 17A | 15.0 | | | | | | | | 1.44 | | | | | | | | 237 | | 0.755 | 4.057 | 3.062 | 0.412 | 3.474 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 17A | 22A | 98.5 | | | | | | 0.23 | 0.23 | 10.46 | | | | | | | | 1073 | | 3.415 | 3.385 | 11.561 | 2.992 | 14.553 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |

# THE REGIONAL MUNICIPALITY OF HALTON

**Project No.:** 16987
**Location:** Star Oak Developments Limited
Town of Oakville

## SANITARY SEWER DESIGN

**Date:** January 5, 2022
**Designed By:** M.Maveal
**Checked By:** V.Cavallo

| Population Densities | | | |
|---|---|---|---|
| | Residential - Low Density | 55 | ppha |
| | Residential - High Density | 135 | ppha |
| | Commercial | 90 | ppha |
| | Industrial / School | 125 | ppha |
| | Park | 40 | ppha |
| | Road Allowance | 0 | ppha |

Ave. Daily per Capita Flow: 275 L/c/d

Inflitration Allowance: 0.286 L/s/ha

$PF = K_{av}\{1+14/(4+P^{1/2})\}$

$K_{av} = A_R + 0.80\,(A_I+A_C)/(A_R+A_I+A_C)$

n = 0.013

| STREET | Manhole | | Length | Tributary Area (Ha) | | | | | | | | Population Tributary | | | | | | | | Average (L/s) | Average (L/s) | Peaking | Max. | Infilt- | Max. | SEWER | | | | | PIPE | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Increment | | | | | | | | Increment | | | | | | | | | | | | | | | | | | | | | |
| | From | To | (m) | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Increment | Total | PF | (L/s) | (L/s) | Flow Expect. (L/s) | Size Dia. (mm) | Slope (%) | Q (L/s) | V (m/s) Full Flow | V (m/s) Actual Flow | Type | Class | |
| PHOENIX WAY | 18A | 19A | 27.0 | 0.35 | | | | 0.22 | | 0.57 | 0.57 | 19 | | | | 9 | | 28 | 28 | 0.089 | 0.089 | 4.023 | 0.359 | 0.163 | 0.522 | 200 | 3.00 | 59.3 | 1.83 | 1.75 | PVC | SDR35 | |
| PHOENIX WAY | 19A | 20A | 48.0 | 0.24 | | | | | | 0.24 | 0.81 | 13 | | | | | | 13 | 41 | 0.042 | 0.131 | 4.096 | 0.538 | 0.232 | 0.769 | 200 | 2.50 | 54.1 | 1.67 | 1.60 | PVC | SDR35 | |
| PHOENIX WAY | 20A | 14A | 18.0 | 0.10 | | | | | | 0.10 | 0.91 | 6 | | | | | | 6 | 47 | 0.018 | 0.149 | 4.112 | 0.612 | 0.260 | 0.872 | 200 | 1.50 | 41.9 | 1.29 | 1.24 | PVC | SDR35 | |
| PHOENIX WAY | 14A | 21A | 38.0 | 0.05 | 0.14 | | | | | 0.19 | 1.10 | 3 | 19 | | | | | 22 | 68 | 0.069 | 0.218 | 4.114 | 0.896 | 0.315 | 1.210 | 200 | 1.50 | 41.9 | 1.29 | 1.24 | PVC | SDR35 | |
| PHOENIX WAY | 21A | 22A | 15.0 | | | | | | | | 1.10 | | | | | | | | 68 | | 0.218 | 4.114 | 0.896 | 0.315 | 1.210 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 22A | 23A | 92.0 | | | | | | 0.20 | 0.20 | 11.76 | | | | | | | | 1141 | | 3.633 | 3.386 | 12.300 | 3.363 | 15.663 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 23A | 34A | 64.0 | | | | | | 0.19 | 0.19 | 11.95 | | | | | | | | 1141 | | 3.633 | 3.380 | 12.278 | 3.418 | 15.696 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 24A | 25A | 21.5 | 0.41 | | | | | | 0.41 | 0.41 | 23 | | | | | | 23 | 23 | 0.072 | 0.072 | 4.373 | 0.314 | 0.117 | 0.431 | 200 | 1.00 | 34.2 | 1.06 | 1.01 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 25A | 26A | 39.0 | 0.34 | | | | | | 0.34 | 0.75 | 19 | | | | | | 19 | 41 | 0.060 | 0.131 | 4.331 | 0.569 | 0.215 | 0.783 | 200 | 1.00 | 34.2 | 1.06 | 1.01 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 26A | 27A | 56.0 | 0.44 | | | | | | 0.44 | 1.19 | 24 | | | | | | 24 | 65 | 0.077 | 0.208 | 4.290 | 0.894 | 0.340 | 1.234 | 200 | 1.50 | 41.9 | 1.29 | 1.24 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 27A | 28A | 50.0 | 0.20 | 0.12 | | | | | 0.32 | 1.51 | 11 | 16 | | | | | 27 | 93 | 0.087 | 0.295 | 4.252 | 1.254 | 0.432 | 1.686 | 200 | 3.50 | 64.0 | 1.97 | 1.89 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 28A | 33A | 72.5 | | 0.37 | | | | | 0.37 | 1.88 | | 50 | | | | | 50 | 143 | 0.159 | 0.454 | 4.198 | 1.905 | 0.538 | 2.443 | 200 | 0.50 | 24.2 | 0.75 | 0.72 | PVC | SDR35 | |
| BLOCK 154 | 38A | 39A | 8.5 | | | 0.71 | | | | 0.71 | 0.71 | | | 64 | | | | 64 | 207 | 0.203 | 0.657 | 3.916 | 2.574 | 0.203 | 2.777 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| LOYALIST TRAIL | 39A | 29A | 47.5 | | | | | | | | 0.71 | | | | | | | | 207 | | 0.657 | 3.916 | 2.574 | 0.203 | 2.777 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| BLOCK 154 | 40A | 29A | 7.0 | | | 0.71 | | | | 0.71 | 0.71 | | | 64 | | | | 64 | 270 | 0.203 | 0.861 | 3.745 | 3.223 | 0.203 | 3.426 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| LOYALIST TRAIL | 29A | 30A | 21.0 | | | | | | | | 1.42 | | | | | | | | 270 | | 0.861 | 3.745 | 3.223 | 0.406 | 3.629 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 30A | 31A | 95.0 | 1.05 | | | | | | 1.05 | 2.47 | 58 | | | | | | 58 | 328 | 0.184 | 1.044 | 3.796 | 3.965 | 0.706 | 4.672 | 300 | 1.00 | 100.9 | 1.38 | 1.33 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 31A | 32A | 57.5 | 0.50 | | | | | | 0.50 | 2.97 | 28 | | | | | | 28 | 356 | 0.088 | 1.132 | 3.809 | 4.312 | 0.849 | 5.161 | 300 | 2.00 | 142.7 | 1.96 | 1.88 | PVC | SDR35 | |

# THE REGIONAL MUNICIPALITY OF HALTON

**Project No.:** 16987
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|---|---|---|---|
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| | Residential - High Density | 135 | ppha |
| | Commercial | 90 | ppha |
| | Industrial / School | 125 | ppha |
| | Park | 40 | ppha |
| | Road Allowance | 0 | ppha |

Ave. Daily per Capita Flow: 275 L/c/d

Inflitration Allowance: 0.286 L/s/ha

PF = $K_{av}\{1+14/(4+P^{1/2})\}$

$K_{av} = A_R + 0.80\,(A_I+A_C)/(A_R+A_I+A_C)$

n = 0.013

| STREET | Manhole | | Length | Tributary Area (Ha) | | | | | | | | Population Tributary | | | | | | | | Average (L/s) | Average (L/s) | Peaking | Max. | Infilt- | Max. | SEWER | | | | | PIPE | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Increment | | | | | | | Cumm. | Increment | | | | | | | Cumm. | | | | | | | Size | Slope | Q | V (m/s) | | | | |
| | From | To | (m) | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | | Increment | Total | PF | (L/s) | (L/s) | Expect. (L/s) | Dia. (mm) | (%) | (L/s) | Full Flow | Actual Flow | Type | Class | |
| HILLSBOROUGH CRES. | 32A | 33A | 54.0 | 0.16 | | | | | | 0.16 | 3.13 | 9 | | | | | | 9 | 364 | 0.028 | 1.160 | 3.812 | 4.422 | 0.895 | 5.317 | 300 | 3.00 | 174.7 | 2.39 | 2.30 | PVC | SDR35 | |
| HILLSBOROUGH CRES. | 33A | 34A | 25.5 | | | | | | | | 5.01 | | | | | | | | 507 | | 1.614 | 3.807 | 6.145 | 1.433 | 7.578 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 34A | 35A | 56.5 | | 0.45 | | | | | 0.45 | 17.41 | | 61 | | | | | 61 | 1709 | 0.193 | 5.440 | 3.355 | 18.253 | 4.979 | 23.232 | 300 | 0.40 | 63.8 | 0.87 | 0.84 | PVC | SDR35 | |
| BURNHAMTHORPE RD. | 35A | Ex.2 | 44.0 | | | | | | | | 17.41 | | | | | | | | 1709 | | 5.440 | 3.355 | 18.253 | 4.979 | 23.232 | 300 | 0.40 | 63.8 | 0.87 | 0.84 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 10(BO) | 9(BO) | 113.0 | | | | 10.21 | | | 10.21 | 10.21 | | | | 1276 | | | 1276 | 1276 | 4.062 | 4.062 | 2.983 | 12.119 | 2.920 | 15.039 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 9(BO) | 8(BO) | 115.0 | | | | | | 0.53 | 0.53 | 10.74 | | | | | | | | 1276 | | 4.062 | 2.983 | 12.119 | 3.072 | 15.190 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 8(BO) | 7(BO) | 115.0 | | | | 4.31 | | | 4.31 | 15.05 | | | | 539 | | | 539 | 1815 | 1.715 | 5.777 | 2.895 | 16.722 | 4.304 | 21.026 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 7(BO) | 6(BO) | 108.5 | | | | 6.07 | | | 6.07 | 21.12 | | | | 759 | | | 759 | 2574 | 2.415 | 8.192 | 2.798 | 22.925 | 6.040 | 28.965 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 6(BO) | 5(BO) | 100.0 | | | | | | | | 21.12 | | | | | | | | 2574 | | 8.192 | 2.798 | 22.925 | 6.040 | 28.965 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| WILLIAM HALTON PKWY | 5(BO) | 4(BO) | 100.0 | | | | 6.16 | | | 6.16 | 27.28 | | | | 770 | | | 770 | 3344 | 2.451 | 10.643 | 2.722 | 28.965 | 7.802 | 36.767 | 300 | 0.50 | 71.3 | 0.98 | 0.94 | PVC | SDR35 | |
| SIXTH LINE | 4(BO) | 3(BO) | 75.5 | | | | 12.99 | | | 12.99 | 40.27 | | | | 1624 | | | 1624 | 4968 | 5.168 | 15.811 | 2.598 | 41.078 | 11.517 | 52.596 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 3(BO) | 2(BO) | 115.0 | | | | 3.10 | | | 3.10 | 43.37 | | | | 388 | | | 388 | 5355 | 1.233 | 17.044 | 2.574 | 43.869 | 12.404 | 56.273 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 2(BO) | 1B(BO) | 20.4 | | | | | | | | 43.37 | | | | | | | | 5355 | | 17.044 | 2.574 | 43.869 | 12.404 | 56.273 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 1B(BO) | 1A(BO) | 113.5 | | 6.56 | | 2.40 | | | 8.96 | 52.33 | | 886 | | 300 | | | 1186 | 6541 | 3.774 | 20.818 | 2.587 | 53.847 | 14.966 | 68.813 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 1A(BO) | PLUG | 1.5 | | | | | | | | 52.33 | | | | | | | | 6541 | | 20.818 | 2.587 | 53.847 | 14.966 | 68.813 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| ASSUME PLUG REMOVED (FUTURE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SIXTH LINE | PLUG | 36A | 109.0 | | | | | | 0.34 | 0.34 | 52.67 | | | | | | | | 6541 | | 20.818 | 2.586 | 53.837 | 15.064 | 68.900 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 36A | 37A | 126.5 | | 0.76 | | | | | 0.76 | 53.43 | | 103 | | | | | 103 | 6643 | 0.327 | 21.144 | 2.589 | 54.733 | 15.281 | 70.014 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |
| SIXTH LINE | 37A | Ex.1 | 120.5 | | 0.85 | | 8.90 | | | 9.75 | 63.18 | | 115 | | 1113 | | | 1227 | 7870 | 3.906 | 25.051 | 2.525 | 63.248 | 18.069 | 81.318 | 375 | 0.50 | 129.3 | 1.13 | 1.09 | PVC | SDR35 | |

# THE REGIONAL MUNICIPALITY OF HALTON

**Project No.:** 16987
**Location:** Star Oak Developments Limited
Town of Oakville

## SANITARY SEWER DESIGN

**Date:** January 5, 2022
**Designed By:** M.Maveal
**Checked By:** V.Cavallo

| | | | |
|---|---|---|---|
| Population Densities | Residential - Low Density | 55 | ppha |
| | Residential - High Density | 135 | ppha |
| | Commercial | 90 | ppha |
| | Industrial / School | 125 | ppha |
| | Park | 40 | ppha |
| | Road Allowance | 0 | ppha |

Ave. Daily per Capita Flow 275 L/c/d

Inflitration Allowance 0.286 L/s/ha

$PF = K_{av}\{1+14/(4+P^{1/2})\}$

$K_{av} = A_R + 0.80\,(A_I+A_C)/(A_R+A_I+A_C)$

n = 0.013

| STREET | Manhole | | Length | Tributary Area (Ha) | | | | | | | | Population Tributary | | | | | | | | Average (L/s) | Average (L/s) | Peaking | Max. | Infilt- | Max. | S E W E R | | | | | PIPE | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Increment | | | | | | | | Increment | | | | | | | | | | | | | | | | | | | | | |
| | From | To | (m) | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Res. LD | Res. HD | Comm. | Ind. | Park | Road | Total | Cumm. | Increment | Total | Factor PF | (L/s) | (L/s) | Flow Expect. (L/s) | Size Dia. (mm) | Slope (%) | Q (L/s) | V (m/s) Full Flow | V (m/s) Actual Flow | Type | Class | |
| SIXTH LINE | Ex.1 | Ex.2 | 26.516 | | | | | | | | 63.18 | | | | | | | | 7870 | | 25.051 | 2.525 | 63.248 | 18.069 | 81.318 | 525 | 2.00 | 634.5 | 2.84 | 2.73 | PVC | SDR35 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SIXTH LINE | Ex.2 | Ex.3 | 53.323 | | | | | | | | 80.59 | | | | | | | | 9580 | | 30.490 | 2.523 | 76.914 | 23.049 | 99.962 | 525 | 1.60 | 567.5 | 2.54 | 2.44 | PVC | SDR35 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |