# HOLBROOK LANDFILL

## 2021 WATER MONITORING REPORT

COUNTY OF OXFORD

PROJECT NO.: 111-53037-05
DATE: FEBRUARY 03, 2022

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February 03, 2022

Mr. Frank Gross, C.Tech
Manager of Transportation & Waste
County of Oxford
21 Reeve Street,
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Dear Sir:

**Subject :** **Holbrook Landfill, County of Oxford**
**2021 Water Monitoring Report**

We are pleased to provide one (1) digital copy of the 2021 Water Monitoring Report for the closed Holbrook Landfill.

The report contains a discussion of the results of the monitoring completed in 2021, including an assessment of compliance, and provides conclusions and recommendations.  Technical data are appended.

The "Monitoring and Screening Checklist" with signed declaration, as per the MECP Technical Guidance Document – Monitoring and Reporting for Waste Disposal Sites is provided in Appendix G.

Yours truly,
**WSP Canada Inc.**

Albert Siertsema, P.Eng., PMP
Project Engineer
Earth & Environment

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# 1 INTRODUCTION

## 1.1 BACKGROUND

The closed Holbrook Landfill (site) is located on Part of Lots 20 and 21, Concession III near the village of Holbrook in the Township of Norwich. The site is located north of Quaker Street (Norwich Road 3), and is bounded by agricultural land to the east and west, and swampy lands of the Long Point Conservation Authority to the north and south. The general site location is shown on Figure 1.

It is understood that the landfill site was originally owned by Ingersoll Sanitation Ltd. and started accepting waste around 1970. The site was subsequently owned and operated by Superior Sanitation Services Inc. before the County of Oxford took over the site in January 1982. The landfill operated until July 1986, at which time it was capped and seeded as part of the staged development and closure of the site. During County ownership from January 1982 until July 1986, the site received only domestic, commercial, and non-hazardous industrial solid waste.

The site operated under Provisional Certificate of Approval (CofA) No. A070702 issued on March 31, 1983 which permitted landfilling at the site until June 30, 1984. It is understood that the County subsequently obtained an extension of the CofA from June 1984, until the site was closed in 1986. A copy of the site CofA (Waste) is provided in Appendix A.

The County purchased the property to the east of the landfill for use as a buffer zone on August 15, 1990.

Following closure of the site, the County monitored the groundwater and surface water quality at the site, while the Ministry of the Environment, Conservation and Parks (MECP) monitored off-site domestic wells in the area. The monitoring data since closure was reviewed by Charlesworth & Associates in 1996 and a revised monitoring program was recommended. The MECP approved the revised monitoring program for the site, which has been undertaken by the County on an annual basis. The groundwater and surface water monitoring locations are shown on the Site Plan, Figure 2.

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The new approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the new ECA, a closure plan was submitted to the MECP, which included a trigger mechanism and contingency plan as well as a new monitoring program. The closure plan was accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018.

WSP Canada Inc. (WSP) was retained by the County to complete the 2021 annual monitoring program at the site.

## 1.2 SUPPLEMENTAL INVESTIGATIONS

### *1.2.1 WELL NETWORK UPGRADE PROGRAM 2013-2015*

In 2012, GENIVAR (now called WSP) completed a site survey, well network inspection and hydrogeological assessment work program at the site (GENIVAR, 2013). The work program followed the recommendations provided in the 2010 Water Monitoring Report as well as the MECP review of the 2009 Water Monitoring Report, as outlined in their letter dated April 4, 2011.

Additional borehole logs, historic groundwater elevation data and geological cross-sections from this program have been incorporated into this report.

Based on the results of the well inspection and hydrogeological assessment program, it was recommended that the monitoring network at the Site be upgraded. This work program would include the drilling and installation of new wells, decommissioning and replacement of existing wells and completion of a Site survey, among other things. The well network upgrades were completed in a phased approach.

Phase I of the work program was completed in the summer of 2013 and included the decommissioning of well 17, drilling and installation of background wells 39 and 40, and the drilling and installation of leachate well 41. The locations of the installed wells are shown on the Site Plan, Figure 2. Wells 39, 40 and 41 were surveyed and incorporated into the annual monitoring program in 2014.

Phase II of the well network upgrade program was completed in the fall of 2014. This work program included the decommissioning of 15 wells, drilling and installation of 9 replacement wells, and installation of a single staff gauge. The locations of the installed wells and staff gauge are shown on the Site Plan, Figure 2. The replacement wells and new staff gauge were surveyed and incorporated into the 2015 annual monitoring program.

The remaining phase (Phase III) of the well network upgrade program was completed in the summer of 2015. This work program included the decommissioning of 16 wells, drilling and installation of 12 replacement wells, and the drilling and installation of 3 new monitoring wells. The locations of the installed wells are shown on the Site Plan, Figure 2. A full Site survey was completed following this final phase of the work program, in order to calculate groundwater elevations (in metres above sea level) at all the new and replacement monitoring wells. The wells were incorporated into a revised annual monitoring program in 2016, as outlined in Section 2.0.

### *1.2.2 SUPPLMENTAL DRILLING AND SAMPLING PROGRAM 2019*

In 2019, a supplemental drilling program was completed at the site to investigate exceedances noted at observation well 26R. Monitoring wells 45 and 46 were installed north of well 26R on August 15 and 16, 2019. The locations of the new wells are shown on the Site Plan (Figure 2) and the borehole logs are provided in Appendix B. A survey of the reference elevations for the new wells was completed by the County of Oxford. These wells were added to the annual monitoring program for supplemental groundwater elevation and quality information.

## 1.3 PHYSICAL SETTING

### TOPOGRAPHY AND DRAINAGE

The elevation of the original ground surface at the site generally decreased in a southwesterly direction from the northeast portion of the site where the refuse was placed, towards a small creek in the southwest portion, then increased towards the western property boundary. Following the closure of the landfill site, the drainage configuration at the site was modified by the capped landfill, which is reportedly the highest elevation on the property, and by the subsequent landscaping which has created a pond in the southwest portion of the site.

The swampy area to the north of the property is part of the headwaters of Otter Creek which flows in a generally northeasterly direction.

The small creek situated within the site property originates to the northwest of the site and flows in a somewhat southerly direction to the southwestern part of the site before draining into a swampy area south of the road. This area is the headwaters of Branch Creek, which flows in a southeasterly direction away from the area.

## GEOLOGIC SETTING

The description of the site geology provided herein is based on a review of published maps and reports, including findings from other investigations carried out in the general area, and historic intrusive investigations completed at the Holbrook landfill.

Cross-sections depicting the general stratigraphy across the site are provided on Figure 3 (Cross-section A-A′), Figure 4 (Cross-section B-B′) and Figure 5 (Cross-section C-C′). The locations of the cross-sections are shown on Figure 2.

The study area is situated within the Mount Elgin Ridges physiographic region of Southern Ontario (Chapman and Putnam, 1984). The ridges generally consist of moraines of brown clay or silty clay till with low areas covered with alluvial silt, sand and gravel.

The Holbrook landfill site is situated within an undrumlinized till plain. Three approximately northeast to southwest trending till moraines occur in the area. The Ingersoll Moraine is found to the west of the village of Holbrook and the St. Thomas Moraine occurs northeast and southwest of the landfill site. Additionally, the Norwich moraine occurs south of Newark and extends in a northeasterly direction to the north of Norwich. Several northwest to southeast trending drumlins occur immediately north of the village of Holbrook and represent the southeasterly extent of a large drumlin field which lies to the northwest.

The surficial deposits in the area are generally related to ice moving in a northwesterly direction out of the Erie basin. The soil generally consists of a clay loam of the Huron series with a silt loam of the Honeywood series occurring in the vicinity of the northern boundary of the site (Soil Survey of Oxford County, 1961).

Glaciofluvial outwash deposits occur in the northern part of the property (Barnett, 1976 and Cowan, 1975). These deposits consist primarily of sand, gravelly sand, and sandy gravel.

In the southern part of the property the surficial deposits are principally the Port Stanley Till, which is a silty to silty clay till and represents a glacial advance during the Port Bruce Stadial. The Port Stanley Till occurs at the surface of the Ingersoll, St. Thomas, and Norwich Moraines.

A bog deposit occurs adjacent to and south of the southern boundary of the property.

A large area of glaciolacustrine, shallow water, fine to medium and silty fine sand occurs to the northeast and east of the site. Glaciofluvial outwash sand and ice-contact stratified drift consisting primarily of sand were deposited to the northwest.

As noted above, the surficial overburden at the Site consists of a glaciofluvial outwash deposit (Upper Sand and Gravel Unit) in the northern area, and the Port Stanley Till (Upper Clayey Silt Unit) in the south. Beneath these uppermost soils is a clayey silt unit, which may or may not contain gravel (Lower Clayey Silt Unit) and is variable in thickness. This in turn is underlain by a laterally extensive sand and gravel formation (Lower Sand and Gravel Unit). The Lower Sand and Gravel Unit is reportedly underlain by a relatively thick gravelly silt till formation.

The overburden deposits at the site range from approximately 29 m to 46 m in thickness. In general, the surficial deposits increase in thickness from east to west.

The bedrock underlying the site consists of Middle Devonian limestone and dolostone of the Detroit River Group. None of the intrusive investigations at the site encountered bedrock.

## HYDROGEOLOGIC SETTING

The local geologic units at the site are grouped into four (4) hydrostratigraphic units as summarized below, and as shown in the cross-section Figures 3, 4, and 5. Results of historic in-situ hydraulic conductivity testing completed at the site (James F. MacLaren Ltd., 1979 and MacLaren Engineers, 1982) are also provided.

| | | **CALCULATED HYDRAULIC CONDUCTIVITY RESULTS (cm/s)** | |
|---|---|---|---|
| **FLOW SYSTEM** | **HYDROSTRATIGRAPHY** | **Range** | **Mean** |
| Shallow Flow System | Upper Sand and Gravel Unit | 5.6x10$^{-1}$ - 9.0x10$^{-6}$ | 2.9x10$^{-1}$ - 2.6x10$^{-3}$<br>coarse sediments<br>fine sediments |
| | Upper Clayey Silt Unit | 8.1x10$^{-5}$ - 9.4x10$^{-5}$ | 8.8x10$^{-5}$ |
| | Lower Clayey Silt Unit (confining / semi-confining layer) | 3.5x10$^{-6}$ - 9.5x10$^{-6}$ | 6.5x10$^{-6}$ |
| Deep Flow System | Lower Sand and Gravel Unit | 3.6x10$^{-1}$ - 7.2x10$^{-5}$ | 3.6x10$^{-1}$ - 6.1x10$^{-5}$<br>coarse sediments<br>fine sediments |

Although each hydrostratigraphic unit is identified as part of a groundwater flow system, each flow system has a hydraulic influence on the others. Shallow groundwater flow directions are expected to follow the surface drainage patterns.

The Upper Sand and Gravel Unit and Upper Clayey Silt Unit are considered to represent the shallow groundwater flow system. The Lower Sand and Gravel Unit represents the deeper groundwater flow system at the site.

The Lower Clayey Silt Unit likely forms a confining or semi-confining layer restricting groundwater movement. The unit may be intermittently present as the lateral extent and thickness of the unit is unknown. The Lower Clayey Silt Unit has the capacity to transmit water laterally; however, groundwater movement through this unit is inferred to be slower and predominantly downward, as weak downward vertical hydraulic gradients between the shallow and deep flow systems in the vicinity of the landfill have been reported.

The Upper Sand and Gravel Unit and the Lower Sand and Gravel Unit have the greatest capacity to transmit groundwater. The Upper Clayey Silt Unit and the Lower Clayey Silt Unit consist of finer grained material and groundwater movement through the soils is expected to be slow, based on the hydraulic conductivity results shown above.

# 2 ANNUAL MONITORING PROGRAM

## 2.1 OBJECTIVES AND SCOPE

The principal objectives of the annual monitoring program at the Holbrook landfill site are as follows.

- To provide documentation of the monitoring program results and findings.
- To assess the current and potential impacts of the landfill site on overburden groundwater quality.
- To assess the current and potential impacts of the landfill site on surface water quality.
- To provide recommendations on future monitoring and remedial actions, if required.

The monitoring program includes a data collection component, and an analysis and interpretation component. This report documents the data collected as part of the 2021 annual monitoring program activities, and our interpretation of the results. Available historic data are also incorporated into the report.

## 2.2 ANNUAL MONITORING PROGRAM

The 2021 annual program at the site included groundwater and surface water monitoring. The groundwater monitoring program included on-site observation wells and a private domestic well. In 2021, groundwater level measurements, groundwater sampling of on-site wells and private domestic wells, and surface water sampling were completed by WSP following general monitoring protocols and procedures, provided in Table 2-1.

### *2.2.1 GROUNDWATER – ON-SITE OBSERVATION WELLS*

The groundwater monitoring program completed in 2021 included the following items.

- Annual groundwater level measurements at thirty (30) observation well locations in May;
- Annual staff gauge measurement at one (1) staff gauge located in Branch Creek;
- Annual groundwater sample collection from eighteen (18) observation wells (seventeen (17) on-site wells and one (1) private domestic well) in May 2021; and
- Additional groundwater level measurements and groundwater sample collection in May 2021 at two wells installed in 2019 (45 and 46).

**Table 2-1 Monitoring Protocols and Procedures**

| GROUNDWATER LEVEL MEASUREMENT | GROUNDWATER/LEACHATE SAMPLING | SURFACE WATER SAMPLING |
|---|---|---|
| ▪ Monitor integrity is visually inspected (casing, lock, caps, etc.)<br>▪ Well cap is carefully removed to avoid introducing foreign material into monitor<br>▪ A water level is measured using a clean electronic water level meter with a stainless steel probe and graduated cable<br>▪ The water level measurement is referenced to a known geodetic elevation on the monitor and checked twice for confirmation<br>▪ The water level is recorded in the dedicated project field book and checked against previous reading<br>▪ If the water level is significantly greater than historic value, the level in the well is checked again<br>▪ The water level depth probe and cable are rinsed with de-ionized water between wells<br>▪ Water levels in each monitor are measured and recorded prior to purging | ▪ Each monitoring well is purged prior to sampling in order to remove stagnant water in the monitor and surrounding sand pack.<br>▪ Purging and sampling is carried out using the dedicated inertial lift pump and high density polyethylene tubing in place within the monitors.<br>▪ Well volumes are determined in the field based on the water level measurement. At least 3 well volumes are removed for moderate yield wells, or 1 to 2 well volumes for low yield wells (wells that dry out and are slow to recover). The volume of water purged is measured in a graduated container.<br>▪ Field parameters (pH, conductivity and temperature) are measured using calibrated instruments during purging to ensure that representative formation water is sampled. Purging is considered completed once the pH, conductivity, and temperature have stabilized.<br>▪ The groundwater sample is collected from the well as soon as there is a sufficient volume of liquid within the well, usually on the same day or on the following day, at the latest.<br>▪ Samples collected for metals analysis are field filtered using a high capacity in-line 0.45 micron disposable filter. The sample is collected directly from the filter discharge into the sample bottle.<br>▪ Water samples are collected directly into the laboratory provided bottles with the appropriate preservatives added. Sample bottles are marked, labelled, and sealed in the field.<br>▪ Samples are stored in coolers packed with ice, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures.<br>▪ Field notes including date, weather, the sampling data, time, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book. | ▪ Attempts are made to schedule surface water monitoring events to correspond to periods of anticipated flow whenever possible (i.e. 24 hrs after a significant precipitation event).<br>▪ Surface water samples at each location are collected prior to flow measurement.<br>▪ Monitoring is completed from downstream to upstream locations to avoid sediment disturbance which may influence sample integrity.<br>▪ Surface water samples are collected directly into the laboratory provided bottles that do not have preservatives. For bottles with preservatives added, standard grab sampling methods are used and then the water decanted into laboratory provided bottles with the appropriate preservatives. The sample container is pointed upstream and care is taken to avoid particulate and organic matter in the water.<br>▪ Sample bottles are marked, labelled and sealed in the field.<br>▪ Samples are stored in ice packed coolers, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures.<br>▪ Field parameters (pH, conductivity, temperature and dissolved oxygen) are measured from a separate beaker of water using calibrated instruments.<br>▪ When the flows are adequate, stream flow discharge is estimated based on the cross-sectional area of the stream, and the water velocity.<br>▪ A cross-sectional profile of the stream is determined by measuring the cross sectional width and depth of the wetted stream at various points. The velocity is estimated by measuring travel time between two profiles across the stream.<br>▪ Field notes including date, weather, time, sampling data, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book. |

The 2021 groundwater monitoring network at the site is outlined in the following table.

| MONITORING NETWORK | DESIGNATION | |
|---|---|---|
| | **Annual Water Levels** | **Annual Groundwater Sampling** |
| Shallow Flow System | 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 40, 41, 43, 44, 45, 46 | 11R, 16AR, 19R, 26R, 28R, 32R, 40, 41, 43, 44, 45, 46 |
| Deep Flow System | 16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 39, 42 | 21R, 24R, 25R, 27, 37R, 38, 39, 42, D2 |

*Notes:*
- A number of shallow flow system observation wells may be screened across the upper flow system and the shallow confining layer.

Groundwater samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the following parameters.

| | | | |
|---|---|---|---|
| **GENERAL PARAMETERS** | | | |
| pH | Conductivity | Hardness | |
| **MAJOR AND MINOR IONS** | | | |
| Alkalinity | Chloride | Potassium | Sulphate |
| Calcium | Magnesium | Sodium | |
| **NUTRIENTS AND ORGANICS** | | | |
| Ammonia | Nitrite | DOC | |
| Nitrate | TKN | | |
| **DISSOLVED METALS** | | | |
| Boron | Iron | | |
| Chromium | Manganese | | |

Select wells (26R, 27, 32R, 37R, 38, 39, 40, 41, 42, 43, 44, 45, and 46) were also analyzed for the volatile organic compounds of vinyl chloride, benzene, and 1,4 dichlorobenzene in May 2021, as per the approved environmental monitoring program.

The groundwater sampling locations are shown on the Site Plan, Figure 2. Copies of available borehole logs for the observation wells are provided in Appendix B. Monitoring well details are provided in Table C-1, Appendix C. It is assumed that the observation well designations and borehole logs are consistent between those used in previous reports (Charlesworth & Associates, 2008 and MacLaren Engineers, 1982).

## 2.2.2 GROUNDWATER – PRIVATE DOMESTIC WELL

Since 1997, the County has sampled a private domestic well that is now referred to as the Pearce domestic well (D2), formerly the Roswell domestic well. Of the more than thirty (30) private domestic wells in the vicinity of the site, domestic well D2 was deemed the most likely to exhibit potential influences from landfill leachate, given the inferred flow regimes at the site.  The location of domestic well D2 is shown on Figure 2.

The private domestic well groundwater monitoring program completed in 2021 included annual groundwater sampling at well D2 in May.  Groundwater samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the parameters previously noted for the groundwater monitoring program.

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### 2.2.3 SURFACE WATER

Surface water monitoring was completed at the stations listed in the following table.  The locations of the surface water monitoring stations are shown on Figure 2.

| SURFACE WATER STATION | RELATIVE POSITION | SAMPLING FREQUENCY |
|---|---|---|
| **C01** | The on-site stream, south (downstream) of the landfill where the stream leaves the site property boundary via a culvert beneath Quaker Street.  Station C01 is downstream of surface water stations C04 and C06. | Semi-annually (spring and fall) |
| **C06** | Collected from a swampy area, northwest (upstream) of the landfill where the on-site stream enters the site property. | |
| **C04** | The on-site stream, intermediate station southwest (downstream) of the landfill.  Station C04 is downstream of stations C06 and P02. | Annually (spring) |
| **P02** | The on-site pond situated adjacent west (downstream) of the landfill.  The pond is inferred to be the receiving body for shallow groundwater moving from beneath the landfill.  Drainage from P02 enters the on-site stream between sampling points C04 and C06. | |
| **P03** | The on-site retention pond situated close to the landfill in the northern portion of the site. | |
| **P01** | The on-site retention pond situated in the southeast portion of the site. | |
| **NE1** | The pond situated in the northeast portion of the site, at the toe of the landfill. | |

The semi-annual sample collection was completed on April 12 and October 7, 2021, and the annual sample collection was completed on April 12, 2021.  The surface water monitoring protocols and procedures are presented in Table 2-1.

The surface water samples were submitted to SGS Canada Inc. in Lakefield, Ontario for analysis of the parameters listed below.

| | | | |
|---|---|---|---|
| **GENERAL PARAMETERS** | | | |
| pH | Conductivity | Hardness | |
| **MAJOR AND MINOR IONS** | | | |
| Alkalinity | Chloride | Potassium | Sulphate |
| Calcium | Magnesium | Sodium | |
| **NUTRIENTS AND ORGANICS** | | | |
| Ammonia | Nitrite | Un-ionized Ammonia | |
| Nitrate | | | |
| **DISSOLVED METALS** | | | |
| Boron | Iron | | |
| Chromium | Manganese | | |

### *2.2.4 LANDFILL GAS*

During 2021, landfill gas measurements were completed on an annual basis at standpipes SP3R, SP4R, and SP5. The locations of these standpipes are shown on Figure 2. The monitoring included the measurement of methane, carbon dioxide, oxygen, and balance gas concentrations, as well as water levels to determine whether or not the screened interval was partially flooded. Measurements and readings were completed on April 12, 2021.

# 3 GROUNDWATER LEVELS AND FLOW CONDITIONS

Groundwater levels are measured annually in the observation wells at the site prior to the sampling event. The groundwater level elevation data from May 2021 and the available historic water level elevation data for the site are provided in Table C-2 and graphically in Figures C-1 through C-15, Appendix C. A well survey to establish elevation and location was completed in 2012, and groundwater elevations have been calculated from the current and historic water levels measured at the site. New observation wells installed in 2013 were surveyed for location and elevation in 2014, while new and replacement wells installed in 2014/2015 were surveyed for location and elevation in 2015. The two wells installed in August 2019 were surveyed for location and elevation in 2019.

It is noted that the majority of wells in the monitoring well network were installed in 2013-2015, and were only incorporated into the groundwater monitoring program in 2014-2016. As such, there is limited data available for historic comparisons. In 2021, groundwater elevations measured in the observation wells were typically within or below their respective historic ranges. Monitoring wells 10R, 11R, 24R, 25R, 26R, 27, 28R, 32R, 33R, 42, and 44 had groundwater elevations in May 2021 which were below their respective historic ranges.

Groundwater level elevations measured in the observation wells decreased from May 2020 to May 2021, with the exception of the creek surface water elevation measured at SG1. Also, as noted historically, flowing conditions were observed in May 2021 at observation wells 26R and 27, meaning that the groundwater pressure was above both the ground surface and the top of the pipe. An extension was added to the top of the pipe in order to obtain a measurable groundwater elevation at these wells. The May 2021 groundwater elevations at observation wells 45 and 46 were also at or above ground surface, but were below the top of pipe.

## 3.1 GROUNDWATER FLOW

Observation wells at the site have been grouped into the shallow groundwater flow system, deep groundwater flow system, or confining/semi-confining system.

The groundwater table is located in the Upper Sand and Gravel Unit and the Upper Clayey Silt Unit which represents the shallow flow system. The groundwater table elevations measured in May 2021 and the interpreted shallow water table contours are presented on Figure 6. In general, groundwater movement in the shallow flow system across most of the site is inferred to be southwesterly towards the on-site creek, while shallow groundwater movement in the western portion of the site (west of the creek) is inferred to flow east towards the creek. However, the shallow flow system groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. In addition, recently installed monitors 45 and 46 indicate there is localized groundwater flow from the south of the site moving north towards the waste.

Hence, over the majority of the site, groundwater flow in the shallow flow system is inferred to converge on the creek, contributing to the flow of the creek. Also, given that the thickness of the Upper Sand and Gravel Unit in the northern part of the site thins toward the creek in the southwest, shallow groundwater below the landfill likely contributes to the creek. Further, the retention pond located in the central portion of the site likely acts as a discharge zone for the shallow groundwater. As such, any leachate influences observed in the shallow flow system across the majority of the site would likely impact the surface water quality. There may be a minor component of localized shallow groundwater flow from the fill area east, north and southeast toward the buffer property.

Based on historic borehole logs, the base of waste was at an elevation of approximately 279 mASL to 280 mASL; though there was an area of deeper waste, approximately 275 mASL, in the west central portion of the fill area (BH22) that was associated with a swampy depression. Previous observation wells in the waste disposal area are no longer present. In order to determine if groundwater (leachate) mounding is present at the site, leachate well 41 was incorporated into the 2014 annual monitoring program. Based on the May 2021 liquid level within well 41 (283.38 mASL), localized perched leachate mounding is likely present at the site. This mounding is attributed to areas of low hydraulic conductivity within the refuse, and has the potential to influence shallow groundwater quality adjacent to the disposal area or result in surface seeps.

Though some shallow flow system observation wells located adjacent to the north and northeast of the landfill are situated hydraulically upgradient of the landfill, it is possible that they have been historically influenced by localized landfill effects and as such, are not considered to be suitable background observation wells. Shallow flow system well 40 is more representative of upgradient conditions, and was incorporated into the 2014 annual monitoring program as a background observation well.

Groundwater elevations measured in the deeper flow system in May 2021 are presented in Figure 7. Groundwater flow in the deep flow system is inferred to be in a generally south to southeasterly direction under a very low horizontal hydraulic gradient. As shown on Figure 7, the difference in head across most of the site is less than 1 m, although there is a greater head of at least 1.7 m between the background wells in the northwest corner of the site and the downgradient wells.

Observation well 39 was installed in 2013 to serve as a background observation well for the deep flow system. However, the groundwater elevation measured in the well did not appear to correspond with the other deep flow system groundwater elevations on site. Well 39 was drilled to a similar depth as nearby deep flow system wells, but a significant layer of clayey silt was not encountered when drilling the borehole for observation well 39. Based on recommendations from the 2014 annual water monitoring report, a deeper observation well (42) was installed in the summer of 2015, which penetrated a confining to semi-confining layer of approximately 6.5 m of clayey silt. Observation well 42 was incorporated into the 2016 monitoring program as a deep flow system background observation well. Similar to observation well 39, the groundwater elevation measured in observation well 42 does not appear to correspond with the other deep flow system groundwater elevations on site, but rather corresponds to the shallow groundwater elevation at this location. It is inferred that the confining/semi-confining unit in the northwestern corner of the site may be discontinuous, as there is little to no difference in groundwater elevation between the shallow and deep flow systems.

As part of a further evaluation into the source of trigger exceedances at monitoring well 26R, shallow observation wells 45 and 46 were installed in August 2019, north of monitoring well 26R. Since first measuring groundwater levels from within boundary monitoring well 26R in 2016, artesian conditions have consistently been observed. Artesian conditions have also been observed at monitoring wells 45 and 46, since their installation. Based on groundwater elevations measured in 2020 and 2021, groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46, closer to the landfill mound. It should be noted, however, that limited data is available for wells 45 and 46 as they were recently installed in August 2019. Continued monitoring will be required to confirm this conclusion.

Groundwater levels in the shallow flow system are generally higher than those in the deeper flow system at corresponding downgradient locations. As such, vertical hydraulic gradients are downward through the less permeable confining/semi-confining unit. The vertical linear velocity of groundwater downward through the confining/semi-confining layer was estimated to be in the order of 0.01 to 1.5 m/yr (MacLaren Engineers, 1982). By comparison, the horizontal linear groundwater velocity in the deeper flow system is estimated to be in the range of 12.7 to 45.7 m/yr (MacLaren Engineers, 1982). As such, the volume of flow through the deeper flow system is considerably greater than the vertical leakage of shallow groundwater downward through the confining/semi-confining unit.

For the purposes of assessing the groundwater quality, the downgradient observation wells were divided into groups based on their location in the inferred flow regimes, which is consistent with the previous reports at the site. This approach facilitates the assessment of groundwater quality within the two flow systems with respect to the inferred groundwater flow regimes and potential leachate impact.

# 4 GROUNDWATER QUALITY

The available groundwater chemical data for the site from 1979 to 2021 are provided in Appendix D. The groundwater chemical results for the shallow flow system and the deeper flow system are provided in Tables D-1 and D-2, respectively. The private domestic groundwater chemical results are provided in Table D-3. The tables also provide the applicable Ontario Drinking Water Quality Standards (2003, revised June 2006) (ODWQSs). Time versus concentration graphs for chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are presented on Figures D-1 to D-35, Appendix D. The 2021 laboratory certificates of analysis are included in Appendix F.

The quality assurance/quality control (QA/QC) program for the monitoring program at the site included a field and a laboratory component. Standard field protocols were used to ensure consistency.

Laboratory reports were reviewed as part of the laboratory QA/QC program. Blind duplicate samples were collected from wells 21R and 37R in May 2021. Duplicate samples were similar to the original samples results with the calculated Relative Percent Difference (RPD) generally within the 20% guideline for acceptability or less than two times the laboratory reported method detection limit (MDL). Acceptable data quality control including laboratory blanks, spiked blanks, laboratory duplicates, and laboratory percent recoveries of analysis indicated that the detected constituent concentrations were accurate and reflected actual groundwater conditions at the time of sample collection and are acceptable for inclusion into the database.

## 4.1 LEACHATE CHEMISTRY

Leachate is produced from the infiltration of precipitation through the waste. Processes within the waste degrade the quality of the percolating water to create leachate. The chemical composition of leachate can vary within the waste cells depending on various factors such as refuse composition, age, hydraulic conductivity, residence time, and the leachate flow regime.

There is currently one leachate well (41) in the observation well network, located in the south portion of the landfill, for characterizing the leachate quality. This leachate well has been sampled since 2014. It is noted that older refuse is located in the north portion of the landfill and younger refuse is located in the south potion of landfill (James F. MacLaren Ltd., 1979). As such, it is likely that the leachate strength in the north portion of the landfill is weaker than the leachate strength in the south portion of the landfill.

The 2021 leachate chemistry results are provided in Table 4-1. The groundwater chemistry ranges from the background shallow flow system and deeper flow system observations wells, along with the range of representative concentrations for municipal landfills in Ontario are also summarized.

The 2021 leachate quality at the Site was generally below or within the lower portion of the range of representative concentrations for municipal landfills in Ontario (Freeze and Cherry, 1979 and the Ministry of the Environment, 1993). The leachate strength at the site is considered to be very weak, with chloride and sodium concentrations below their respective ODWQSs. Nonetheless, concentrations of most parameters in the leachate well were elevated relative to the background shallow and deep flow system groundwater. In particular, concentrations of chloride, alkalinity, potassium, boron, iron, ammonia, TKN, benzene, 1,4-dichlorobenze, and historic concentrations of vinyl chloride are notably elevated in the landfill leachate relative to the background groundwater quality, and serve as diagnostic leachate indicator parameters for the site.

The historic laboratory leachate quality data at leachate well 41 is provided in Table D-1, Appendix D. Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-1 through D-7, Appendix D. Several leachate indicator parameter concentrations have decreased overall since 2016. Parameter concentrations at leachate well 41 in 2021 were generally within their historic range, with the exception of hardness, sulphate, calcium and DOC which were above their respective historic ranges.

**Table 4-1 2021 Background Groundwater Chemistry Relative to Landfill Leachate Chemistry**

| PARAMETER | ONTARIO DRINKING WATER QUALITY STANDARDS | PARAMETER CONCENTRATIONS | | | |
|---|---|---|---|---|---|
| | | Leachate (well 41) | 2021 Background Range | | Typical Landfill Leachate (source) |
| | | | Shallow Flow System (well 40) | Deep Flow System (well 39 and 42) | |
| pH | 6.5 - 8.5 OG | 7.63 | 8.15 | 8.16 - 8.22 | 6 - 7 (2) |
| Conductivity | - | 2160 | 722 | 386 - 684 | |
| Hardness | 80 – 100 OG | 685 | 450 | 198 - 374 | 400 - 2,000 (2) |
| Chloride | 250 AO | 80 | 20 | <1 - 38 | 20 - 2,500 (2) |
| Sulphate | 500 AO | 22 | 45 | 2 - 50 | <1 - 300 (2) |
| Alkalinity | 30 – 500 OG | 1030 | 337 | 213 - 275 | 300 - 2,000 (2) |
| Calcium | - | 199 | 142 | 42.3 107 | 100 - 1,000 (2) |
| Magnesium | - | 45.9 | 23.2 | 22.5 - 25.7 | 100 - 1,500 (1) |
| Potassium | - | 66.5 | 1.02 | 1.21 - 1.82 | 200 - 1,000 (1) |
| Sodium | 200 AO | 63.3 | 10.4 | 19.2 - 21.7 | 200 - 1,200 (1) |
| Ammonia | - | 99.1 | 0.3 | <0.1 - 0.4 | 5 - 1,000 (2) |
| TKN | - | 95.8 | <0.5 | <0.5 - <0.5 | 1 - 100 (2) |
| Nitrate | 10.0 MAC | <0.06 | <0.06 | <0.06 - 0.39 | |
| Nitrite | 1.0 MAC | <0.03 | <0.03 | <0.03 - 0.04 | 0.1 - 0.50 (2) |
| DOC | 5 AO | 146 | 6.8 | 1.5 - 2.0 | |
| Boron | 5.0 IMAC | 1.90 | 0.036 | 0.034 - 0.048 | 0.5 - 10 (2) |
| Chromium | 0.05 MAC | 0.00306 | 0.00029 | 0.0001 - 0.0002 | <0.01 - 0.5 (2) |
| Iron | 0.3 AO | 60.6 | 3.19 | 0.177 - 0.316 | 1 - 1,000 (1) |
| Manganese | 0.05 AO | 0.391 | 0.242 | 0.011 - 0.165 | 0.01 - 100 (1) |
| Vinyl Chloride | 1 MAC | 0.5 | <0.2 | <0.20 | |
| Benzene | 1 MAC | 18.8 | <0.5 | <0.50 | |
| 1,4 Dichlorobenzene | 5 MAC<br>1 AO | 17.9 | <0.5 | <0.50 | |

*Notes:* All concentrations in mg/L except pH (unitless), conductivity (µS/cm), and VOCs vinyl chloride, benzene and 1,4-dichlorobenzene (µg/L)
Shading indicates concentration exceeds Ontario Drinking Water Quality Standard.
(1) Typical leachate characteristics data from Freeze & Cherry (1979).
(2) Typical leachate characteristics data from the Ministry of the Environment (1993).

## 4.2 GROUNDWATER CHEMISTRY

Background concentrations for groundwater were established in the 1980s, based on chemical results from upgradient domestic wells. However, the domestic wells used were screened in various aquifer units, and the background concentrations were not representative of either the shallow or deeper groundwater flow system.

During the time when the site was operating, shallow groundwater beneath the fill area was considered to be impacted based on the results from observation well 34, drilled through the refuse and screened in the underlying shallow aquifer. Observation well 34 was reportedly destroyed in 1984. Also, some of the wells adjacent to the northeast and east of the fill area showed evidence of leachate influences, likely from periodic leachate seeps. The reports at the time concluded that any contamination in the shallow flow system had not migrated off-site as the flow system likely discharged to the on-site stream. It is understood that the periodic leachate seeps would have been addressed through the site closure works and are no longer an issue.

Within the deeper flow system, leachate impacts in the groundwater were not observed during the site operation. Observation well 36, screened in the deeper aquifer below the waste, did not show any evidence of leachate influence. The well reportedly became non-functional after 1985; and was destroyed during historic landfilling activities.

Nineteen (19) overburden groundwater observation wells, one (1) leachate observation well, and one (1) private domestic well were sampled for general inorganic parameters as part of the 2021 monitoring program. Twelve (12) of the overburden groundwater observations wells and the one (1) leachate observation well were also sampled for select volatile organic compounds (VOCs). Based on the inferred shallow groundwater flow pattern and measured groundwater elevations, some observation wells located along the north and northeastern landfill boundary may have been situated hydraulically upgradient of the landfill. Given their proximity however, it is possible that they were influenced in the past by localized landfill effects and thus, they are not considered to be representative of background conditions in the shallow flow system. Similarly, there were no observation wells situated hydraulically upgradient of the landfill in the deeper groundwater flow system prior to 2013. Observation wells 39 and 40 were installed in mid-2013 to address these deficiencies and have since been included in the annual monitoring program. Observation well 42 was installed in 2015 and has been included in the annual monitoring program since 2016. These wells are considered to be representative of background conditions, as they are situated hydraulically upgradient of the inferred landfill mound.

## 4.2.1 GROUNDWATER QUALITY COMPARISON

A summary of the 2021 chemical results for the observation wells at the site, along with their respective historical ranges, is provided in Table 4-2. For assessment purposes, the observation wells were divided into the following groups based on their location in the inferred groundwater flow regime, as shown below.

| **FLOW SYSTEM** | **OBSERVATION WELLS AND POSITIONS RELATIVE TO FILL AREA** | |
|---|---|---|
| **Shallow Flow System** | Background northwest | 40 |
| | Adjacent northeast | 32R |
| | Adjacent east | 11R |
| | East | 44 |
| | Adjacent west | 19R |
| | Adjacent southeast | 28R |
| | South | 26R, 45, & 46 |
| | Southeast | 43 |
| **Deep Flow System** | Background northwest | 39 & 42 |
| | Adjacent northeast | 24R |
| | Adjacent east | 25R |
| | East | 38 |
| | Adjacent west | 21R |
| | South | 27 |
| | Southeast | 37R & D2 |

## Table 4-2: Historic Groundwater Quality Comparison

| Observation Well Position Relative to the Landfill | Well | pH | | Conductivity | | Hardness | | Chloride | | Sulphate | | Alkalinity | | Calcium | | Magnesium | | Potassium | | Sodium | | Ammonia | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results |
| ***Refuse*** | | | | | | | | | | | | | | | | | | | | | | | |
| Landfill Mound | 41 | 6.46 - 7.79 | 7.63 | 1840 - 3670 | 2160 | **501 - 633** | **685** | 66.9 - **267** | 80 | <1.5 - 4.0 | 22 | 301 **- 1590** | **1030** | 121 - 178 | 199 | 38.6 - 61.3 | 45.9 | 50.2 - 132 | 66.5 | 54.1 - 151 | 63.3 | 72.8 - 195 | 99.1 |
| ***Shallow Flow System*** | | | | | | | | | | | | | | | | | | | | | | | |
| Background Northwest | 40 | 7.24 - 8.15 | 8.15 | 658 - 782 | 722 | **359 - 385** | **450** | 16.5 - 22.2 | 20 | 34.5 - 41.0 | 45 | 328 - 349 | 337 | 106 - 116 | 142 | 20.1 - 24.0 | 23.2 | 0.89 - 1.15 | 1.02 | 10.5 - 12.0 | 10.4 | 0.16 - 0.22 | 0.3 |
| Adjacent Northeast | 32/32R | 7.65 - 8.25 | 8.14 | 220 - 598 | 519 | **148 - 335** | **351** | 1.0 - 12.5 | 14 | 25.0 - 37.1 | 39 | 167 - 284 | 245 | 40.9 - 88.6 | 95.4 | 11.8 - 27.6 | 27.5 | 0.783 - 2.0 | 0.920 | 4.0 - 22.5 | 8.47 | <0.02 - 0.06 | <0.1 |
| Adjacent East | 11/11R | 6.88 - 8.20 | 7.98 | 290 - 1650 | 1550 | **120 - 825** | **761** | 3.9 - 104 | 120 | 2.60 - 29.9 | 4 | 105 - **827** | **715** | 36.4 - 202 | 194 | 6.5 - 78.1 | 66.8 | 0.75 - 6.33 | 3.09 | 3.9 - 60.5 | 54.7 | 0.72 - 5.74 | 3.3 |
| East | 44 | 7.58 - 8.22 | 7.98 | 708 - 840 | 667 | **362 - 395** | **342** | 12.3 - 13.9 | 16 | 37.7 - 46.0 | 61 | 262 - 302 | 229 | 87.4 - 98.7 | 86.8 | 33.6 - 35.9 | 30.5 | 1.26 - 1.37 | 1.39 | 6.21 - 6.58 | 7.22 | <0.010 - 0.07 | <0.1 |
| Adjacent West | 19R | 7.43 - 8.27 | 8.27 | 385 - 504 | 432 | **190 - 210** | **245** | 1.55 - 4.19 | 2 | 25.5 - 27.8 | 30 | 213 - 232 | 205 | 39.9 - 48.7 | 61.0 | 18.4 - 22.3 | 22.6 | 1.29 - 1.65 | 1.44 | 13.8 - 27.3 | 14.4 | <0.010 - 0.16 | <0.1 |
| West | 16AR | 7.75 - 7.99 | 8.15 | 571 - 635 | 619 | **276 - 305** | **319** | 23.3 - 24.2 | 27 | 54.5 - 59.0 | 86 | 268 - 277 | 244 | 59.8 - 68.6 | 72.9 | 30.7 - 32.5 | 33.3 | 1.30 - 2.38 | 1.42 | 22.1 - 23.3 | 24.4 | <0.02 - 0.045 | <0.1 |
| Adjacent Southeast | 28/28R | 7.30 - 8.29 | 8.00 | 380 - 662 | 480 | **184 - 382** | **232** | 1.6 - 6.4 | 3 | 25.9 - 37.8 | 67 | 150 - **789** | 239 | 39.0 - 82.9 | 51.4 | 21.0 - 40.4 | 25.1 | 0.66 - 2.94 | 1.47 | 6.6 - 28.4 | 22.3 | 0.06 - 0.16 | 0.10 |
| South | 26/26R | 7.21 - 8.13 | 8.08 | 595 - 2210 | 1790 | **339 - 648** | **657** | 15.8 - **319** | **260** | 14.8 - 18.0 | 21 | 223 - **739** | **601** | 85.8 - 161 | 172 | 25.6 - 65.3 | 55.4 | 1.10 - 3.20 | 2.95 | 8.11 - **208** | 183 | 0.042 - 0.11 | <0.1 |
| | 45 | 7.90 | 8.24 | 334 | 328 | **143** | **184** | 1.14 | <1 | 19.4 | 25 | 157 | 153 | 33.3 | 50.1 | 14.6 | 14.3 | 1.62 | 1.05 | 28.2 | 24.6 | 0.131 | <0.1 |
| | 46 | 7.88 | 8.20 | 430 | 391 | **247** | **262** | 2.97 | 2 | 14.8 | 33 | 222 | 198 | 63.4 | 71.4 | 21.4 | 20.3 | 1.10 | 1.02 | 4.35 | 2.36 | 0.052 | <0.1 |
| Southeast | 43 | 7.53 - 8.25 | 8.24 | 321 - 421 | 394 | **117 - 130** | **110** | 1.35 - 14.6 | 16 | 10.6 - 25.2 | 59 | 174 - 202 | 172 | 22.5 - 26.0 | 23.5 | 13.9 - 16.5 | 12.5 | 1.12 - 1.78 | 1.2 | 22.0 - 49.0 | 49.4 | 0.06 - 0.14 | 0.1 |
| ***Deep Flow System*** | | | | | | | | | | | | | | | | | | | | | | | |
| Background Northwest | 39 | 7.52 - 8.18 | 8.16 | 666 - 773 | 684 | **294 - 354** | **374** | 33.9 - 39.8 | 38 | 41.9 - 47.7 | 50 | 280 - 315 | 275 | 76.3 - 98.0 | 107 | 23.5 - 27.8 | 25.7 | 1.55 - 1.83 | 1.82 | 20.0 - 23.1 | 21.7 | 0.04 - 0.11 | <0.1 |
| | 42 | 7.42 - 8.21 | 8.22 | 347 - 422 | 386 | **161 - 281** | **198** | 0.51 - 2.12 | <1 | 1.45 - 5.69 | 2 | 211 - 269 | 213 | 28.2 - 34.4 | 42.3 | 20.6 - 29.0 | 22.5 | 1.06 - 1.45 | 1.21 | 18.0 - 21.3 | 19.2 | 0.29 - 0.42 | 0.4 |
| Adjacent Northeast | 24/24R | 7.27 - 8.36 | 8.29 | 288 - 920 | 410 | **130 - 404** | **238** | 0.5 - 65.5 | 2 | 13.4 - 41.2 | 12 | 141 - 348 | 208 | 28.3 - 118 | 59.5 | 14.9 - 26.4 | 21.8 | 0.48 - 2.59 | 1.18 | 10.9 - 32.4 | 11.5 | 0.013 - 0.42 | 0.4 |
| Adjacent East | 25/25R | 6.93 - 8.22 | 8.32 | 270 - 1518 | 427 | **133 - 500** | **206** | 3.1 - 213 | 13 | 4.20 - 53.4 | 9 | 138 - 500 | 206 | 32.4 - 120 | 53.8 | 11.0 - 70.5 | 17.4 | 0.95 - 15.0 | 1.30 | 6.13 - **296** | 13.1 | 0.060 - 0.19 | 0.2 |
| East | 38 | 7.30 - 8.32 | 8.08 | 290 - 630 | 553 | **173 - 330** | **260** | 3.0 - 23.3 | 27 | 21.1 - 25.6 | 24 | 158 - 280 | 237 | 47.5 - 86.8 | 71.2 | 13.0 - 27.0 | 19.9 | 0.44 - 2.0 | 1.10 | 9.92 - 24.5 | 14.5 | 0.07 - 0.13 | <0.1 |
| Adjacent West | 21/21R | 7.10 - 8.26 | 8.22 | 409 - 606 | 609 | **210 - 440** | **312** | 5.0 - 29.0 | 36 | 15.0 - 33.2 | 14 | 181 - 270 | 266 | 50.2 - 95.5 | 83.6 | 15.7 - 26.4 | 25.2 | 0.40 - 2.31 | 1.63 | 8.1 - 27.5 | 15.0 | 0.09 - 0.20 | 0.1 |
| South | 27 | 7.00 - 8.14 | 8.07 | 400 - 905 | 686 | **298 - 384** | **361** | 10.0 - 62.7 | 41 | 29.5 - 42.1 | 34 | 236 - 340 | 284 | 75.0 - 104 | 104 | 22.0 - 30.3 | 24.4 | 1.23 - 5.32 | 1.42 | 12.1 - 33.6 | 15.1 | <0.02 - 0.10 | <0.1 |
| Southeast | 37/37R | 7.10 - 8.32 | 8.05 | 394 - 655 | 596 | **252 - 493** | **316** | 10.0 - 32.2 | 35 | 35.8 - 44.5 | 41 | 217 - 290 | 238 | 62.9 - 92.3 | 87.1 | 22.9 - 34.6 | 24.0 | <0.02 - 1.75 | 1.29 | 7.09 - 13.8 | 12.0 | 0.05 - 0.15 | <0.1 |
| | D2 * | 7.30 - 8.38 | 8.19 | 398 - 888 | 689 | <0.50* **- 430** | 2.2* | 1.0 - 47.0 | 37 | 30.0 - 43.0 | 35 | 210 - 370 | 278 | 0.089* - 122 | 0.50* | <0.05 * - 31.6 | 0.236* | 0.08* - 3.11 | 0.824* | 11.0 - 168* | 160* | <0.010 - 0.12 | <0.1 |

*Notes:*
- Concentrations are in mg/L with the exception of VOCs which are in µg/L, pH which is in SU, and conductivity which is in µS/cm.
- Bold and shading indicates exceedance of ODWQS.
- Blank indicates there is no historic data for thie specified parameter.
- Shaded parameters across title row have been identified as diagnostic indicator parameters.
- * Groundwater sample from domestic well D2 is inferred to be softened prior to collection; the results should be viewed with caution.

## Table 4-2: Historic Groundwater Quality Comparison

| Observation Well Position Relative to the Landfill | Well | TKN | | Nitrate | | Nitrite | | DOC | | Boron | | Chromium | | Iron | | Manganese | | Vinyl Chloride | | Benzene | | 1,4 Dichlorobenzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results | Historic Range | 2021 Results |
| ***Refuse*** | | | | | | | | | | | | | | | | | | | | | | | |
| Landfill Mound | 41 | 84.3 - 212 | 95.8 | <0.10 - <0.50 | <0.06 | <0.050 - <0.50 | <0.03 | **27.4 - 75.7** | **146** | 1.63 - 4.85 | 1.90 | <0.0050 - 0.011 | 0.00306 | **43.6 - 63.7** | **60.6** | **0.179 - 0.486** | **0.391** | <0.50 - **1.2** | 0.5 | **<8.00 - 25** | **18.8** | **<4.00 - 71** | **17.9** |
| ***Shallow Flow System*** | | | | | | | | | | | | | | | | | | | | | | | |
| Background Northwest | 40 | 0.16 - 1.48 | <0.5 | <0.05 - 0.13 | <0.06 | <0.010 - <0.25 | <0.03 | **6.6 - 8.06** | **6.8** | 0.019 - 0.024 | 0.036 | <0.00050 - 0.005 | 0.00029 | **2.79 - 9.96** | **3.19** | **0.211 - 0.931** | **0.242** | <0.17 - <0.68 | <0.2 | <0.20 - <0.80 | <0.5 | <0.20 - <0.50 | <0.5 |
| Adjacent Northeast | 32/32R | <0.10 - 0.85 | <0.5 | <0.05 - 0.11 | 0.08 | <0.010 - <0.05 | <0.03 | 1.2 - 2.43 | 2.7 | 0.028 - 0.043 | 0.043 | <0.00050 - <0.003 | 0.0001 | <0.01 - **2.56** | **0.747** | 0.020 - **0.380** | 0.0389 | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| Adjacent East | 11/11R | 2.38 - 6.95 | 4.6 | <0.10 - <0.25 | 0.12 | <0.050 - <0.25 | <0.03 | **10.5 - 20.5** | **16.9** | 0.203 - 0.264 | 0.204 | <0.00050 - 0.008 | 0.00042 | <0.02 - **8.96** | **2.67** | 0.048 - **0.432** | **0.059** | **2.2 - 2.6** | | <0.20 - 0.22 | | <0.10 | |
| East | 44 | <0.10 - 0.46 | <0.5 | **20.7 - 27.4** | **15.4** | <0.010 - <0.25 | <0.03 | 0.8 - 3.12 | 1.2 | 0.022 - 0.04 | 0.032 | 0.00078 - <0.003 | 0.00040 | <0.01 - 0.034 | 0.01 | 0.00124 - 0.003 | <0.002 | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| Adjacent West | 19R | 0.19 - 1.80 | <0.5 | <0.05 - 0.22 | 0.23 | <0.010 - <0.050 | <0.03 | 0.9 - 2.8 | 3.6 | 0.039 - 0.061 | 0.050 | <0.00050 - <0.003 | 0.00017 | <0.010 - **0.313** | <0.007 | 0.00081 - **0.084** | 0.0002 | <0.17 | | <0.20 | | <0.10 | |
| West | 16AR | <0.10 - 1.13 | <0.5 | <0.05 - 0.087 | 0.09 | <0.010 - <0.05 | <0.03 | 1.3 - 2.62 | 1.1 | 0.032 - 0.045 | 0.040 | <0.00050 - <0.003 | 0.00013 | <0.01 - 0.178 | 0.03 | 0.0176 - 0.031 | 0.024 | - | | - | | - | |
| Adjacent Southeast | 28/28R | 0.15 - 0.43 | <0.5 | <0.020 - 0.09 | <0.06 | <0.010 - <0.05 | <0.03 | 1.1 - 2.9 | 2.0 | 0.073 - 0.090 | 0.085 | <0.00050 - <0.003 | 0.00018 | <0.01 - **1.66** | 0.27 | 0.0177 - **0.627** | 0.019 | <0.17 | | <0.20 | | <0.10 | |
| South | 26/26R | 0.85 - 1.05 | 0.6 | <0.10 - <0.5 | <0.06 | <0.050 - <0.5 | <0.03 | **10.6 - 13.0** | **9.8** | 1.73 - 1.85 | 1.41 | <0.003 - 0.012 | 0.00053 | 0.19 - **2.16** | **2.19** | 0.030 - **0.118** | 0.045 | <0.17 - <0.68 | <0.2 | <0.20 - <0.80 | <0.5 | <0.10 - <0.50 | <0.5 |
| | 45 | 0.22 | <0.5 | <0.020 | 0.11 | 0.048 | <0.03 | 4.3 | 1.8 | 0.133 | 0.118 | <0.00050 | 0.00015 | 0.050 | 0.049 | 0.0293 | 0.0193 | <0.50 | <0.2 | <0.50 | <0.5 | <0.50 | <0.5 |
| | 46 | 0.56 | <0.5 | <0.020 | <0.06 | <0.010 | <0.03 | 2.6 | 3.1 | 0.013 | 0.015 | <0.00050 | 0.00014 | **0.667** | **0.562** | 0.0181 | 0.0177 | <0.50 | <0.4 | <0.50 | <1 | <0.50 | <1 |
| Southeast | 43 | 0.20 - 0.36 | 0.6 | <0.05 - 0.151 | 0.20 | <0.05 - 0.022 | 0.08 | 2.0 - 2.51 | 1.6 | 0.13 - 0.166 | 0.162 | <0.00050 - <0.003 | 0.00012 | <0.010 - 0.145 | 0.01 | 0.009 - 0.0123 | <0.002 | <0.17 - <0.68 | <0.2 | <0.20 - <0.80 | <0.5 | <0.10 - <0.50 | <0.5 |
| ***Deep Flow System*** | | | | | | | | | | | | | | | | | | | | | | | |
| Background Northwest | 39 | <0.10 - 0.36 | <0.5 | 0.14 - 0.670 | 0.39 | <0.05 - 0.054 | 0.04 | 1.2 - 3.65 | 2.0 | 0.025 - 0.029 | 0.034 | <0.00050 - 0.004 | 0.00008 | 0.183 - 0.271 | **0.316** | **0.131 - 0.182** | **0.165** | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| | 42 | 0.29 - 1.09 | <0.5 | <0.020 - 0.031 | <0.06 | <0.010 - <0.05 | <0.03 | 0.9 - 2.44 | 1.5 | 0.051 - 0.063 | 0.048 | <0.00050 - <0.003 | 0.00017 | 0.038 - **1.77** | **0.177** | 0.010 - **0.106** | 0.011 | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| Adjacent Northeast | 24/24R | 0.25 - 0.75 | <0.5 | <0.05 - 0.296 | 2.48 | <0.010 - <0.05 | <0.03 | 2.9 - 4.36 | 3.7 | 0.045 - 0.053 | 0.043 | <0.00050 - <0.003 | <0.00008 | <0.01 - **6.10** | **0.567** | <0.00050 - **0.100** | 0.0168 | <0.17 | | <0.20 | | <0.10 | |
| Adjacent East | 25/25R | 0.12 - 0.35 | <0.5 | <0.020 - <0.05 | 0.22 | <0.010 - <0.05 | <0.03 | 1.8 - **5.42** | 2.3 | 0.047 - 0.069 | 0.057 | <0.00050 - <0.003 | 0.00013 | <0.01 - **1.90** | **0.70** | 0.006 - **0.825** | 0.026 | <0.17 | | <0.20 | | <0.10 | |
| East | 38 | <0.10 - 0.22 | <0.5 | <0.020 - <0.05 | <0.06 | <0.010 - <0.05 | <0.03 | 1.2 - 2.37 | 1.3 | 0.043 - 0.048 | 0.068 | <0.00050 - <0.003 | <0.00008 | <0.01 - **3.05** | **0.56** | <0.020 - **0.093** | 0.047 | <0.17 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| Adjacent West | 21/21R | 0.18 - 0.45 | <0.5 | <0.020 - <0.05 | <0.06 | <0.010 - <0.05 | <0.03 | 1.1 - 2.36 | 1.7 | 0.046 - 0.050 | 0.066 | <0.00050 - <0.003 | 0.00008 | <0.01 - **1.06** | **1.08** | <0.020 - **0.250** | 0.0449 | <0.17 | | <0.20 | | <0.10 | |
| South | 27 | <0.10 - 0.63 | <0.5 | <0.020 - <0.25 | <0.06 | <0.010 - <0.25 | <0.03 | 1.0 - 2.99 | 1.2 | 0.083 - 0.266 | 0.084 | <0.00050 - 0.005 | 0.00012 | <0.04 - **1.09** | **0.92** | 0.050 - **0.065** | **0.062** | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| Southeast | 37/37R | <0.10 - 0.37 | <0.5 | <0.020 - <0.25 | <0.06 | <0.010 - <0.25 | <0.03 | 0.8 - 2.26 | <1.0 | 0.048 - 0.056 | 0.056 | <0.00050 - 0.004 | 0.00009 | 0.02 - **3.27** | **0.72** | 0.030 - **0.211** | 0.041 | <0.17 - <0.50 | <0.2 | <0.20 - <0.50 | <0.5 | <0.10 - <0.50 | <0.5 |
| | D2 * | <0.05 - 0.25 | 0.5 | <0.020 - <0.25 | <0.06 | <0.010 - <0.25 | <0.03 | 1.4 - 3.54 | 1.2 | 0.051 - 0.060 | 0.051 | <0.00050 - 0.004 | 0.00033 | <0.01 - **1.89** | 0.09 | <0.00050 - **0.054** | <0.002 | <0.17 | | <0.20 | | <0.10 | |

*Notes:*
- Concentrations are in mg/L with the exception of VOCs which are in µg/L, pH which is in SU, and conductivity which is in µS/cm.
- Bold and shading indicates exceedance of ODWQS.
- Blank indicates there is no historic data for thie specified parameter.
- Shaded parameters across title row have been identified as diagnostic indicator parameters.
- * Groundwater sample from domestic well D2 is inferred to be softened prior to collection; the results should be viewed with caution.

## SHALLOW GROUNDWATER FLOW SYSTEM

As observed in Table 4-2, the 2021 parameter concentrations in the shallow groundwater observation wells were typically within or below their respective historic concentration ranges for the wells. The following parameters were above the historic range for the specified well and former well, if applicable:

- Well 11R – chloride;
- Well 16AR – pH, hardness, chloride, sulphate, calcium, magnesium, sodium and nitrate;
- Well 19R – hardness, sulphate, calcium, magnesium, nitrate and DOC;
- Well 26R – hardness, sulphate, calcium and iron;
- Well 28R – sulphate;
- Well 32R – hardness, chloride, sulphate, calcium and DOC;
- Well 40 – hardness, sulphate, calcium, ammonia and boron;
- Well 43 – chloride, sulphate, sodium, TKN, nitrate and nitrite; and
- Well 44 – chloride, sulphate, potassium and sodium.

It is noted that the parameters TKN, nitrate, nitrite, DOC, and boron were first added to the sampling program in 2016/2017; therefore, the comparison to historic data is limited for these parameters until a larger historic database is available. In addition, the majority of wells in the monitoring well network were installed in 2013-2015, and were only incorporated into the groundwater monitoring program in 2014-2016. As such, there is limited data available for historic comparisons. The elevated concentrations in replacement wells with respect to the historic range of results at the former wells may be the result of the slight variations in screen depth and location for the replacement monitoring wells.

Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-8 through D-35, Appendix D.

Shallow flow system well 40 is representative of upgradient conditions, and was incorporated into the 2014 annual monitoring program as a background observation well. Concentrations of leachate indicator parameters have generally fluctuated with no increasing or decreasing trends, with the exception of a significant iron concentration spike that occurred in May 2017. The iron concentrations since 2017 have returned to the expected historic concentration range. Ammonia and boron concentrations were both slightly elevated in well 40 compared to the limited historical data.

Over the long-term, concentrations of general parameters and major and minor ions at observation wells 32 and 32R typically increased between the 1980s and mid to late 1990s. Since then however, concentrations have typically fluctuated with no overall pattern. As noted on the concentration versus time graphs for this well, leachate indicator parameter concentrations have fluctuated with no overall increasing trends. It is noted that the chloride concentration in 2021 was above the historic range for well 32/32R.

The sampling results for observation wells 11 and 11R, located adjacent to the east, show that concentrations of select general parameters and major and minor ions increased from the late 1970s to late 1980s, decreased until mid-1990s, and typically fluctuated with no overall trend since that time. One exception is alkalinity concentrations, which fluctuated with an overall increase from the late 1990s/early 2000s to 2015. Metals concentrations at well 11 have fluctuated over the long term with no overall trend. In 2016, observation well 11 was decommissioned and replaced by observation well 11R. When compared to recent results at former well 11, most parameters at replacement well 11R had appreciably elevated concentrations in 2016-2021. These concentrations indicate a residual landfill influence, directly adjacent to the east of the landfill mound. The higher concentrations at replacement well 11R do not necessarily indicate a change in groundwater conditions at the site, however, continued monitoring at observation well 11R is recommended. Chloride concentrations in the replacement well 11R may be trending upward and should continue to be monitored.

Although there is a limited database as the wells were only installed/sampled within the last 5 years, concentrations of leachate indicator parameters at observation wells 16AR, 19R, 43, and 44 have generally fluctuated with no discernable increasing or decreasing trends.

At observation wells 28 and 28R, general parameter, major and minor ion, and metal concentrations have fluctuated over the long term with no overall increasing or decreasing trend. It is noted that there was a discernable increase in the potassium concentrations from 2012 to 2015, although this concentration has decreased from 2016 into 2021 at replacement well 28R. Continued monitoring at observation well 28R is recommended.

Concentrations of several leachate indicator parameters (chloride, alkalinity, potassium, and iron) displayed increasing concentration trends with time from 1997 to 2012 at observation well 26. The condition of the well was determined to be deteriorating and was decommissioned and replaced with observation well 26R in 2015 to monitor downgradient groundwater conditions in the shallow flow system. This well was incorporated into the monitoring program and sampled in 2016. Parameter concentrations in replacement well 26R appear to be slightly decreasing with time, although they remain elevated compared to historical levels. Chloride concentrations display the most significant concentration increase over time between 2004 and 2016, although they have since been noted to be decreasing. In order to further investigate the groundwater conditions in the vicinity of observation well 26R, a supplemental drilling program was completed and two additional wells (45 and 46) were installed in August 2019. Groundwater samples were collected from monitoring wells 45 and 46 on August 28, 2019, May 12, 2020, and May 11, 2021 and submitted to the laboratory for analysis of the annual groundwater parameter package. It is noted that VOCs have not been detected in the samples collected from monitoring wells 45 and 46 since installation. The parameter concentrations at monitoring wells 45 and 46 are significantly below the concentrations at 26R. In particular, chloride and boron concentrations, which exceeded the trigger levels at well 26R, were well below the trigger levels at wells 45 and 46 in 2019 through 2021.

Based on the groundwater elevation and chemistry results at recently installed wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46. Meanwhile, key parameter concentrations within monitoring wells 45 and 46 were well below the concentrations at 26R. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.

It is suspected that road salting is a contributing factor in the increasing concentrations at well 26R, as both chloride and sodium concentrations were significantly greater at well 26R than within leachate well 41 in 2021, as well as in recent historical results. VOCs have not been detected in the samples collected at well 26R.

Groundwater quality at the adjacent and downgradient observation wells were generally similar to those observed in background well 40. The exceptions, which were discernably higher than historic background levels (greater than 50% higher), were concentrations of: conductivity, hardness, chloride, alkalinity, calcium, magnesium, potassium, sodium, ammonia, TKN, DOC, and boron at observation well 11R; sulphate and sodium at observation well 16AR; conductivity, hardness, chloride, alkalinity, magnesium, potassium, sodium, and boron at observation well 26R; sodium and boron at observation wells 28R, 43, and 45; nitrate and boron at observation well 19R; boron at observation well 32R; and nitrate at observation well 44.

In general, the highest parameter concentrations in the shallow groundwater flow system at the site were typically observed in observation well 11R and included elevated concentrations of a number of general parameters and major ions.  This was followed by concentrations at 26R.  Conversely, parameter concentrations at shallow groundwater wells 16AR, 19R, 28R, 32R, 43, 44, 45, and 46 were typically similar to those observed in the background well.

In summary, there may have been some historical landfill impacts in a number of the shallow groundwater flow system wells adjacent to the northeast, and particularly adjacent to the east of the landfill; however, these impacts have generally abated such that there was no clear indication of leachate influence in the shallow observation wells further downgradient to the east/southeast at the site during 2021.  The area adjacent to the east of the landfill, near 11R, should continue to be inspected to confirm that there are no leachate seeps.  Potentially increasing parameter concentrations observed at observation well 11R may be landfill related, although some parameter concentrations appear to be decreasing in recent years.  Off-site influenced groundwater appears to be contributing to the elevated concentrations at 26R, as supported by additional monitoring completed at wells 45 and 46.  Continued additional monitoring should be undertaken at wells 45 and 46 to confirm this inference.  Similar to well 11R, some leachate indicator parameter concentrations at well 26R appear to be decreasing in recent years.

### DEEP GROUNDWATER FLOW SYSTEM

As observed in Table 4-2, the 2021 parameter concentrations in the deeper groundwater observation wells were typically within or below their respective historic concentration ranges for the wells, with some exceptions.  The following parameters were above the historic range for the specified well and former well, if applicable:

- Well 21R – Conductivity, chloride, boron and iron;
- Well 24R – Nitrate;
- Well 25R – pH, ammonia and nitrate;
- Well 37R – Chloride;
- Well 38 – Chloride and boron;
- Well 39 – Hardness, sulphate, calcium, boron and iron; and
- Well 42 – pH and calcium.

It is noted that the parameters ammonia, nitrate and boron were first added to the sampling program in 2016/2017; therefore, there is limited historic data available for comparison.  The elevated concentrations in replacement wells with respect to the historic range of results at the former wells may be the result of the slight variations in screen depth and location for the replacement monitoring wells.

Time versus concentration graphs for the leachate indicator parameters of chloride, alkalinity, potassium, boron, iron, ammonia, and TKN are shown on Figures D-8 through D-35, Appendix D.

Deep flow system wells 39 and 42 are representative of upgradient conditions, and were incorporated into the 2014 and 2016 annual monitoring programs, respectively, as background observation wells.  Concentrations of leachate indicator parameters have generally fluctuated with no increasing or decreasing trends.

It is observed in these graphs that the 2010 through 2021 iron concentrations in deep wells 21/21R, 24/24R, 25/25R, and 38 are marginally to appreciably elevated relative to the historic data in the respective wells.  The reason for this trend is not clear, although it is inferred that the change in iron concentrations may be related to a change in laboratory analytical method; as a different laboratory was used after 2010.

The concentration versus time graphs for observation well 24/24R, located adjacent to the northeast, show that leachate indicator concentrations have fluctuated over the long term with no overall increasing or decreasing trends.

At observation well 25/25R, located adjacent to the east of the landfill, concentrations of most parameters fluctuated with an overall increase from 1999 to 2007, followed by an overall decrease from 2007 to 2015, and now appear to be generally stable.

To the east and southeast of the landfill, along the eastern limit of the buffer zone property (CAZ), the concentration versus time graphs for well 37/37R and well 38, show that leachate indicator parameter concentrations have fluctuated over the long term with no overall increasing or decreasing trends. The exceptions are the chloride concentrations, which have increased marginally in both wells since the early 2000s, but are still considered low and are far below the ODWQS. The spike in iron concentration at well 37R in 2019 was suspected to be the result of a failure in the groundwater filter during sampling, as the groundwater was noted to be high in sediment. Iron concentrations at well 37R have since returned to within historical range.

To the west of the landfill area, at observation well 21/21R, most parameters have generally fluctuated over the long term with no overall trend with the exception of iron concentrations which appear to be increasing over time. Chloride concentrations in the old well 21 fluctuated with an overall increase from 1999 to 2007, followed by an overall decrease from 2008 to 2014. Chloride concentrations in the replacement well 21R appear to be increasing since sampling began in 2015 with a historical high reported in 2021. However, the concentrations are still considered low and remain far below the ODWQS.

At observation well 27, located south of the landfill, most parameter concentrations fluctuated with no overall increasing trends prior to 1995. When monitoring of well 27 resumed again in 2012, most constituent concentrations appeared to slightly increase compared to prior to 1995.

Groundwater quality at the adjacent and downgradient observation wells were generally similar to those observed in background wells 39 and 42.

In general, the highest parameter concentrations in the deep groundwater flow system at the site were observed in background well 39 and observation well 27 (located along the southern property boundary). The recent historic chemical database for well 27 is limited; however, the May 2021 parameter concentrations do not show clear evidence of an adverse leachate influence, given the chloride concentration of just 41.0 mg/L and the absence of VOC detections. There is no conclusive evidence of a leachate influence on the deep groundwater quality at well 27 at this time.

Parameter concentrations at well 21/21R situated west of the landfill, and well 37/37R at the southeast corner of the buffer zone property (CAZ) were also marginally elevated relative to the other deeper flow system wells; but typically similar to, or below the parameter concentrations at well 39 in the northwest corner. As discussed previously, recent chloride concentrations in the replacement well 21R may be increasing, but still remain relatively low. Concentrations of other leachate indicators are fluctuating within historical ranges. Marginally increasing chloride concentrations were observed at observation well 37/37R, but remain relatively low and well below the ODWQS for chloride. The increasing chloride concentrations may be indicative of the natural fluctuations in the deeper flow system or influences from road salting activities. As such, there is no conclusive evidence of a leachate influence on the deep groundwater quality at wells 21/21R and 37/37R at this time.

In summary, there was no clear evidence of a leachate influence in the deeper groundwater flow system along the northeast portion of the property boundary (well 24R), adjacent east to the landfill mound (well 25R), west of the landfill (well 21R) and south of the landfill (27). Continued monitoring is recommended to expand the chemical databases. Deeper groundwater quality at the east and southeast limits of the buffer zone property (wells 38 and 37R respectively) do not demonstrate a leachate influence.

### 4.2.2 DOMESTIC WELLS

As observed in Table 4-2, the 2021 parameter concentrations in domestic well D2 (Pearce) were within or below their respective historic concentration ranges, with the exception of TKN. Domestic well D2 is believed to obtain its water from the deep flow system.

It is noted that domestic well D2 (Pearce) came under new ownership before the 2015 sampling event, with notable renovations happening at the home. Previous groundwater chemical results (2012-2013, 2016-2020) strongly suggested that the water was treated (ie. softened) prior to sample collection. This was also the case in the 2021 sample.

The concentration versus time graphs for well D2 show that parameter concentrations have fluctuated over the long term with no overall increasing or decreasing trends at this location.

Parameter concentrations at domestic groundwater well D2 (Pearce) were generally similar to those observed at the other deep flow system wells. Anthropogenic sources, such as road salting, septic beds, home renovations, and/or the well distribution system may be responsible for some of the historically elevated concentrations at domestic well D2. Groundwater quality in the well does not show evidence of leachate influence, based on a comparison with background shallow groundwater quality.

### 4.2.3 TRILINEAR DIAGRAM

The natural variability in the overburden groundwater quality at the Site is illustrated on the trilinear diagram (Figure 8) using the May 2021 analytical results. The anion chemical results are presented on the triangular graph in the lower right, while the cation chemical results are presented on the triangular graph in the lower left. The anion and cation results are combined on the diamond shaped graph in the centre. Water with similar chemical signatures will plot together on the tri-linear plot.

Leachate chemistry from the Site is plotted in red on the trilinear plot, for reference purposes. Leachate chemistry from well 41 is bicarbonate enriched and sulphate deficient, with a slightly dominant calcium cation.

The shallow and deep flow system groundwater quality at the Site generally plots together on the trilinear diagram. As shown on Figure 8, groundwater is typically enriched with bicarbonate (anion), with a dominant calcium cation. An exception is the groundwater quality at domestic well D2, which is enriched with bicarbonate (anion) and sodium (cation), as a result of the water being treated (ie. softened) prior to sample collection.

The shallow and deep groundwater samples from the site plot consistently together near the left corner of the combined graph, with the exception of well 26R which was influenced by elevated chloride and sodium concentrations, and domestic well D2 which was influenced by elevated sodium concentrations. However, the water quality at these wells do not exhibit typical leachate quality influences. As mentioned in Section 4.2.1, observation well 26R is suspected to be influenced by road salting, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41. As mentioned in Section 4.2.2, the groundwater quality at domestic well D2 suggests that the water was treated (ie. softened) prior to sample collection. Shallow groundwater in well 43 also plotted slightly separate from the other monitors due to the influence of slightly elevated sodium concentrations.

The leachate chemistry from the Site plots slightly lower than most groundwater quality, near the left corner of the combined graph. Typical municipal leachate would plot toward the lower left-central area of the combined graph. The location of the well 41 chemistry on the combined graph suggests a weak leachate strength.

In summary, the trilinear plot does not provide any indication of a discernible leachate impact to the shallow or deep groundwater flow systems.

### 4.2.4 ONTARIO DRINKING WATER QUALITY STANDARDS

The following parameters were detected at concentrations exceeding the Ontario Drinking Water Quality Standards (ODWQS) (MECP, June 2003) in samples collected from the shallow flow system and deeper flow system observation wells during 2021.

- Hardness at all wells sampled in 2021, except Domestic Well D2;
- Alkalinity at shallow flow system wells 11R and 26R;
- Chloride at shallow flow system well 26R;
- Nitrate at shallow flow system well 44;
- DOC at shallow flow system wells 11R, 26R and 40;
- Iron at shallow flow system wells 11R, 26R, 32R, 40, and 46, and at deep flow system wells 21R, 24R, 25R, 27, 37R, 38, 39 and 42; and
- Manganese at shallow flow system wells 11R and 40, and at deep flow system wells 27 and 39.

Most parameters that exceeded the ODWQS within the shallow groundwater flow system and deep groundwater flow system have objectives or guidelines related to the aesthetic quality or operational treatment of the water and are not health related. The exception to this is nitrate, which has a maximum acceptable concentration limit. The nitrate exceedance observed at shallow flow system well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the shallow groundwater adjacent to the east side of the landfill mound. It is much more likely that this concentration is the result of agricultural activities that surround this well location. A supplemental sample was collected at observation well OW33R in May 2019, in order to better assess the landfill’s potential contribution of nitrate on the east side of the site. The nitrate concentration at well OW33R was 0.496 mg/L which is well below the ODWQS of 10.0 mg/L for nitrate, and significantly less than the concentrations observed at well 44 (24.1 mg/L in 2019, 20.7 mg/L in 2020 and 15.4 mg/L in 2021). Given that well 33R is directly adjacent to the landfill and the nitrate concentration was low, the elevated nitrate concentration at well 44 is unlikely to be landfill related.

Concentrations of hardness, iron, and manganese observed in the shallow and deep groundwater flow systems, and DOC in the shallow flow system, appear to naturally approach or exceed the ODWQS, since exceedances for these parameters have been observed at background wells. Alkalinity exceedances observed at shallow groundwater well 11/11R may indicate residual landfill influences. The chloride exceedance at observation well 26R is inferred to be related to road salting influences.

### 4.2.5 GUIDELINE B-7 COMPLIANCE ASSESSMENT

Guideline B-7 was established by the MECP as a mechanism to assess the acceptable level of leachate impacts on the groundwater system. Guideline B-7 is applied to groundwater quality at the property boundary, and is intended to protect both existing and potential reasonable uses of the groundwater on adjacent properties. The Guideline states that, for non-health related parameters, the impact from the landfill should not raise the concentration by more than half the difference between the background concentration and the Ontario Drinking Water Quality Standard or Objective (ODWQS).

### SHALLOW FLOW SYSTEM

Groundwater movement in the shallow flow system across most of the site is inferred to converge on the on-site stream; though the groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. Hence, there may be a minor component of localized shallow groundwater flow from the fill area east and southeast toward the buffer property.

MECP Guideline B-7 criteria were calculated to assess the significance of the landfill effects on the shallow groundwater flow system along the eastern property boundary. Guideline B-7 is normally applied at the property boundary, and is intended to protect both existing and potential reasonable uses of that groundwater on adjacent properties.

Guideline B-7 criteria were calculated for parameters that have ODWQS. The chemistry results measured in 2021 from shallow background monitoring well 40 were used as the reference concentration for the groundwater flow system.

Table 4-3 provides a comparison of the calculated Guideline B-7 criteria and downgradient wells on Site.

### Table 4-3 2021 Guideline B-7 Compliance – Shallow Flow System

| PARAMETER | REFERENCE QUALITY | ODWQS | GUIDELINE B-7 | MONITORING WELL | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 26R | 32R | 43 | 44 | 45* | 46* |
| Hardness | 450 | 80-100 | **450 †** | 657 | 351 | 110 | 342 | 184 | 262 |
| Chloride | 20 | 250 | **135** | 260 | 14 | 16 | 16 | <1 | 2 |
| Sulphate | 45 | 500 | **273** | 21 | 39 | 59 | 61 | 25 | 33 |
| Alkalinity | 337 | 30-500 | **419** | 601 | 245 | 172 | 229 | 153 | 198 |
| Sodium | 10.4 | 200 | **105** | 183 | 8.47 | 49.4 | 7.22 | 24.6 | 2.36 |
| Nitrate | <0.06 | 10.0 | **2.52** | <0.06 | 0.08 | 0.20 | 15.4 | 0.11 | <0.06 |
| Nitrite | <0.03 | 1.0 | **0.26** | <0.03 | <0.03 | 0.08 | <0.03 | <0.03 | <0.03 |
| DOC | 6.8 | 5 | **6.8 †** | 9.8 | 2.7 | 1.6 | 1.2 | 1.8 | 3.1 |
| Boron | 0.036 | 5.0 | **1.28** | 1.41 | 0.043 | 0.162 | 0.032 | 0.118 | 0.015 |
| Chromium | 0.00029 | 0.05 | **0.013** | 0.00053 | 0.00010 | 0.00012 | 0.00040 | 0.00015 | 0.00014 |
| Iron | 3.19 | 0.3 | **3.19 †** | 2.19 | 0.747 | 0.01 | 0.01 | 0.049 | 0.562 |
| Manganese | 0.242 | 0.05 | **0.242 †** | 0.045 | 0.0389 | <0.002 | <0.002 | 0.0193 | 0.0177 |
| Vinyl Chloride (µg/L) | 0.1 | 1 | **0.33** | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.4 |
| Benzene (µg/L) | <0.50 | 1 | **0.44** | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <1 |
| 1,4 Dichlorobenzene (µg/L) | <0.50 | 5 MAC | **1.44** | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <1 |
| | | 1 AO | **0.63** | | | | | | |

Notes:
- All concentrations are mg/L unless otherwise noted.
- ODWQS - Ontario Drinking Water Quality Standards (June 2003)
- Shading indicates concentrations exceed Guideline B-7 criteria.
- Reference quality based on 2021 groundwater quality measured from background observation well 40.
- † When the reference concentration is greater than the ODWQS, the reference value is used as the Guideline B-7 Criterion.
- * Wells included for comparison purposes only, as GB-7 is actually assessed at the property boundary.

In summary, concentrations at the landfill property boundary complied with the Guideline B-7 (GB-7) criteria, with the exception of hardness, chloride, alkalinity, sodium, DOC, and boron at observation well 26R, and nitrate at well 44.

The hardness exceedance at observation wells 26R is consistent with historic results. These exceedances do not appear to be related to the landfill. Concentrations of hardness observed in the shallow flow system appear to naturally exceed the ODWQS, as exceedances for these parameters are observed at the background well.

As discussed previously, the nitrate exceedance observed at well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the shallow groundwater adjacent to the east side of the landfill mound. Furthermore, other leachate indicator parameters such as chloride, alkalinity, and VOCs are not elevated at well 44. A supplemental sample was collected at observation well OW33R in 2019, in order to better assess the landfill’s contribution of nitrate on the east side of the site. The nitrate concentration was found to be low at well 33R (well below ODWQS and GB-7 Criteria), indicating the elevated nitrate concentration at well 44 is unlikely to be landfill related. The nitrate concentration is likely the result of agricultural activities that surround this well location.

It is suspected that road salting is a contributing factor in the exceedances at observation well 26R, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41 in 2021, as well as in recent historical results. As discussed earlier, in order to further investigate the groundwater conditions in the vicinity of observation well 26R, a supplemental drilling program was completed and two additional wells (45 and 46) were installed in August 2019. Groundwater samples were collected from monitoring wells 45 and 46 on August 28, 2019, May 12, 2020, and May 11, 2021 and submitted to the laboratory for analysis of the annual groundwater parameter package. It is noted that VOCs were not detected in the samples collected from monitoring wells 45 and 46 in 2019 through 2021. The parameter concentrations at monitoring wells 45 and 46 were significantly lower than the concentrations at 26R, and no concentrations exceeded the GB-7 Criteria in 2019 through 2021. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.

As limited historic databases are available for several of the parameters at observation wells 26R and 44, continued monitoring is recommended to confirm these Guideline B-7 exceedances.

### DEEP GROUNDWATER FLOW SYSTEM

Groundwater flow in the deep flow system is inferred to be in a generally south to southeasterly direction under a low horizontal hydraulic gradient. MECP Guideline B-7 criteria were calculated to assess the significance of the landfill effects on the deep groundwater flow system. Guideline B-7 is applied at the property boundary, and is intended to protect both existing and potential reasonable uses of the groundwater on adjacent properties.

Guideline B-7 criteria were calculated for parameters that have ODWQS. The median chemistry results measured in 2021 from deep background monitoring wells 39 and 42 were used as the reference concentration for the deep flow system.

Table 4-4 provides a comparison of the calculated Guideline B-7 criteria and deep flow system downgradient wells on Site. Guideline B-7 is applied at the property boundary and is applicable to observation wells 27, 37R, and 38.

**Table 4-4 2021 Guideline B-7 Compliance – Deep Flow System**

| PARAMETER | REFERENCE QUALITY | ODWQS | GUIDELINE B-7 | MONITORING WELL | | |
|---|---|---|---|---|---|---|
| | | | | 27 | 37R | 38 |
| Hardness | 286 | 80-100 | **286 †** | **361** | **316** | **260** |
| Chloride | 19.3 | 250 | ***135*** | 41 | 35 | 27 |
| Sulphate | 26.0 | 500 | ***263*** | 34 | 41 | 24 |
| Alkalinity | 244 | 30-500 | ***372*** | 284 | 238 | 237 |
| Sodium | 20.5 | 200 | ***110*** | 15.1 | 12.0 | 14.5 |
| Nitrate | 0.21 | 10.0 | ***2.66*** | <0.06 | <0.06 | <0.06 |
| Nitrite | 0.03 | 1.0 | ***0.27*** | <0.03 | <0.03 | <0.03 |
| DOC | 1.8 | 5 | ***3.4*** | 1.2 | <1.0 | 1.3 |
| Boron | 0.041 | 5.0 | ***1.28*** | 0.084 | 0.056 | 0.068 |
| Chromium | 0.0001 | 0.05 | ***0.013*** | 0.00012 | 0.00009 | <0.00008 |
| Iron | 0.247 | 0.3 | ***0.27*** | **0.92** | **0.72** | **0.56** |
| Manganese | 0.088 | 0.05 | **0.088 †** | 0.062 | 0.041 | 0.047 |
| Vinyl Chloride (µg/L) | <0.20 | 1 | ***0.33*** | <0.2 | <0.2 | <0.2 |
| Benzene (µg/L) | <0.50 | 1 | ***0.44*** | <0.5 | <0.5 | <0.5 |
| 1,4 Dichlorobenzene (µg/L) | <0.50 | 5 MAC | ***1.44*** | <0.50 | <0.50 | <0.50 |
| | | 1 AO | ***0.63*** | | | |

Notes:
- All concentrations are mg/L unless otherwise noted.
- ODWQS - Ontario Drinking Water Quality Standards (June 2003)
- Shading indicates concentrations exceed Guideline B-7 criteria.
- Reference quality based on 2021 groundwater quality measured from background observation wells 39 and 42.
- † When the reference concentration is greater than the ODWQS, the reference value is used as the Guideline B-7 Criterion.

In summary, concentrations at the property boundary complied with the Guideline B-7 criteria, with the exception of hardness and iron at wells 27, 37R, and 38. As stated in Section 4.2.4., concentrations of hardness and iron appear to be naturally elevated in the deep flow system. The hardness concentrations at observation wells 27, 37R and 38 are actually below the 2021 background result at well 39. As such, the site is considered to be in compliance at the downgradient property boundaries.

### *4.2.6 TRIGGER MECHANISM COMPLIANCE ASSESSMENT*

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The new approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the new ECA, a closure plan was submitted to the MECP on June 28, 2017, which included a trigger mechanism and contingency plan as well as a new monitoring program.

On October 24, 2017, the County received comments from the MECP regarding their review of the closure plan. One of the comments made by the MECP noted that some of the trigger parameters had been selected based on very few sets of analytical sets of data. The reviewer felt that the list of trigger parameters should be reviewed/revised after a few years to ensure that the parameters selected are meaningful.

A response to the MECP comments was provided by WSP on December 8, 2017, on behalf of the County. In the response, it was noted that trigger parameters for the groundwater trigger mechanism plan were selected based on the available data, as the historic monitoring program contained very few practical leachate indicator parameters. It was agreed that the trigger parameters will be reassessed after a few years to ensure that the selected parameters are meaningful.

The closure plan and response were accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018; however, the trigger mechanism plan was not implemented in 2021 as the chemical database was still limited. Table 4-5 outlines the current groundwater trigger concentrations and boundary criteria, with 2021 results for the selected boundary wells.

**Table 4-5 2021 Groundwater Trigger Mechanism Compliance Assessment**

| | | MONITORING WELL | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TRIGGER LEVEL** | **Shallow Flow System** | | | **Deep Flow System** | | |
| | | **26R** | **43** | **44** | **27** | **37R** | **38** |
| Chloride | 134 | **260** | 16 | 16 | 41 | 35 | 27 |
| Boron | 1.3 | **1.41** | 0.162 | 0.032 | 0.084 | 0.056 | 0.068 |
| Vinyl Chloride (µg/L) | 0.4 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Benzene (µg/L) | 0.4 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,4 Dichlorobenzene (µg/L) | 1.3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |

Notes:
- All concentrations are mg/L unless otherwise noted.
- Shading indicates concentrations exceed proposed trigger boundary criteria.

The property boundary groundwater trigger criteria at the site were not exceeded during 2021, with the exception of chloride and boron concentrations at observation well 26R. It is suspected that road salting and/or off-site sources are contributing factors in the chloride and boron concentrations at observation well 26R, as both these concentrations were greater at well 26R than within the leachate well 41 in 2021, as well as in recent historical results. It is also noted that VOCs have not been detected in the samples collected at well 26R. As discussed previously, based on the groundwater elevation and chemistry results at recently installed wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Additional monitoring results will be required to confirm this conclusion.

Continued monitoring is required to expand the chemical database at the boundary wells.

# 5 SURFACE WATER QUALITY

The general surface water chemical results from the surface water stations are provided in Table E-1, Appendix E. The laboratory certificates of analysis are provided in Appendix F. Concentration versus time graphs for conductivity, hardness, alkalinity, calcium, chloride, magnesium, iron, and manganese are presented on Figures E-1 through E-21. Surface water samples are collected semi-annually from stations C01 and C06, and annually in April from stations C04, P01, P02, P03, and NE1. The surface water station locations are shown on Figure 2.

The QA/QC program for the monitoring program at the site included a field and a laboratory component. Standard field protocols were used to ensure consistency.

Laboratory reports were reviewed as part of the laboratory QA/QC program.  Blind duplicate samples were collected from surface water station C01 in April and station C01 in October 2021.  In general, duplicate samples were similar to the original samples results with the calculated Relative Percent Difference (RPD) within the 20% guideline for acceptability or less than two times the laboratory reported method detection limit (MDL), with the exception of chromium in April (>2MDL).  Acceptable data quality control including laboratory blanks, spiked blanks, laboratory duplicates, and laboratory percent recoveries of analysis indicated that the detected constituent concentrations were accurate and reflected actual surface water conditions at the time of sample collection and are acceptable for inclusion into the database.

## 5.1 SURFACE WATER QUALITY COMPARISON

### I) WETLANDS ON NORTHEAST BOUNDARY (NE1)

Surface water station NE1 is situated in the wetland area north of the site, associated with the Otter Creek drainage system.  Station NE1 is the pond situated at the toe of the landfill, and receives runoff from the north and east side slopes of the landfill.

The 2021 chemistry results at surface water station NE1 were generally within their respective historic ranges.There are no drainage channels within the low relief (swampy) area northeast of the landfill.  Surface water run-off into the swampy area travels overland as sheet flow, usually forming ponds and eventually infiltrating into the soil.  As such, stagnant water conditions usually exist at the time of sampling at station NE1.  During stagnant conditions, chemical precipitates, evaporation and biological activity serve to change the water quality.  Thus, the concentration results at NE1 are likely indicative of the swampy, stagnant conditions in the area, and are not representative of the natural water quality in flowing conditions.

As illustrated in Figures E-10 to E-12, parameter concentrations at NE1 have fluctuated over time with no overall long-term increasing or decreasing trends.

Of the parameters tested, only the parameters pH, alkalinity, un-ionized ammonia, boron, chromium, and iron have PWQOs.  The 2021 surface water chemistry at station NE1 complied with the PWQOs for the parameters tested, with the exception of iron which was above the PWQO.  The 2021 iron concentration was within the historical range for this sampling location, but was the highest reported concentration since 2006.

Based on the monitoring results, surface water quality in the northeast portion of the site was not measurably affected by the landfill site in 2021.

### III) ON-SITE STREAM (C01, C04, AND C06) AND ADJACENT RETENTION POND (P02)

Surface water station C06 is located in a swampy area near the northwest corner of the site, inferred to be the headwaters of the on-site stream, and represents the upstream surface water quality conditions in the on-site stream.  Station C04 is located downstream of C06 in the on-site stream, within the landfill property, while station C01 is located furthest downstream at the southern property boundary.  The on-site stream exits the southern portion of the site via a culvert beneath Quaker Street.

Surface water station P02 is located on the retention pond situated in the central portion of the site, adjacent and west of the landfill.  The pond receives surface water run-off from the western portion of the fill area, and also shallow groundwater moving from beneath the landfill.  Drainage from the retention pond (P02) enters the on-site stream between surface water stations C06 and C04.

The 2021 chemistry results from the stations along the on-site stream were within their respective historic ranges with the exception of several parameters for station CO6. Conductivity, hardness, alkalinity and calcium were above their respective historic ranges in October 2021. Within the retention pond at station P02, the 2021 chemistry results were within their respective historic ranges.

It is noted that the parameters sulphate, potassium, sodium, ammonia, un-ionized ammonia, nitrate, nitrite, boron, and chromium were first added to the sampling program in 2017/2018; and thus, comparison to historic data and trend analysis is impractical for these parameters until a larger historic database is available.

The 2021 chemistry results from the on-site stream and pond P02 are shown on Table 5-1 in sequence of the flow direction, downstream from station C06.

**Table 5-1 2021 Surface Water Chemistry – On-Site Stream and Pond P02**

| | C06 | P02 | C04 | C01 |
|---|---|---|---|---|
| pH | 8.05 - 8.05 | 8.13 | 8.11 | 7.96 - 8.07 |
| Conductivity | 549 - 754 | 799 | 737 | 677 - 728 |
| Hardness | 280 - 382 | 316 | 320 | 319 - 322 |
| Chloride | 30 - 41 | 63 | 52 | 49 - 52 |
| Sulphate | <2 - 14 | 20 | 30 | 1 - 15 |
| Alkalinity | 237 - 342 | 306 | 285 | 269 - 300 |
| Calcium | 89.5 - 122 | 83.0 | 86.9 | 89.1 - 91.4 |
| Magnesium | 13.9 - 18.8 | 26.3 | 25.0 | 22.1 - 24.1 |
| Potassium | 1.82 - 2.19 | 11.8 | 9.95 | 7.93 - 8.98 |
| Sodium | 13.2 - 22.6 | 37.9 | 33.4 | 29.2 - 31.8 |
| Ammonia | <0.1 - <0.1 | 7.5 | 5.3 | 0.2 - 0.5 |
| Un-ionized Ammonia | <0.001 - <0.001 | 0.144 | 0.121 | 0.003 - 0.007 |
| Nitrate | 0.11 - 0.76 | 0.27 | 0.43 | 0.35 - 1.03 |
| Nitrite | <0.03 - <0.03 | <0.03 | 0.04 | <0.03 - 0.030 |
| Boron | 0.026 - 0.034 | 0.435 | 0.417 | 0.301 - 0.397 |
| Chromium | 0.00041 - 0.0007 | 0.00035 | 0.00045 | 0.00022 - 0.00053 |
| Iron | 0.11 - 0.60 | 0.36 | 0.34 | 0.15 - 0.58 |
| Manganese | 0.0334 - 0.243 | 0.104 | 0.103 | 0.055 - 0.511 |

*Notes:* All concentrations in mg/L except pH (unitless) and conductivity (µS/cm).

As observed in Table 5-1, parameter concentrations typically increased between stations C06 and C04. The increase is likely related to the quality of surface water discharge from pond P02. Surface water quality concentrations generally remained similar between stations C04 and C01. The chemical results for station C01 were collected semi-annually, while the results from C04 were collected only annually (April). Based on a comparison of the April results alone, all parameter concentrations decreased between intermediate station C04 and downstream station C01 with the exception of calcium; however, parameter concentrations at downstream station C01 were still mostly higher than those observed at upstream station C06. This was also generally the case in October 2021 where concentrations at downstream station C01 were still mostly higher than those observed at upstream station C06.

As illustrated in Figures E-1 to E-9 for stations C01 to C06 and Figures E-16 to E-18 for pond P02, parameter concentrations have typically fluctuated over the long-term with no overall increasing or decreasing trends; though there are some exceptions. Chloride concentrations at stations C01, C04 and C06 increased between about 1998 and 2002, and have generally fluctuated with no overall trend since that time. Alkalinity and conductivity concentrations at C04 have also increased overall since the mid-1990s, although the concentrations appear to be stabilizing or decreasing in recent years. Alkalinity, hardness, conductivity, and chloride concentrations at retention pond station P02 have fluctuated with an overall increasing trend from the mid-1990s to 2015, but decreased in 2016/2017 and now appear to be fluctuating around this level.

The increasing parameter concentrations observed in retention pond P02 from the mid-1990s to 2015 are likely attributable to landfill influences since the pond is inferred to receive shallow groundwater flow from beneath the landfill. Likewise, the increased chloride concentrations at surface water stations C01 and C04 are likely related, at least in part, to discharge of shallow groundwater from beneath the landfill. Station C06 is located along the western property boundary. It is unlikely that any shallow groundwater from beneath the landfill is reaching the stream at this point. Thus, the increasing chloride levels at C06 may be related to off-site influences, such as road salting along County Road 13. However, monitoring should be continued for confirmation.

Previous reports have suggested that the increasing chloride concentrations observed at downstream station C01 coincided with the increase of chloride concentrations observed at shallow groundwater observation well 26, which is under artesian conditions. Packer systems were installed in shallow observation well 26 and deep observation well 27 (also artesian) in the summer of 2009 to prevent the wells from flowing to the receiving surface water course. An appreciable decrease in chloride concentrations at downstream station C01 was not observed in the sampling results after the packers were installed. As a result of the artesian conditions observed at well 26/26R, shallow groundwater with elevated chloride concentrations (similar to those at 26/26R) may be discharging into the low lying forested area west of well 26/26R and possibly directly into Branch Creek, contributing to the chloride levels.

A comparison of the chloride concentrations at C01, C04, and pond P02 (Figures E-2, E-5 and E-17, Appendix E) indicates that they are likely related. Since 1998, chloride levels at C01 have ranged from 29.0 mg/L to 79.8 mg/L with an average of 52.1 mg/L, while levels at C04 have ranged from 33.0 mg/L to 63.3 mg/L with an average of 50.8 mg/L. The chloride concentrations at pond P02 have ranged from 10.0 mg/L to 65.4 mg/L with an average of 49.1 mg/L. It is also understood that the area in the vicinity of surface water station C01 (i.e., a culvert) occasionally floods above the road level during the spring freshet and/or periods of high rainfall. As such, flooding and road salting influences may also contribute to the elevated chloride concentrations observed at station C01.

The 2021 concentrations at on-site stream stations C01, C04, and C06 and retention pond station P02 generally complied with the PWQOs, with the following exceptions:

- Unionized ammonia concentrations at stations C04 and P02;
- Boron concentrations at stations C01 (April and October), C04 and P02; and
- Iron concentrations at stations C01 (October), C04, C06 (October) and P02.

In summary, weak landfill influences are likely observed in the surface water quality in retention pond P02, and in the on-site stream at intermediate station C04. The retention pond and on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. At station C01, landfill influences from the upstream portions of the on-site stream, shallow groundwater discharge, and road salting practices have all likely contributed to the chloride levels at the station.

### IV) NORTHERN ON-SITE RETENTION POND (P03)

Surface water station P03 is located on the retention pond situated in the northern portion of the site, near the fill area. The pond likely receives surface water run-off from portions of the north and northwest areas of the landfill area. Surface water at station P03 could not be evaluated in 2021 as the station was dry at the time of the sampling event.

As illustrated in Figures E-19 to E-21, parameter concentrations from previous sampling events have fluctuated over the long-term with spikes of elevated concentrations, but with no overall increasing or decreasing trends.

### V) SOUTHEAST ON-SITE RETENTION POND (P01)

Surface water station P01 is located on the retention pond situated in the southeast portion of the site. The pond likely receives surface water run-off from portions of the south and southeast areas of the landfill area.

The 2021 chemistry results at retention pond P01 were within their respective historic ranges, with the exception of magnesium which was slightly above its historic range. As illustrated in Figures E-13 to E-15, concentrations of most parameters have fluctuated over the long-term with no overall increasing trend. Chloride concentrations increased in 2000, but have fluctuated with an overall decreasing trend since 2003. A slight increasing trend in concentrations of hardness and calcium may be present, however the 2021 concentrations were below their respective historical maximum for these parameters. The 2021 surface water concentrations at station P01 complied with the PWQO, with the exception of boron and iron.

Based on the monitoring results, surface water quality in retention pond P01, in the southeast portion of the site, was not measurably affected by the landfill site in 2021.

## 5.2 TRIGGER MECHANISM COMPLIANCE ASSESSMENT

On September 8, 2016, the site CofA (Waste) was updated by the MECP to Amended Environmental Compliance Approval (ECA) No. A070702. The approval incorporated the County owned buffer lands to the east of the landfill into a Contaminant Attenuation Zone (CAZ). As part of the ECA, a closure plan was submitted to the MECP on June 28, 2017, which included a trigger mechanism and contingency plan as well as a new monitoring program.

On October 24, 2017, the County received comments from the MECP regarding their review of the closure plan. One of the comments made by the MECP noted that the surface water monitoring data for the trigger parameters and the database is quite small. The reviewer felt that once a larger database of results is established, especially for unionized ammonia and boron, then the initial set of triggers should be re-assessed.

A response to the MECP comments was provided by WSP on December 8, 2017, on behalf of the County. In the response, it was agreed that once a larger database of results is established, the proposed triggers may need to be re-assessed. It is proposed to finalize the trigger criteria once a minimum of eight data sets have been collected for each parameter.

The closure plan and response were accepted by the MECP in Notice No. 1 of the ECA, dated March 6, 2018. Table 5-2 outlines the current surface water trigger concentrations and boundary criteria, with 2021 results for the downstream surface water trigger location (C01).

**Table 5-2 2021 Surface Water Trigger Mechanism Compliance Assessment**

**SURFACE WATER STATION C01**

| PARAMETER | TRIGGER LEVEL | Date (2021) | |
|---|---|---|---|
| | | April 12 | October 7 |
| Chloride | 120 | 49 | 52 |
| Boron | 1.5 | 0.397 | 0.301 |
| Un-ionized Ammonia | 0.02 | 0.003 | 0.007 |

Notes:
- All concentrations are mg/L unless otherwise noted.
- Shading indicates concentrations exceed proposed trigger criteria.

None of the surface water trigger criteria at the site were exceeded during 2021. Continued monitoring is required to expand the chemical database, particularly for boron and un-ionized ammonia.

## 5.3 SUMMARY

Based on the monitoring results, the on-site stream surface water quality demonstrates a weak landfill influence through the central portion of the site (station C04). It should be noted that the landfill influence is marginal, with the 2021 chloride concentration at 52 mg/L.

At the downstream station C01, where the on-site stream leaves the property, surface water quality has demonstrated marginally elevated chloride levels for a number of years. The chloride levels may be attributed to landfill influences from the upstream portions of the on-site stream, from shallow groundwater discharge, and from road salting practices. The April and October 2021 boron concentrations and October 2021 iron concentrations at downstream station C01 exceeded the PWQO.

Therefore, based on the monitoring results, surface water quality in the on-site stream leaving the site has been affected by landfill influences from the upstream portions of the on-site stream and in the shallow groundwater, and possibly from road salting activities. It is noted however, that the landfill influences in the surface water quality leaving the site are minor at most, with chloride concentrations ranging from 49 to 52 mg/L in 2021. The Canadian Environmental Quality Guideline (CEQG) for chloride for the protection of aquatic life is 120 mg/L. Surface water quality leaving the site at station C01 complies with the current trigger level boundary criteria.

# 6 LANDFILL GAS MONITORING RESULTS

Landfill gas concentrations were measured at standpipes SP3R, SP4R, and SP5 on April 12, 2021, as per the approved monitoring program. These standpipes are located adjacent to the east, northeast, and north of the landfill mound, respectively.

The following table summarizes the landfill gas monitoring results and water levels within the standpipes in 2021. The combustible gas concentrations were measured as a percent of the lower explosive limit (LEL) for methane, and are presented in the following table. The LEL for methane represents 5% gas by volume in air.

| SAMPLING LOCATION | % LEL Methane | % $CO_2$ | % $O_2$ | % Balance Gas | Groundwater Elevation (masl) |
|---|---|---|---|---|---|
| SP3R | 0.0 | 0.0 | 20.9 | 79.1 | 280.44 |
| SP4R | 0.0 | 0.0 | 20.8 | 79.2 | 279.16 |
| SP5 | 0.0 | 0.0 | 20.9 | 79.1 | 279.48 |

Methane was not detected at any of the locations, suggesting that landfill gas is not migrating from the site. At SP3R and SP4R, the water level was above the screened portion of the well (flooded), while the water level at SP5 was within the screened interval of the well (partially flooded).

# 7 2022 MONITORING PROGRAM

The annual monitoring program, as detailed in the ECA, should be continued at the Holbrook Landfill site in 2022. The packers placed in shallow and deep groundwater wells 26R and 27 should be maintained to prevent discharge from the flowing wells from reaching the surface water drainage system.

Table 7-1 provides the recommended 2022 environmental monitoring program for the Site.

**Table 7-1 2022 Environmental Monitoring Program**

| ACTIVITY | LOCATION | SAMPLING FREQUENCY | ANALYSIS / MEASUREMENT |
|---|---|---|---|
| Groundwater and Leachate Level Monitoring | **Shallow Flow System:** 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 40, 43, 44, 45, 46, SG1<br>**Deep Flow System:** 16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 39, 42<br>**Leachate Well:** 41 | Annual (May) | Water Level Measurement |
| Groundwater and Leachate Sampling | **Shallow Flow System:** 11R, 16AR, 19R, 26R, 28R, 32R, 40, 43, 44, 45, 46<br>**Deep Flow System:** 21R, 24R, 25R, 27, 37R, 38, 39, 42<br>**Private Wells:** D2 (Pearce)<br>**Leachate Well:** 41 | Annual (May) | **Field Parameters:** pH, conductivity, temperature<br>**General Parameters:** pH, conductivity, hardness<br>**Major and Minor Ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate<br>**Nutrients and Organics:** ammonia, nitrate, nitrite, TKN, DOC<br>**Dissolved Metals:** boron, chromium, iron, manganese |
| | **Shallow Flow System:** 32R, 26R, 40, 43, 44, 45, 46<br>**Deep Flow System:** 27, 37R, 38, 39, 42<br>**Leachate Well:** 41 | Annual (May) | **Volatile Organic Compounds:** vinyl chloride, benzene, 1,4 dichlorobenzene |

| ACTIVITY | LOCATION | SAMPLING FREQUENCY | ANALYSIS / MEASUREMENT |
|---|---|---|---|
| Landfill Gas Monitoring | **Standpipes:** SP3R, SP4R, SP5 | Annual | Methane, carbon dioxide, oxygen, balance gas, as well as water level |
| Surface Water Sampling | **Surface Water Station:** C01, C06 | Semi-annual (spring and fall) | **Field Parameters:** pH, conductivity, temperature, turbidity<br>**General Parameters:** pH, conductivity, hardness<br>**Major and Minor Ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate<br>**Nutrients and Organics:** ammonia, un-ionized ammonia, nitrate, nitrite<br>**Total Metals:** boron, chromium, iron, manganese |
| | **Surface Water Station:** C04, P01, P02, P03, NE1 | Annual (spring) | |

# 8 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the 2021 monitoring program presented in this report, the following conclusions are provided.

- Groundwater movement in the shallow flow system across most of the site is inferred to be southwesterly towards the on-site creek, while shallow groundwater movement in the western portion of the site (west of the creek) is inferred to flow east towards the creek. However, the shallow flow system groundwater elevations indicate that a mound exists in the fill area, inducing a localized radial flow away from the fill area to the east and southeast. Thus, groundwater flow in the shallow flow system across the majority of the site is inferred to converge on the on-site stream, with a minor component of localized shallow groundwater flow from the fill area toward the east and southeast.
- The retention pond located in the central portion of the site (pond P02) likely receives shallow groundwater inflow from beneath the landfill.
- Groundwater movement in the deeper flow system is inferred to be in a generally south to southeasterly direction beneath the site. The horizontal hydraulic gradient across the site is low, with a grade change of less than 1 m from the north to southeast limits of the site.
- The leachate strength at the site is relatively weak, with chloride and sodium concentrations below their respective Ontario Drinking Water Quality Standards (ODWQSs).
- There may have been some historical landfill impacts in a number of the shallow groundwater flow system wells adjacent to the northeast and particularly to the east and southeast of the landfill; however, most of these have abated such that there was no clear indication of leachate influence in the shallow observation wells at the downgradient property boundaries to the east/southeast at the site during 2021. The shallow groundwater quality complies with Guideline B-7, with the exception of hardness, chloride, alkalinity, sodium, DOC, and boron at observation well 26R, and nitrate at well 44. Concentrations of hardness are interpreted to be naturally elevated in the shallow flow system. The nitrate exceedance at well 44 is not likely to be the result of a landfill leachate impact as nitrate has not been detected within the leachate, and only in very low concentrations in the

shallow groundwater adjacent to the east side of the landfill mound. Furthermore, other leachate indicator parameters such as chloride, alkalinity, and VOCs are not elevated at well 44. The nitrate concentration is likely the result of agricultural activities that surround this well location.

- It is suspected that road salting and/or off-site sources are a contributing factor in the exceedances at observation well 26R, as both chloride and sodium concentrations were greater at well 26R than within leachate well 41 in 2021, as well as in recent historical results. Based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound. Groundwater appears to flow north from the property boundary at 26R toward monitoring wells 45 and 46. Meanwhile, key parameter concentrations within monitoring wells 45 and 46 were well below the concentrations at 26R. Continued additional monitoring of wells 45 and 46 is recommended to confirm this conclusion.
- There was no clear indication of leachate influence in the deeper groundwater flow system at the property boundaries in 2021. The deep groundwater quality complies with Guideline B-7, with the exception of hardness and iron at wells 27, 37R, and 38. Concentrations of hardness and iron are interpreted to be naturally elevated in the deep flow system. The hardness concentrations at observation wells 27, 37R and 38 are actually below the 2021 background result at well 39. Thus, the site is considered to be in compliance at the downgradient property boundaries.
- None of the groundwater trigger criteria at the site were exceeded during 2021, with the exception of chloride and boron concentrations at observation well 26R. It is suspected that road salting and/or off-site sources are contributing factors in the chloride and boron concentrations at observation well 26R, as both these concentrations were greater at well 26R than within the leachate well 41 in 2021, as well as in recent historical results. It is also noted that VOCs have not been detected in the samples collected at well 26R. As discussed previously, based on the groundwater elevation and chemistry results at wells 45 and 46, the elevated concentrations and trigger exceedances in property boundary well 26R do not appear to be the result of shallow groundwater migrating from the landfill mound.
- Surface water quality in the wetland at the northeast site boundary, and the northern and southeast on-site retention ponds was not measurably affected by the landfill in 2021. Surface water quality at intermediate station C04 along the on-site stream and retention pond P02 in the central part of the site were inferred to be slightly influenced by the landfill.
- Surface water quality in the on-site stream leaving the site (station C01) has been affected by landfill influences from the upstream portions of the on-site stream, shallow groundwater discharge, and possibly road salting activities. However, the landfill influences in the surface water quality leaving the site are very weak, based on the monitoring results, with chloride values below the CEQG water quality guideline for the protection of aquatic life. Surface water quality leaving the site at station C01 complies with the current trigger level boundary criteria.
- No methane was detected during the 2021 monitoring event at any of the landfill gas monitoring probes, located adjacent to the east, northeast, and north of the landfill mound.

Based on the findings of the 2021 monitoring program, the following recommendations are provided for consideration.

- Monitoring should be continued at the site in 2022 with the recommended program presented in Section 7.0.
- The landfill slopes should continue to be inspected to confirm that there are no leachate seeps in the area.
- Supplemental groundwater samples should continue to be collected in 2022 at observation wells 45 and 46 to further evaluate the source of the trigger exceedances at observation well 26R.
- Once monitoring for the expanded parameter database has been completed for a few years, the groundwater and surface water trigger mechanism plans should be re-assessed. A minimum of eight data sets should be collected for each parameter, before re-assessing.

# 9 REFERENCES

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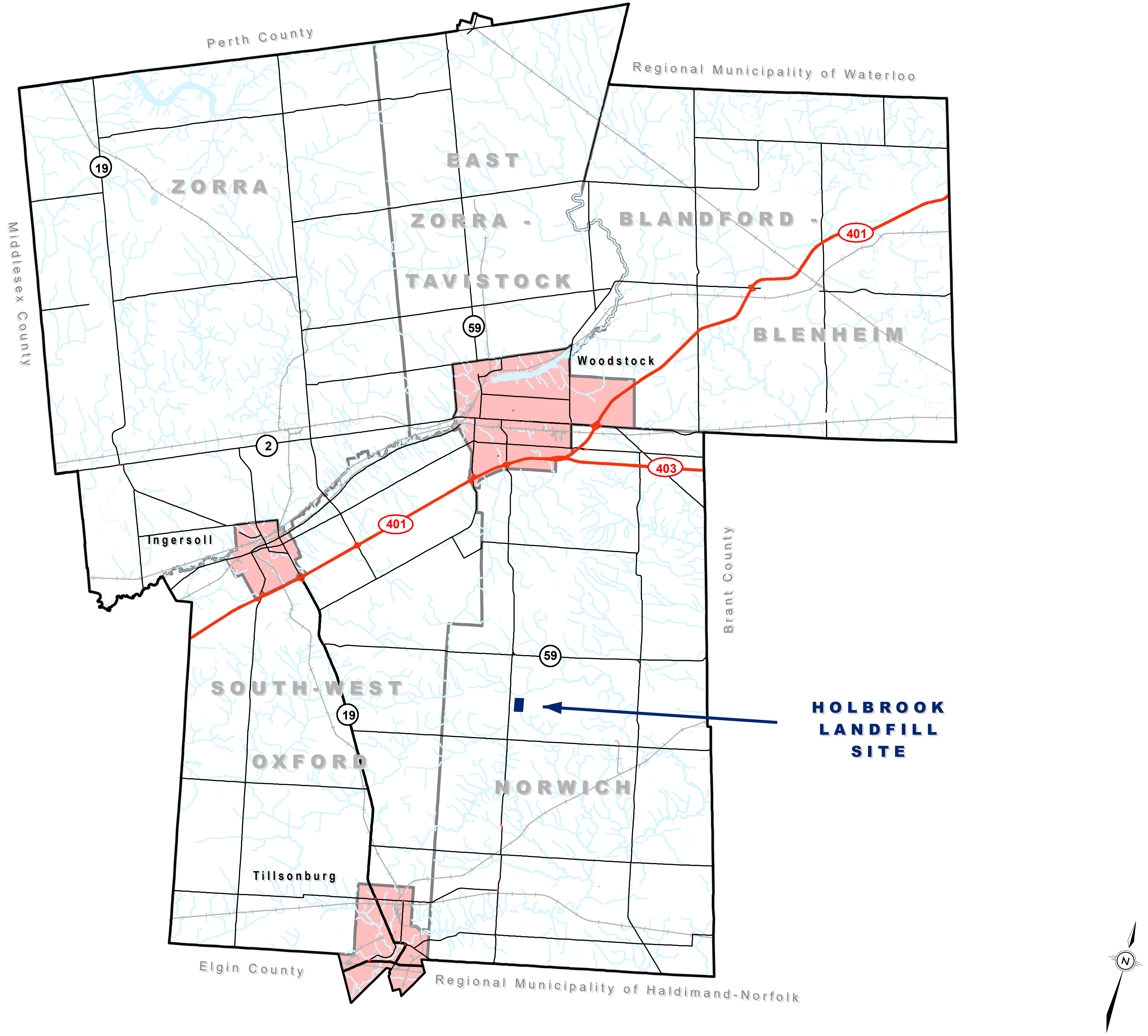
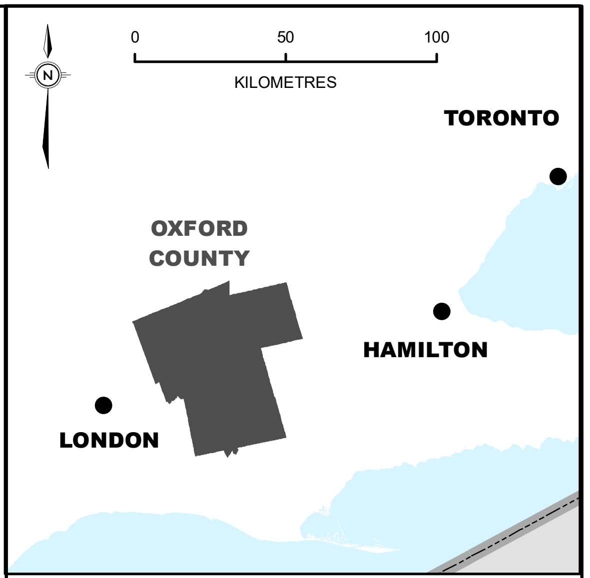
# FIGURES





0 5 10
KILOMETRES

NAD 1983 UTM Zone 17N

# SITE LOCATION MAP

2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

| | |
|---|---|
| DATE: | JANUARY 2022 |
| PROJECT: | 111-53037-05 |
| SCALE: | 1 : 250,000 |
| DRAWN BY: | CGN |
| FIGURE No: | 1 |

wsp
55 KING STREET, SUITE 700
ST. CATHARINES, ON L7R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

H:\Projects\2011\111-53037 Holbrook Landfill\04 2020\Graphics\111-53037-04-F1-LP.mxd

LEGEND

| | |
|---|---|
| | PROPERTY LINE (APPROXIMATE) |
| 28R ⊕ | SHALLOW AQUIFER MONITORING WELL |
| 21R ⊕ | DEEP AQUIFER MONITORING WELL |
| 41 ⊗ | LEACHATE MONITORING WELL |
| 20 ⊕ | HISTORIC MONITORING WELL (ASSUMED LOCATION) |
| SP3R ● | STANDPIPES |
| SG1 ⊞ | STAFF GAUGE |
| D-2 ● | DOMESTIC WELL |
| P01 ▲ | SURFACE WATER SAMPLING LOCATION |
| ← | SURFACE WATER FLOW DIRECTION |
| A | CROSS-SECTION LOCATION AND DESIGNATION |

0 80 160 m

SOURCE:
PARCEL FABRIC, PROPERTY BOUNDARIES AND ORTHOPHOTO PROVIDED BY OXFORD COUNTY, 2011.

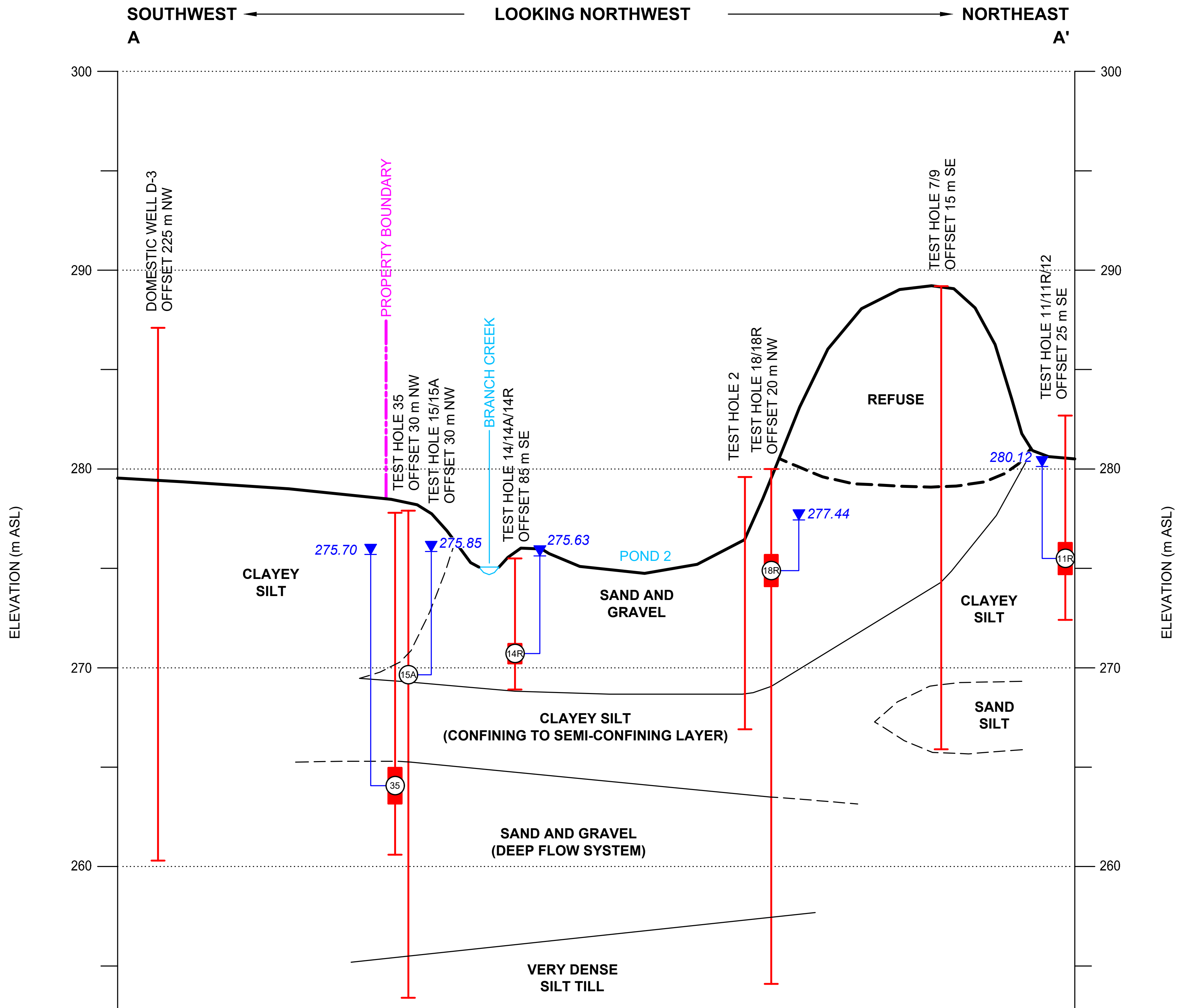
# SITE PLAN

2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

| | |
|---|---|
| DATE: | JANUARY 2022 |
| PROJECT: | 111-53037-05 |
| SCALE: | 1 : 4,000 |
| DRAWN BY: | CGN |

55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

FIGURE No: 2



LEGEND

15 WELL DESIGNATION
GROUND SURFACE
GROUNDWATER ELEVATION (MAY 11, 2021)
SCREENED INTERVAL
15A SCREEN DESIGNATION
INFERRED STRATIGRAPHIC CONTACT
INFERRED ORIGINAL GROUND SURFACE

HORIZONTAL SCALE:
0 80 160 m
16x VERTICAL SCALE EXAGERRATION

NOTES:
1. GROUND SURFACE TOPOGRAPHY BASED ON INFORMATION PROVIDED IN "HYDROGEOLOGICAL INVESTIGATIONS, HOLBROOK SANITARY LANDFILL SITE, 1979-1982" BY MACLAREN ENGINEERS, OCTOBER 1982.
2. STRATIGRAPHY INTERPRETED FROM BOREHOLES LOGGED BY VARIOUS CONSULTANTS.

GEOLOGICAL SEQUENCES/CONTACTS HAVE BEEN INTERPOLATED AND MAY DIFFER FROM THAT DEPICTED.

# CROSS SECTION A-A'

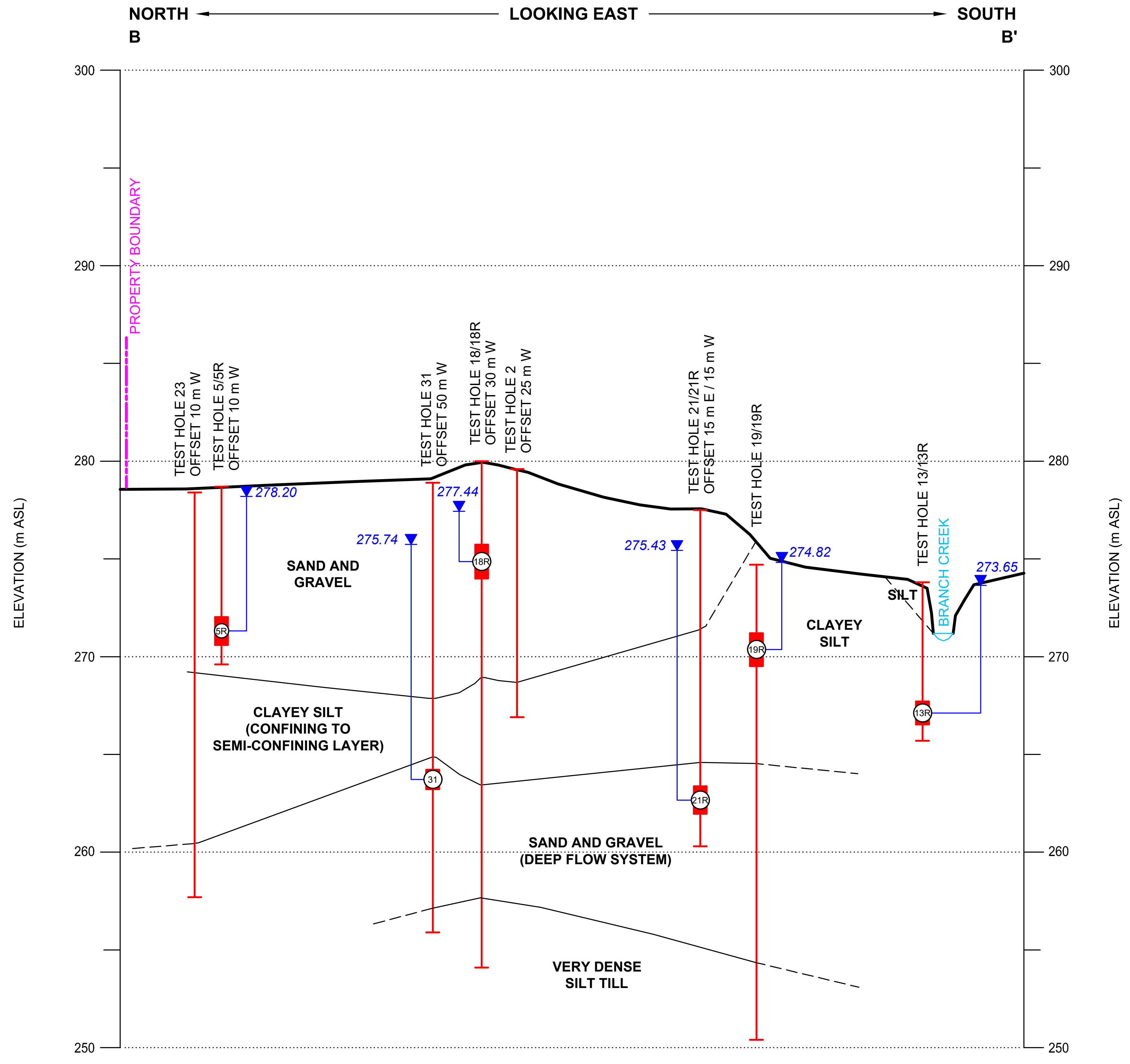
2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

DATE: JANUARY 2022
PROJECT: 111-53037-05
HORIZONTAL SCALE: 1 : 4,000
DRAWN BY: CGN

55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

FIGURE No: 3

C:\USERS\INCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F3-CS.DWG



LEGEND

15 WELL DESIGNATION

GROUND SURFACE

GROUNDWATER ELEVATION
(MAY 11, 2021)

SCREENED INTERVAL

15A SCREEN DESIGNATION

INFERRED STRATIGRAPHIC CONTACT

INFERRED ORIGINAL GROUND SURFACE

HORIZONTAL SCALE:
0 80 160 m
16x VERTICAL SCALE EXAGERRATION

NOTES:
1. GROUND SURFACE TOPOGRAPHY BASED ON INFORMATION PROVIDED IN "HYDROGEOLOGICAL INVESTIGATIONS, HOLBROOK SANITARY LANDFILL SITE, 1979-1982" BY MACLAREN ENGINEERS, OCTOBER 1982.
2. STRATIGRAPHY INTERPRETED FROM BOREHOLES LOGGED BY VARIOUS CONSULTANTS.

GEOLOGICAL SEQUENCES/CONTACTS HAVE BEEN INTERPOLATED AND MAY DIFFER FROM THAT DEPICTED.

# CROSS SECTION B-B'

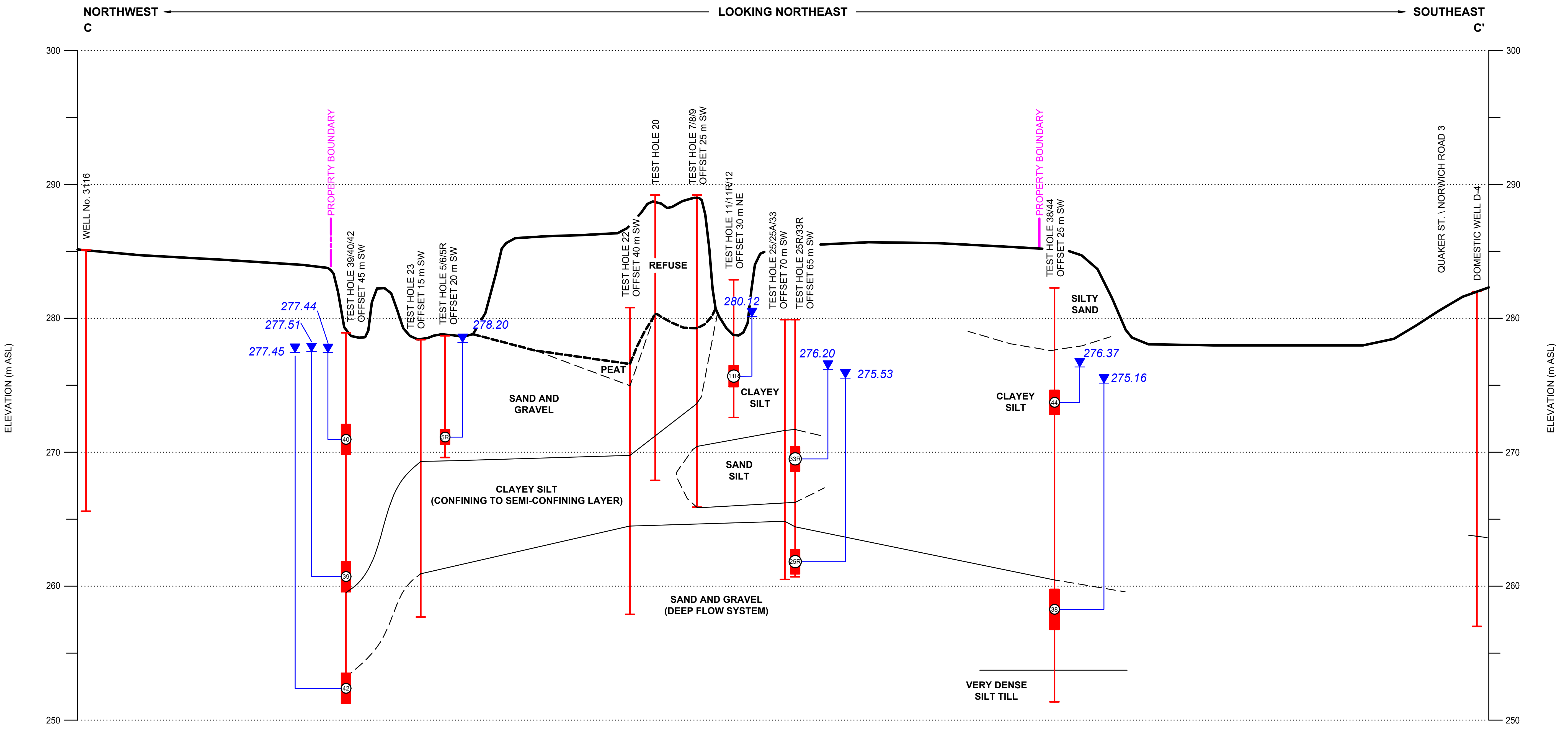
2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

DATE: JANUARY 2022
PROJECT: 111-53037-05
HORIZONTAL SCALE: 1 : 4,000
DRAWN BY: CGN

55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

FIGURE No: 4

C:\USERS\INCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F4-CS.DWG



HORIZONTAL SCALE:

0 100 200 m

16x VERTICAL SCALE EXAGERRATION

NOTES:
1. GROUND SURFACE TOPOGRAPHY BASED ON INFORMATION PROVIDED IN "HYDROGEOLOGICAL INVESTIGATIONS, HOLBROOK SANITARY LANDFILL SITE, 1979-1982" BY MACLAREN ENGINEERS, OCTOBER 1982.
2. STRATIGRAPHY INTERPRETED FROM BOREHOLES LOGGED BY VARIOUS CONSULTANTS.

GEOLOGICAL SEQUENCES/CONTACTS HAVE BEEN INTERPOLATED AND MAY DIFFER FROM THAT DEPICTED.

LEGEND

| | |
|---|---|
| 15 | WELL DESIGNATION |
| ━━ | GROUND SURFACE |
| ▼ | GROUNDWATER ELEVATION (MAY 11, 2021) |
| ▮ | SCREENED INTERVAL |
| 15A | SCREEN DESIGNATION |
| ─── | INFERRED STRATIGRAPHIC CONTACT |
| ‑ ‑ ‑ | INFERRED ORIGINAL GROUND SURFACE |

# CROSS SECTION C-C'

2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

DATE: JANUARY 2022

PROJECT: 111-53037-05

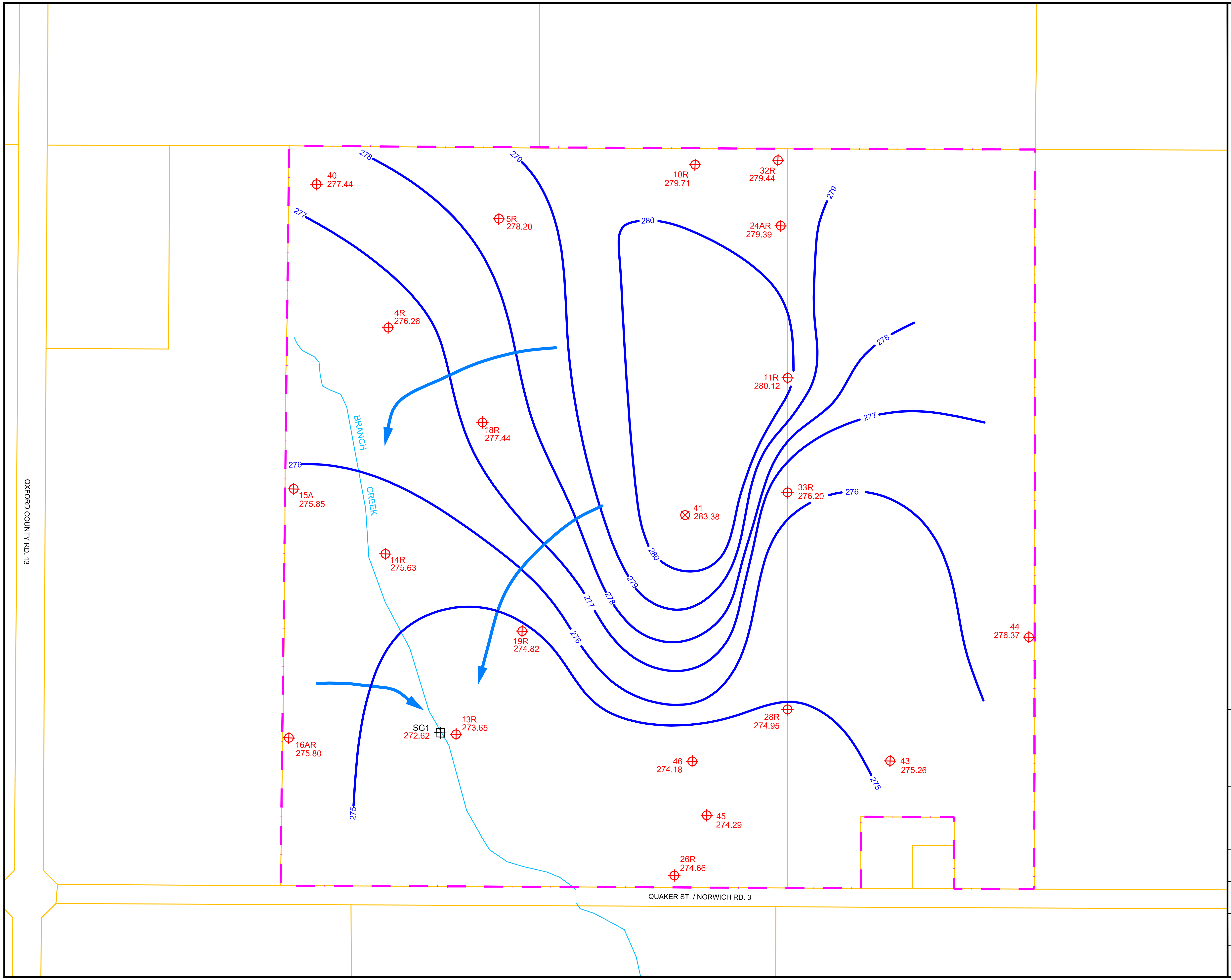
HORIZONTAL SCALE: 1 : 5,000

DRAWN BY: CGN

55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

FIGURE No: 5

C:\USERS\NCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F5-CS.DWG



LEGEND

| | |
|---|---|
| ━ ━ | PROPERTY LINE (APPROXIMATE) |
| 28R ⊕ | SHALLOW AQUIFER MONITORING WELL |
| 41 ⊗ | LEACHATE MONITORING WELL |
| SG1 ⊞ | STAFF GAUGE |
| 283.38 | GROUNDWATER ELEVATION FOR MAY 2021 (m ASL) |
| —279— | INFERRED GROUNDWATER CONTOUR (m ASL) |
| ← | PROBABLE DIRECTION OF GROUNDWATER MOVEMENT |

N

0 80 160 m

SOURCE:
PARCEL FABRIC, PROPERTY BOUNDARIES AND ORTHOPHOTO PROVIDED BY OXFORD COUNTY, 2011.

# SHALLOW FLOW SYSTEM GROUNDWATER ELEVATIONS - MAY 2021

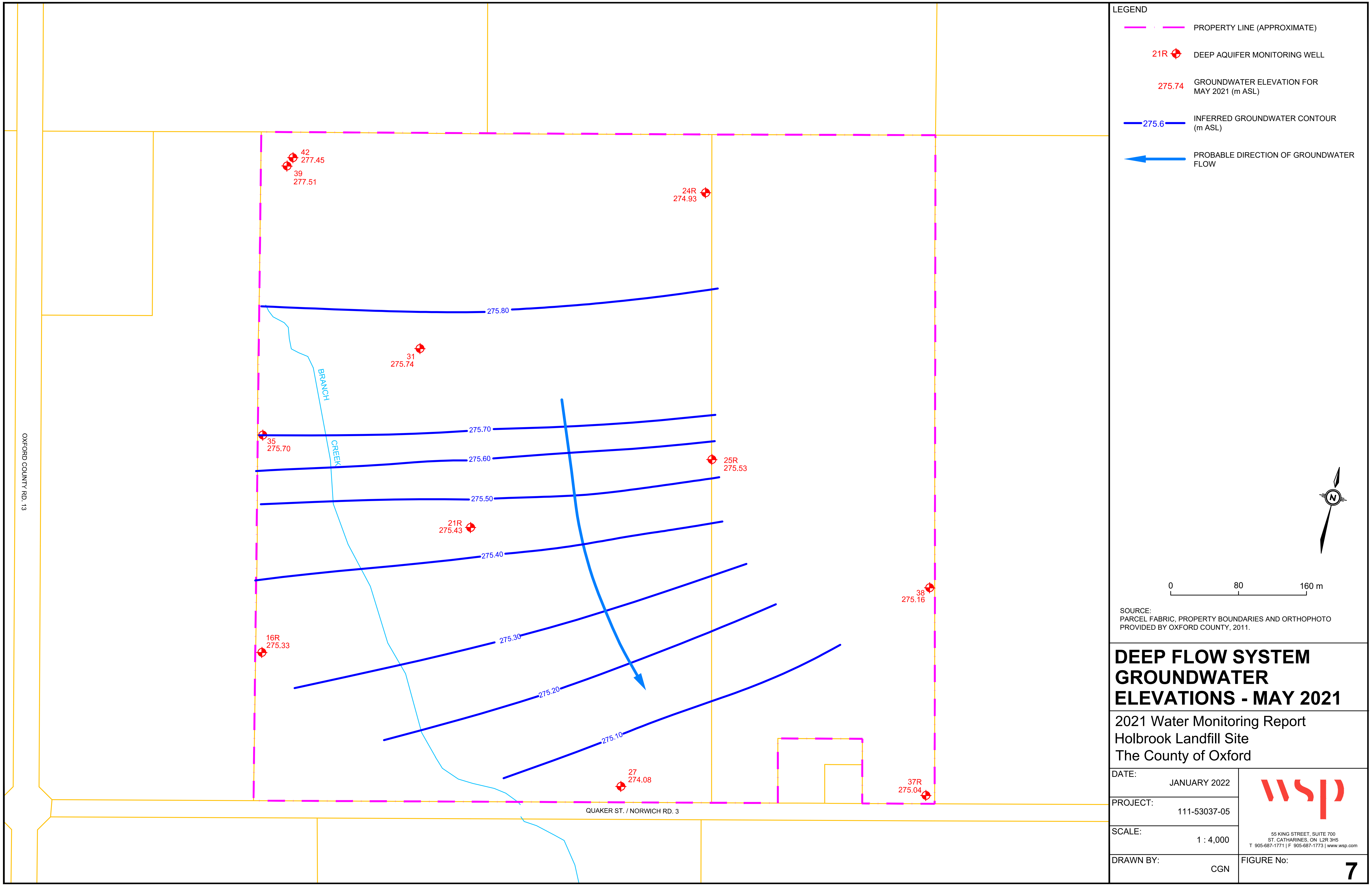
2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

DATE: JANUARY 2022
PROJECT: 111-53037-05
SCALE: 1 : 4,000
DRAWN BY: CGN

55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

FIGURE No: 6

C:\USERS\NCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F6-GW.DWG



SOURCE:
PARCEL FABRIC, PROPERTY BOUNDARIES AND ORTHOPHOTO PROVIDED BY OXFORD COUNTY, 2011.

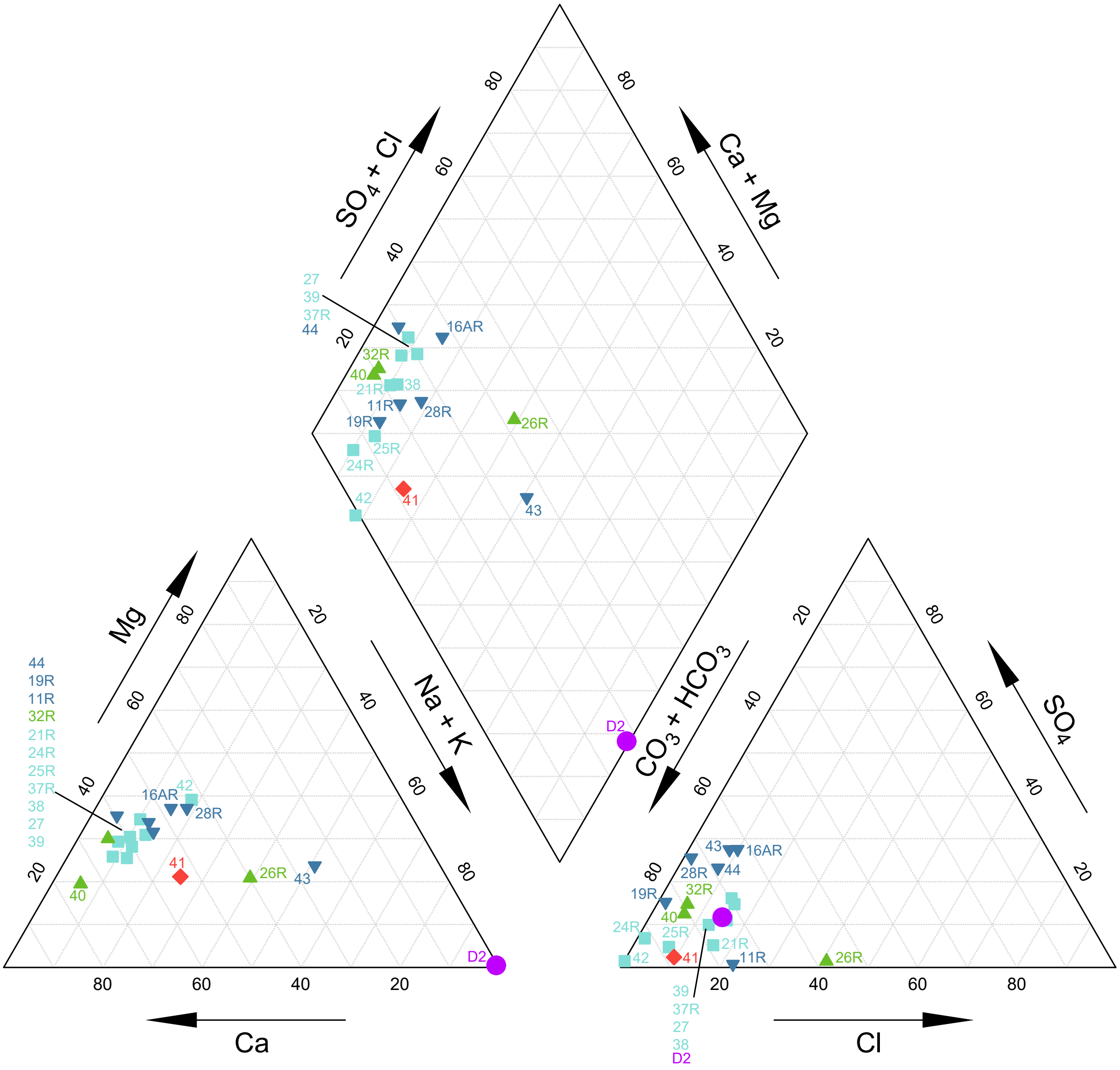
# DEEP FLOW SYSTEM GROUNDWATER ELEVATIONS - MAY 2021

2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

DATE: JANUARY 2022
PROJECT: 111-53037-05
SCALE: 1 : 4,000
DRAWN BY: CGN
FIGURE No: 7

wsp
55 KING STREET, SUITE 700
ST. CATHARINES, ON L2R 3H5
T 905-687-1771 | F 905-687-1773 | www.wsp.com

C:\USERS\INCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F7-GW.DWG



LEGEND

41 ◆ LEACHATE WELL

40 ▲ SHALLOW FLOW SYSTEM WELL

28 ■ SHALLOW FLOW SYSTEM / SHALLOW CONFINING LAYER WELL

25R ▼ DEEP FLOW SYSTEM WELL

D2 ● DOMESTIC WELL

# TRILINEAR DIAGRAM - MAY 2021

wsp

2021 Water Monitoring Report
Holbrook Landfill Site
The County of Oxford

SCALE: AS SHOWN

DRAWN BY: CGN

DATE: JANUARY 2022

PROJECT: 111-53037-05

FIGURE No: 8

C:\USERS\INCN02832\ONEDRIVE - WSP O365\111-53037-05 HOLBROOK LANDFILL SITE\4 MODELS AND DRAWINGS\41 XX\DWG\111-53037-05-F8-TL.DWG

# APPENDIX

# A

# CERTIFICATES OF APPROVAL

Ontario

Ministry
of the
Environment

Southwestern
Region

985 Adelaide Street South
London, Ontario.
N6E 1V3
(519) 681-3600

February 4, 1983

Mr. D. Pratt
County Engineer
County of Oxford
Box 397
Woodstock, Ontario

Dear Sir:

RE: Holbrook Landfill
Certificate A-07-07-02
Our File M & P 19-03

On January 31, 1983 Mr. J. Stinson, Environmental Officer, inspected the Holbrook landfill site. The site is inspected to determine the operating condition at that time.

The site was well operated with a small dumping face and an ample supply of cover material. A larger fence was constructed around the landfill area to contain the litter.

The site is well run and maintained. If additional information is required please contact this office.

Yours truly,

J. F. Janse, P. Eng.
District Officer
Municipal and Private Abatement

JFS:jc
4/1/3F

of the
Environment
Ontario

Provisional Certificate No.
A 070702

# PROVISIONAL CERTIFICATE OF APPROVAL
# WASTE DISPOSAL SITE

Under the Environmental Protection Act and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to:

County of Oxford,
P.O. Box 397,
415 Hunter Street,
Woodstock, Ontario.
N4S 7Y3

for the use and operation of a 10.12 hectare (25 acre) landfilling site within a total site area of 40.5 hectares (100 acres),

all in accordance with the following plans and specifications:

Located:
S.W. 1/4 Lot 20, and S.E. 1/4 Lot 21, Concession 3,
Township of Norwich,
County of Oxford.

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval)

Domestic, commercial and non-hazardous solid industrial wastes.

and subject to the following conditions:

1. The use, operation and closure of the site shall be in accordance with the following documents:

   (1) Report prepared by MacLaren Engineers entitled "County of Oxford, Contingency Plan for Solid Waste Disposal", dated March 1982.

   (2) The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated December 8, 1982.

   (3) Report prepared by MacLaren Engineers entitled "Hydrogeological Investigations - Summary Report - October 1982".

Dated this 31st day of March, 1983.

Director, Section 38
Environmental Protection Act

Ministry
of the
Environment
Ontario

# PROVISIONAL CERTIFICATE OF APPROVAL
# WASTE DISPOSAL SITE

The following conditions are additional to the conditions shown on Provisional Certificate of Approval Number A 070702 dated March 31, 1983

(4) Application form signed by D.L. Pratt of the County of Oxford entitled "Application for a Certificate of Approval for a Waste Disposal Site (Landfill)" dated March 15, 1982.

2. Background water quality levels for the site are to be determined to the satisfaction of the Director of the Southwestern Region of the Ministry of the Environment.

3. Upon cessation of waste disposal operations at the site, the site is to be properly closed utilizing at least 2 feet of suitable final cover material, in a manner which establishes properly graded final slopes and to the satisfaction of the Director of the Southwestern Region of the Ministry of the Environment.

4. No waste is to be deposited at the site after June 30, 1984.

5. By June 30, 1983 suitable plans accomodating a minimum 5% slope in all of cell 1 and detailing the staged development and closure of the site are to be submitted to the Director of the Environmental Approvals and Project Engineering Branch and, following its approval, shall be implemented.

6. Where there is a conflict between a provision of documents (1),(3), or (4) listed in condition 1 and a provision of document (2) listed in condition 1, the provision in document (2) shall apply.

7. By June 30, 1983 a suitable surface water control plan is to be submitted to the Director of the Environmental Approvals and Project Engineering Branch and, following its approval, shall be implemented.

Ontario

MINISTRY OF THE ENVIRONMENT

# NOTICE

**TO:**

County of Oxford,
P.O. Box 397,
415 Hunter Street,
Woodstock, Ontrio.
N4S 7Y3

You are hereby notified that Provisional Certificate of Approval No. A 070702 has been issued to you subject to the conditions outlined therein.

The reasons for the imposition of these conditions are as follows:

1. The reason for the imposition of condition no. 1 is to ensure that the use, operation and closure of the site is in accordance with the plans and documentation submitted for approval and approved by the Director of the Environmental Approvals and Project Engineering Branch and is carried out in an orderly and systematic manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

2. The reason for the imposition of condition no. 2 is that defining proper background water quality levels is an integral part of a monitoring program to establish that pollutant attenuation is taking place on site as intended and the use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

3. The reason for the imposition of condition no. 3 is to ensure that the site is operated and closed in an aesthetically acceptable manner and to control insects, rodents and infiltration and to ensure that the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

4. The reason for the imposition of condition no. 4 is that the applicant has estimated, based on an anticipated rate of landfilling, that the site should reach its design capacity by June 30, 1984.

5. The reason for the imposition of condition no. 5 is that although a minimum 5% final slope is to be achieved in cell 1 and cell 2 of the site to control infiltration, the design plans and specifications contained in document (1) listed in condition 1 do not provide for a minimum 5% final slope in a portion of cell 1. Suitable plans and specifications are therefore necessary to ensure that the minimum 5% final slope is achieved in all portions of cell 1 and cell 2. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

6. The reason for the imposition of condition no.6 is to clarify the manner in which the site is to be orderly and systematically used, operated and closed in the event that there is conflict between the provisions of document (2) and the provisions of documents (1),(3) or (4). The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

7. The reason for the imposition of condition no. 7 is that a suitable surface water control plan is an integral part of an operating and development report for a landfilling site which is needed to ensure that the use, operation and closure of the site is carried out in a proper manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R. of Ontario 1980) pursuant to that Act. The use, operation and closure of the site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board.

This Notice should be served upon:

The Secretary
Environmental Appeal Board
1 St. Clair Avenue West
5th Floor
Toronto, Ontario M4V 1K7

AND

The Director
Section 38, E.P.A.
Ministry of the Environment
135 St. Clair Ave. W.,
Toronto, Ontario M4V 1P5

Dated at Toronto this 31st day of March, 1983.

Director
Section 38, E.P.A.
Ministry of the Environment

Ontario

Environmental
Appeal Board

1 St. Clair Avenue Wes
Toronto, Ontario
M4V 1K7

# FORM OF NOTICE OF APPEAL
## EXPLANATORY NOTES

Appeals to the Environmental Appeal Board should be made in the attached form, which is intended to provide the Board and the respondent with specific details regarding the nature of the appeal.

The form has been structured to allow sufficient space for a typical appeal, and two copies of the form are attached in case the appellant wishes to insert the information on the form provided. A third copy is attached for retention by the appellant.

The form is not intended to be restricting or confining and if, in a particular case, it is found that insufficient space is available on the forms provided, the particulars may be attached on additional plain white sheets.

In some cases, appellants may prefer not to use the forms provided by the Board. The Board will accept Notices of Appeal submitted on the appellant's stationery, provided that the required format and particulars as indicated on the Board's form are present.

Ontario

Ministry
of the
Environment

Provisional Certificate No.
A 070702

HOLBROOK CofA

# PROVISIONAL CERT
# WASTE DI

Under the Environmental Protection A
limitations thereof, this Provisional Certificate of Approval is issued to:

County of Oxford,
P.O. Box 397,
415 Hunter Street,
Woodstock, Ontario.
N4S 7X3

THIS IS A TRUE COPY OF THE
ORIGINAL CERTIFICATE MAILED
on June 28/84
(Signed)

for the use and operation of a 10.12 hectare (25 acre) landfilling site within a total site area of 10.5 hectares (100 acres)

all in accordance with the following plans and specifications:

Located: S.W. 1/4 Lot 20 and S.E. 1/4 Lot 21, Concession 3,
Township of Norwich,
County of Oxford.

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval) domestic, commercial and non-hazardous solid industrial wastes.

and subject to the following conditions:

1. The use, operation and closure of the site shall be in accordance with the following documents:

   (1) Report prepared by MacLaren Engineers entitled "Support Document for Proposed 1984 Extension to the Holbrook Sanitary Landfill Site" dated April 1984.

   (2) Report prepared by MacLaren Engineers entitled "Additional Hydrogeological Investigations at the Holbrook Sanitary Landfill Site" dated October 1983.

Dated this 28th day of June, 19 84.

Director, Section 38
Environmental Protection Act

MOE 1408 (9/81)

# PROVISIONAL CERTIFICATE OF APPROVAL
# WASTE DISPOSAL SITE

The following conditions are additional to the conditions shown on Provisional Certificate

of Approval Number A 070702 dated June 28, 1984

(3) The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated May 29, 1984.

(4) Application form signed by D.L. Pratt of the County of Oxford entitled "Application for a Certificate of Approval for a Waste Disposal Site (Landfill)" dated April 10, 1984.

2. By August 31, 1984 a list of erosion control measures suitable to the Director of the Southwestern Region of the Ministry of the Environment (herein after referred to as "The Director") shall be submitted to him.

3. The erosion control measures submitted pursuant to condition no. 2 above shall be implemented in accordance with the approval of The Director.

4. The Site Plan, Figure no. 1 contained in the report entitled "Support Document for Proposed 1984 Extension to the Holbrook Sanitary Landfill Site" dated April, 1984 shall be modified in a manner approved by The Director to provide a minimum slope greater than 5%.

5. Where waste is to be placed on top of existing final cover, the existing final cover material must be removed prior thereto.

6. No waste is to be deposited at the site after June 30, 1986.

7. The surface water sampling program as outlined in Section 2 of the Agreement between the County of Oxford and the Township of Norwich dated May 29, 1984 shall be modified to include analysis for total phosphorus and ammonia in addition to the parameters listed in the Agreement.

Ontario

MINISTRY OF THE ENVIRONMENT

# NOTICE

June 28/84.
JB

TO: County of Oxford,
P.O. Box 397,
415 Hunter Street,
Woodstock, Ontario. N4S 7Y3

You are hereby notified that Provisional Certificate of Approval No. A 070702 has been issued to you subject to the conditions outlined therein.

The reasons for the imposition of these conditions are as follows:

1. The reason for the imposition of condition no. 1 is to ensure that the use, operation and closure of the site is in accordance with the plans and documentation submitted for approval and approved by the Director of the Environmental Approvals and Project Engineering Branch and is carried out in an orderly and systematic manner and the landfilling operation will be in accordance with the provisions of the Environmental Protection Act and Regulation 309 (R.R.O. 1980) pursuant to that Act. The use, operation and closure of this site without such a condition may create a nuisance or may result in a hazard to the health or safety of any person.

2. The reason for the imposition of condition nos. 2 and 3 is to ensure that erosion is minimized on the side slopes of the landfilled area and the operation of the site without such condition may create a nuisance.

3. The reason for the imposition of condition no. 4 is to reduce the amount of infiltration that would result in leachate production.

4. The reason for the imposition of condition no. 5 is to promote the downward migration of leachate and to minimize leachate breakouts.

5. The reason for the imposition of condition no. 6 is that the applicant has agreed to not to extend the use of the site after June 30, 1986.

6. The reason for the imposition of condition no. 7 is that the added parameters mentioned therein are significant as indicators of the possible effect of landfills on aquatic life.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board.

This Notice should be served upon:

The Secretary
Environmental Appeal Board
1 St. Clair Avenue West
5th Floor
Toronto, Ontario M4V 1K7

AND

The Director
Section 38, E.P.A.
Ministry of the Environment
135 St. Clair Ave. W.,
Toronto, Ontario M4V 1P5

Dated at Toronto this 28th day of June, 1984.

Director,
Section 38, E.P.A.,
Ministry of the Environment.

**Ministry of the Environment and Climate Change**
**Ministère de l'Environnement et de l'Action en matière de changement climatique**

## AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER A070702
Issue Date: September 8, 2016

County of Oxford
21 Reeve St Post Office Box No. 1614
Woodstock, Ontario
N4S 7Y3

Site Location: Holbrook Landfill - closed
Part of Lot 20 & 21, Concession 3
Norwich Township, County of Oxford

*You have applied under section 20.2 of Part II.1 of the* Environmental Protection Act, *R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:*

10.12 hectare landfilling site within a total site area of 40.5 hectares.

*For the purpose of this environmental compliance approval, the following definitions apply:*

"*Approval* " means this Environmental Compliance Approval and any Schedules to it, including the application and supporting documentation listed in Schedule "A";

"Director" means any Ministry employee appointed in writing by the Minister pursuant to section 5 of the EPA as a Director for the purposes of Part II.1 of the EPA;

"*District Manager*" means the District Manager of the local district office of the *Ministry* in which the *Site* is geographically located;

"*EPA* " means *Environmental Protection Act* , R.S.O. 1990, c. E. 19, as amended;

*"Ministry"* means the Ontario Ministry of the Environment and Climate Change;

"*Owner*" means any person that is responsible for the establishment or operation of the *Site* being approved by this *Approval,* and includes The County of Oxford and its successors and assigns;

"*Regional Director* " means the Regional Director of the local Regional Office of the *Ministry* in which the *Site* is located; and

*"Regulation 232"* means Ontario Regulation 232/98 (New Landfill Standards) made under the *EPA* , as amended from time to time;

"*Regulation 347* " means Ontario Regulation 347, R.R.O. 1990, made under the EPA, as amended;

"*Regulation 903"* means Regulation 903, R.R.O. 1990, made under the *OWRA,* as amended;

"*Site* " means the entire waste disposal site, including the buffer land at Parts of Lot 20 & 21, Concession 3, Township of Norwich, County of Oxford.

*You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:*

TERMS AND CONDITIONS

## 1. GENERAL

### Compliance

1 The *Owner* and *Operator* shall ensure compliance with all the conditions of this *Approval* and shall ensure that any person authorized to carry out work on or operate any aspect of the *Site* is notified of this *Approval* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2 Any person authorized to carry out work on or operate any aspect of the *Site* shall comply with the conditions of this *Approval* .

### In Accordance

3 Except as otherwise provided by this *Approval,* the *Site* shall be designed, developed, built, operated and maintained in accordance with the documentation listed in the attached Schedule “A”.

### Interpretation

4 Where there is a conflict between a provision of any document listed in Schedule "A" in this *Approval,* and the conditions of this *Approval,* the conditions in this *Approval* shall take precedence.

5 Where there is a conflict between the application and a provision in any document listed in Schedule "A", the application shall take precedence, unless it is clear that

the purpose of the document was to amend the application and that the *Ministry* approved the amendment.

6 Where there is a conflict between any two documents listed in Schedule "A", the document bearing the most recent date shall take precedence.

7 The conditions of this *Approval* are severable. If any condition of this *Approval,* or the application of any condition of this *Approval* to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this *Approval* shall not be affected thereby.

**Other Legal Obligations**

8 The issuance of, and compliance with, this *Approval* does not:
  (a) relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement; or
  (b) limit in any way the authority of the *Ministry* to require certain steps be taken or to require the *Owner* and *Operator* to furnish any further information related to compliance with this *Approval* .

**Adverse Effect**

9 The *Owner* shall take steps to minimize and ameliorate any adverse effect on the natural environment or impairment of water quality resulting from the *Site,* including such accelerated or additional monitoring as may be necessary to determine the nature and extent of the effect or impairment.

10 Despite an *Owner* or any other person fulfilling any obligations imposed by this *Approval* the person remains responsible for any contravention of any other condition of this *Approval* or any applicable statute, regulation, or other legal requirement resulting from any act or omission that caused the adverse effect to the natural environment or impairment of water quality.

**Change of Ownership**

11 The *Owner* shall notify the *Director,* in writing, and forward a copy of the notification to the *District Manager,* within 30 days of the occurrence of any changes in the following information:
  (a) the ownership of the *Site;*
  (b) the *Operator* of the *Site;*
  (c) the address of the *Owner or Operator;* and
  (d) the partners, where the *Owner or Operator* is or at any time becomes a partnership and a copy of the most recent declaration filed under the *Business Names Act* , R. S. O. 1990, c. B.17, shall be included in the notification.

12 No portion of this *Site* shall be transferred or encumbered after closing of the *Site* unless the *Director* is notified in advance and sufficient financial assurance is deposited with the *Ministry* to ensure that these conditions will be carried out.

13 In the event of any change in ownership of the *Site,* other than change to a successor municipality, the *Owner* shall notify the successor of and provide the successor with a copy of this *Approval,* and the *Owner* shall provide a copy of the notification to the *District Manager* and the *Director.*

**Certificate of Requirement/Registration on Title**

Registration on Title Requirement

14 Prior to dealing with the property in any way, the *Owner* shall provide a copy of this *Approval* and any amendments, to any person who will acquire an interest in the property as a result of the dealing.

15 (a) Within sixty (60) calendar days from the date of issuance of this *Approval,* the *Owner* shall submit to the *Director* a completed Certificate of Requirement which shall include:
- (i) a plan of survey prepared, signed and sealed by an Ontario Land Surveyor, which shows the area of the *Site* where waste has been or is to be deposited at the *Site;*
- (ii) proof of ownership of the *Site;*
- (iii) a letter signed by a member of the Law Society of Upper Canada or other qualified legal practitioner acceptable to the *Director,* verifying the legal description provided in the Certificate of Requirement;
- (iv) the legal abstract of the property; and
- (v) any supporting documents including a registerable description of the *Site.*

(b) Within fifteen (15) calendar days of receiving a Certificate of Requirement authorized by the *Director,* the *Owner* shall:
- (i) register the Certificate of Requirement in the appropriate Land Registry Office on the title to the property; and
- (ii) submit to the *Director* and *District Manager,* written verification that the Certificate of Requirement has been registered on title.

**Registration on Title Requirement - Contaminant Attenuation Zone (CAZ)**

16. The Owner shall, within sixty (60) calendar days from the date of issuance of this Approval, submit to the *Director* documents confirming that a contaminant attenuation zone (CAZ) has been established, in either fee simple or by way of a groundwater easement.

17 Within thirty (30) calendar days from the date of establishing a contaminant attenuation zone (CAZ) (overburden and/or bedrock aquifers) in either fee simple or by way of a groundwater easement, the *Owner* shall submit to the *Director* a completed Certificate of Requirement which shall include:

(a) If rights are obtained in fee simple, the *Owner* shall provide:
  (i) documentation evidencing ownership of the CAZ obtained in compliance with *O.Reg. 232/98,* as amended;
  (ii) a completed Certificate of Requirement and supporting documents containing a registerable description of the CAZ; and
  (iii) a letter signed by a member of the Law Society of Upper Canada; or other qualified legal practitioner acceptable to the *Director,* verifying the legal description of the CAZ.

(b) within fifteen (15) calendar days of receiving a Certificate of Requirement signed or authorized by the *Director,* the Owner shall:
  (i) register the Certificate of Requirement in the appropriate Land Registry Office on the title to the property; and
  (ii) submit to the *Director* and the *District Manager,* written verification that the Certificate of Requirement has been registered on title.

(c) If rights are obtained by way of a groundwater easement, the Applicant shall:
  (i) provide a copy of the easement;
  (ii) provide a plan of survey signed and sealed by an Ontario Land Surveyor for the CAZ;
  (ii) submit proof of registration on title of the groundwater easement to the *Director;*

(d ) The *Owner* shall not amend or remove or consent to the removal of the easement or CAZ from title without the prior written consent of the *Director.*

## 2. CLOSURE PLAN

*1. By no later than July 15, 2017,* the *Owner* shall submit to the *Director* for approval, with copies to the *District Manager,* a detailed *Site* closure plan pertaining to the termination of landfilling operations at this *Site,* post-closure inspection, maintenance and monitoring, and end use. The plan shall include but not be limited to the following information:

(a) a plan showing *Site* appearance after closure;
(b) a description of the proposed end use of the *Site;*

(c) a descriptions of the procedures for closure of the *Site,* including:

- (i) advance notification of the public of the *Landfill* closure;
- (ii) posting of a sign at the *Site* entrance indicating that the *Landfill* is closed and identifying any alternative waste disposal arrangements;
- (iii) completion, inspection and maintenance of the final cover and landscaping;
- (iv) *Site* security;
- (v) removal of unnecessary *Landfill* related structures, buildings and facilities;
- (vi) final construction of any control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas; and
- (vii) a schedule indicating the time period for implementing sub-conditions (i) to (vi) above.

(d) descriptions of the procedures for post-closure care of the *Landfill,* including:

- (i) operation, inspection and maintenance of the control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas;
- (ii) record keeping and reporting; and
- (iii) complaint contact and response procedures;

(e) an assessment of the adequacy of and need to implement the contingency plans for leachate and methane gas; and

(f) an updated estimate of the contaminating life span of the *Site,* based on the results of the monitoring programs to date.

2 The *Site* shall be closed in accordance with the closure plan as approved by the *Director.*

3 The Site is hereby acknowledged to be closed for receipt of waste for disposal since 1986, and no waste management activities shall be carried out at the Site without approval of the Director.

## 3.0 LANDFILL MONITORING

### Compliance

1 The *Site* shall be operated in such a way as to ensure compliance with the following:

(a) Reasonable Use Guideline B-7 for the protection of the groundwater at the *Site;* and

(b) Provincial Water Quality Objectives included in the July 1994 publication entitled *Water Management Policies, Guidelines, Provincial Water Quality Objectives,* as amended from time to time or limits set by the *Regional Director,* for the protection of the surface water at and off the *Site.*

(c) The *Owner* shall submit to the *Director* , Environmental Approvals Branch, Ministry of the Environment and Climate Change an application for approval to amend the *ECA* to address any non-compliance Guideline B-7, including if warranted an application to incorporate a contaminant attenuation zone into the approval, and including a proposed updated *EMP* . The application shall outline the options that were considered for bringing the *Site* into compliance with Guideline B-7 and the rationale for the preferred option, and include all necessary supporting documentation.

2 The *Owner* shall monitor surface water and ground water in accordance with documents in Schedule "A".

**Annual Report**

3 A written report on the development, operation and monitoring of the *Site,* shall be completed annually (the "Annual Report"). The Annual Report shall be submitted to the *District Manager,* by March 31st of the year following the period being reported upon.

4 The Annual Report shall include but not be limited to the following information:
(a) the results and an interpretive analysis of the results of all leachate, groundwater, surface water and landfill gas monitoring, including an assessment of the need to amend the monitoring programs;
(b) site plans showing the final contours of the *Site* and vegetative cover;
(c) a discussion of any operational problems encountered at the *Site* and corrective action taken;
(d) a report on the status of all monitoring wells and a statement as to compliance with *Regulation 903;*
(e) any other information with respect to the *Site* which the *District Manager* may require from time to time; and
(f) a summary and analysis of all hydraulic and geochemical monitoring results.

**Groundwater Wells and Monitors**

5 The *Owner* shall ensure that all groundwater monitoring wells which form part of the monitoring program are properly capped, locked and protected from damage.

6 Any groundwater monitoring well included in the on-going monitoring program that are damaged shall be assessed, repaired, replaced or decommissioned by the *Owner,* as required.

(a) The *Owner* shall repair or replace any monitoring well which is destroyed or in any way made to be inoperable for sampling such that no more than one regular sampling event is missed.

(b) All monitoring wells which are no longer required as part of the groundwater monitoring program, and have been approved by the *District*

*Manager* for abandonment, shall be decommissioned by the *Owner,* as required, in accordance with *Reg. 903,* that will prevent contamination through the abandoned well. A report on the decommissioning of the well shall be included in the Annual Report for the period during which the well was decommissioned.

## Changes to the Monitoring Plan

7 The *Owner* may request to make changes to the monitoring program(s) to the *District Manager* in accordance with the recommendations of the annual report. The *Owner* shall make clear reference to the proposed changes in separate letter that shall accompany the annual report.

8 Within fourteen (14) days of receiving the written correspondence from the *District Manager* confirming that the *District Manager* is in agreement with the proposed changes to the environmental monitoring program, the *Owner* shall forward a letter identifying the proposed changes and a copy of the correspondences from the *District Manager* and all other correspondences and responses related to the changes to the monitoring program, to the *Director* requesting the *Approval* be amended to approve the proposed changes to the environmental monitoring plan prior to implementation.

9 In the event any other changes to the environmental monitoring program are proposed outside of the recommendation of the annual report, the *Owner* shall follow current ministry procedures for seeking approval for amending the *Approval.*

## Trigger Mechanism and Contingency Plan

10 By no later than July 15, 2017*,* the *Owner* shall submit to the *Director,* for approval, and copies to the *District Manager,* details of a trigger mechanisms plan for surface water and groundwater quality monitoring for the purpose of initiating investigative activities into the cause of increased contaminant concentrations

11. By no later than July 15, 2017, the *Owner* shall submit to the *Director* for approval, and copies to the *District Manager,* details of a contingency plan to be implemented in the event that the surface water or groundwater quality exceeds any trigger mechanism.

12 In the event of a confirmed exceedance of a site-specific trigger level relating to leachate mounding or groundwater or surface water impacts due to leachate, the *Owner* shall immediately notify the *District Manager,* and an investigation into the cause and the need for implementation of remedial or contingency actions shall be carried out by the *Owner* in accordance with the approved trigger

mechanisms and associated contingency plans.

13 If monitoring results, investigative activities and/or trigger mechanisms indicate the need to implement contingency measures, the *Owner* shall ensure that the following steps are taken:

(a) The *Owner* shall notify the *District Manager,* in writing of the need to implement contingency measures, no later than 30 days after confirmation of the exceedances;
(b) Detailed plans, specifications and descriptions for the design, operation and maintenance of the contingency measures shall be prepared and submitted by the *Owner* to the *District Manager* for approval; and
(c) The contingency measures shall be implemented by the *Owner* upon approval by the *District Manager* .

14 The *Owner* shall ensure that any proposed changes to the site-specific trigger levels for leachate impacts to the surface water or groundwater, are approved in advance by the *Director* via an amendment to this *Approval.*

## SCHEDULE "A"

1. Report prepared by Maclaren Engineers entitled " Support Document for Proposed 1984 extension to the Holbrook Sanitary landfill Site" dated April 1984.

2. Report prepared by MacLaren Engineers entitled " Additional Hydrogeological Investigation at the Holbrook Sanitary Landfill Site" dated October 1983.

3. The terms of the Agreement between the Corporation of the County of Oxford and the Corporation of the Township of Norwich concerning the use, operation and closure of the site dated May 29, 1984.

4. Application form signed by D.L. Pratt of the County of Oxford entitled " Application for a Certificate of Approval for a Waste Disposal Site ( Landfill) " dated April 10, 1984.

5. Holbrook Landfill County of Oxford - 2012 Water Monitoring Report" prepared by Genivar Inc. dated May 2013

*The reasons for the imposition of these terms and conditions are as follows:*

## GENERAL

- The reason for Conditions 1(1), (2), (4), (5), (6), (7), (8), (9) and (10) is to clarify the legal rights and responsibilities of the *Owner* under this *Approval* .

- The reasons for Condition 1(3) is to ensure that the *Site* is designed, operated, monitored and maintained in accordance with the application and supporting documentation submitted by the *Owner,* and not in a manner which the *Director* has not been asked to consider.

- The reasons for Condition 1(11) are to ensure that the *Site* is operated under the corporate name which appears on the application form submitted for this approval and to ensure that the *Director* is informed of any changes.

- The reasons for Condition 1(12) are to restrict potential transfer or encumbrance of the *Site* without the approval of the *Director* and to ensure that any transfer of encumbrance can be made only on the basis that it will not endanger compliance with this *Approval* .

- The reason for Condition 1(13) is to ensure that the successor is aware of its legal responsibilities.

- The reason for Condition 1(14) and (15) are that the Part II.*1 Director* is an individual with authority pursuant to Section 197 of the Environmental Protection Act to require registration on title and provide any person with an interest in property before dealing with the property in any way to give a copy of the Approval to any person who will acquire an interest in the property as a result of the dealing.

## CLOSURE PLAN

- The reasons for Condition 2 are to ensure that final closure of the *Site* is completed in an aesthetically pleasing manner, in accordance with Ministry standards, and to ensure the long-term protection of the health and safety of the public and the environment.

## LANDFILL MONITORING

- Condition 3(1) is included to provide the groundwater and surface water limits to prevent water pollution at the *Site.*

- Conditions 3(2) is included to require the Owner to demonstrate that the *Site* is performing as designed and the impacts on the natural environment are acceptable. Regular monitoring allows for the analysis of trends over time and ensures that there is an early warning of potential problems so that any necessary remedial/contingency action can be taken.

- The reasons for Condition ( 3) and 3(4) are to ensure that regular review of site development, operations and monitoring data is documented and any possible improvements to site design, operations or monitoring programs are identified. An annual report is an important tool used in reviewing site activities and for determining the effectiveness of site design.

- Conditions 3(5), 3(6) and 3(7) are included to ensure the integrity of the groundwater monitoring network so that accurate monitoring results are achieved and the natural environment is protected.

- Reasons for conditions 3(8), 3(9) and 3(10) are included to streamline the approval of the changes to the monitoring plan.

- Reason for conditions 3(11) to 3 (14) inclusive are added to ensure the *Owner* has a plan with an organized set of procedures for identifying and responding to potential issues relating to groundwater and surface water contamination at the *Site's* compliance point.

**Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). A070702 issued on March 31, 1983**

*In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:*

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.*

*The Notice should also include:*

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;

6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in.

*And the Notice should be signed and dated by the appellant.*

*This Notice must be served upon:*

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of Part II.1 of the Environmental Protection Act
Ministry of the Environment and Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

*The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.*

DATED AT TORONTO this 8th day of September, 2016

Dale Gable, P.Eng.
Director
appointed for the purposes of Part II.1 of the
*Environmental Protection Act*

HV/
c: District Manager, MOECC London - District
Field Alert, County of Oxford

COUNTY OF OXFORD
RECEIVED

MAR 13 2018

REFER TO ____________

File/ EDMS: ____________

Ontario
Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

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## AMENDMENT TO ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER A070702
Notice No. 1
Issue Date: March 6, 2018

County of Oxford
21 Reeve St
Post Office Box, No. 1614
Woodstock, Ontario
N4S 7Y3

Site Location: Holbrook Landfill - closed
Lot 20 & 21, Concession 3
Norwich Township, County of Oxford

*You are hereby notified that I have amended Approval No.* *A070702* *issued on* *September 8, 2016* *for* the post closure inspection, monitoring and maintenance of 10.2 hectare closed Holbrook Landfill site within a total site area of 62.31 hectares, *as follows:*

Definition of *"Site"* is revised as follows:

*"Site"* means the entire waste disposal site, including the buffer land and Contaminant Attenuation Zone located at Parts 1 and 2 of Lot 20 & 21, Concession 3, Township of Norwich, County of Oxford.

**Conditions 2(1), 3(2), 3(10) and 3(11) are hereby revoked and replaced with the following:**

### 2. CLOSURE PLAN

2. (1) Closure plan dated June 2017 and amended by letter report dated December 8, 2017 prepared by WSP and submitted to Bob Slivar, Senior Environmental Officer, London District Office, Ministry of the Environment and Climate Change, is hereby approved subject to the conditions of this *Approval.*

### 3.0 LANDFILL MONITORING

3. (2) The *Owner* shall monitor surface water and ground water in accordance with Schedules

"B" and "C".

**Trigger Mechanism and Contingency Plan**

3. (10) Trigger mechanisms shall be in accordance with Items 6 and 7 in Schedule "A".

3. (11) Contingency plan in the event of a confirmed exceedance of a site-specific trigger level relating to leachate mounding or groundwater or surface water impacts due to leachate shall be in accordance with Items 6 and 7 in Schedule "A".

**Conditions 2(2) and 2(3) are added to the *Approval:***

2. (2) No person shall use, operate, establish, alter, enlarge or extend a waste disposal site except under and in accordance with an environmental compliance approval. As such the *Owner/Operator* shall obtain approval from the *Director* through an amendment to this *Approval* prior to any changes to the approved closure plan/facilities within the closed *Site.*

2. (3) Notwithstanding condition 2(1), the *Owner* shall submit to the *Director* for approval for any change to the current "natural open space with restricted public access". Supporting documentation to the application shall contain the following as a minimum:

   (a) Detailed plan showing all the groundwater monitoring wells;
   (b) A detailed site plan showing where any structures or pathways are located;

   (c) Potential dangers related to methane gas is a concern to the *Ministry.* Decomposition of waste and producing methane can continue many years pass the closure of a landfill depending on factors within the landfill that expedite or slow down decomposition of An assessment of methane gas in the landfill as this will help the *Ministry* determine if the site is safe for public use; and
   (d) Consultation with the interested parties (specially residents within 500 m) about the change in landuse and the proposal.

**The following items are added to the Schedule "A":**

## SCHEDULE "A"

6. Report titled "Holbrook Landfill, Closure Plan" dated June 2017 prepared by WSP Canada Inc.

7. Letter report dated December 8, 2017 prepared by Albert Siertsema, P.Eng., Project Engineer, Environment and Dan Mohr, P.Eng., Assistant Vice President Environment, Ontario, submitted to Bob Slivar, Senior Environmental Officer, London District Office, Ministry of the Environment and Climate Change as a response to comments from Technical Support, Ministry of the Environment and Climate Change.

## Schedule "B"
## Surface Water Monitoring Program

| ACTIVITY | LOCATION | SAMPLING FREQUENCY | ANALYSIS / MEASUREMENT |
|---|---|---|---|
| Surface Water Sampling | **Surface Water Station:** C01, C06 | Semi-annual (spring and fall) | **Field Parameters:** pH, conductivity, temperature, turbidity<br>**General Parameters:** pH, conductivity, hardness<br>**Major and Minor Ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate<br>**Nutrients and Organics:** ammonia, un-ionized ammonia, nitrate, nitrite<br>**Dissolved Metals:** boron, chromium, iron, manganese |
|  | **Surface Water Station:** C04, P01, P02, P03, NE1 | Annual (spring) | **Field Parameters:** pH, conductivity, temperature, turbidity<br>**General Parameters:** pH, conductivity, hardness<br>**Major and Minor Ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate<br>**Nutrients and Organics:** ammonia, un-ionized ammonia, nitrate, nitrite<br>**Dissolved Metals:** boron, chromium, iron, manganese |

## Schedule "C"
## Groundwater and Landfill Gas Monitoring Programs

| ACTIVITY | LOCATION | SAMPLING FREQUENCY | ANALYSIS / MEASUREMENT |
|---|---|---|---|
| Groundwater and Leachate Level Monitoring | **Shallow Flow System:** 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16AR, 18R, 19R, 24AR, 26R, 28R, 32R, 33R, 39, 40, 43, 44, SG1<br>**Deep Flow System:** 16R, 21R, 24R, 25R, 27, 31, 35, 37R, 38, 42<br>**Leachate Well: 41** | Annual (May) | Water Level Measurement |
| Groundwater and Leachate Sampling | **Shallow Flow System:** 11R, 16AR, 19R, 26R, 28R, 32R, 40, 43, 44<br>**Deep Flow System:** 21R, 24R, 25R, 27, 37R, 38, 39, 42<br>**Private Wells:** D2 (Pearce)<br>**Leachate Well: 41** | Annual (May) | **Field Parameters:** pH, conductivity, temperature<br>**General Parameters:** pH, conductivity, hardness<br>**Major and Minor Ions:** alkalinity, calcium, chloride, magnesium, potassium, sodium, sulphate<br>**Nutrients and Organics:** ammonia, nitrate, nitrite, TKN, DOC<br>**Dissolved Metals:** boron, chromium, iron, manganese |
|  | **Shallow Flow System:** 32R, 26R, 40, 43, 44<br>**Deep Flow System:** 27, 37R, 38, 39, 42<br>**Leachate Well: 41** | Annual (May) | **Volatile Organic Compounds:** vinyl chloride, benzene, 1,4 dichlorobenzene |
| Landfill Gas Monitoring | **Standpipes:** SP3R, SP4R, SP5 | Annual | Methane, carbon dioxide, oxygen, balance gas, as well as water level |

**The reasons for this amendment to the *Approval* are as follows:**

- Preamble is amended to clarify the approved total *Site* area which includes Contaminant Attenuation Zone.

- Condition 2(1) was revised to approve the closure plan for the *Site* to ensure the final closure of the *Site* is completed in an aesthetically pleasing manner, in accordance with *Ministry* standards, and to ensure the long-term protection of the health and safety of the public and the environment.

- Condition 3(2) is included to require the *Owner* to demonstrate that the *Site* is performing as designed and the impacts on the natural environment are acceptable. Regular monitoring allows for the analysis of trends over time and ensures that there is an early warning of potential problems so that any necessary remedial/contingency action can be taken. This condition was revised to approve the revised groundwater and surface water monitoring program.

- Conditions 3(10) and 3(11) approved trigger mechanisms and contingency plans proposed for the *Site.* This provides a plan with an organized set of procedures for identifying and responding to potential issues relating to groundwater and surface water contamination at the *Site's* compliance point.

- Conditions 2(2) and 2(3) are added to ensure that the *Site* is designed, operated, monitored and maintained in accordance with the application and supporting documentation submitted by the *Owner,* and not in a manner which the *Director* has not been asked to consider.

**This Notice shall constitute part of the approval issued under Approval No. A070702 dated September 8, 2016 as amended.**

*In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:*

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.*

*The Notice should also include:*

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;

6. The municipality or municipalities within which the project is to be engaged in.

*And the Notice should be signed and dated by the appellant.*

*This Notice must be served upon:*

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of Part II.1 of the Environmental Protection Act
Ministry of the Environment and Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

*The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.*

DATED AT TORONTO this 6th day of March, 2018

Dale D. Gable

Dale Gable, P.Eng.
Director
appointed for the purposes of Part II.1 of the
*Environmental Protection Act*

RM/
c: District Manager, MOECC London - District
Dave Vermeeren, Waste Management Supervisor, County of Oxford

# APPENDIX

# B

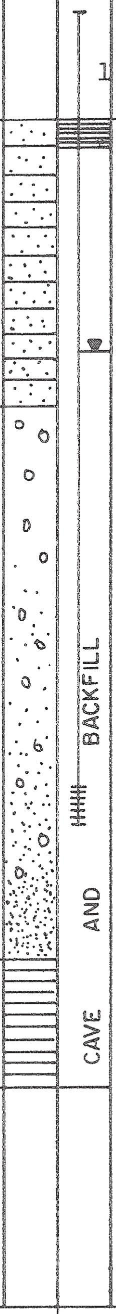
## BOREHOLE LOGS

# GEOLOGICAL LOG

# TEST HOLE No. 2

SHEET 1 OF 1

SCALE (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15



| EL (m) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 279.6 | GROUND SURFACE | | | |
| 0.0 | Yellowish grey loose very fine sandy silt | 1 | SS | 9 |
| | | 2 | SS | 6 |
| 275.9 / 3.7 | Grey compact layered silty fine to medium gravelly very fine to coarse sand | 3 | SS | 10 |
| | | 4 | SS | 20 |
| | | 5 | SS | 13 |
| | Grey interlayered compact fine sand and medium to coarse sand near base | 6 | SS | 14 |
| 268.6 / 11.0 | Grey clayey silt (grey silty sand with some clay from above) | 7 | SS | 15 |
| | | 8 | SS | 17 |
| 266.9 / 12.7 | End of Hole | | | |

## NOTES

DATE DRILLED 1 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 2.5
(m below ground surface)

STATIC WATER LEVEL 2.9 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.7 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 2 Decommissioning

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2014/09/30
**supervisor** | MEQ
**reviewer** | AMS

| Depth Scale (m) | Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) |
|---|---|---|---|---|---|---|
| 0 | 276.5 | **GROUND SURFACE** | | | | |
| | | Yellowish grey loose very fine sandy silt | | | | 276 |
| 1 | | | | | | 275 |
| 2 | | | | | | 274 |
| 3 | | | | | | 273 |
| | 272.8<br>3.7 | Grey compact layered silty fine to medium gravelly very fine to coarse sand | | | | |
| 4 | | | | | | 272 |
| 5 | | | | | | 271 |
| 6 | | | | | | 270 |
| 7 | | | | | | 269 |
| 8 | | | | | | 268 |
| 9 | 267.4<br>9.1 | **END OF BOREHOLE** | | | | |

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
✚ Field Vane
■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH2 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 4

SHEET 1 OF 1

| SCALE (ft)(m) | EL (m) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 279.0 | GROUND SURFACE | | 0.99 m | | | |
| (ft) 5, 10, 15, 20, 25, 30, 35, 40, 45, 50<br>(m) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 | 0.0 | Brown fine gravelly clayey silt | | CLAY | | | |
| | | | | CAVE AND BACKFILL | 1 | SS | 6 |
| | | | | | 2 | SS | 14 |
| | 275.0<br>4.0 | Brown interlayered fine sandy silt to silty fine sand and fine to medium sand overlying dense fine gravelly very fine to very coarse sand near base | | | 3 | SS | -- |
| | | | | | 4 | SS | 31 |
| | 272.4<br>6.6 | End of Hole | | | | | |

## NOTES

DATE DRILLED 1 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 3.8
(m below ground surface)

STATIC WATER LEVEL 2.4 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.6 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

**MacLaren**

MacLAREN
ENGINEERS INC.

## TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 4 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2014/09/24
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | SUBSURFACE PROFILE: Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | SUBSURFACE PROFILE: Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value<br>Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m)<br>× Dynamic Cone<br>10 20 30 40<br>Undrained Shear Strength (kPa)<br>○ Unconfined + Field Vane<br>● Pocket Penetrometer ■ Lab Vane<br>40 80 120 160 | Water Content (%) & Plasticity<br>PL MC LL<br>10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.3 | **GROUND SURFACE** | | | | | | | | | | |
| 0<br>1<br>2<br>3 | | Brown fine gravelly clayey silt | | | | | 279<br>278<br>277<br>276 | | | | | |
| 4<br>5<br>6 | 275.3<br>4.0 | Brown interlayered fine sandy silt to silty fine sand and fine to medium sand overlying dense fine gravelly very fine to very coarse sand near base | | | | | 275<br>274 | | | | | |
| | 273.2<br>6.1 | **END OF BOREHOLE** | | | | | | | | | | |

Stratigraphy inferred from original borehole log for BH4 (MacLaren Engineers Inc., 1979).

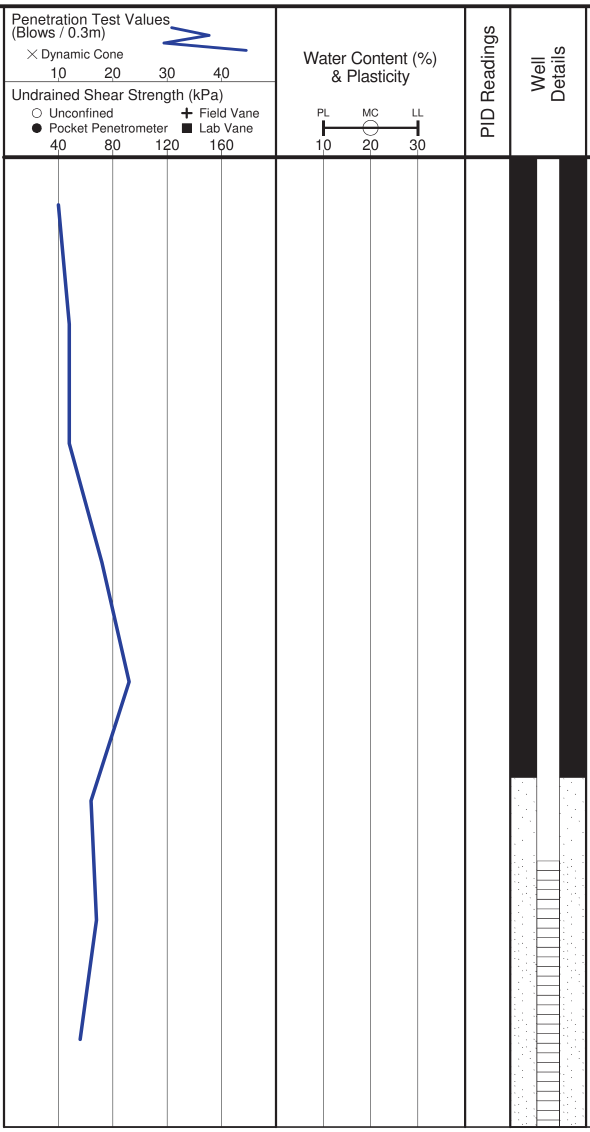
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 4R

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/24
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** MEQ
**position |**
**coring |** *n/a*
**reviewer |** AMS

SUBSURFACE PROFILE

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value |
|---|---|---|---|---|
| | **GROUND SURFACE** | | | |
| | Brown **TOPSOIL** and organics, some roots, some clayey silt, dry, loose. | 1 | SS | 10 |
| 0.6 | Orangey brown to brown fine **SAND AND GRAVEL**, some silt, moist to wet, compact. | 2 | SS | 12 |
| | Some roots and cobbles, red brown silty sand. | 3 | SS | 12 |
| | | 4 | SS | 18 |
| | | 5 | SS | 23 |
| 3.8 | Grey brown coarse **SAND AND GRAVEL**, trace fine sand, trace silt, saturated, compact. | 6 | SS | 16 |
| | | 7 | SS | 17 |
| | | 8 | SS | 14 |
| 6.2 | **END OF BOREHOLE** | | | |



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

Depth Scale (m): 0 1 2 3 4 5 6

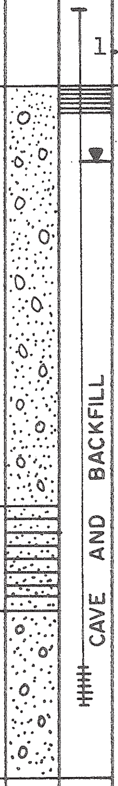
Elevation Scale (mARD)

# GEOLOGICAL LOG

# TEST HOLE No. 5

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 278.7 | GROUND SURFACE | | 1.03 m | | | |
| 5 10 15<br>1 2 3 4 5 | 0.0<br>273.2 | Brown compact medium gravelly very fine to very coarse sand with layers of medium sand | | CLAY | 1<br>2<br>3 | SS<br>SS<br>SS | 10<br>14<br>19 |
| 20<br>6 | 5.5<br>271.8 | Brown compact fine sandy silt and very fine sand | | CAVE AND BACKFILL | 4 | SS | 20 |
| 25<br>7 8 9 | 6.9<br>269.6 | Brown dense fine gravelly coarse to very coarse sand | | | 5 | SS | 38 |
| 30 35 40 45 50<br>10 11 12 13 14 15 | 9.1 | End of Hole | | | | | |



## NOTES

DATE DRILLED 1 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 1.0
(m below ground surface)

STATIC WATER LEVEL 1.0 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 277.7 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN
ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 5 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2014/09/23
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev<br>Depth<br>(m) | SUBSURFACE PROFILE<br>STRATIGRAPHY | Graphic Plot | SAMPLE<br>Number | Type | SPT N-Value<br>Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m)<br>× Dynamic Cone<br>10 20 30 40<br>Undrained Shear Strength (kPa)<br>○ Unconfined ✚ Field Vane<br>● Pocket Penetrometer ■ Lab Vane<br>40 80 120 160 | Water Content (%) & Plasticity<br>PL MC LL<br>10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.2 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown compact medium gravelly very fine to very coarse sand with layers of medium sand | | | | | 279 | | | | | |
| 1 | | | | | | | 278 | | | | | |
| 2 | | | | | | | 277 | | | | | |
| 3 | | | | | | | 276 | | | | | |
| 4 | | | | | | | 275 | | | | | |
| 5 | | | | | | | 274 | | | | | |
| | 273.7<br>5.5 | Brown compact fine sandy silt and very fine sand | | | | | | | | | | |
| 6 | | | | | | | 273 | | | | | |
| | 272.3<br>6.9 | Brown dense fine gravelly coarse to very coarse sand | | | | | | | | | | |
| 7 | | | | | | | 272 | | | | | |
| 8 | 271.1<br>8.1 | | | | | | | | | | | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH5 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpi

# LOG OF BOREHOLE 5R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**position |**

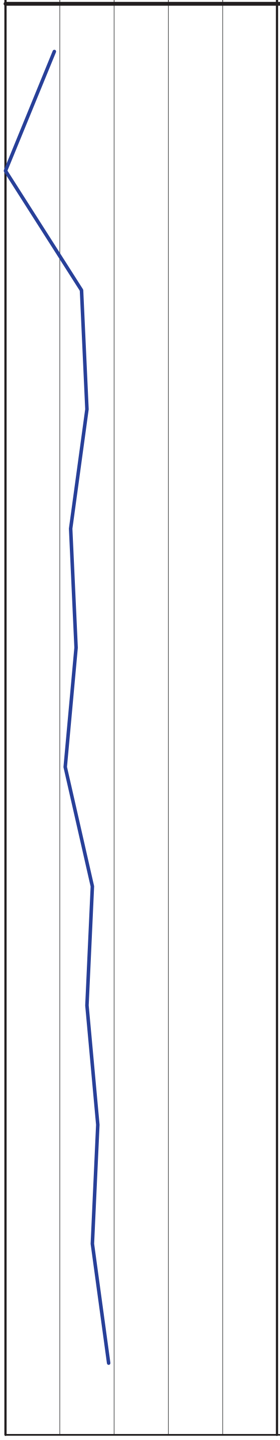
**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**project no. |** 111-53037-00 132-00
**date started |** 2014/09/24
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE STRATIGRAPHY | SAMPLE Number | SAMPLE Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|
| 0 | | **GROUND SURFACE** | | | |
| | | Brown fine to coarse **SAND**, some medium gravel, some organics, dry to moist, very loose to loose. | 1 | SS | 9 |
| 1 | 1.1 | Grey brown to orangey brown fine to coarse **SAND**, trace to some silt, some medium gravel, moist to wet, compact. | 2 | SS | 0 |
| 2 | | | 3 | SS | 14 |
| | | | 4 | SS | 15 |
| 3 | | | 5 | SS | 12 |
| 4 | | | 6 | SS | 13 |
| 5 | 4.6 | Grey brown fine to coarse **SAND AND GRAVEL**, trace to some silt, wet, compact. | 7 | SS | 11 |
| | | | 8 | SS | 16 |
| 6 | | | 9 | SS | 15 |
| 7 | | | 10 | SS | 17 |
| 8 | 7.6 | Grey brown coarse **SAND AND GRAVEL**, some silt, saturated, compact. | 11 | SS | 16 |
| | | | 12 | SS | 19 |
| 9 | 9.1 | **END OF BOREHOLE** | | | |

Elevation Scale (mARD)

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40
Undrained Shear Strength (kPa)
○ Unconfined ✚ Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160



Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

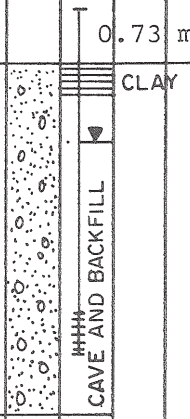
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

# GEOLOGICAL LOG

# TEST HOLE No. 6

SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 278.7 | GROUND SURFACE | | | | | |
| | 0.0 | Brown compact medium gravelly very fine to very coarse sand with layers of medium sand | | | | | |
| | 274.1<br>4.6 | End of Hole | | | | | |



Scale (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
Scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

## NOTES

DATE DRILLED 1 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 1.0
(m below ground surface)

STATIC WATER LEVEL 1.0 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 277.7 Static Water Elevation (mGSD) (26 JUNE 1979) *

Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 6 Decommissioning

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2014/09/23
**supervisor** | MEQ
**reviewer** | AMS

| Depth Scale (m) | Elev<br>Depth<br>(m) | SUBSURFACE PROFILE<br>**STRATIGRAPHY** | Graphic Plot | SAMPLE<br>Number | Type | SPT N-Value<br>Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m)<br>× Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa)<br>○ Unconfined + Field Vane<br>● Pocket Penetrometer ■ Lab Vane<br>40 80 120 160 | Water Content (%) & Plasticity<br>PL MC LL<br>10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.2 | **GROUND SURFACE** | | | | | | | | | | |
| 0–3 | | Brown compact to medium gravelly very fine to very coarse sand with layers of medium sand | | | | | 279<br>278<br>277<br>276 | | | | | |
| | 275.5<br>3.7 | | | | | | | | | | | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH6 (MacLaren Engineers Inc., 1979).

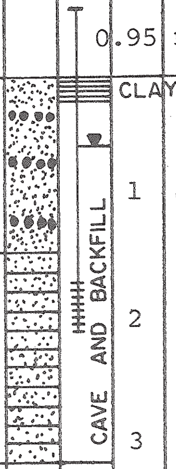
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

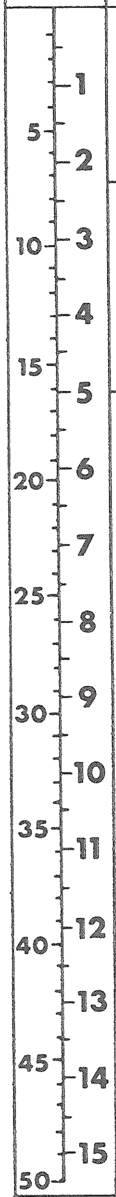
# GEOLOGICAL LOG

# TEST HOLE No. 10

SHEET 1 OF 1

| SCALE (ft)(m) | EL (m) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 280.0 | GROUND SURFACE | | | | | |
| | 0.0<br>277.7 | Brown compact fine to medium sand with fine gravel layers | | | 1 | SS | 23 |
| | 2.3<br>275.0 | Brown loose silty very fine sand | | | 2<br>3 | SS<br>SS | 9<br>6 |
| | 5.0 | End of Hole | | | | | |





## NOTES

DATE DRILLED 3 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 0.8
(m below ground surface)

STATIC WATER LEVEL 0.9 *
(m below ground surface)

PIPE DIAMETER 51 (mm)
LENGTH OF PIEZOMETER 0.5 (m)
TYPE OF PIEZOMETER
Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 279.2 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

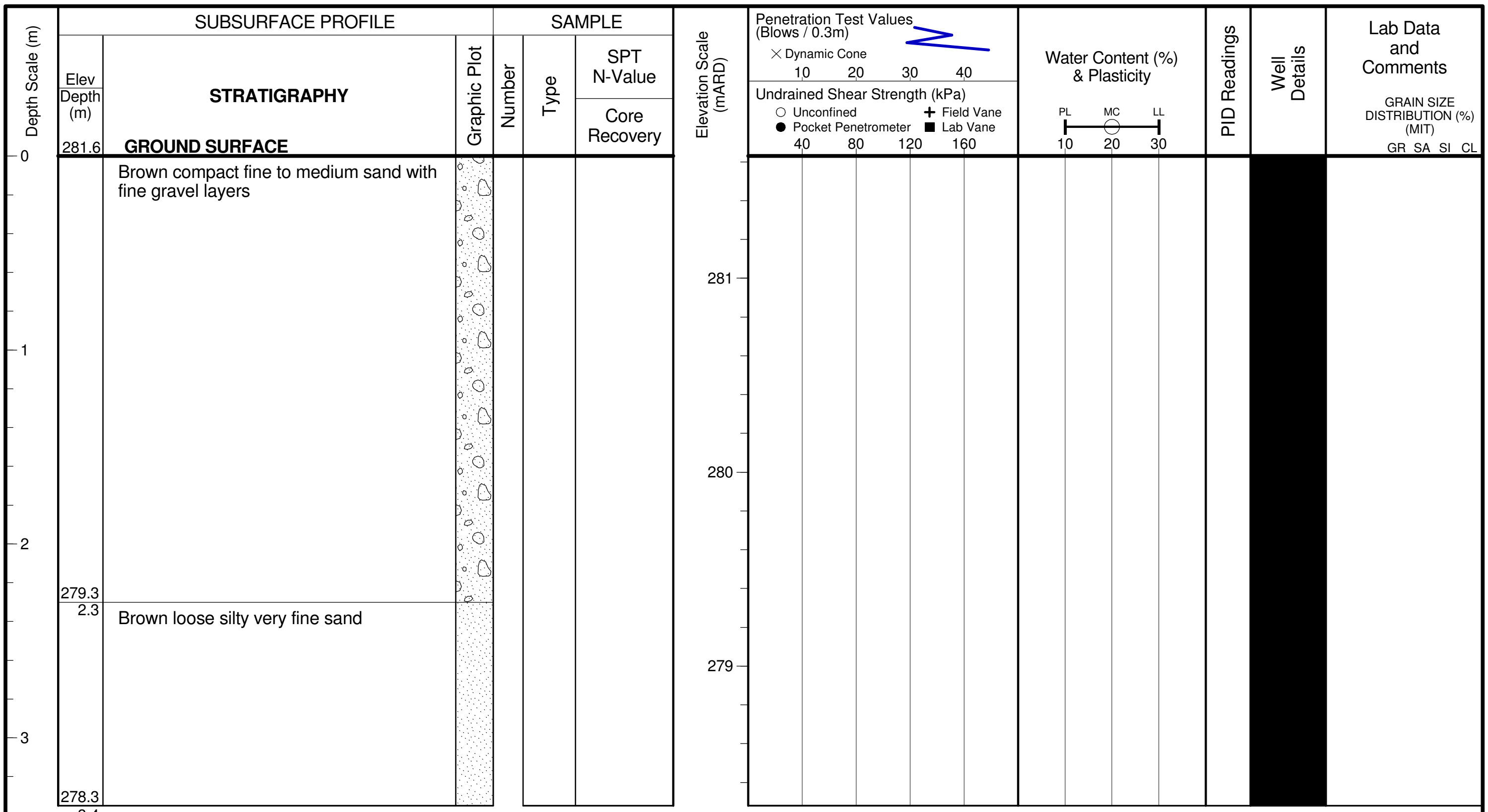
PROJECT NO. 11602-5

# LOG OF BOREHOLE 10 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/09
**supervisor |** MEQ
**reviewer |** AMS



| Elev<br>Depth<br>(m) | STRATIGRAPHY |
|---|---|
| 281.6 | **GROUND SURFACE** |
| | Brown compact fine to medium sand with fine gravel layers |
| 279.3<br>2.3 | Brown loose silty very fine sand |
| 278.3<br>3.4 | **END OF BOREHOLE** |

Stratigraphy inferred from original borehole log for BH10 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 10R

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, Oxford County
**project no.** | *111-53037-00 132-02*

**rig type** | ACKER SOIL-MAX, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

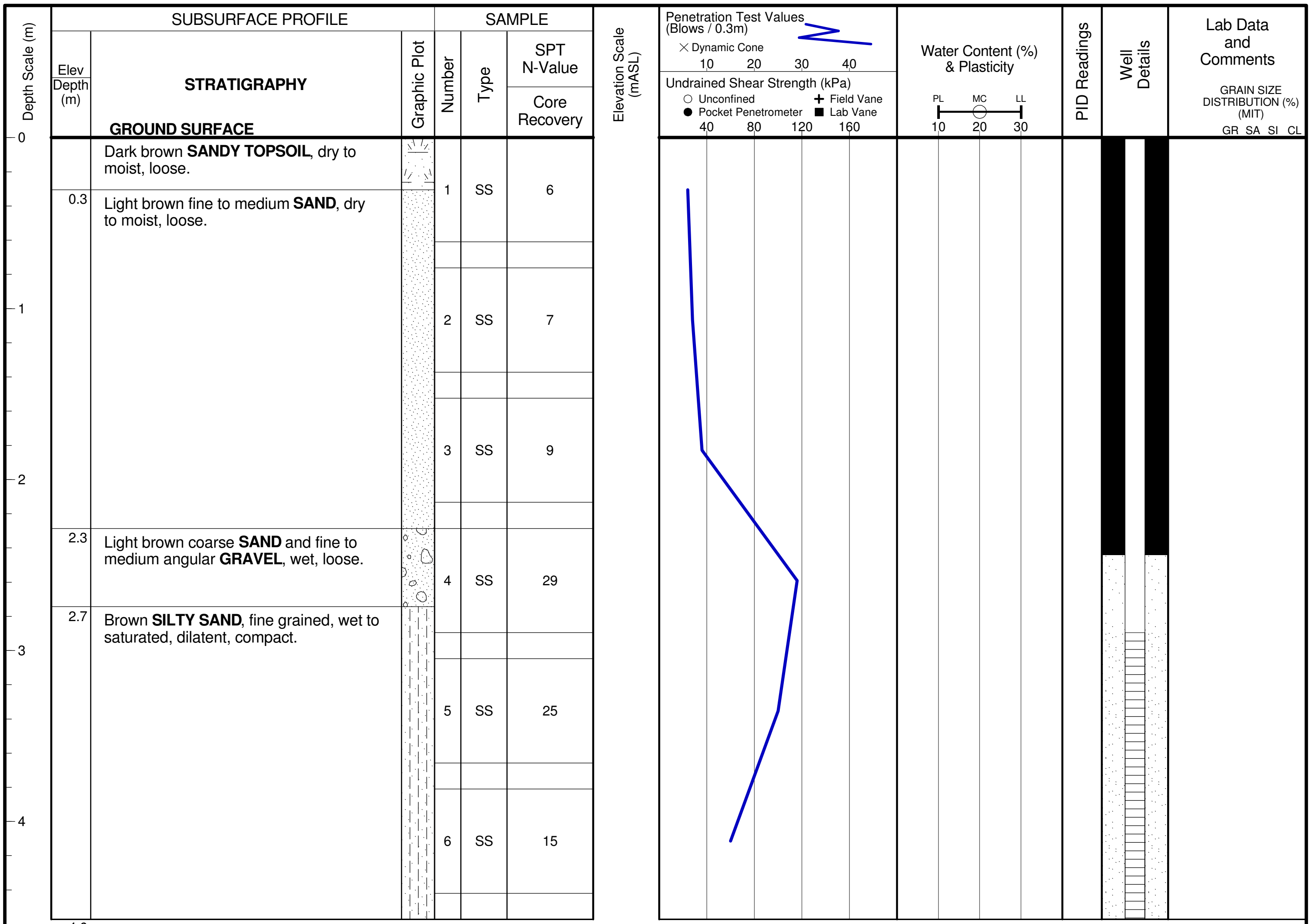
**date started** | 2015/07/09
**supervisor** | MEQ
**reviewer** | AMS

SUBSURFACE PROFILE

| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| | **GROUND SURFACE** |
| | Dark brown **SANDY TOPSOIL**, dry to moist, loose. |
| 0.3 | Light brown fine to medium **SAND**, dry to moist, loose. |
| 2.3 | Light brown coarse **SAND** and fine to medium angular **GRAVEL**, wet, loose. |
| 2.7 | Brown **SILTY SAND**, fine grained, wet to saturated, dilatent, compact. |
| 4.6 | **END OF BOREHOLE** |

SAMPLE

| Number | Type | SPT N-Value / Core Recovery |
|---|---|---|
| 1 | SS | 6 |
| 2 | SS | 7 |
| 3 | SS | 9 |
| 4 | SS | 29 |
| 5 | SS | 25 |
| 6 | SS | 15 |



# GEOLOGICAL LOG

# TEST HOLE No. 11

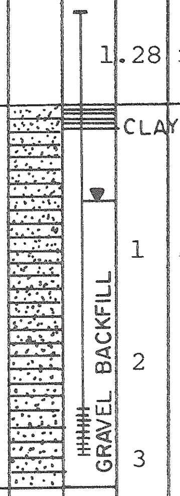
SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|
| | 280.5 | GROUND SURFACE | | | |
| | 0.0 | Brown clayey very fine sandy silt | 1 | SS | 9 |
| | | | 2 | SS | 16 |
| | | | 3 | SS | 16 |
| | 275.5<br>5.0 | End of Hole | | | |

SCALE (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

STRAT. PLOT / PIEZOMETER



## NOTES

DATE DRILLED 3 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 1.2
(m below ground surface)

STATIC WATER LEVEL 1.3 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 279.1 Static Water Elevation (m GSD) (26 JUNE 1979) *

╪ Piezometer

MacLaren

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 11 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/15
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40; Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 280.8 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown clayey very fine sandy silt | | | | | | | | | ■ | |
| 1 | | | | | | | 280 | | | | | |
| 2 | | | | | | | 279 | | | | | |
| 3 | | | | | | | 278 | | | | | |
| 4 | | | | | | | 277 | | | | | |
| | 276.3<br>4.5 | | | | | | | | | | | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH11 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 11R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

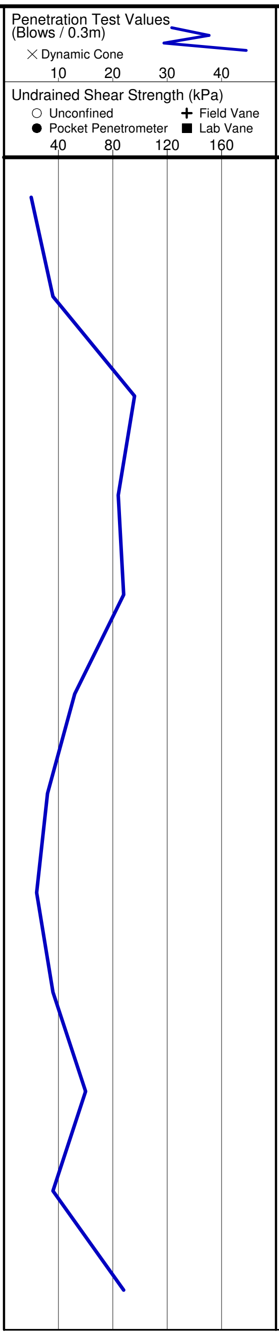
**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/24
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|
| | **GROUND SURFACE** | | | |
| | Dark brown **TOPSOIL**, some fine silty sand, rootlets, moist, loose. | 1 | SS | 5 |
| 0.3 | Reddish brown fine to medium **SAND**, trace gravel, dry to moist, loose, compact below 1.5 m. | 2 | SS | 9 |
| | | 3 | SS | 24 |
| | | 4 | SS | 21 |
| 3.1 | Reddish brown fine **SAND**, trace to some silt, trace fine gravel, wet, compact. | 5 | SS | 22 |
| | | 6 | SS | 13 |
| 4.6 | Reddish brown **SANDY SILT**, trace clay, wet, stiff. | 7 | SS | 8 |
| 5.3 | Grey-brown **CLAYEY SILT**, some fine to medium sand, APL to WTPL, stiff. | 8 | SS | 6 |
| | | 9 | SS | 9 |
| 6.9 | Grey-brown **SANDY SILT**, trace clay, trace fine to medium gravel, wet, compact. | 10 | SS | 15 |
| | | 11 | SS | 9 |
| 8.4 | Grey **CLAYEY SILT**, some gravel, trace sand, DTPL, very stiff. | 12 | SS | 22 |
| 9.0 | **END OF BOREHOLE** | | | |

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

Elevation Scale (mASL)

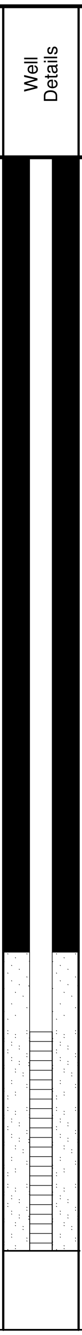


Water Content (%) & Plasticity

PL MC LL

10 20 30

PID Readings



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

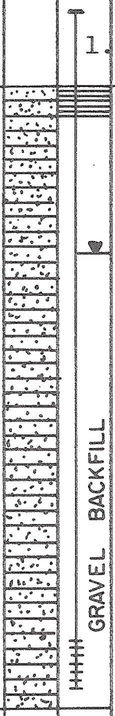
GR SA SI CL

# GEOLOGICAL LOG

# TEST HOLE No. 12

SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 280.5 | GROUND SURFACE | | 1.01 m | | | |
| | 0.0 | | | CLAY | | | |
| 1 | | | | | | | |
| 5<br>2 | | | | | | | |
| 10<br>3 | | | | | | | |
| 4 | | Brown clayey very fine sandy silt | | | | | |
| 15<br>5 | | | | GRAVEL BACKFILL | | | |
| 20<br>6 | | | | | 1 | SS | -- |
| 7 | | | | | | | |
| 25 | | | | | 2 | SS | 20 |
| 8 | 272.4<br>8.1 | End of Hole | | | | | |
| 30<br>9 | | | | | | | |
| 10 | | | | | | | |
| 35<br>11 | | | | | | | |
| 40<br>12 | | | | | | | |
| 13 | | | | | | | |
| 45<br>14 | | | | | | | |
| 15<br>50 | | | | | | | |



## NOTES

DATE DRILLED 3 May 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 1.2 (m below ground surface)

STATIC WATER LEVEL 2.2 * (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON

WA-WASH

▽ 278.3 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 12 Decommissioning

| | | | | | |
|---|---|---|---|---|---|
| **project** \| | Holbrook Landfill Site | | | | |
| **client** \| | Oxford County | **rig type** \| | Acker Soil-Max, track-mounted | **date started** \| | 2015/07/16 |
| **location** \| | Holbrook, ON | **method** \| | Hollow stem augers, 215 mm dia. | **supervisor** \| | MEQ |
| **project no.** \| | *111-53037-00 132-02* | **coring** \| | *n/a* | **reviewer** \| | AMS |

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 280.7 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown clayey very fine sandy silt | | | | | 280 | | | | | |
| 1 | | | | | | | 279 | | | | | |
| 2 | | | | | | | 278 | | | | | |
| 3 | | | | | | | 277 | | | | | |
| 4 | | | | | | | 276 | | | | | |
| 5 | | | | | | | 275 | | | | | |
| 6 | | | | | | | 274 | | | | | |
| 7 | | | | | | | 273 | | | | | |
| | 272.9<br>7.8 | | | | | | | | | | | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH12 (MacLaren Engineers Inc., 1979).

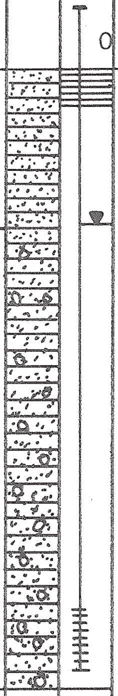
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpi

# GEOLOGICAL LOG

# TEST HOLE No. 13

SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 273.8 | GROUND SURFACE | | 0.88 m | | | |
| 5 (ft)<br>1, 2 (m) | 0.0<br>271.7 | Brown mottled silt near surface overlying Brown compact silty very fine sand |  | CLAY | 1 | SS | 24 |
| 10, 15, 20, 25 (ft)<br>3, 4, 5, 6, 7, 8 (m) | 2.1<br>265.7 | Grey/brown fine gravelly very fine sandy clayey silt | | | 2<br>3<br>4<br>5 | SS<br>SS<br>SS<br>SS | 15<br>18<br>16<br>15 |
| 30, 35, 40, 45, 50 (ft)<br>9, 10, 11, 12, 13, 14, 15 (m) | 8.1 | | | | | | |

## NOTES

DATE DRILLED 13 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND -
(m below ground surface)

STATIC WATER LEVEL 2.2 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 271.6 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

**MacLaren**

MacLAREN
ENGINEERS INC.

**TEST HOLE RECORD** | **G.M.P.** | PROJECT NO. 11602-5

# LOG OF BOREHOLE 13 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted

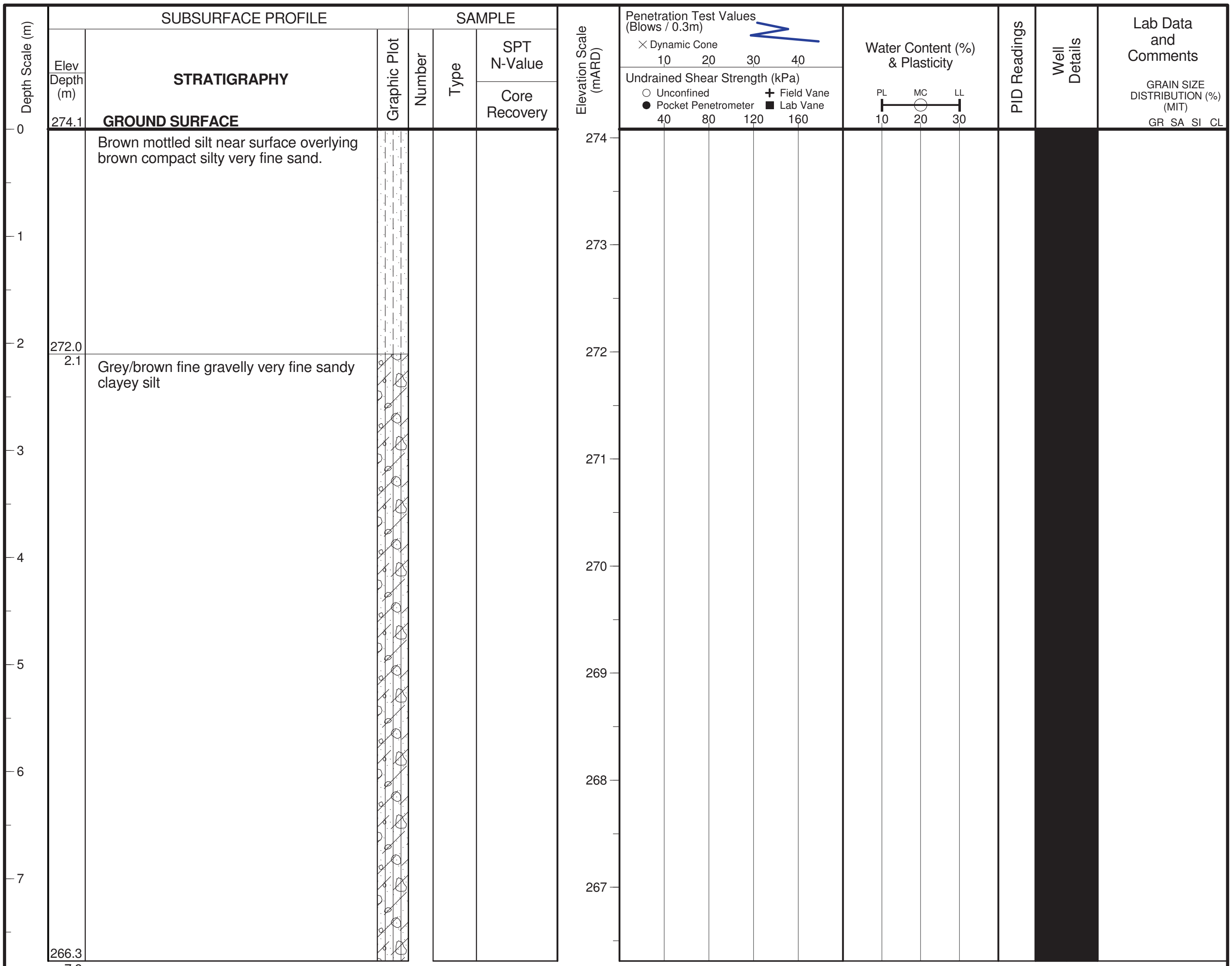
**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2014/09/25

**supervisor |** MEQ

**reviewer |** AMS



| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| 274.1 | **GROUND SURFACE** |
| | Brown mottled silt near surface overlying brown compact silty very fine sand. |
| 272.0<br>2.1 | Grey/brown fine gravelly very fine sandy clayey silt |
| 266.3<br>7.8 | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH13 (MacLaren Engineers Inc., 1979).

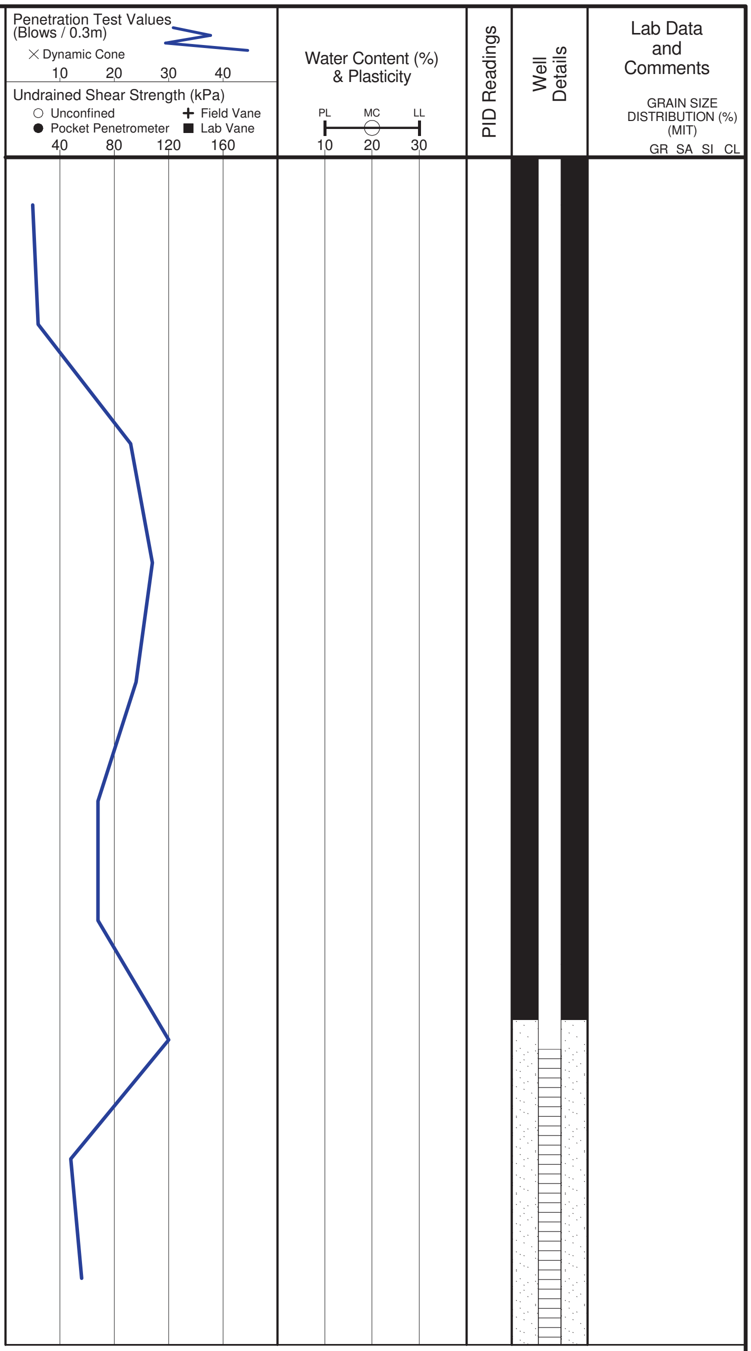
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 13R

WSP

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/25
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** SCL
**position |**
**coring |** *n/a*
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value |
|---|---|---|---|---|
| | **GROUND SURFACE** | | | |
| 0 | Orangey brown **SILTY SAND**, trace rootlets and roots, some fine to coarse sand, trace gravel, moist, loose. | 1 | SS | 5 |
| | | 2 | SS | 6 |
| 1.5 | Orangey brown fine to medium **SAND**, some silt, some rounded gravel, moist to wet, compact. | 3 | SS | 23 |
| | | 4 | SS | 27 |
| | Increasing presence of coarse gravel and cobbles at 3 m. | 5 | SS | 24 |
| 3.8 | Orangey brown **SANDY SILT**, becoming grey brown below 5 m, trace fine rounded gravel, dilatent, APL, very stiff. | 6 | SS | 17 |
| | | 7 | SS | 17 |
| | | 8 | SS | 30 |
| 6.1 | Grey **SILT**, some clay, trace to some fine sand, trace rounded gravel, weakly dilatent, APL to WTPL, stiff. | 9 | SS | 12 |
| | | 10 | SS | 14 |
| 7.6 | **END OF BOREHOLE** | | | |



# GEOLOGICAL LOG

# TEST HOLE No. 14

SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 275.5 | GROUND SURFACE | | 1.23 m | | | |
| | 0.0 | Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand | | | CLAY<br>1 | SS | 16 |
| | 273.7<br>1.8 | Grey fine gravelly clayey very fine to fine sandy silt | | | 2 | SS | 9 |
| | 271.5<br>4.0 | Grey dense interlayered fine, medium and coarse sand, sandy gravel and gravelly sand. (Grey silty very fine sand at base). | | | 3<br>4 | SS<br>SS | 40<br>42 |
| | 268.9<br>6.6 | End of Hole | | | | | |

Scale (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
Scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

## NOTES

DATE DRILLED 13 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 0.8
(m below ground surface)

STATIC WATER LEVEL +0.7 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.2 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

**TEST HOLE RECORD**

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 14 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted

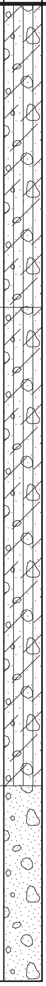
**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2014/09/17

**supervisor |** MEQ

**reviewer |** AMS



| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value / Core Recovery |
|---|---|---|---|---|---|---|
| | 275.9 | **GROUND SURFACE** | | | | |
| 0 | | Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand | | | | |
| | 274.3<br>1.6 | Grey fine gravelly clayey very fine to fine sandy silt | | | | |
| | 271.9<br>4.0 | Grey dense interlayered fine, medium and coarse sand, sandy gravel and gravelly sand. (Grey silty very fine sand at base). | | | | |
| | 270.9<br>5.0 | **END OF BOREHOLE** | | | | |

Depth Scale (m): 0, 1, 2, 3, 4

Elevation Scale (mARD): 275, 274, 273, 272, 271

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined ✚ Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH14 (MacLaren Engineers Inc., 1979).

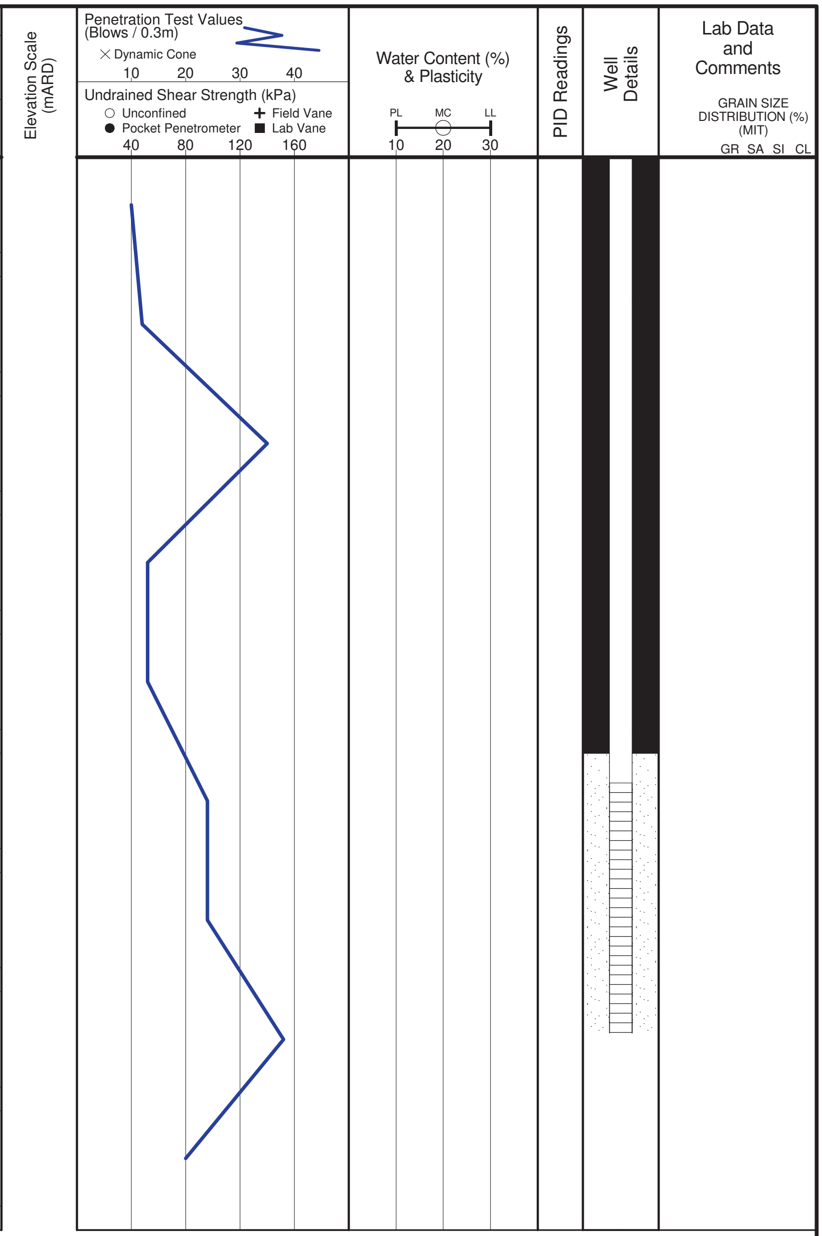
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 14R

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/17
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** MEQ
**position |**
**coring |** *n/a*
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE STRATIGRAPHY | SAMPLE Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|
| 0 | | **GROUND SURFACE** | | | |
| | | Brown grey **CLAYEY SILT**, with orange striations, some sandy silt, trace medium gravel, trace organics, DTPL to APL, firm. | 1 | SS | 10 |
| 1 | | | 2 | SS | 12 |
| 2 | 1.5 | Brown grey fine **SILTY SAND**, some medium gravel, wet, loose to compact. | 3 | SS | 35 |
| | | | 4 | SS | 13 |
| 3 | 2.6 | Grey **CLAYEY SILT**, trace fine gravel, trace sand, APL to WTPL, firm. | 5 | SS | 13 |
| 4 | 3.8 | Grey medium to coarse **SAND AND GRAVEL**, some sandy silt, trace clay, saturated, compact to dense. | 6 | SS | 24 |
| 5 | | Increasing presence of coarse gravel and cobbles at 5 m. | 7 | SS | 24 |
| | | | 8 | SS | 38 |
| 6 | | | 9 | SS | 20 |
| | 6.9 | **END OF BOREHOLE** | | | |

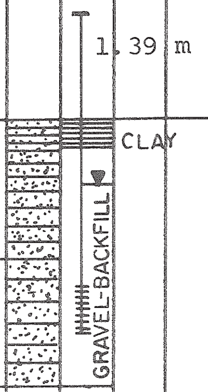


# GEOLOGICAL LOG

# TEST HOLE No. 14A

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 275.5 | GROUND SURFACE | | | | | |
| | 0.0<br>273.7 | Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand | | | | | |
| | 1.8<br>272.1 | Grey fine gravelly clayey very fine to fine sandy silt | | | | | |
| | 3.4 | End of Hole | | | | | |



SCALE (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

## NOTES

DATE DRILLED 13 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 0.8
(m below ground surface)

STATIC WATER LEVEL 0.8 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 274.7 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 14A Decommissioning

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2014/09/17
**supervisor** | MEQ
**reviewer** | AMS

| Depth Scale (m) | Elev<br>Depth<br>(m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) |
|---|---|---|---|---|---|---|---|
| | 275.9 | **GROUND SURFACE** | | | | | |
| 0 | | Grey gravelly clayey fine sandy silt overlying grey compact silty fine sand | | | | | |
| 1 | | | | | | | 275 |
| | 274.1<br>1.8 | Grey fine gravelly clayey very fine to fine sandy silt | | | | | |
| 2 | | | | | | | 274 |
| | 273.2<br>2.7 | | | | | | |

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined + Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH14A (MacLaren Engineers Inc., 1979).

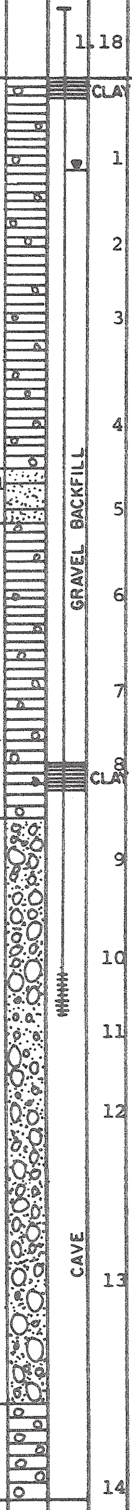
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# GEOLOGICAL LOG

# TEST HOLE No. 15

SHEET 1 OF 1

SCALE (ft) 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
SCALE (m) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27



| EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 277.9 | GROUND SURFACE | | | |
| 0.0 | Brown gravelly clayey silt | 1 | SS | 6 |
| | | 2 | SS | 32 |
| | | 3 | SS | 19 |
| | | 4 | SS | 24 |
| 271.2<br>6.7 | Brown compact interlayered silty fine sand, fine to medium sand and very fine sandy silt | 5 | SS | 11 |
| 270.3<br>7.6 | Brown gravelly clayey silt | 6 | SS | 4 |
| | | 7 | SS | 92 |
| | | 8 | SS | 39 |
| 265.1<br>12.8 | Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt) | 9 | SS | -- |
| | | 10 | SS | 35 |
| | | 11 | SS | 22 |
| | | 12 | SS | -- |
| | | 13 | SS | -- |
| 255.0<br>22.9 | Brown very dense gravelly silt till | 14 | SS | 70+ |
| 253.4<br>24.5 | End of Hole | | | |

## NOTES

DATE DRILLED 13 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND —
(m below ground surface)
STATIC WATER LEVEL 1.6 *
(m below ground surface)

PIPE DIAMETER 51 (mm)
LENGTH OF PIEZOMETER 0.5 (m)
TYPE OF PIEZOMETER Trow

SAMPLE TYPE
SS-SPLIT SPOON
WA-WASH

▽ 276.3 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren
MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 15 Decommissioning

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2014/09/22
**supervisor** | MEQ
**reviewer** | AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40; Undrained Shear Strength (kPa) ○ Unconfined ✚ Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | 278.3 | **GROUND SURFACE** |  |  |  |  |  |  |  |  |  |  |
| 0 |  | Brown gravelly clayey silt |  |  |  |  | 278 |  |  |  |  |  |
| 1 |  |  |  |  |  |  | 277 |  |  |  |  |  |
| 2 |  |  |  |  |  |  | 276 |  |  |  |  |  |
| 3 |  |  |  |  |  |  | 275 |  |  |  |  |  |
| 4 |  |  |  |  |  |  | 274 |  |  |  |  |  |
| 5 |  |  |  |  |  |  | 273 |  |  |  |  |  |
| 6 |  |  |  |  |  |  | 272 |  |  |  |  |  |
|  | 271.6<br>6.7 | Brown to compact interlayered silty fine sand, fine to medium sand and very fine sandy silt |  |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  | 271 |  |  |  |  |  |
|  | 270.7<br>7.6 | Brown gravelly clayey silt |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  | 270 |  |  |  |  |  |
| 9 |  |  |  |  |  |  | 269 |  |  |  |  |  |
| 10 |  |  |  |  |  |  | 268 |  |  |  |  |  |
| 11 |  |  |  |  |  |  | 267 |  |  |  |  |  |
| 12 |  |  |  |  |  |  | 266 |  |  |  |  |  |
|  | 265.5<br>12.8 | Brown compact to dense fine to very coarse sandy fine to medium gravel (minor silt) |  |  |  |  |  |  |  |  |  |  |
| 13 |  |  |  |  |  |  | 265 |  |  |  |  |  |
| 14 |  |  |  |  |  |  | 264 |  |  |  |  |  |
| 15 |  |  |  |  |  |  | 263 |  |  |  |  |  |
|  | 262.3<br>16.0 | **END OF BOREHOLE** |  |  |  |  |  |  |  |  |  |  |

Stratigraphy inferred from original borehole log for BH15 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

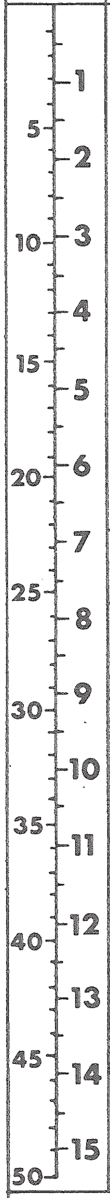
**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

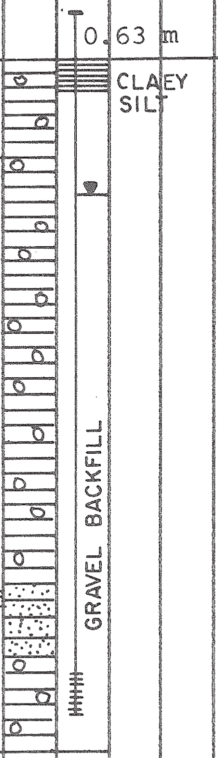
# GEOLOGICAL LOG

# TEST HOLE No. 15A

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 278.1 | GROUND SURFACE |
| 0.0 | Brown gravelly clayey silt |
| 271.2<br>6.9 | Brown compact interlayered silty fine sand, fine to medium sand and very fine sandy silt |
| 270.3<br>7.8 | Brown gravelly clayey silt |
| 269.0<br>9.1 | End of Hole |





## NOTES

DATE DRILLED 14 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND --
(m below ground surface)

STATIC WATER LEVEL 1.8 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.3 Static Water Elevation (m GSD) (26 JUNE 1979)*

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

**TEST HOLE RECORD**

G.M.P.

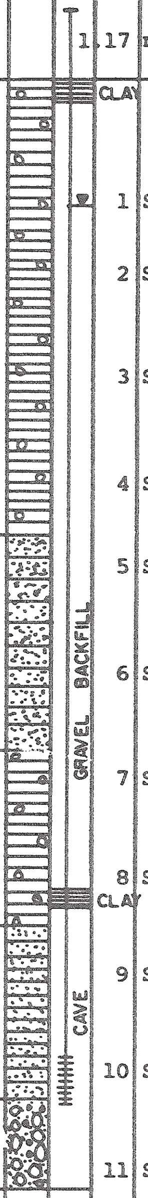
PROJECT NO. 11602-5

# GEOLOGICAL LOG

# TEST HOLE No. 16

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 277.8 | GROUND SURFACE |
| 0.0 | Brown gravelly clayey silt<br>(Brown fine sandy gravel layer at ~ 4.6 m BGS) |
| 270.8 / 7.0 | Brown very loose to compact very fine sandy silt |
| 267.4 / 10.4 | Brown gravelly clayey silt |
| 264.7 / 13.1 | Brown very loose to compact silty very fine to fine sand |
| 262.0 / 15.8 | Brown dense medium to coarse sand, fine to coarse sandy fine to medium gravel |
| 260.6 / 17.2 | End of Hole |



| SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|
| 1 | SS | 32 |
| 2 | SS | 15 |
| 3 | SS | 12 |
| 4 | SS | 14 |
| 5 | SS | 13 |
| 6 | SS | 3 |
| 7 | SS | 23 |
| 8 | SS | 40 |
| 9 | SS | 3 |
| 10 | SS | 21 |
| 11 | SS | 24+ |

## NOTES

DATE DRILLED 14 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND -- (m below ground surface)

STATIC WATER LEVEL 2.0 * (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS - SPLIT SPOON

WA - WASH

▽ 275.9 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G. M. P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 16 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2014/09/18
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 278.2 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown gravelly clayey silt<br><br>(Brown fine sandy gravel layer at ~ 4.6 m BGS) | | | | | 278 | | | | | |
| 7 | 271.2<br>7.0 | Brown very loose to compact very fine sandy silt | | | | | 271 | | | | | |
| | 267.8<br>10.4 | Brown gravelly clayey silt | | | | | | | | | | |
| 13 | 265.1<br>13.1 | Brown very loose to compact silty very fine to fine sand | | | | | 265 | | | | | |
| | 262.4<br>15.8 | **END OF BOREHOLE** | | | | | | | | | | |

Stratigraphy inferred from original borehole log for BH16 (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 16R

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/19
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** MEQ
**position |**
**coring |** *n/a*
**reviewer |** AMS

SUBSURFACE PROFILE

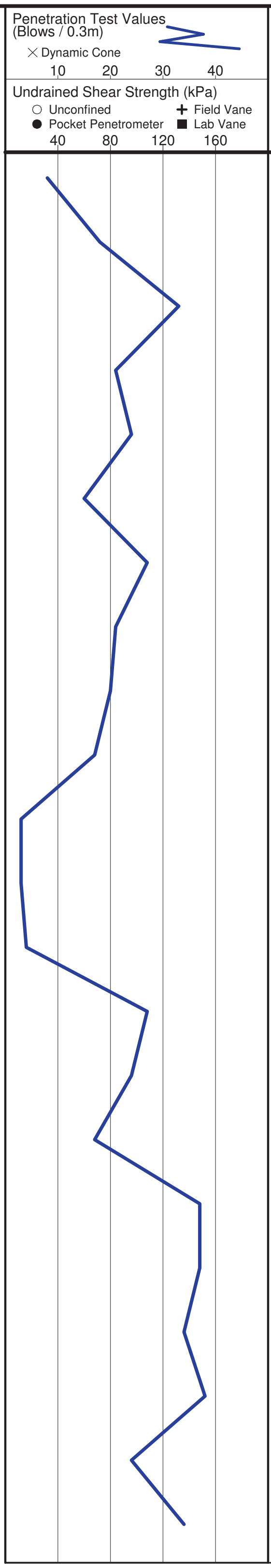
| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| | **GROUND SURFACE** |
| | Brown **CLAYEY SILT**, some fine to medium gravel, trace sand, DTPL, stiff to very stiff.<br>Abundant rootlets to 0.8 m depth. |
| 2.3 | Brown to grey **CLAYEY SILT**, some orange striations, trace fine sand, trace gravel, DTPL, stiff to very stiff. |
| 4.9 | Grey brown fine **SILTY GRAVEL AND SAND**, trace to some cobbles, wet, compact. |
| 6.0 | Grey **CLAYEY SILT**, trace fine silty sand, APL, stiff. |
| 7.8 | Grey fine **SANDY SILT**, trace clayey silt, trace fine gravel and coarse sand, WTPL, soft. |
| 10.0 | Grey **SANDY SILT TILL**, some medium gravel, some fine to coarse sand seams, APL, stiff to very stiff.<br>Reddish brown from 11.0 m to 11.5 m depth.<br>150mm thick coarse gravelly sand seam at 12.9 m depth. |
| 13.7 | Grey fine **SAND**, some silt, trace fine gravel, wet, compact.<br>300mm thick coarse gravel seam at 16.5m depth. |
| 16.8 | **END OF BOREHOLE** |

SAMPLE

| Number | Type | SPT N-Value / Core Recovery |
|---|---|---|
| 1 | SS | 8 |
| 2 | SS | 18 |
| 3 | SS | 33 |
| 4 | SS | 21 |
| 5 | SS | 24 |
| 6 | SS | 15 |
| 7 | SS | 27 |
| 8 | SS | 21 |
| 9 | SS | 20 |
| 10 | SS | 17 |
| 11 | SS | 3 |
| 12 | SS | 3 |
| 13 | SS | 4 |
| 14 | SS | 27 |
| 15 | SS | 24 |
| 16 | SS | 17 |
| 17 | SS | 37 |
| 18 | SS | 37 |
| 19 | SS | 34 |
| 20 | SS | 38 |
| 21 | SS | 24 |
| 22 | SS | 34 |

Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Elevation Scale (mARD)



Water Content (%) & Plasticity

PL MC LL

10 20 30

PID Readings

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

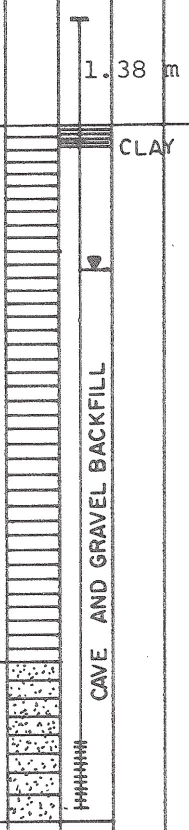
library: genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 16A

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 277.8 | GROUND SURFACE | | | | | |
| | 0.0 | Brown gravelly clayey silt<br>(Brown fine sandy gravel layer at ~ 4.6 m BGS) | | | | | |
| | 270.8<br>7.0 | Brown very loose to compact very fine sandy silt | | | | | |
| | 268.7<br>9.1 | End of Hole | | | | | |



## NOTES

DATE DRILLED 14 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND --
(m below ground surface)

STATIC WATER LEVEL 1.8*
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.0 Static Water Elevation (m GSD) (26 JUNE 1979) *

╪ Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 16A Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County **rig type |** CME 75, track-mounted **date started |** 2014/09/18

**location |** Holbrook, ON **method |** Hollow stem augers, 215 mm dia. **supervisor |** MEQ

**project no. |** *111-53037-00 132-00* **coring |** *n/a* **reviewer |** AMS

| Depth Scale (m) | Elev<br>Depth<br>(m) | SUBSURFACE PROFILE<br>**STRATIGRAPHY** | Graphic Plot | SAMPLE<br>Number | Type | SPT N-Value<br>Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 278.2 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown gravelly clayey silt | | | | | 278 | | | | | |
| 1 | | | | | | | 277 | | | | | |
| 2 | | | | | | | 276 | | | | | |
| 3 | | | | | | | 275 | | | | | |
| 4 | | | | | | | 274 | | | | | |
| | | (Brown fine sandy gravel layer at ~ 4.6 m BGS) | | | | | | | | | | |
| 5 | | | | | | | 273 | | | | | |
| 6 | | | | | | | 272 | | | | | |
| 7 | 271.2<br>7.0 | Brown very loose to compact very fine sandy silt | | | | | 271 | | | | | |
| 8 | | | | | | | 270 | | | | | |
| | 269.4<br>8.8 | **END OF BOREHOLE** | | | | | | | | | | |

Stratigraphy inferred from original borehole log for BH16A (MacLaren Engineers Inc., 1979).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

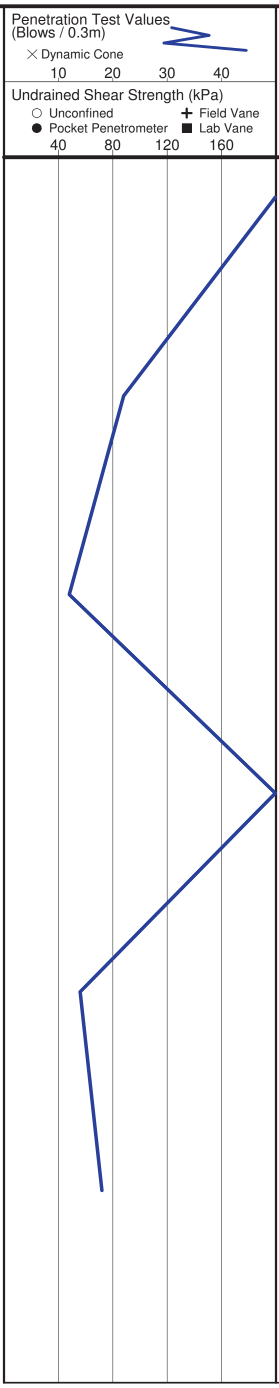
**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 16AR

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/22
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** MEQ
**position |**
**coring |** *n/a*
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|
| 0 | | **GROUND SURFACE** | | | |
| | | Brown **CLAYEY SILT**, some fine to medium gravel, trace sand, DTPL, stiff to very stiff.<br>Abundant rootlets to 0.8 m depth. | 1 | SS | 55 |
| 2 | | | 2 | SS | 22 |
| | 2.3 | Brown to grey **CLAYEY SILT**, some orange striations, trace fine sand, trace gravel, DTPL, stiff to very stiff. | | | |
| 3 | | | 3 | SS | 12 |
| 5 | | | 4 | SS | 58 |
| | 4.9 | Grey brown fine **SILTY GRAVEL AND SAND**, trace to some cobbles, wet, compact. | | | |
| 6 | 6.0 | Grey **CLAYEY SILT**, trace fine silty sand, APL, stiff. | | | |
| | | | 5 | SS | 14 |
| 8 | 7.8 | Grey fine **SANDY SILT**, trace clayey silt, trace fine gravel and coarse sand, WTPL, soft. | 6 | SS | 18 |
| | 9.4 | **END OF BOREHOLE**<br>Stratigraphy inferred from adjacent borehole 16. | | | |

Elevation Scale (mARD)



Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

library: genivar - library.glb report: gen log v1 file: bhlogs.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 17

SHEET 1 OF 1

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 278.6 | GROUND SURFACE | | 1.04 m | | | |
| | 0.0 | Yellowish brown loose very fine sandy silt overlying brown clayey silt | | CLAY | | | |
| 1 | | | | | | | |
| 5 – 2 | | | | | 1 | SS | 6 |
| 10 – 3 | 274.9 | | | CAVE AND BACKFILL | 2 | SS | 7 |
| 4 | 3.7 | Brown interlayered compact fine to medium and medium to coarse sand overlying brown gravelly medium to coarse sand | | | | | |
| 15 – 5 | | | | | 3 | SS | 10 |
| 20 – 6 | 271.7 | | | | 4 | SS | 5 |
| 7 | 6.9 | Brown fine to coarse sandy fine to medium gravel overlying fine to coarse sand near base | | | | | |
| 25 – 8 | | | | | 5 | SS | -- |
| 30 – 9 | 269.0 | | | | 6 | AU | -- |
| 10 | 9.6 | End of Hole | | | | | |
| 35 – 11 | | | | | | | |
| 40 – 12 | | | | | | | |
| 13 | | | | | | | |
| 45 – 14 | | | | | | | |
| 15 | | | | | | | |
| 50 | | | | | | | |

## NOTES

DATE DRILLED 29 June 1979

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND 1.2
(m below ground surface)

STATIC WATER LEVEL 1.5 *
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 0.5 (m)

TYPE OF PIEZOMETER Trow

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 277.1 Static Water Elevation (m GSD) (26 JUNE 1979) *

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# BOREHOLE NO. BH17 DECOMMISSIONING

PAGE 1 of 1

**PROJECT NAME:** HOLBROOK LANDFILL

**PROJECT NO.:** 111-53037-00 132-00

**CLIENT:** COUNTY OF OXFORD

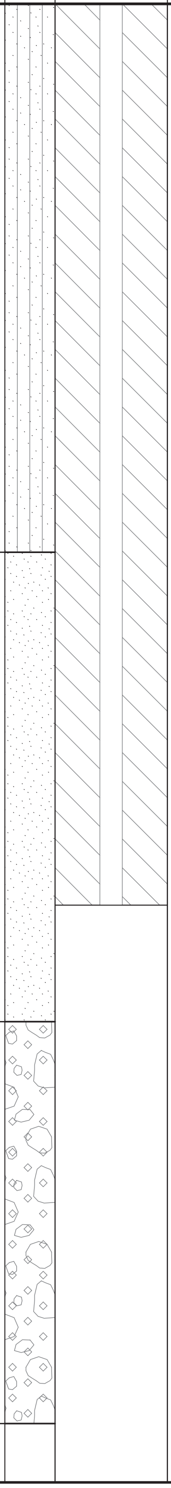
**DATE COMPLETED:** Jul 18, 2013

**BOREHOLE TYPE:** HOLLOW STEM AUGER

**SUPERVISOR:** TJB

**GROUND ELEVATION:** 278.6 mASL

**REVIEWER:** RFK



| DEPTH (m) | STRATIGRAPHIC DESCRIPTION | STRATIGRAPHY | MONITOR DETAILS | SAMPLE TYPE | SAMPLE N VALUE | SAMPLE % WATER | SAMPLE % RECOVERY | SAMPLE RQD (%) | CONE PENETRATION "N" VALUE 10 20 30 SHEAR STRENGTH | WATER CONTENT % 10 20 30 WP WL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | YELLOWISH BROWN LOOSE VERY FINE SANDY SILT OVERLYING BROWN CLAYEY SILT | | | | | | | | | | STRATIGRAPHY INFERRED FROM ORIGINAL BOREHOLE LOG FOR BH17 (MacLaren Engineers Inc., 1979) |
| 3.7 | BROWN INTERLAYERED COMPACT FINE TO MEDIUM AND MEDIUM TO COARSE SAND OVERLYING BROWN GRAVELLY MEDIUM TO COARSE SAND | | | | | | | | | | ORIGINAL BOREHOLE CAVED AND WAS BACKFILLED TO 6 m DEPTH BEFORE WELL INSTALLATION. |
| 6.9 | BROWN FINE TO COARSE SANDY FINE TO MEDIUM GRAVEL OVERLYING FINE TO COARSE SAND NEAR BASE | | | | | | | | | | |
| 9.6 | END OF ORIGINAL BOREHOLE | | | | | | | | | | |

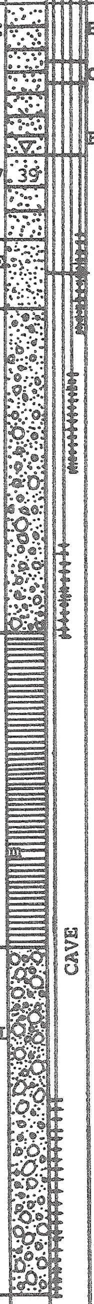
Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

# GEOLOGICAL LOG

# TEST HOLE No. 18

SHEET 1 OF 1

| EL (m GSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 280.0 | T.H. 18B 0.6 m<br>T.H. 18C 0.43 m<br>GROUND SURFACE | T.H. 18A 0.86 m<br>T.H. 18 0.99 m | | |
| 0.0 | BROWN COMPACT SILTY V. FINE SAND | BACKFILL | | |
| | | CLAY | | |
| | | 1 | SS | 14 |
| | (CLAYEY FROM 0 - 1.1 m; MINOR CLAY & SOME F. GRAVEL AT 1.5 m) | BACKFILL | | |
| | 277.39 | 2 | SS | 9 |
| 276.0<br>4.0 | GREY V. LOOSE V.FINE - FINE SAND WITH SOME SILT | 3 | SS | 0 |
| 274.8<br>5.2 | GREY COMPACT C. SAND & F. GRAVEL (SOME SILT - M. SAND MATRIX & M. GRAVEL) | 4. | SS | 48 |
| | | 5 | SS | 25 |
| | COARSE SANDY F. GRAVELLY MED. SAND AT 9.1 m ( SOME V.F. - FINE SAND MATRIX & M. GRAVEL) | 6 | SS | 11 |
| | | 7 | SS | 29 |
| 269.2<br>10.8 | DK. GREY COMPACT CLAYEY SILT (MINOR V.F. SAND & OCCAS. C. SAND, F. GRAVEL) INTERLAYERED WITH ≤5 mm LAYERS OF GREY SILTY V. FINE SAND AT 13.5 m F.- MED. GRAVELLY CLAYEY SILT AT 15 m | 8 | SS | 20 |
| | | 9 | SS | 13 |
| | | 10 | SS | 42 |
| 263.7<br>16.3 | GREY V. DENSE SAND & GRAVEL (BOTH VARIABLE IN SIZE FROM FINE - COARSE) | 11 | SS | -- |
| | | 12 | SS | 100 |
| | GREY C. SANDY F. GRAVELLY MED. SAND AT 16.8 m | 13 | SS | 59 |
| 257.7<br>22.3 | DK. GREY V. DENSE V. STONY SILT TILL (MINOR V. FINE SAND) | 14 | SS | 150 + |
| 254.1<br>25.9 | END OF HOLE | 15 | SS | 150+ |



## NOTES

DATE DRILLED 10,11,14 Sept 81

TYPE OF RIG CME 55

DRILLING METHOD HOLLOW STEM AUGERS

DEPTH WATER FOUND ~ 1.5
(m below ground surface)

STATIC WATER LEVEL 2.6 *
(m below ground surface)

PIPE DIAMETER* 51,13 (mm)

LENGTH OF PIEZOMETER 15.3 (m)

TYPE OF PIEZOMETER SLOTTED & FIBERGLASS WRAPPED

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽277.39 Static Water Elevation (m GSD) (23 Sept 81)

Piezometer

| T.H. No. | Static Water Elevation (m GSD) |
|---|---|
| * 18 | 277.39 |
| 18A | Blocked |
| 18B | 277.59 |
| 18C | 276.10 |

MacLaren

MACLAREN ENGINEERS PLANNERS & SCIENTISTS INC

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 18 Decommissioning

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2014/09/16
**supervisor** | MEQ
**reviewer** | AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE STRATIGRAPHY | Graphic Plot | SAMPLE Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.8 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown compact silty very fine sand<br>(Clayey from 0 - 1.1 m, minor clay and some fine gravel at 1.5 m) | | | | | | | | | | |
| 1 | | | | | | | 279 | | | | | |
| 2 | | | | | | | 278 | | | | | |
| 3 | | | | | | | 277 | | | | | |
| 4 | 275.8<br>4.0 | Grey very loose very fine - fine sand with some silt | | | | | 276 | | | | | |
| 5 | 274.6<br>5.2 | Grey compact coarse sand and fine gravel<br>(some silt to medium sand matrix and medium gravel) | | | | | 275 | | | | | |
| | 274.2<br>5.6 | **END OF BOREHOLE** | | | | | | | | | | |

Stratigraphy inferred from original borehole log for BH18 (MacLaren Engineers Inc., 1981).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

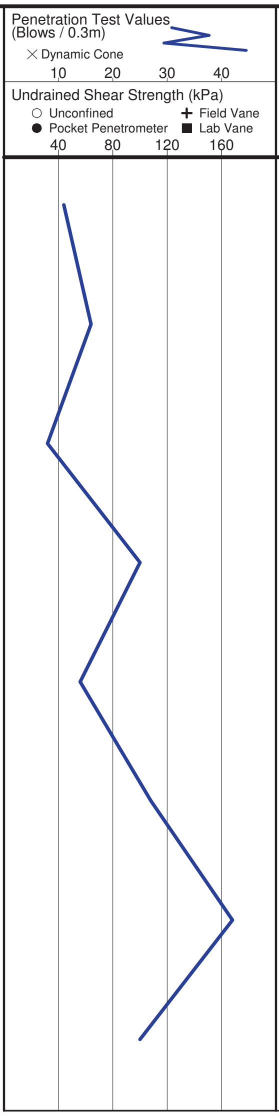
# LOG OF BOREHOLE 18R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**position |**

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**project no. |** 111-53037-00 132-00
**date started |** 2014/09/16
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery | Water Content (%) & Plasticity | PID Readings | Lab Data and Comments |
|---|---|---|---|---|---|---|---|
| 0 | **GROUND SURFACE** | | | | | | |
| | Brown **SILTY SAND**, some organics, some fine sand, some fine to medium subrounded gravel, moist, loose. | 1 | SS | 11 | | | |
| | | 2 | SS | 16 | | | |
| 1.5 | Grey brown fine **SILTY SAND**, some fine to medium gravel, trace clay, moist, loose. | 3 | SS | 8 | | | |
| | | 4 | SS | 25 | | | |
| 3.3 | Grey brown medium **SAND AND GRAVEL**, occassional subangular medium gravel, some silt, wet, compact. | 5 | SS | 14 | | | |
| | | 6 | SS | 27 | | | |
| | Clayey silt seam at 4.7 m depth. | 7 | SS | 42 | | | |
| | | 8 | SS | 25 | | | |
| 6.1 | **END OF BOREHOLE** | | | | | | |



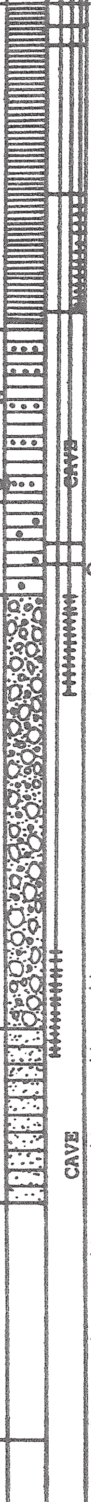
# GEOLOGICAL LOG

# TEST HOLE No. 19

SHEET 1 OF 1

T.H. 19A 0.94 m
T.H.19B 0.91 m
T.H. 19 0.97 m

| EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 274.7 | GROUND SURFACE | | | |
| 0.0<br>269.2 | BROWN COMPACT SL. CLAYEY SILT (SOME F. GRAVEL) | BACKFILL<br>CLAY<br>1<br>BACKFILL<br>2<br>GRAVEL<br>3 | <br><br>SS<br><br>SS<br><br>SS | <br><br>24<br><br>13<br><br>14 |
| 5.5<br>266.2 | GREY COMPACT INTERLAYERED CLAYEY SILT & SILTY V. FINE - FINE SAND<br>(CLAYEY SILT CONTAINS THIN LAYERS OF SILTY V.FINE SAND) | 4<br>5 | SS<br>SS | 16<br>29 |
| 8.5<br>264.6 | GREY DENSE V.F. GRAVELLY CLAYEY SILT (MINOR SAND) | 6<br>CLAY | SS | 39 |
| 10.1<br>257.0 | GREY DENSE INTERLAYERED SAND AND GRAVEL<br>(GENERALLY F. GRAVELLY MED. & COARSE SAND, F. - MED. GRAVEL) | 7<br>8<br>9<br>10 | SS<br>SS<br>SS<br>SS | 79 +<br>48<br>28<br>43 |
| 17.7<br>254.0 | GREY COMPACT TO DENSE V. SILTY V. FINE SAND (SOME CLAYEY SILT INTERBEDS) | 11<br>12 | SS<br>SS | 43<br>25 |
| 20.7<br>250.0 | DK. GREY V. DENSE V. STONY SILT TILL<br>(LAYER OF GREY V. SILTY V. FINE SAND AT 23 m) | 13<br>14<br>15 | SS<br>SS<br>SS | 76 +<br>137<br>181 |
| 24.3 | END OF HOLE | | | |



## NOTES

DATE DRILLED 14 - 16 Sept 81

TYPE OF RIG CME 55

DRILLING METHOD HOLLOW STEM AUGERS

DEPTH WATER FOUND ~ 5.5
(m below ground surface)
STATIC WATER LEVEL +0.85 *
(m below ground surface)

PIPE DIAMETER 51.13 (mm)
LENGTH OF PIEZOMETER 1.5,1.6 m
TYPE OF PIEZOMETER SLOTTED & FIBERGLASS WRAPPED

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

275.55 Static Water Elevation (m GSD) (23 Sept 81)

Piezometer

| T.H. NO. | Static Water Elevation (m GSD) |
|---|---|
| * 19 | 275.55 |
| 19A | 275.65+ |
| 19B | 275.61+ |

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TEST HOLE RECORD

G.M.P.

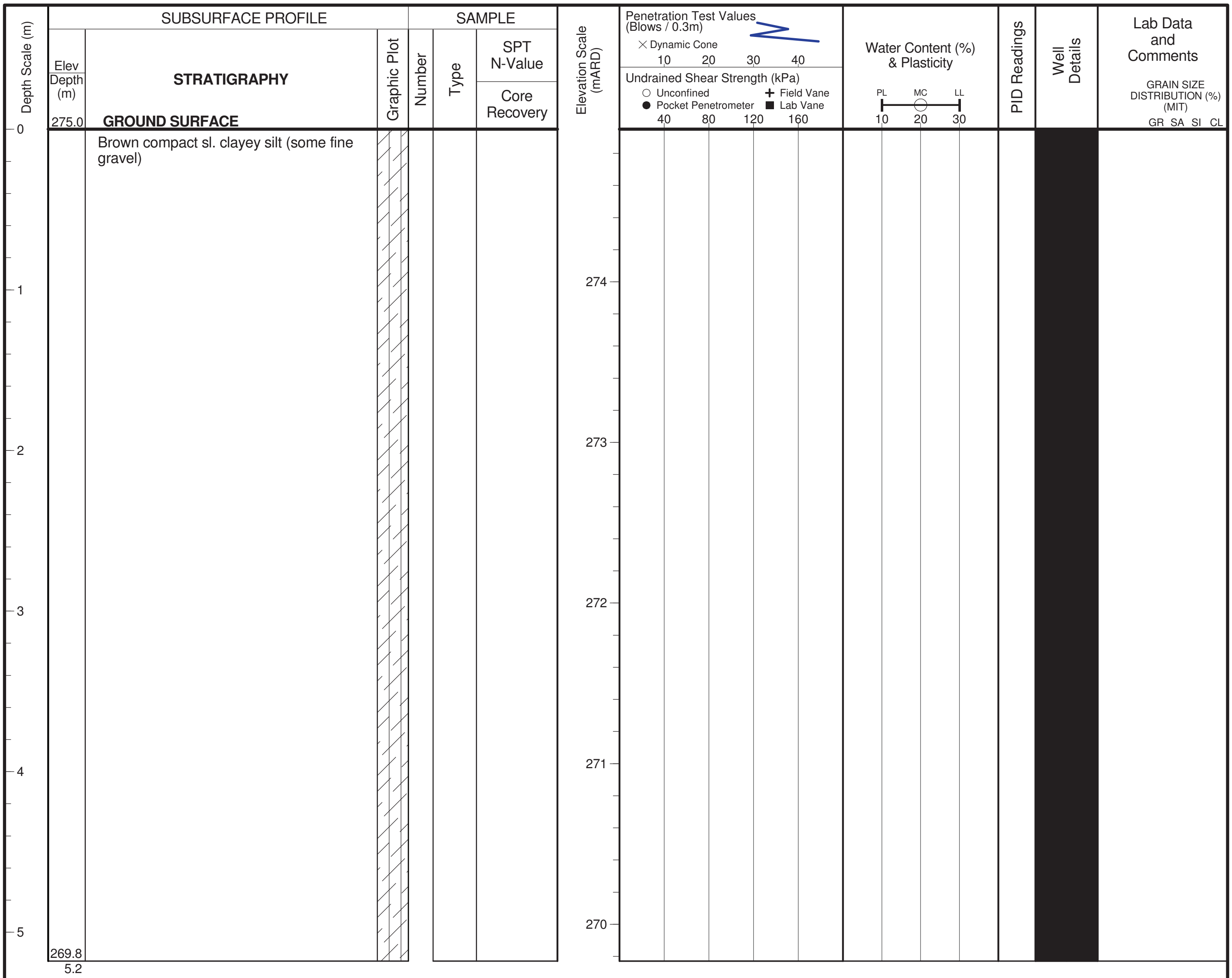
PROJECT NO. 11602-5

# LOG OF BOREHOLE 19 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2014/09/26
**supervisor |** MEQ
**reviewer |** AMS



275.0 **GROUND SURFACE**

Brown compact sl. clayey silt (some fine gravel)

269.8
5.2

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH19 (MacLaren Engineers Inc., 1981).

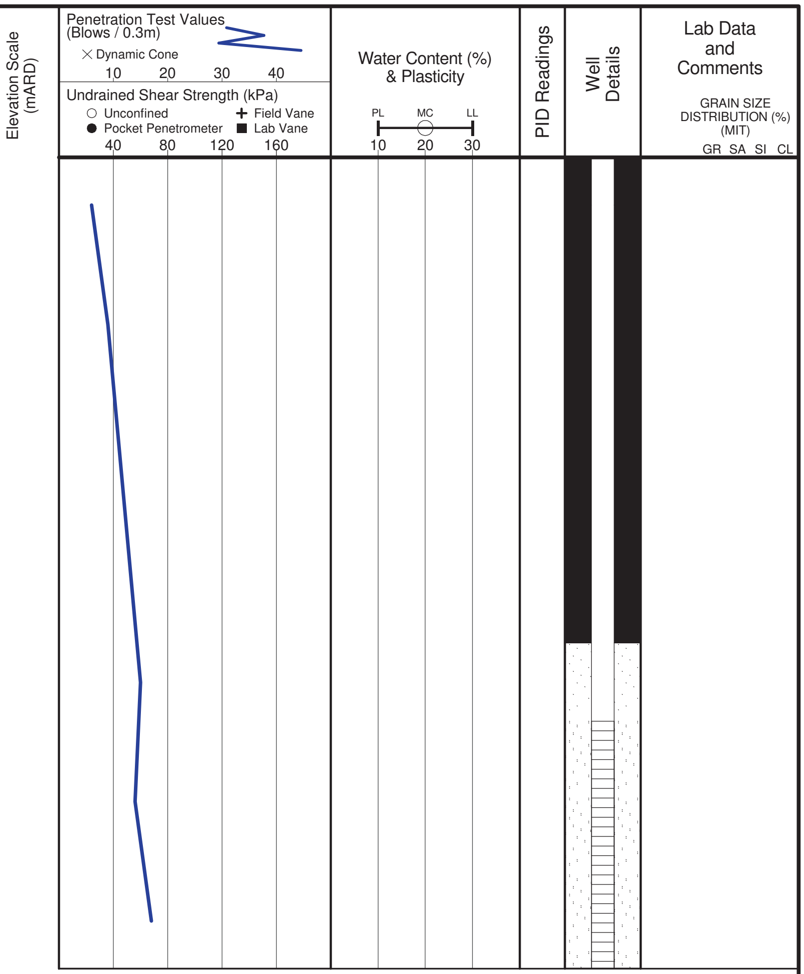
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpi

# LOG OF BOREHOLE 19R

**project |** Holbrook Landfill Site
**project no. |** 111-53037-00 132-00
**client |** Oxford County
**rig type |** CME 75, track-mounted
**date started |** 2014/09/26
**location |** Holbrook, ON
**method |** Hollow stem augers, 215 mm dia.
**supervisor |** SCL
**position |**
**coring |** *n/a*
**reviewer |** AMS

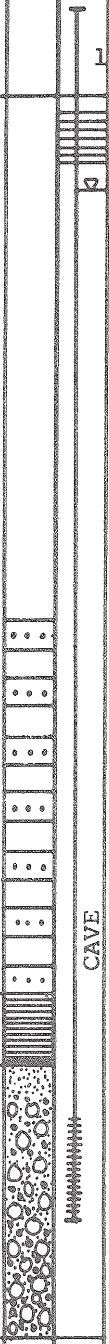
| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE – STRATIGRAPHY | SAMPLE Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|
| 0 | | **GROUND SURFACE** | | | |
| | | Dark brown **SILTY SAND TO SANDY SILT**, trace to some organics and rootlets, trace clay, moist, loose. | 1 | SS | 6 |
| | 0.8 | Orangey brown to grey brown **CLAYEY SILT**, trace to some fine gravel, trace cobble, APL, stiff. | 2 | SS | 9 |
| | | | 3 | SS | |
| 2 | | Becoming grey below 2 m depth. | | | |
| | | | 4 | SS | 13 |
| | | | 5 | SS | 15 |
| | | | 6 | SS | 14 |
| | | | 7 | SS | 17 |
| | 5.2 | **END OF BOREHOLE** | | | |



# GEOLOGICAL LOG

# TEST HOLE No. 21

SHEET 1 OF 1



| SCALE (ft)(m) | EL (mGSD)<br>DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 277.5 | GROUND SURFACE | | 1.05 m | | | |
| 1<br>5<br>2<br>10<br>3<br>4<br>15<br>5<br>20<br>6<br>7 | 0.0 | BROWN SL. CLAYEY SILT (GRAVELLY FROM 2 - 6 m) OVERLYING GREY COMPACT INTERLAYERED CLAYEY SILT (OCCAS. GRAVEL) & SILTY V. FINE SAND OF VARIABLE THICKNESS | | BACKFILL<br>CLAY | | | |
| 25<br>8 | | | | | 1 | SS | 22 |
| 9<br>30 | | | | | 2 | SS | 23 |
| 10<br>35<br>11 | | (SILTY V.FINE TO FINE SAND WITH SOME MED. SAND AT 10.7 & 12.2 m) | | | 3 | SS | 7 |
| 12<br>40 | 265.0 | | | CAVE | 4 | SS | 37 |
| 13 | 12.5<br>264.1 | GREY DENSE V. GRAVELLY CLAYEY SILT | | | | | |
| 45<br>14<br>15<br>50<br>16 | 13.4 | GREY DENSE GRANULAR MED.-COARSE SAND OVERLYING F.-MED. SANDY GRAVEL WHICH CONTAINS SOME SILT & V.F. SAND | | | 5 | SS | 44 |
| 55<br>17 | 260.3 | | | | 6 | SS | 66 |
| 18<br>60<br>19<br>65<br>20<br>21<br>70 | 17.2 | END OF HOLE | | | | | |

## NOTES

DATE DRILLED 13 - 16 Oct./81

TYPE OF RIG CME 55

DRILLING METHOD Hollow Stem Augers, Casing

DEPTH WATER FOUND ~2.4
(m below ground surface)
STATIC WATER LEVEL 1.3
(m below ground surface)

PIPE DIAMETER 51 (mm)
LENGTH OF PIEZOMETER 1.2 (m)
TYPE OF PIEZOMETER SLOTTED AND FIBREGLASS WRAPPED

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 276.22 Static Water Elevation (m GSD) (26 Oct./81)

Piezometer

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& SCIENTISTS INC

TEST HOLE RECORD

G.M.P.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 21 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted

**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2015/07/20

**supervisor |** MEQ

**reviewer |** AMS

SUBSURFACE PROFILE | SAMPLE

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined ✚ Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

| Depth Scale (m) | Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) |
|---|---|---|---|---|---|---|---|
| 0 | 277.8 | **GROUND SURFACE** | | | | | |
| 0–12.5 | | Brown clayey silt (gravelly from 2 - 6 m) overlying grey compact interlayered clayey silt (occassional gravel) & silty very fine sand of variable thickness<br>(Silty very fine to fine sand with some medium sand at 10.7 & 12.2 m) | | | | | 277–266 |
| 12.5 | 265.3<br>12.5 | Grey dense very gravelly clayey silt | | | | | 265 |
| 13.4 | 264.4<br>13.4 | Grey dense granular medium to coarse sand overlying fine to medium sandy gravel which contains some silt & very fine sand | | | | | 264–263 |
| 15.5 | 262.3<br>15.5 | **END OF BOREHOLE** | | | | | |

Stratigraphy inferred from original borehole log for BH21 (MacLaren Engineers Inc., 1981).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

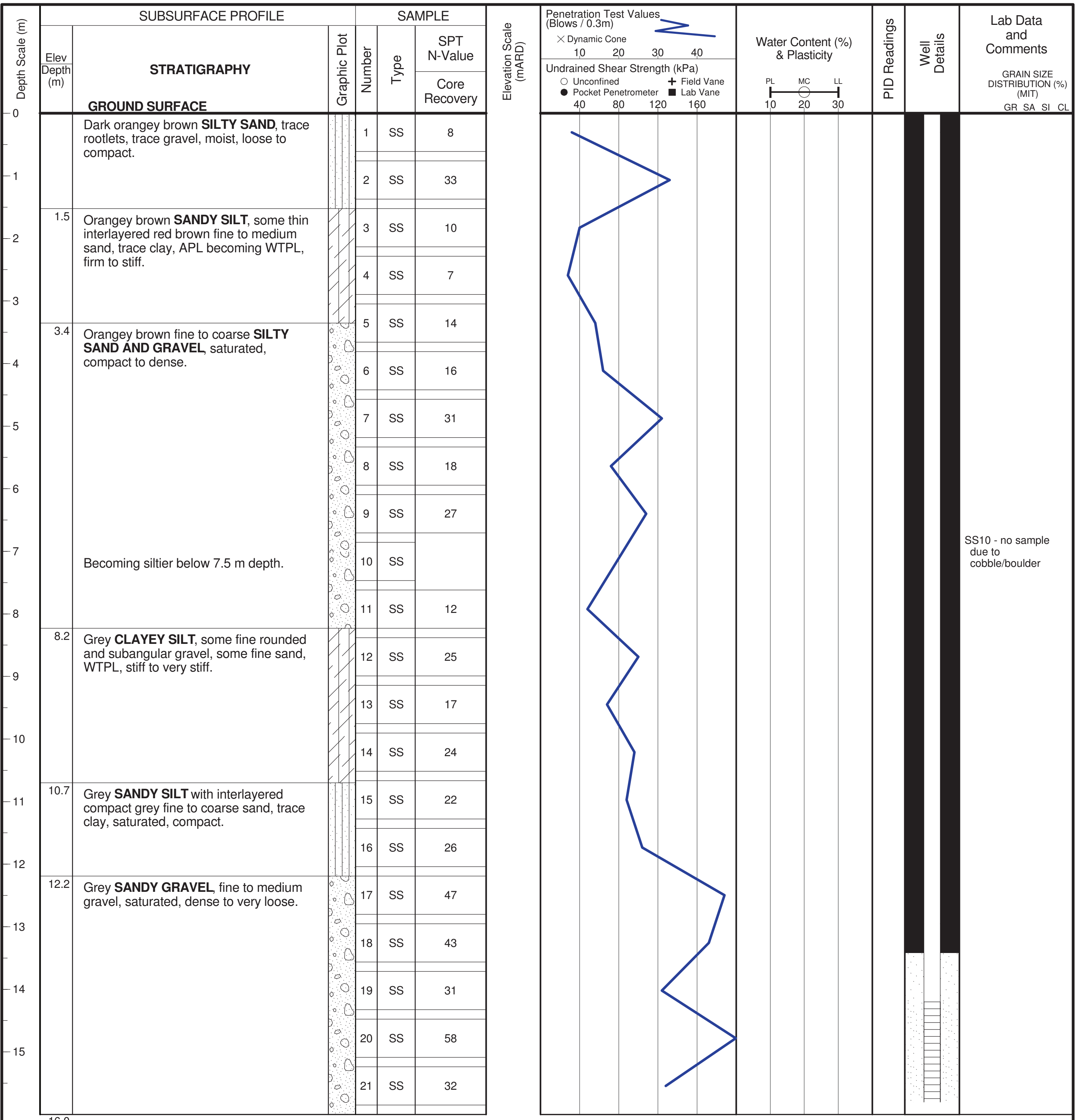
# LOG OF BOREHOLE 21R

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, ON
**position** |

**rig type** | CME 75, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**project no.** | 111-53037-00 132-00
**date started** | 2014/09/29
**supervisor** | SCL
**reviewer** | AMS

| Elev<br>Depth (m) | STRATIGRAPHY<br>GROUND SURFACE | Number | Type | SPT N-Value | Lab Data and Comments |
|---|---|---|---|---|---|
| | Dark orangey brown **SILTY SAND**, trace rootlets, trace gravel, moist, loose to compact. | 1 | SS | 8 | |
| | | 2 | SS | 33 | |
| 1.5 | Orangey brown **SANDY SILT**, some thin interlayered red brown fine to medium sand, trace clay, APL becoming WTPL, firm to stiff. | 3 | SS | 10 | |
| | | 4 | SS | 7 | |
| 3.4 | Orangey brown fine to coarse **SILTY SAND AND GRAVEL**, saturated, compact to dense. | 5 | SS | 14 | |
| | | 6 | SS | 16 | |
| | | 7 | SS | 31 | |
| | | 8 | SS | 18 | |
| | | 9 | SS | 27 | |
| | Becoming siltier below 7.5 m depth. | 10 | SS | | SS10 - no sample due to cobble/boulder |
| | | 11 | SS | 12 | |
| 8.2 | Grey **CLAYEY SILT**, some fine rounded and subangular gravel, some fine sand, WTPL, stiff to very stiff. | 12 | SS | 25 | |
| | | 13 | SS | 17 | |
| | | 14 | SS | 24 | |
| 10.7 | Grey **SANDY SILT** with interlayered compact grey fine to coarse sand, trace clay, saturated, compact. | 15 | SS | 22 | |
| | | 16 | SS | 26 | |
| 12.2 | Grey **SANDY GRAVEL**, fine to medium gravel, saturated, dense to very loose. | 17 | SS | 47 | |
| | | 18 | SS | 43 | |
| | | 19 | SS | 31 | |
| | | 20 | SS | 58 | |
| | | 21 | SS | 32 | |
| 16.0 | **END OF BOREHOLE** | | | | |

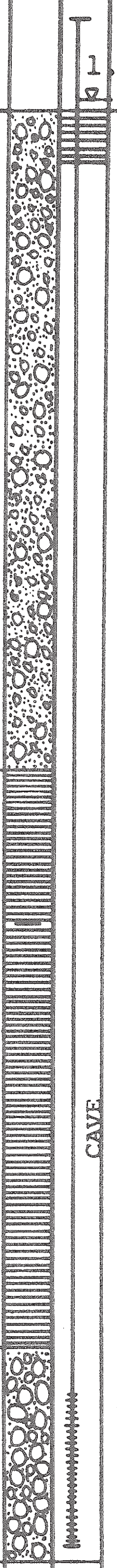


library: genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 23

SHEET 1 OF 1



| SCALE (ft)(m) | EL (mGSD) DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 278.4 | GROUND SURFACE | | 1.12 m | | | |
| | 0.0 | GREY COARSE SAND AND GRAVEL<br>(SOME SILT AND FINE SAND) | | CLAY | 1 | SS | 28 |
| | | | | | 2 | SS | 39 |
| | 269.0 | | | | 3 | SS | 20 |
| | 9.4 | GREY COMPACT CLAYEY SILT | | | 4 | SS | 26 |
| | | GREY V. DENSE GRAVELLY CLAYEY SILT | | | 5 | SS | 187+ |
| | | | | CAVE | 6 | SS | 166 |
| | | | | | 7 | SS | 204 |
| | 260.7 | | | | 8 | SS | 63 |
| | 17.7 | GREY COARSE SANDY GRAVEL | | | 9 | SS | 190 |
| | 257.7 | | | | | | |
| | 20.7 | END OF HOLE | | | | | |

## NOTES

DATE DRILLED 22,23 Oct./81

TYPE OF RIG CME 55

DRILLING METHOD HOLLOW STEM AUGERS

DEPTH WATER FOUND --
(m below ground surface)

STATIC WATER LEVEL +0.2
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 2.1 (m)

TYPE OF PIEZOMETER SLOTTED AND NYLON SCREEN WRAPPED

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

278.66 ▽ Static Water Elevation (m GSD) (26 Oct./81)

Piezometer

**TEST HOLE RECORD**

G.M.P.

MacLaren

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PROJECT NO. 11602-5

# LOG OF BOREHOLE 23 Decommissioning

**project** | Holbrook Landfill Site

**client** | Oxford County

**location** | Holbrook, ON

**project no.** | *111-53037-00 132-02*

**rig type** | Acker Soil-Max, track-mounted

**method** | Hollow stem augers, 215 mm dia.

**coring** | *n/a*

**date started** | 2015/07/09

**supervisor** | MEQ

**reviewer** | AMS

SUBSURFACE PROFILE | SAMPLE: Number, Type, SPT N-Value, Core Recovery

Depth Scale (m) | Elevation Scale (mARD)

Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160

Water Content (%) & Plasticity PL MC LL 10 20 30

PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| 278.9 | **GROUND SURFACE** |
| | Grey coarse sand and gravel (some silt and fine sand) |
| 269.5<br>9.4 | Grey compacy clayey silt |
| 267.4<br>11.5 | Grey very dense gravelly clayey silt |
| 261.2<br>17.7 | Grey coarse sandy gravel |
| 258.5<br>20.4 | **END OF BOREHOLE** |

Stratigraphy inferred from original borehole log for BH23 (MacLaren Engineers Inc., 1981).

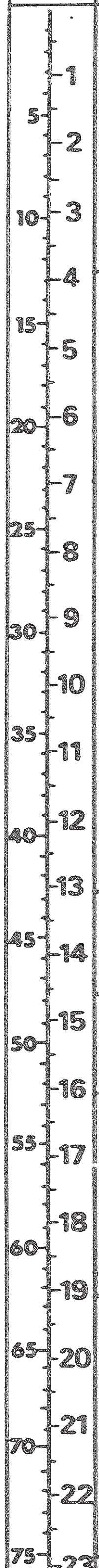
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

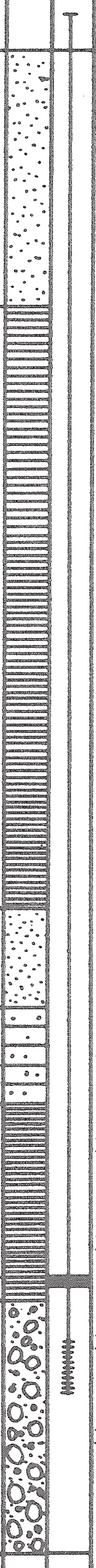
**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpi

# GEOLOGICAL LOG

# TEST HOLE No. 24

SHEET 1 OF 1





| EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 279.2 | GROUND SURFACE | 0.56 m | | |
| 0.0 | Brown compact fine to coarse sand with trace gravel | 1 | SS | 20 |
| | | 2 | SS | 18 |
| 275.3 | | | | |
| 3.9 | Brown clayey silt; some fine to coarse sand layers several centimeters thick; trace gravel<br>~ 8.0 - 8.5 m = fine silty sand with trace gravel | 3 | SS | 9 |
| | | 4 | SS | 7 |
| | | 5 | SS | 18 |
| | | 6 | SS | 9 |
| | | 7 | SS | 15 |
| | | 8 | SS | 32 |
| 266.0 | | | | |
| 13.2 | Brown loose fine sand ? | 9 | SS | 6 |
| 264.6 | | | | |
| 14.6 | Brown interlayered fine sand and clay | 10 | SS | 103 |
| 263.0 | | | | |
| 16.2 | Brown silt with fine sand layers (trace of gravel appears near contact with gravel layer) | 11 | SS | 49 |
| | | 12 | SS | 70 |
| 260.0 | | | | |
| 19.2 | Dense sandy gravel (sand generally medium to coarse grained) | 13 | SS | 52 |
| | | 14 | SS | 37 |
| 256.3 | | | | |
| 22.9 | END OF HOLE | | | |

## NOTES

DATE DRILLED 11 Feb./82

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~1
(m below ground surface)

STATIC WATER LEVEL 4.0
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1 (m)

TYPE OF PIEZOMETER Slotted AB pipe and Nitex nylon screen wrapped

SAMPLE TYPE

SS - SPLIT SPOON
WA - WASH

▽ 275.97 Static Water Elevation (m GSD) (18 February 1982)

Piezometer

**MacLaren**

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ENGINEERS, PLANNERS
& SCIENTISTS

TEST HOLE RECORD

E H R

11602-5

# LOG OF BOREHOLE 24 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/13
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE | SAMPLE (Number, Type, SPT N-Value, Core Recovery) | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 | Undrained Shear Strength (kPa) ○ Unconfined ✚ Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

| Elev<br>Depth<br>(m) | STRATIGRAPHY |
|---|---|
| 279.7 | **GROUND SURFACE** |
| | Brown compact fine to coarse sand with trace gravel |
| 275.8<br>3.9 | Brown clayey silt; some fine to coarse sand layers several centimeters thick; trace gravel<br>~8.0 - 8.5 m = fine silty sand with trace gravel |
| 266.5<br>13.2 | Brown loose fine sand |
| 265.1<br>14.6 | Brown interlayered fine sand and clay |
| 263.5<br>16.2 | Brown silt with fine sand layers (trace of gravel appears near contact with gravel layer) |
| 260.5<br>19.2 | Dense sandy gravel (sand generally medium to coarse grained) |
| 259.3<br>20.4 | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH24 (MacLaren Engineers Inc., 1982).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 24R

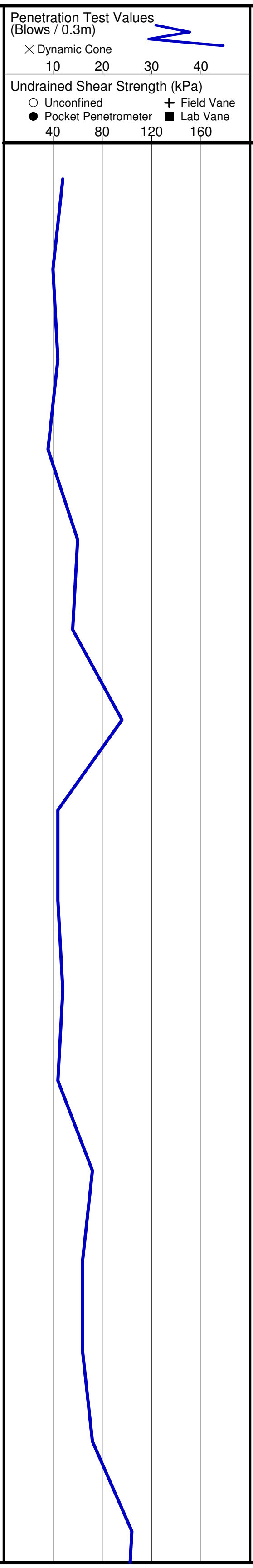
**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/14
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY<br>GROUND SURFACE | SAMPLE Number | SAMPLE Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|
| | Brown fine to medium **SILTY SAND**, some fine gravel, trace organics, moist, compact. | 1 | SS | 12 |
| | Black clayey organic peat layer at 1.2 m depth. | 2 | SS | 10 |
| 1.4 | Grey fine to medium **SAND**, some silt, trace fine gravel, wet, compact. | 3 | SS | 11 |
| | | 4 | SS | 9 |
| | | 5 | SS | 15 |
| | | 6 | SS | 14 |
| | | 7 | SS | 24 |
| 4.9 | Grey **CLAYEY SILT**, trace fine sand, APL to WTPL, stiff. | | | |
| | | 8 | SS | 11 |
| | | 9 | SS | 11 |
| | | 10 | SS | 12 |
| | Fine gravel seams at 7.6 m depth. | | | |
| | | 11 | SS | 11 |
| | | 12 | SS | 18 |
| 9.1 | Grey **SILTY SAND**, trace clay, wet, compact. | 13 | SS | 16 |
| 9.9 | Grey **CLAYEY SILT**, trace medium sand, trace fine gravel, APL to WTPL, very stiff. | 14 | SS | 16 |
| | | 15 | SS | 18 |
| | | 16 | SS | 26 |

Elevation Scale (mASL)



Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

*(continued next page)*

# LOG OF BOREHOLE 24R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

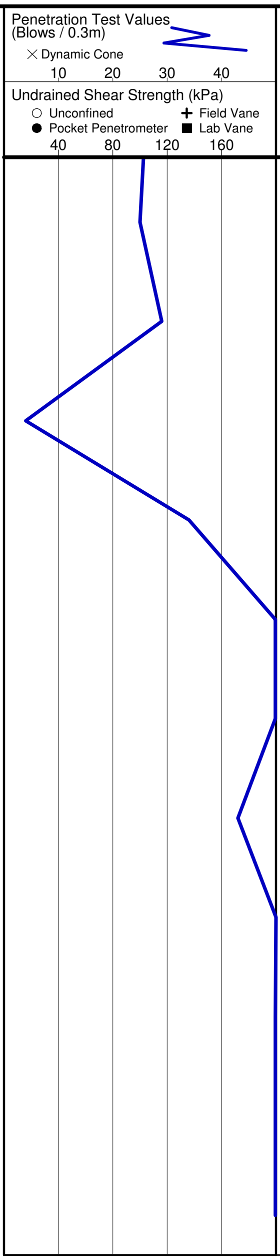
**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/14
**supervisor |** MEQ
**reviewer |** AMS

Depth Scale (m): 12, 13, 14, 15, 16, 17, 18, 19, 20

| SUBSURFACE PROFILE | | | SAMPLE | | |
|---|---|---|---|---|---|
| Elev Depth (m) | **STRATIGRAPHY** *(continued)* | Graphic Plot | Number | Type | SPT N-Value / Core Recovery |
| | Grey **CLAYEY SILT**, trace medium sand, trace fine gravel, APL to WTPL, very stiff. *(continued)* | | 17 | SS | 25 |
| | | | 18 | SS | 29 |
| 13.8 | Grey medium to coarse **SAND**, trace silt, wet, loose. | | 19 | SS | 4 |
| | | | 20 | SS | 34 |
| 14.8 | Grey **CLAYEY SILT**, trace medium to coarse sand and fine to medium gravel, APL, hard. | | 21 | SS | 51 |
| | | | 22 | SS | 80 |
| | | | 23 | SS | 43 |
| | | | 24 | SS | 50 |
| 18.3 | Grey **SAND AND SILT**, trace clay, trace gravel, wet, very dense. | | 25 | SS | 80 |
| 19.1 | Grey coarse **SAND** and fine to coarse **GRAVEL**, trace silt, wet, very dense. | | 26 | SS | 72 |
| | | | 27 | SS | 59 |
| 20.4 | **END OF BOREHOLE** | | | | |

Elevation Scale (mASL)

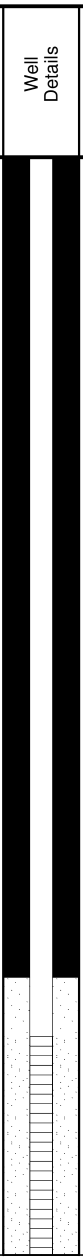


Water Content (%) & Plasticity

PL MC LL

10 20 30

PID Readings



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

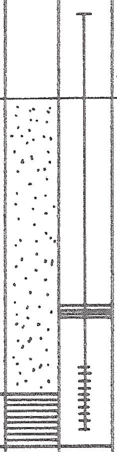
GR SA SI CL

# GEOLOGICAL LOG

# TEST HOLE No. 24A

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 279.2 | GROUND SURFACE | | | 1.08 m | | |
| | 0.0 | Fine coarse brown sand with some gravel | | | | | |
| | 275.3<br>3.9 | Brown clayey silt with trace of gravel | | | | | |
| | 274.6<br>4.6 | END OF HOLE | | | | | |



## NOTES

DATE DRILLED 11 Feb./82

TYPE OF RIG CME 75

DRILLING METHOD Hollow stem augers

DEPTH WATER FOUND ~1
(m below ground surface)

STATIC WATER LEVEL 0.5
(m below ground surface)

PIPE DIAMETER 51 (mm)
LENGTH OF PIEZOMETER 1 (m)
TYPE OF PIEZOMETER Slotted ABS pipe and Nitex nylon screen wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 278.73 Static Water Elevation (m GSD) (18 February 1982)

╪ Piezometer

**MacLaren**

MacLAREN ENGINEERS, PLANNERS & SCIENTISTS

# TEST HOLE RECORD

E.H.R.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 24A Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00  132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/13
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev<br>Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.7 | **GROUND SURFACE** | | | | | | | | | | |
| | | Fine coarse brown sand with some gravel | | | | | 279<br>278<br>277<br>276 | | | | | |
| 1<br>2<br>3 | | | | | | | | | | | | |
| 4 | 275.8<br>3.9 | Brown clayey silt with trace of gravel | | | | | | | | | | |
| | 275.4<br>4.3 | | | | | | | | | | | |

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH24A (MacLaren Engineers Inc., 1982).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# LOG OF BOREHOLE 24AR

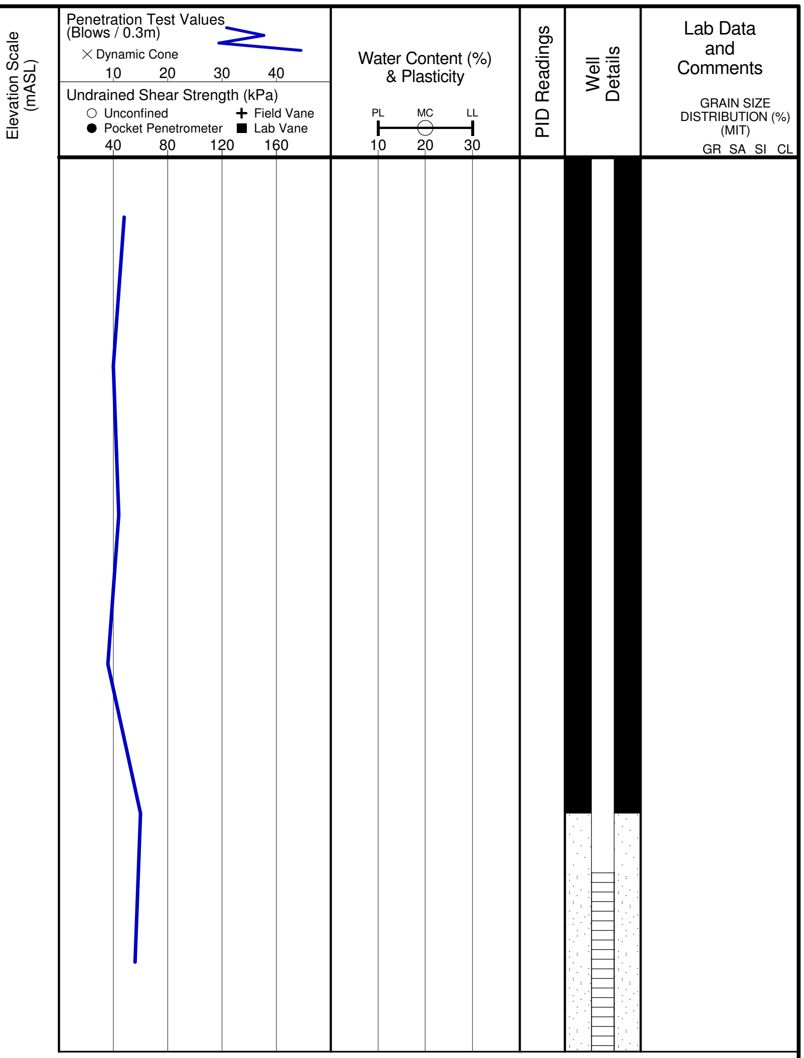
**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/13
**supervisor |** SM
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE STRATIGRAPHY | SAMPLE Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|
| | | **GROUND SURFACE** | | | |
| 0 | | Brown fine to medium **SILTY SAND**, some fine gravel, trace organics, moist, compact. | 1 | SS | 12 |
| 1 | | Black clayey organic peat layer at 1.2 m depth. | 2 | SS | 10 |
| | 1.4 | Grey fine to medium **SAND**, some silt, trace fine gravel, wet, compact. | 3 | SS | 11 |
| 2 | | | 4 | SS | 9 |
| 3 | | | 5 | SS | 15 |
| 4 | | | 6 | SS | 14 |
| | 4.6 | **END OF BOREHOLE** | | | |

Stratigraphy inferred from adjacent borehole 24R.



# GEOLOGICAL LOG

# TEST HOLE No. 25

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 279.9 | GROUND SURFACE | | | 0.61 m | | |
| | 0.0 | Brown compact medium to coarse sand | | | | | |
| | 278.2 | | | | 1 | SS | 15 |
| | 1.7 | | | | | | |
| | | | | | 2 | SS | 14 |
| | | Brown clayey silt with trace of sand and gravel | | | 3 | SS | 23 |
| | | | | | 4 | SS | 18 |
| | | | | | 5 | SS | 23 |
| | 271.4 | | | | | | |
| | 8.5 | | | | 6 | SS | 13 |
| | | Brown sandy silt with some thin layers of fine sand and a trace of gravel | | | 7 | SS | 7 |
| | 267.4 | | | | 8 | SS | 18 |
| | 12.5 | Brown silty clay with some gravel | | | 9 | SS | 25 |
| | 265.3 | | | | | | |
| | 14.6 | Brown gravelly silt with a trace of clay | | | 10 | SS | 97 |
| | 264.0 | | | | | | |
| | 15.9 | | | | 11 | SS | 48 |
| | | Brown sand and gravel | | | | | |
| | 260.5 | | | | 12 | SS | - |
| | 19.4 | END OF HOLE | | | | | |

## NOTES

DATE DRILLED 12 Feb./82

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND Surface
(m below ground surface)

STATIC WATER LEVEL 3.8
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1 (m)

TYPE OF PIEZOMETER Slotted ABS pipe and fibreglass wrapped

SAMPLE TYPE

SS- SPLIT SPOON
WA- WASH

▽276.07 Static Water Elevation (m GSD) (18 February 1982)

Piezometer

MacLaren

MacLAREN
ENGINEERS, PLANNERS
& SCIENTISTS

TEST HOLE RECORD

E.H.R.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 25 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/17
**supervisor |** MEQ
**reviewer |** AMS

| Elev<br>Depth (m) | SUBSURFACE PROFILE<br>STRATIGRAPHY | SAMPLE<br>Number | Type | SPT N-Value / Core Recovery | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 280.4 | **GROUND SURFACE** | | | | | | | | |
| | Brown compact medium to coarse sand | | | | | | | | |
| 278.7<br>1.7 | Brown clayey silt with trace of sand and gravel | | | | | | | | |
| 271.9<br>8.5 | Brown sandy silt with some thin layers of fine sand and a trace of gravel | | | | | | | | |
| 267.9<br>12.5 | Brown silty clay with some gravel | | | | | | | | |
| 265.8<br>14.6 | Brown gravelly silt with a trace of clay | | | | | | | | |
| 264.5<br>15.9 | Brown sand and gravel | | | | | | | | |
| 261.2<br>19.2 | **END OF BOREHOLE** | | | | | | | | |

Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Elevation Scale (mARD): 280 279 278 277 276 275 274 273 272 271 270 269 268 267 266 265 264 263 262

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH25 (MacLaren Engineers Inc., 1982).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 25R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

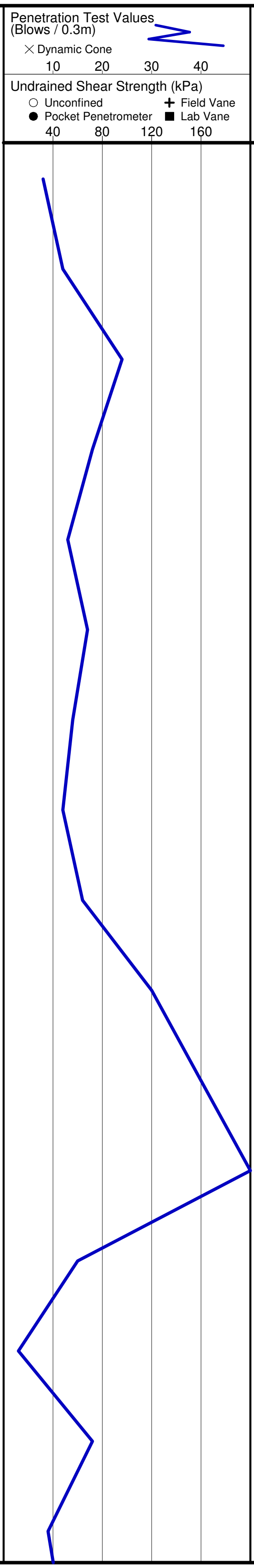
**date started |** 2015/07/22
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|
| | **GROUND SURFACE** | | | |
| | Dark brown **TOPSOIL**, some fine sand, rootlets, moist, loose. | 1 | SS | 8 |
| 0.6 | Reddish brown **CLAYEY SILT**, some fine to medium sand, trace clay, trace rootlets, moist, compact. | 2 | SS | 12 |
| | | 3 | SS | 24 |
| 2.3 | Grey-brown **CLAYEY SILT**, trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff. | 4 | SS | 18 |
| | | 5 | SS | 13 |
| | | 6 | SS | 17 |
| | | 7 | SS | 14 |
| | | 8 | SS | 12 |
| | | 9 | SS | 16 |
| | | 10 | SS | 30 |
| | | 11 | SS | 40 |
| | | 12 | SS | 50 |
| 9.3 | Grey-brown fine **SILTY SAND**, trace clay, trace fine gravel, wet to saturated, compact. | 13 | SS | 15 |
| | | 14 | SS | 3 |
| | | 15 | SS | 18 |
| | | 16 | SS | 9 |

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Elevation Scale (mASL)



Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

*(continued next page)*

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# LOG OF BOREHOLE 25R

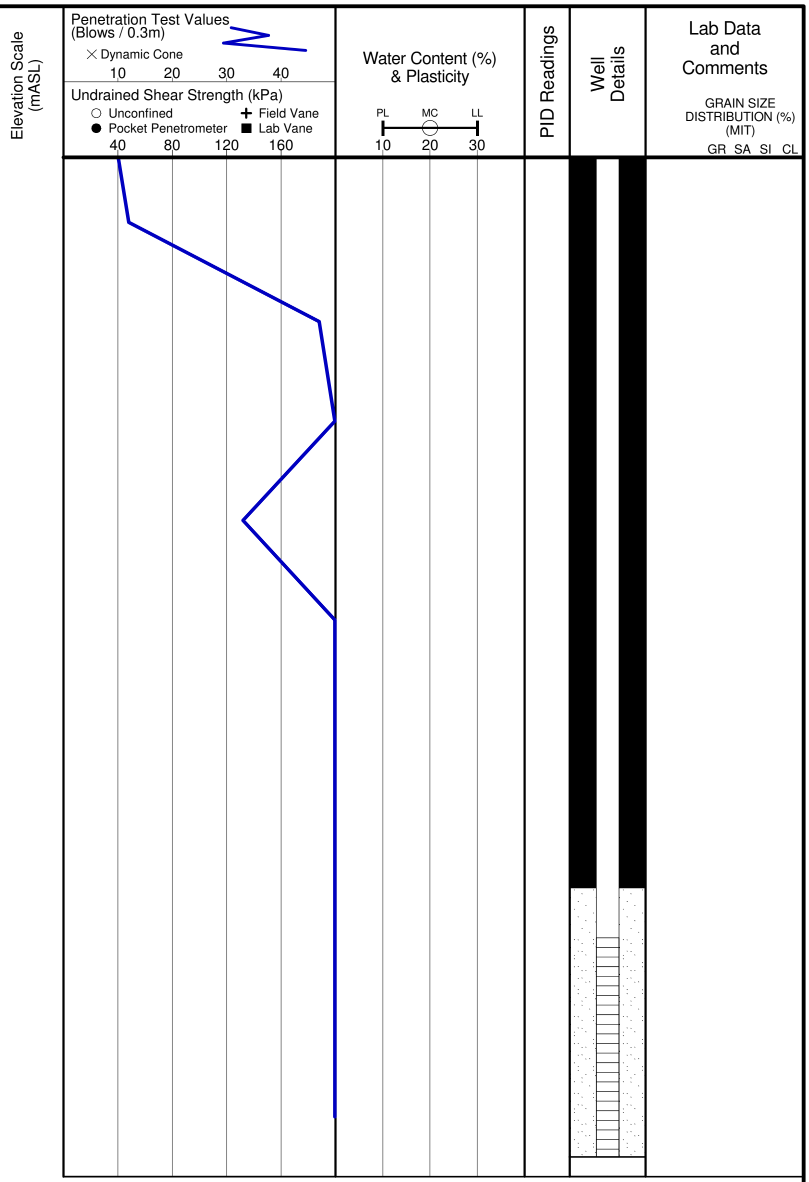
**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/22
**supervisor |** MEQ
**reviewer |** AMS

Depth Scale (m): 12, 13, 14, 15, 16, 17, 18, 19

| SUBSURFACE PROFILE | | SAMPLE | | |
|---|---|---|---|---|
| Elev Depth (m) | **STRATIGRAPHY** *(continued)* | Number | Type | SPT N-Value / Core Recovery |
| | Grey-brown fine **SILTY SAND**, trace clay, trace fine gravel, wet to saturated, compact.<br>Rapidly dilatent below 12.2 m.<br>*(continued)* | 17 | SS | 12 |
| 13.0 | Light grey **CLAYEY SILT AND GRAVEL**, some fine to coarse sand, DTPL, stiff. | 18 | SS | 47 |
| | | 19 | SS | 74 |
| 14.2 | Grey-brown **SAND AND GRAVEL**, some silt, trace clay, saturated, compact. | 20 | SS | 33 |
| 15.2 | Grey-brown **CLAYEY SILT**, some gravel, some fine to coarse sand, APL, stiff to very stiff. | 21 | SS | 81 |
| | | 22 | SS | 88 |
| | | 23 | SS | 63 |
| | | 24 | SS | 53 |
| 18.0 | Grey **SAND AND GRAVEL**, trace silt, wet, hard. | 25 | SS | 83 |
| | | 26 | SS | 85 |
| 19.8 | **END OF BOREHOLE** | | | |



# GEOLOGICAL LOG

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 279.9 | GROUND SURFACE | | | 0.98 m | | |
| | 0.0<br>278.2 | Brown compact medium to coarse sand | | ▽ | | | |
| | 1.7<br>275.3 | Brown compact clayey silt slightly calcareous with trace of sand and gravel | | | | | |
| | 4.6 | END OF HOLE | | | | | |

SCALE (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

# TEST HOLE No. 25A

SHEET 1 OF 1

## NOTES

DATE DRILLED 12 Feb./82

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND Surface
(m below ground surface)

STATIC WATER LEVEL 0.2
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1 (m)

TYPE OF PIEZOMETER Slotted ABS pipe and fibreglass wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 279.85 Static Water Elevation (m GSD) (19 February 1982)

Piezometer

MacLaren

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& SCIENTISTS

# TEST HOLE RECORD

E.H.R.

PROJECT NO. 11602-5

# LOG OF BOREHOLE 25A Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/16
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev<br>Depth (m) | SUBSURFACE PROFILE<br>STRATIGRAPHY | Graphic Plot | SAMPLE<br>Number | Type | SPT N-Value<br>Core Recovery | Elevation Scale (mARD) |
|---|---|---|---|---|---|---|---|
| | 280.4 | **GROUND SURFACE** | | | | | |
| 0 | | Brown compact medium to coarse sand | | | | | 280 |
| 1 | | | | | | | 279 |
| | 278.7<br>1.7 | Brown compact clayey silt slightly calcareous with trace of sand and gravel | | | | | |
| 2 | | | | | | | 278 |
| 3 | | | | | | | 277 |
| | 276.9<br>3.5 | **END OF BOREHOLE** | | | | | |

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Stratigraphy inferred from original borehole log for BH25A (MacLaren Engineers Inc., 1982).

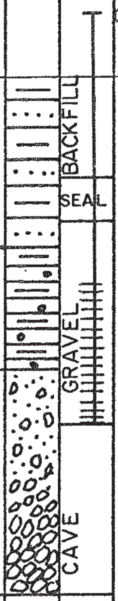
Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

# GEOLOGICAL LOG

# TEST HOLE No. 26

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 271.8 | GROUND SURFACE |
| 0.0 | Red brown to brown interlayered clayey and silty fine sand with minor gravel |
| 269.6<br>2.1 | Red brown to grey clayey silt, minor gravel |
| 268.1<br>3.7 | Fine-medium gravel; minor coarse sand; coarse gravel; minor silt, changing gradually to predominantly coarse gravel |
| 265.2<br>6.6 | END OF HOLE |



| SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|
| 1 | ss | 8 |
| 2 | ss | 58 |
| 3 | ss | 24 |
| 4 | ss | 15 |
| 5 | ss | 14 |
| 6 | ss | 19 |
| 7 | ss | 21 |
| 8 | ss | 19 |

## NOTES

DATE DRILLED Jan. 14,16, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND 3.7
(m below ground surface)

STATIC WATER LEVEL
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1.8 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ Static Water Elevation (m GSD)

Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 26 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted

**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2015/08/06

**supervisor |** MEQ

**reviewer |** AMS

SUBSURFACE PROFILE — SAMPLE

Penetration Test Values (Blows / 0.3m): × Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined; ✚ Field Vane; ● Pocket Penetrometer; ■ Lab Vane; 40 80 120 160

Water Content (%) & Plasticity: PL MC LL; 10 20 30

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

| Depth Scale (m) | Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) | PID Readings | Well Details |
|---|---|---|---|---|---|---|---|---|---|
|  | 272.1 | **GROUND SURFACE** |  |  |  |  |  |  |  |
| 0 |  | Red brown to brown interlayered clayey and silty fine sand with minor gravel |  |  |  |  | 272 |  |  |
| 1 |  |  |  |  |  |  | 271 |  |  |
| 2 | 270.0<br>2.1 | Red brown to grey clayey silt, minor gravel |  |  |  |  | 270 |  |  |
| 3 |  |  |  |  |  |  | 269 |  |  |
|  | 268.4<br>3.7 | Fine-medium gravel; minor coarse sand; coarse gravel; minor silt, changing gradually to predominantly coarse gravel |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  | 268 |  |  |
|  | 267.6<br>4.5 | **END OF BOREHOLE** |  |  |  |  |  |  |  |

Stratigraphy inferred from original borehole log for BH26 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

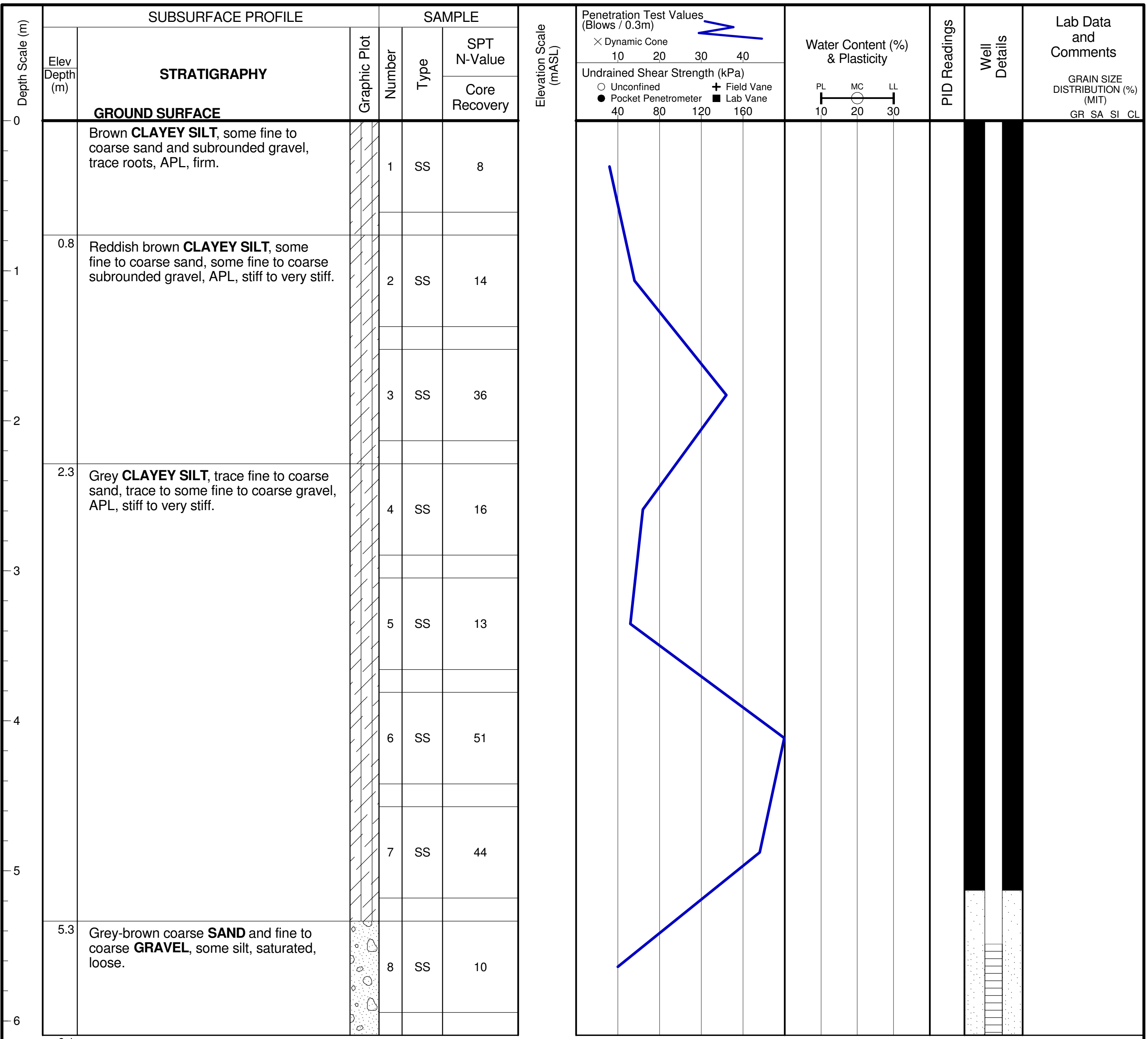
# LOG OF BOREHOLE 26R

**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, Oxford County
**project no.** | *111-53037-00 132-02*

**rig type** | ACKER SOIL-MAX, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2015/08/07
**supervisor** | MEQ
**reviewer** | AMS

| SUBSURFACE PROFILE | | | SAMPLE | | |
|---|---|---|---|---|---|
| Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value<br>Core Recovery |
| | **GROUND SURFACE** | | | | |
| 0 | Brown **CLAYEY SILT**, some fine to coarse sand and subrounded gravel, trace roots, APL, firm. | | 1 | SS | 8 |
| 0.8 | Reddish brown **CLAYEY SILT**, some fine to coarse sand, some fine to coarse subrounded gravel, APL, stiff to very stiff. | | 2 | SS | 14 |
| | | | 3 | SS | 36 |
| 2.3 | Grey **CLAYEY SILT**, trace fine to coarse sand, trace to some fine to coarse gravel, APL, stiff to very stiff. | | 4 | SS | 16 |
| | | | 5 | SS | 13 |
| | | | 6 | SS | 51 |
| | | | 7 | SS | 44 |
| 5.3 | Grey-brown coarse **SAND** and fine to coarse **GRAVEL**, some silt, saturated, loose. | | 8 | SS | 10 |
| 6.1 | **END OF BOREHOLE** | | | | |



# GEOLOGICAL LOG

# TEST HOLE No. 27

SHEET 1 OF 1

| SCALE (ft) (m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 271.7 | GROUND SURFACE | | GAUGE | | | |
| 1<br>5<br>2 | 0.0<br>269.6 | Red brown to brown interlayered clayey silt and silty fine sand with minor gravel | | SEAL | | | |
| 3<br>10 | 2.1<br>268.0 | Red brown to grey clayey silt, minor gravel | | | | | |
| 4<br>15<br>5<br>20<br>6 | 3.7<br>265.0 | Fine-medium gravel; minor coarse sand, coarse gravel and silt; changing gradually to predominantly coarse gravel | | | | | |
| 7<br>25<br>8<br>9<br>30<br>10<br>35 | 6.7<br>260.7 | Dense grey clayey silt; minor fine-coarse sand, fine-coarse gravel, predominantly gravel layer at 8.5-9 m | | BACKFILL<br>SEAL | 1<br>2<br>3<br>4<br>5<br>6 | ss<br>ss<br>ss<br>ss<br>ss<br>ss | 42<br>55<br>52<br>37<br>46<br>48 |
| 11<br>12<br>40<br>13<br>45<br>14<br>15 | 11.0<br>256.7 | Light brown silty fine-coarse sand changing gradually to grey fine to coarse gravel with minor sand | | GRAVEL<br>CAVE | 7<br>8<br>9<br>10<br>11 | ss<br>ss<br>ss<br>ss<br>ss | 5<br>34<br>14<br>18<br>2 |
| 50 | 15.0 | END OF HOLE | | | | | |

## NOTES

DATE DRILLED Jan. 21,24, 1983

TYPE OF RIG CME 75

DRILLING METHOD Casing & Tricone

DEPTH WATER FOUND 3.7,11.0
(m below ground surface)

STATIC WATER LEVEL
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 2.4 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ Static Water Elevation (m GSD)

Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

## TEST HOLE RECORD

DJR

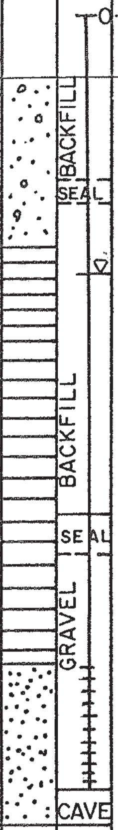
PROJECT NO. 11602-2

# GEOLOGICAL LOG

# TEST HOLE No. 28

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 277.4 | GROUND SURFACE |
| 0.0 | Brown fine sand, minor silt and coarse gravel |
| 275.3<br>2.1 | Brown to dark brown compact-dense clayey silt, minor fine-coarse gravel |
| 270.0<br>7.5 | Light brown loose silty fine sand |
| 267.8<br>9.6 | END OF HOLE |



| SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|
| 1 | ss | 8 |
| 2 | ss | 19 |
| 3 | ss | 31 |
| 4 | ss | 43 |
| 5 | ss | 20 |
| 6 | ss | 23 |
| 7 | ss | 21 |
| 8 | ss | 45 |
| 9 | ss | 77 |
| 10 | ss | 80 |
| 11 | ss | |
| 12 | ss | 18 |
| 13 | ss | 42 |

## NOTES

DATE DRILLED Jan. 17, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 2.7 (m below ground surface)

STATIC WATER LEVEL 2.49 (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1.5 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 274.94 Static Water Elevation (m GSD) (05 April 1983)

⋕ Piezometer

**MacLaren**

MacLAREN
ENGINEERS INC.

TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 28 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/20
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40; Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 277.7 | **GROUND SURFACE** | | | | | | | | | | |
| | | Brown fine sand, minor silt and coarse gravel | | | | | 277 | | | | | |
| 1 | | | | | | | 276 | | | | | |
| 2 | 275.6<br>2.1 | Brown to dark brown compact to dense clayey silt, minor fine to coarse gravel | | | | | 275 | | | | | |
| 3 | | | | | | | 274 | | | | | |
| 4 | | | | | | | 273 | | | | | |
| 5 | | | | | | | 272 | | | | | |
| 6 | | | | | | | 271 | | | | | |
| 7 | 270.2<br>7.5 | Light brown loose silty fine sand | | | | | 270 | | | | | |
| 8 | | | | | | | 269 | | | | | |
| 9 | 268.6<br>9.1 | **END OF BOREHOLE** | | | | | | | | | | |

Stratigraphy inferred from original borehole log for BH28 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

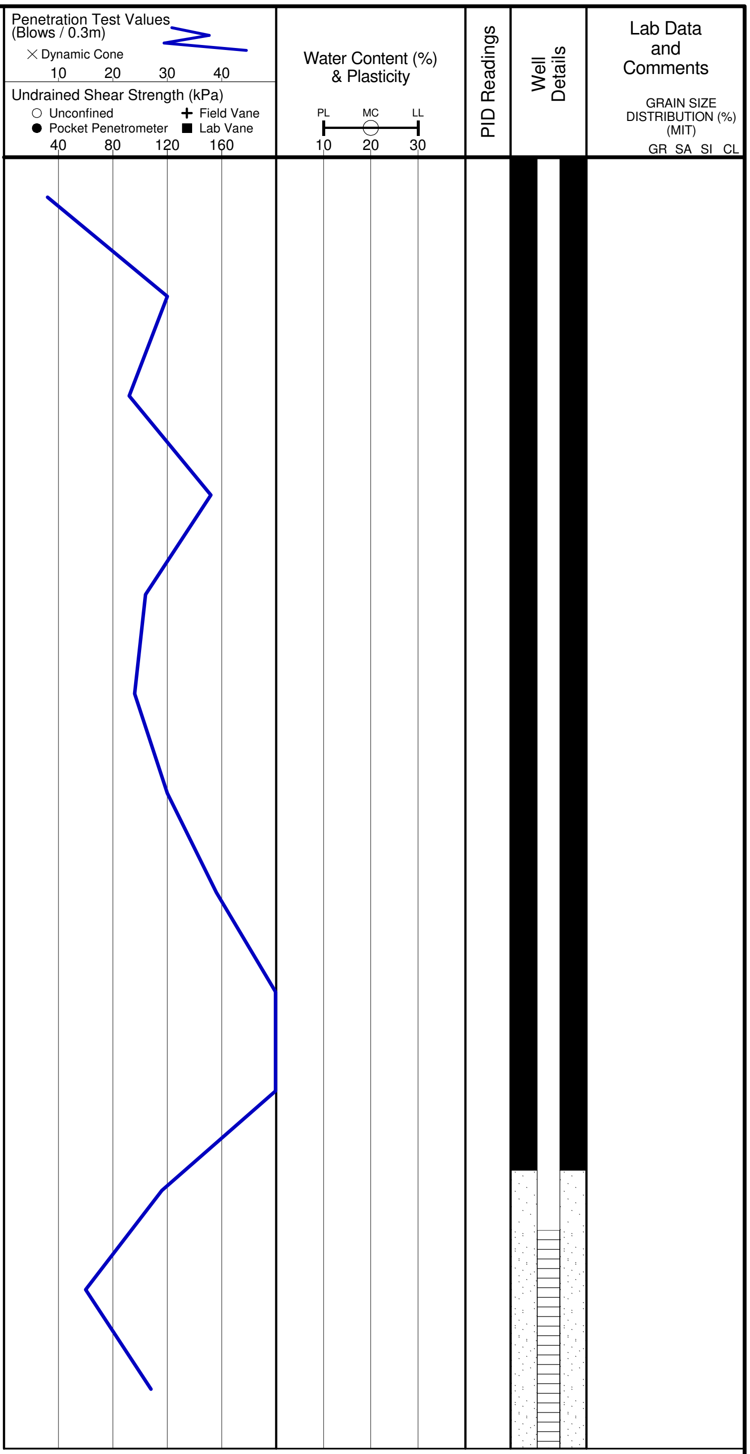
# LOG OF BOREHOLE 28R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/21
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value |
|---|---|---|---|---|
| | **GROUND SURFACE** | | | |
| | Dark brown **TOPSOIL**, trace fine gravel, rootlets, moist, loose. | 1 | SS | 8 |
| 0.6 | Reddish brown medium **SAND**, some silt, some fine to coarse gravel, moist, compact. | 2 | SS | 30 |
| | | 3 | SS | 23 |
| 2.3 | Brown **CLAYEY SILT**, trace fine to coarse sand, trace gravel, DTPL, very stiff. | 4 | SS | 38 |
| 3.1 | Grey **CLAYEY SILT**, trace fine to coarse sand, trace to some gravel, DTPL to APL, very stiff to hard. | 5 | SS | 26 |
| | | 6 | SS | 24 |
| | | 7 | SS | 30 |
| | | 8 | SS | 39 |
| | | 9 | SS | >100 |
| | | 10 | SS | 72 |
| 7.9 | Grey-brown fine **SAND TO SILTY SAND**, saturated, compact. | 11 | SS | 29 |
| | | 12 | SS | 15 |
| | | 13 | SS | 27 |
| 9.9 | **END OF BOREHOLE** | | | |



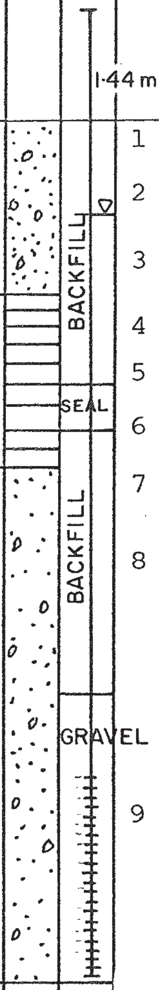
**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 30

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 278.9 | GROUND SURFACE | | | |
| 0.0 | Light brown fine-coarse sand, minor fine-coarse gravel, minor silt | 1<br>2<br>3 | ss<br>ss<br>ss | 6<br>11<br>35 |
| 276.8<br>2.1 | Grey clayey silt, minor fine-coarse sand, fine-coarse gravel | 4<br>5<br>6 | ss<br>ss<br>ss | 18<br>29<br>20 |
| 274.5<br>4.4 | Grey fine-coarse sand, fine gravel; minor silt, minor medium-coarse gravel | 7<br>8<br>9 | ss<br>ss<br>ss | 12<br>25<br>38 |
| 267.8<br>11.1 | END OF HOLE | | | |



## NOTES

DATE DRILLED Jan. 18,19, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND 2.4
(m below ground surface)

STATIC WATER LEVEL 1.41
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 3.0 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽ 277.51 Static Water Elevation (m GSD) (05 April 1983)

╪ Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 30 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2014/09/25
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | SAMPLE: Number | Type | SPT N-Value / Core Recovery | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 279.1 | **GROUND SURFACE** | | | | | | | | |
| | Light brown fine-coarse sand, minor fine-coarse gravel, minor silt | | | | | | | | |
| 277.0<br>2.1 | Grey clayey silt, minor fine-coarse sand, fine-coarse gravel | | | | | | | | |
| 274.7<br>4.4 | Grey fine-coarse sand, fine gravel, minor silt, minor medium-coarse gravel | | | | | | | | |
| 268.1<br>11.0 | **END OF BOREHOLE** | | | | | | | | |

Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

Elevation Scale (mARD): 279 278 277 276 275 274 273 272 271 270 269

Stratigraphy inferred from original borehole log for BH30 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

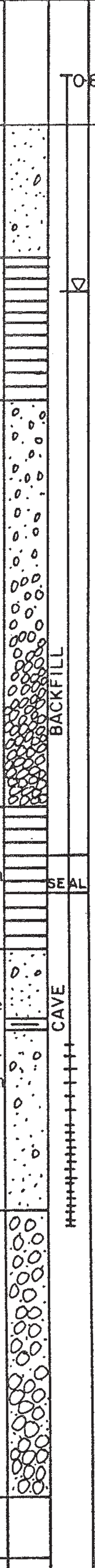
**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 31

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 278.9 | GROUND SURFACE |
| 278.9 / 0.0 | Light brown fine-coarse sand, minor fine-coarse gravel, minor silt |
| 276.8 / 2.1 | Grey clayey silt, minor fine-coarse sand, fine-coarse gravel |
| 274.5 / 4.4 | Light brown-grey silty fine-coarse sand, fine-coarse gravel gradually becoming predominantly grey coarse gravel |
| 267.9 / 11.0 | Grey clayey silt, minor fine-coarse gravel at 11.0m minor silty fine sand at 13.0 m |
| 265.6 / 13.3 | Light brown-grey silty fine sand, minor coarse gravel, medium-coarse sand, significant silt at 14.5m, medium to coarse sand at 16.8 m |
| 261.3 / 17.5 | Fine-coarse gravel with medium sand; minor silt |
| 256.8 / 22.1 | Dense grey sandy till |
| 255.9 / 23.0 | END OF HOLE |



| SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|
| 1 | SS | 16 |
| 2 | SS | 44 |
| 3 | SS | 17 |
| 4 | SS | 18 |
| 5 | SS | 9 |
| 6 | SS | 20 |
| 7 | SS | 13 |
| 8 | SS | 51 |
| 9 | SS | 68 |
| 10 | SS | 29 |
| 11 | SS | 46 |
| 12 | SS | 68 |
| 13 | SS | |
| 14 | SS | 63 |
| 15 | SS | 64 |
| 16 | SS | 76 |
| 17 | SS | 176 |

## NOTES

DATE DRILLED Jan. 25,26, 1983 Feb. 03, 1983

TYPE OF RIG CME 75

DRILLING METHOD Solid Stem Augers Casing and Tricone

DEPTH WATER FOUND
(m below ground surface)

STATIC WATER LEVEL 2.63
(m below ground surface)

PIPE DIAMETER 51 (mm)
LENGTH OF PIEZOMETER 3.0 (m)
TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE
SS - SPLIT SPOON
WA - WASH

▽ 276.25 Static Water Elevation (05 April 1983)

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# GEOLOGICAL LOG

# TEST HOLE No. 32

SHEET 1 OF 1

| EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|
| 279.6 | GROUND SURFACE | | 0.89m | | | |
| 0.0 | Light brown fine-medium sand, minor fine-coarse gravel, sandy clayey silt layer at 2.5 m | | BACK FILL | 1 | ss | 7 |
| | | | SEAL | 2 ▽ | ss | 14 |
| | | | GRAVEL MINOR CAVING | 3 | ss | 28 |
| | | | | 4 | ss | 18 |
| 276.0 | | | | 5 | ss | 8 |
| 3.7 | Grey loose clayey silt | | | 6 | ss | 8 |
| 274.6 | | | | 7 | ss | 5 |
| 5.1 | END OF HOLE | | | | | |

SCALE (ft)(m)

## NOTES

DATE DRILLED Jan. 19, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND ~ 0.6 (m below ground surface)

STATIC WATER LEVEL 0.65 (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1.8 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON

WA-WASH

▽278.96 Static Water Elevation (m GSD) (05 April 1983)

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 32 Decommissioning

WSP

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/10
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE | SAMPLE

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40

Undrained Shear Strength (kPa)
○ Unconfined + Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

| Depth Scale (m) | Elev<br>Depth<br>(m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value<br>Core Recovery | Elevation Scale (mARD) | PID Readings | Well Details |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 280.1 | **GROUND SURFACE** | | | | | 280 | | |
| | | Light brown fine to medium sand, minor fine to coarse gravel, sandy clayey silt layer at 2.5 m | | | | | | | |
| 1 | | | | | | | 279 | | |
| 2 | | | | | | | 278 | | |
| 3 | | | | | | | 277 | | |
| | 276.4<br>3.7 | Grey loose clayey silt | | | | | | | |
| 4 | | | | | | | 276 | | |
| | 275.5<br>4.6 | **END OF BOREHOLE** | | | | | | | |

Stratigraphy inferred from original borehole log for BH32 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

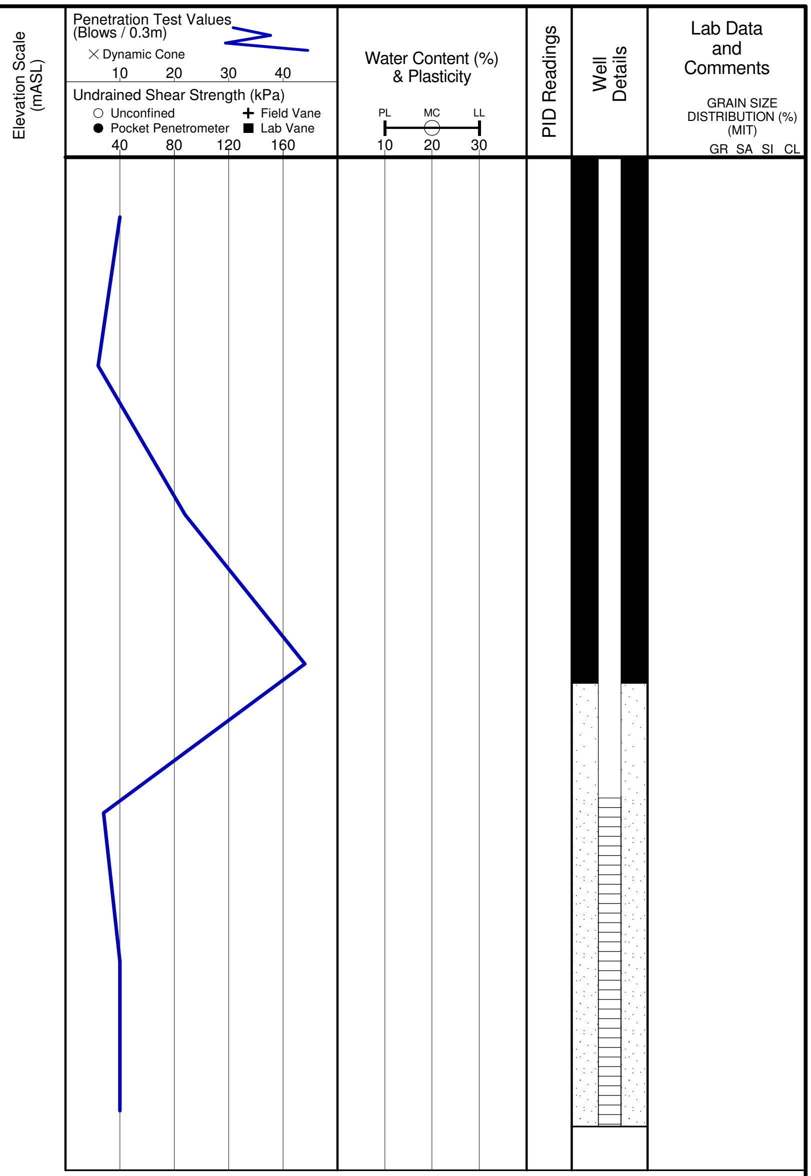
# LOG OF BOREHOLE 32R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/10
**supervisor |** MEQ
**reviewer |** AMS

| SUBSURFACE PROFILE | | SAMPLE | | |
|---|---|---|---|---|
| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery |
| | GROUND SURFACE | | | |
| 0 | Dark brown **TOPSOIL AND ORGANICS**, some fine gravel, dry, loose. | 1 | SS | 10 |
| 0.6 | Brown fine to coarse **SAND**, trace silt, wet, loose, weakly dilatant. | 2 | SS | 6 |
| 1.5 | Brown fine to coarse **SAND**, some medium gravel, trace to some silt, wet, compact to dense. | 3 | SS | 22 |
| | | 4 | SS | 44 |
| 3.4 | Grey **SANDY SILT**, trace clay, wet, compact. | 5 | SS | 7 |
| | | 6 | SS | 10 |
| 4.6 | Grey **SILT**, trace clay, some fine sand, APL, firm. | 7 | SS | 10 |
| 5.2 | **END OF BOREHOLE** | | | |



# GEOLOGICAL LOG

# TEST HOLE No. 33

SHEET 1 OF 1.

| SCALE (ft)(m) | EL (mGSD) / DEPTH (m) | DESCRIPTION | STRAT. PLOT | PIEZOMETER | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|---|---|---|
| | 279.9 | GROUND SURFACE | | 0·76m | | | |
| | 0.0 | Black-grey clayey silt, minor medium gravel | | BACKFILL<br>SEAL | 1 | ss | 7 |
| | | | | | 2 | ss | 5 |
| | 276.5<br>3.4 | Loose brown silty fine sand | | ▽ | 3 | ss | 9 |
| | 275.0<br>4.9 | Brown-grey clayey silt; minor fine-coarse gravel, minor sand | | | 4 | ss | 22 |
| | | | | CAVE | 5 | ss | 39 |
| | | | | SEAL | 6 | ss | 12 |
| | 270.8<br>9.1 | Brown silty fine sand | | CAVE | 7 | ss | 11 |
| | | | | | 8 | ss | 12 |
| | 268.0<br>11.9 | Brown clayey silt | | | 9 | ss | 37 |
| | 267.2<br>12.7 | END OF HOLE | | | | | |

## NOTES

DATE DRILLED Jan. 19, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers

DEPTH WATER FOUND
(m below ground surface)

STATIC WATER LEVEL 3.12
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1.8 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH

▽276.54 Static Water Elevation (m GSD) (05 April 1983)

Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 33 Decommissioning

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/16
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE

| Depth Scale (m) | Elev<br>Depth (m) | STRATIGRAPHY |
|---|---|---|
| 0 | 280.2 | **GROUND SURFACE** |
| | | Black-grey clayey silt, minor medium gravel |
| 3 | 276.8<br>3.4 | Loose brown silty fine sand |
| 5 | 275.3<br>4.9 | Brown-grey clayey silt; minor fine to coarse gravel, minor sand |
| 9 | 271.1<br>9.1 | Brown silty fine sand |
| 12 | 268.3<br>11.9 | Brown clayey silt |
| | 268.1<br>12.1 | |

SAMPLE: Graphic Plot | Number | Type | SPT N-Value / Core Recovery

Elevation Scale (mARD): 280, 279, 278, 277, 276, 275, 274, 273, 272, 271, 270, 269

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40
Undrained Shear Strength (kPa)
○ Unconfined + Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings

Well Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

**END OF BOREHOLE**

Stratigraphy inferred from original borehole log for BH33 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 33R

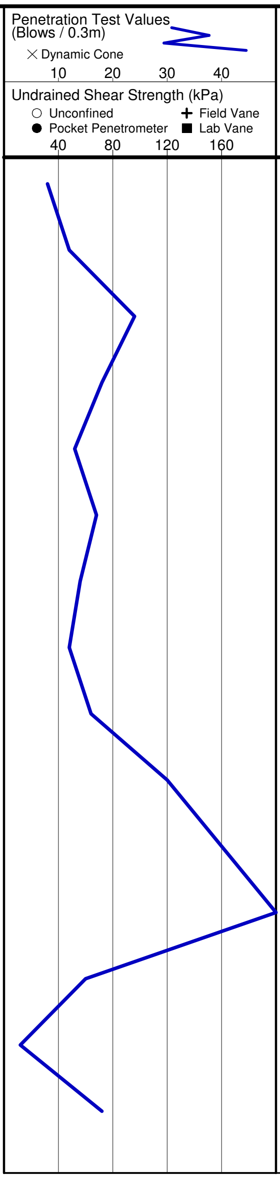
**project** | Holbrook Landfill Site
**client** | Oxford County
**location** | Holbrook, Oxford County
**project no.** | *111-53037-00 132-02*

**rig type** | ACKER SOIL-MAX, track-mounted
**method** | Hollow stem augers, 215 mm dia.
**coring** | *n/a*

**date started** | 2015/07/23
**supervisor** | MEQ
**reviewer** | AMS

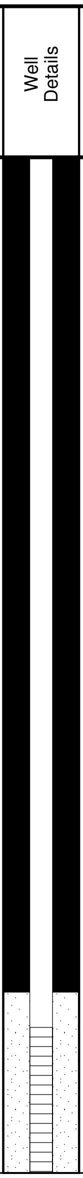
| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| | **GROUND SURFACE** |
| 0 | Dark brown **TOPSOIL**, some fine sand, rootlets, moist, loose. |
| 0.6 | Reddish brown **CLAYEY SILT**, some fine to medium sand, trace clay, trace rootlets, moist, compact. |
| 2.3 | Grey-brown **CLAYEY SILT**, trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff. |
| 9.3 | Grey-brown fine **SILTY SAND**, trace clay, trace fine gravel, wet to saturated, compact. |
| 11.7 | **END OF BOREHOLE**<br>Stratigraphy inferred from adjacent borehole 25R. |

| Number | Type | SPT N-Value |
|---|---|---|
| 1 | SS | 8 |
| 2 | SS | 12 |
| 3 | SS | 24 |
| 4 | SS | 18 |
| 5 | SS | 13 |
| 6 | SS | 17 |
| 7 | SS | 14 |
| 8 | SS | 12 |
| 9 | SS | 16 |
| 10 | SS | 30 |
| 11 | SS | 40 |
| 12 | SS | 50 |
| 13 | SS | 15 |
| 14 | SS | 3 |
| 15 | SS | 18 |



Water Content (%) & Plasticity
PL MC LL
10 20 30

PID Readings



Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

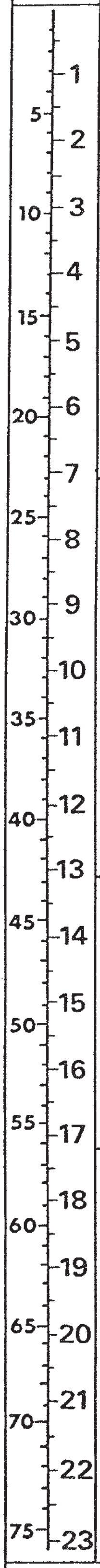
Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

Elevation Scale (mASL)

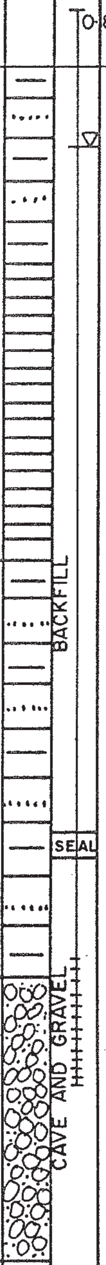
# GEOLOGICAL LOG

# TEST HOLE No. 35

SHEET 1 OF 1



| EL (mGSD) / DEPTH (m) | DESCRIPTION | SAMPLE NUMBER | SAMPLE TYPE | BLOWS/0.3m |
|---|---|---|---|---|
| 277.8 | GROUND SURFACE | | | |
| 0.0 | Grey clayey silt, minor gravel interlayered with silty fine sand at 0.3 m | 1 | ss | 3 |
| | | 2 | ss | 47 |
| | | 3 | ss | 30 |
| | | 4 | ss | 28 |
| 270.7 | | 5 | ss | 9 |
| 7.1 | Brown-grey clayey silt with fine-coarse gravel interlayered with thin horizons of fine-coarse sand | 6 | ss | 27 |
| | | 7 | ss | 17 |
| | | 8 | ss | 11 |
| | | 9 | ss | 73 |
| | | 10 | ss | 58 |
| | | 11 | ss | 34 |
| 264.7 | | 12 | ss | 54 |
| 13.1 | Grey fine-coarse gravel with sand and minor silt | 13 | ss | 27 |
| | | 14 | ss | 32 |
| | | 15 | ss | 33 |
| 260.6 | | 16 | ss | 25 |
| 17.2 | END OF HOLE | | | |



## NOTES

DATE DRILLED Jan.26,27, 1983

TYPE OF RIG CME 75

DRILLING METHOD Hollow Stem Augers, Casing and Tricone

DEPTH WATER FOUND ______ (m below ground surface)

STATIC WATER LEVEL 1.21 (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 1.8 (m)

TYPE OF PIEZOMETER Slotted and Nitex Screen Wrapped

SAMPLE TYPE

SS - SPLIT SPOON
WA - WASH
AU - AUGER

▽276.60 Static Water Elevation (mGSD) (05 April 1983)

╪ Piezometer

**MacLaren**

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# GEOLOGICAL LOG

# TEST HOLE No. 37

SHEET 1 OF 1

| EL (mGSD) | DEPTH (m) | DESCRIPTION |
|---|---|---|
| 274.76 | | GROUND SURFACE |
| | 0.0 | Grey brown clayey silt, minor fine to coarse gravel, layer of silty fine sand at 4.6 m, trace minor fine to coarse sand from 10.6 - 12 m. |
| 259.98 | 14.8 | Fine gravel, some fine to coarse sand and medium to coarse gravel, minor silt |
| 257.84 | 16.9 | Brown grey clayey silt, minor fine to medium sand, fine to coarse gravel |
| 255.55 | 19.2 | Fine to medium gravel, some coarse gravel, minor fine to coarse sand, minor silt |
| 250.99 | 23.8 | Brown silty fine to coarse sand, minor fine to coarse gravel |
| 249.00 | 25.8 | Very dense hard clay till, minor fine to medium gravel sand, silt |
| 248.79 | 26.0 | END OF HOLE |

PIEZOMETER: BACKFILL; SE AL; CAVE AND GRAVEL BACKFILL; CAVE

SAMPLE NUMBER: 1.72 m

| SAMPLE TYPE | BLOWS/0.3m |
|---|---|
| SS | 18 |
| SS | 18 |
| SS | 30 |
| SS | 32 |
| SS | 38 |
| SS | 47 |
| SS | 55 |
| SS | 31 |
| SS | 39 |
| SS | 26 |
| SS | 134 |
| SS | 64 |
| SS | 21 |
| SS | 11 |
| SS | 7 |
| SS | 73 |
| SS | 600 |

## NOTES

DATE DRILLED Feb. 11,14,15 1983

TYPE OF RIG CME 75

DRILLING METHOD Solid Stem Auger, Casing, Tricone

DEPTH WATER FOUND 4.6
(m below ground surface)

STATIC WATER LEVEL ________
(m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 3.0 (m)

TYPE OF PIEZOMETER Slotted and Nitex screen wrapped

SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH
AU-AUGER

▽ Static Water Elevation (m GSD) 275.39 m

Piezometer

MacLaren

MacLAREN ENGINEERS INC.

# TEST HOLE RECORD

DJR

PROJECT NO. 11602-2

# LOG OF BOREHOLE 37 Decommissioning

**project** | Holbrook Landfill Site

**client** | Oxford County

**location** | Holbrook, ON

**project no.** | *111-53037-00 132-02*

**rig type** | Acker Soil-Max, track-mounted

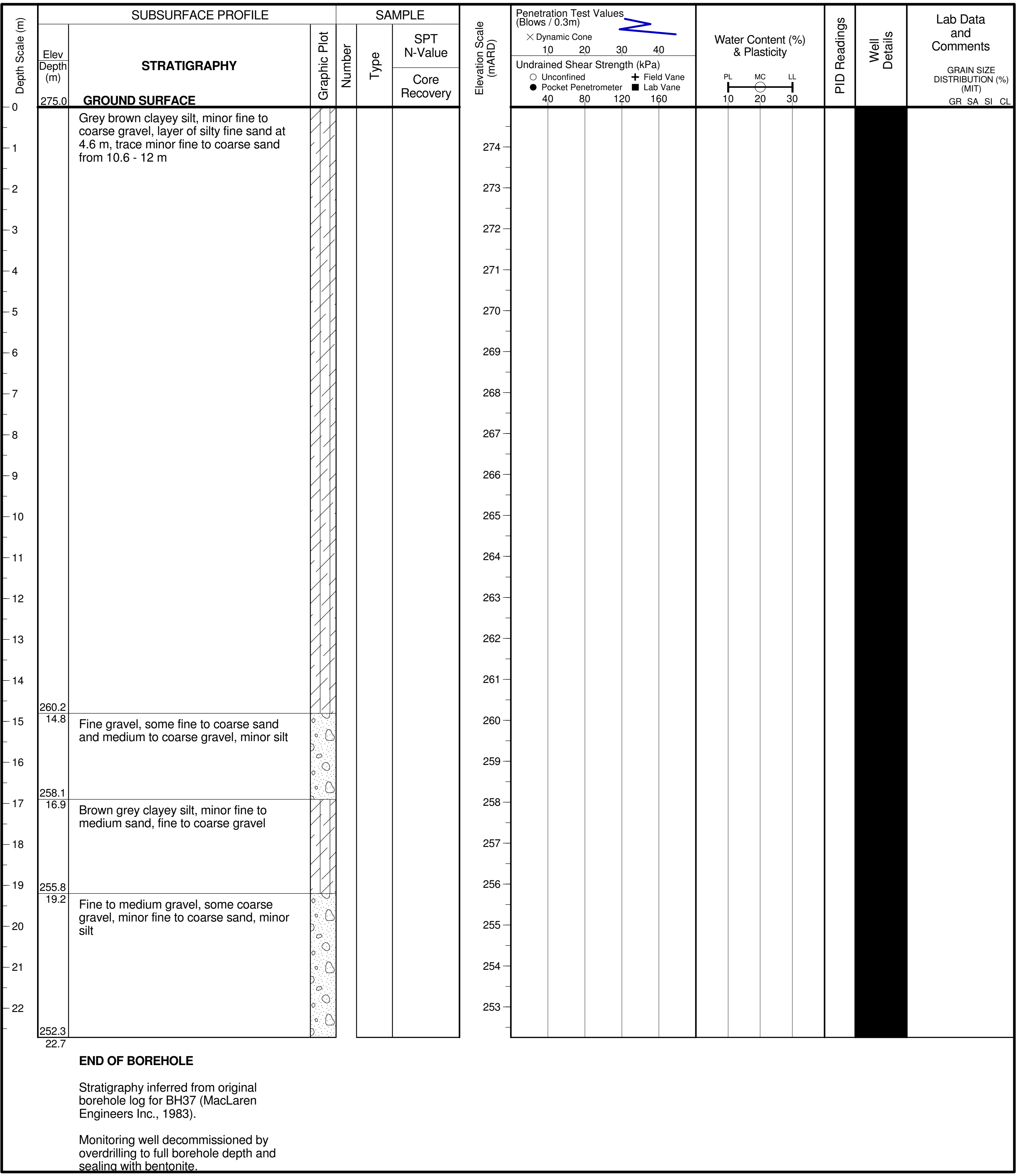
**method** | Hollow stem augers, 215 mm dia.

**coring** | *n/a*

**date started** | 2015/08/04

**supervisor** | MEQ

**reviewer** | AMS



| Elev<br>Depth (m) | STRATIGRAPHY |
|---|---|
| 275.0 | **GROUND SURFACE** |
| | Grey brown clayey silt, minor fine to coarse gravel, layer of silty fine sand at 4.6 m, trace minor fine to coarse sand from 10.6 - 12 m |
| 260.2<br>14.8 | Fine gravel, some fine to coarse sand and medium to coarse gravel, minor silt |
| 258.1<br>16.9 | Brown grey clayey silt, minor fine to medium sand, fine to coarse gravel |
| 255.8<br>19.2 | Fine to medium gravel, some coarse gravel, minor fine to coarse sand, minor silt |
| 252.3<br>22.7 | **END OF BOREHOLE** |

Stratigraphy inferred from original borehole log for BH37 (MacLaren Engineers Inc., 1983).

Monitoring well decommissioned by overdrilling to full borehole depth and sealing with bentonite.

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs - decom.gpj

# LOG OF BOREHOLE 37R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/08/05
**supervisor |** MEQ
**reviewer |** AMS

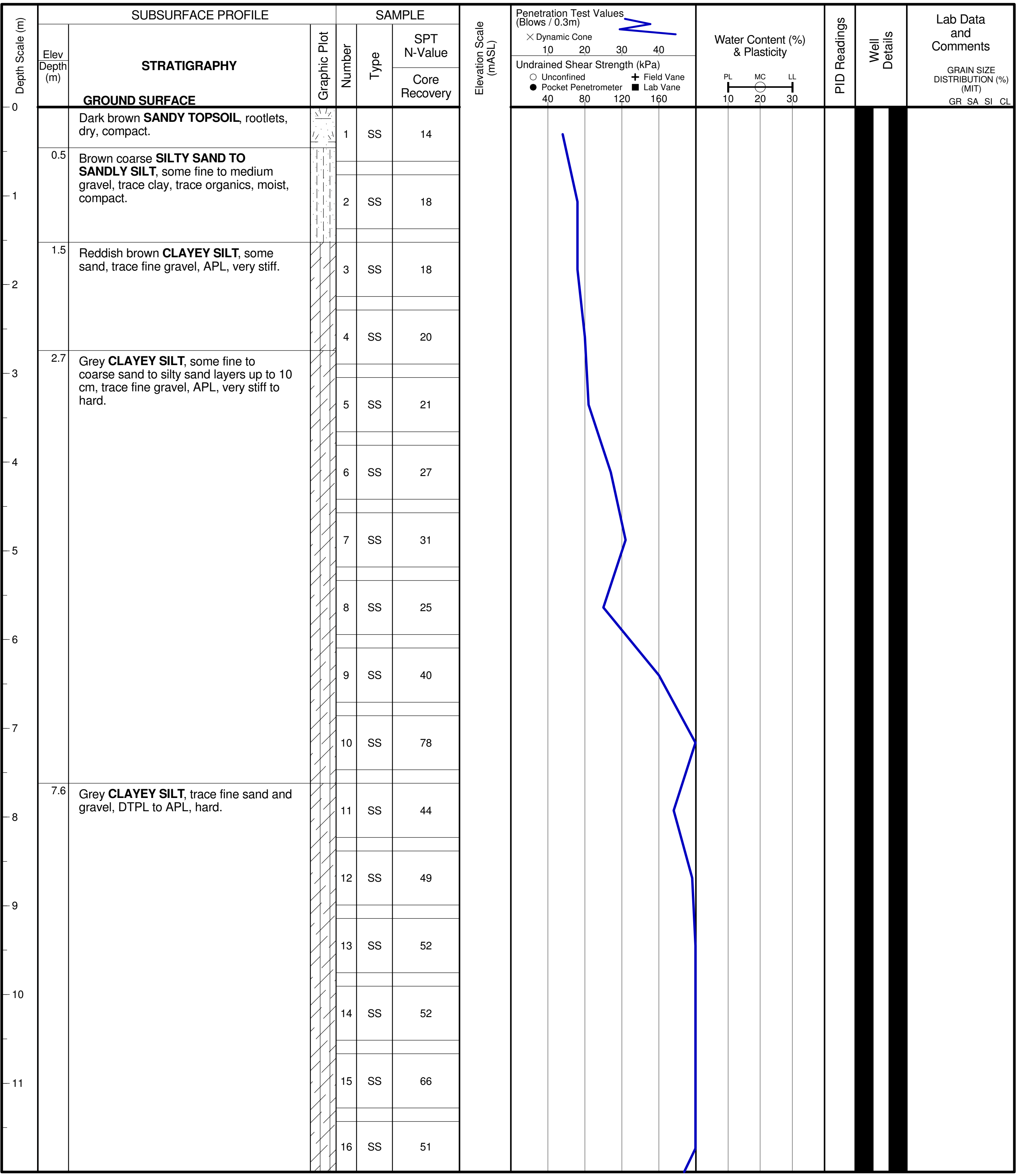
SUBSURFACE PROFILE

| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| | **GROUND SURFACE** |
| | Dark brown **SANDY TOPSOIL**, rootlets, dry, compact. |
| 0.5 | Brown coarse **SILTY SAND TO SANDLY SILT**, some fine to medium gravel, trace clay, trace organics, moist, compact. |
| 1.5 | Reddish brown **CLAYEY SILT**, some sand, trace fine gravel, APL, very stiff. |
| 2.7 | Grey **CLAYEY SILT**, some fine to coarse sand to silty sand layers up to 10 cm, trace fine gravel, APL, very stiff to hard. |
| 7.6 | Grey **CLAYEY SILT**, trace fine sand and gravel, DTPL to APL, hard. |

SAMPLE

| Number | Type | SPT N-Value |
|---|---|---|
| 1 | SS | 14 |
| 2 | SS | 18 |
| 3 | SS | 18 |
| 4 | SS | 20 |
| 5 | SS | 21 |
| 6 | SS | 27 |
| 7 | SS | 31 |
| 8 | SS | 25 |
| 9 | SS | 40 |
| 10 | SS | 78 |
| 11 | SS | 44 |
| 12 | SS | 49 |
| 13 | SS | 52 |
| 14 | SS | 52 |
| 15 | SS | 66 |
| 16 | SS | 51 |

Elevation Scale (mASL)



library: genivar - library.glb report: gen log v1 file: bhlogs.gpj

*(continued next page)*

**Sheet No. 1 of 2**

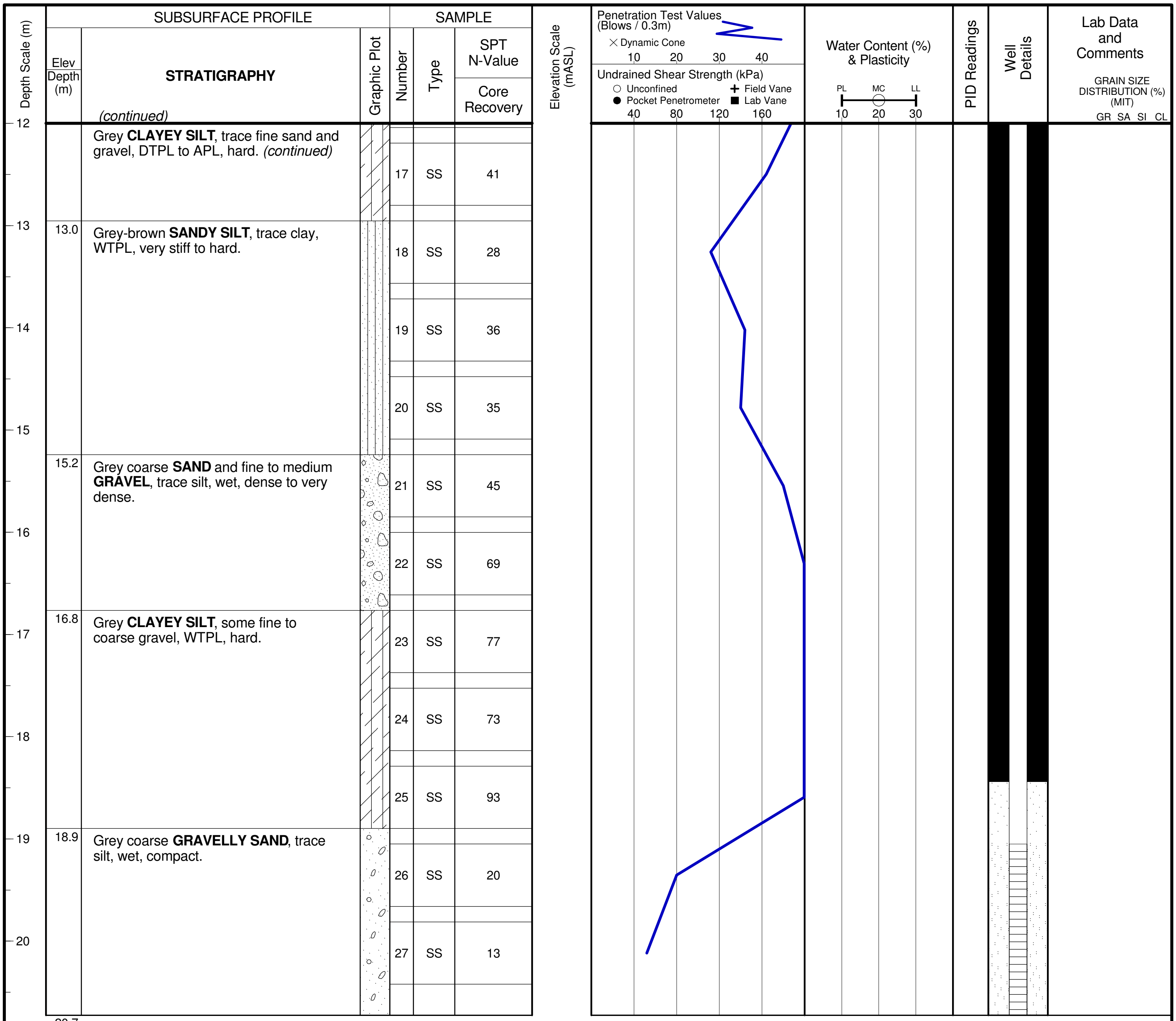
# LOG OF BOREHOLE 37R

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/08/05
**supervisor |** MEQ
**reviewer |** AMS

| SUBSURFACE PROFILE | | SAMPLE | | |
|---|---|---|---|---|
| Elev Depth (m) | **STRATIGRAPHY** *(continued)* | Number | Type | SPT N-Value / Core Recovery |
| | Grey **CLAYEY SILT**, trace fine sand and gravel, DTPL to APL, hard. *(continued)* | 17 | SS | 41 |
| 13.0 | Grey-brown **SANDY SILT**, trace clay, WTPL, very stiff to hard. | 18 | SS | 28 |
| | | 19 | SS | 36 |
| | | 20 | SS | 35 |
| 15.2 | Grey coarse **SAND** and fine to medium **GRAVEL**, trace silt, wet, dense to very dense. | 21 | SS | 45 |
| | | 22 | SS | 69 |
| 16.8 | Grey **CLAYEY SILT**, some fine to coarse gravel, WTPL, hard. | 23 | SS | 77 |
| | | 24 | SS | 73 |
| | | 25 | SS | 93 |
| 18.9 | Grey coarse **GRAVELLY SAND**, trace silt, wet, compact. | 26 | SS | 20 |
| | | 27 | SS | 13 |
| 20.7 | **END OF BOREHOLE** | | | |



**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# GEOLOGICAL LOG

# TEST HOLE No. 38

SHEET 1 OF 1

## NOTES

DATE DRILLED Feb. 15,16,17 1983

TYPE OF RIG CME 75

DRILLING METHOD Solid Stem Augers, Casing and Tricone

DEPTH WATER FOUND ________ (m below ground surface)

STATIC WATER LEVEL ________ (m below ground surface)

PIPE DIAMETER 51 (mm)

LENGTH OF PIEZOMETER 3.0 (m)

TYPE OF PIEZOMETER Slotted and Nitex screen wrapped

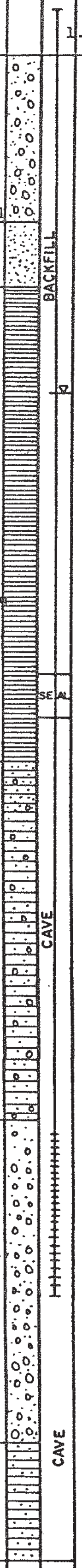
SAMPLE TYPE

SS-SPLIT SPOON
WA-WASH
AU-AUGER

▽ Static Water Elevation (m GSD) 275.45 m

Piezometer

| EL (mGSD) / DEPTH (m) | DESCRIPTION |
|---|---|
| 282.27 | GROUND SURFACE |
| 0.0 | Red brown silty fine to medium sand, fine to coarse gravel<br>Red brown clayey silt, minor fine to coarse gravel |
| 278.92<br>3.4 | Light brown uniform fine sand |
| 277.57<br>4.7 | Red brown to grey clayey silt, minor fine to coarse gravel, minor layer of silty fine to coarse sand at 7.6 m formation becoming more dense at 10.7 m |
| 267.77<br>14.5 | Brown-grey brown clayey silt, minor fine to coarse gravel interlayered with brown silty fine sand and sandy silt<br>Grey clayey silt, fine to coarse sand, fine to coarse gravel |
| 260.27<br>21.9 | Grey fine to coarse gravel medium to coarse sand |
| 253.77<br>28.5 | Grey very dense sandy clayey silt till |
| 251.33<br>30.9 | END OF HOLE |



| SAMPLE TYPE | BLOWS/0.3m |
|---|---|
| SS | 25 |
| SS | 21 |
| SS | 26 |
| SS | 19 |
| SS | 17 |
| SS | 37 |
| SS | 63 |
| SS | 106 |
| SS | 113 |
| SS | 23 |
| SS | 92 |
| SS | 26 |
| SS | 57 |
| SS | 104 |
| SS | 34 |
| SS | 17 |
| SS | 17 |
| SS | 51 |
| SS | 250 |
| SS | 220 |

**MacLaren**

MacLAREN ENGINEERS INC.

TEST HOLE RECORD

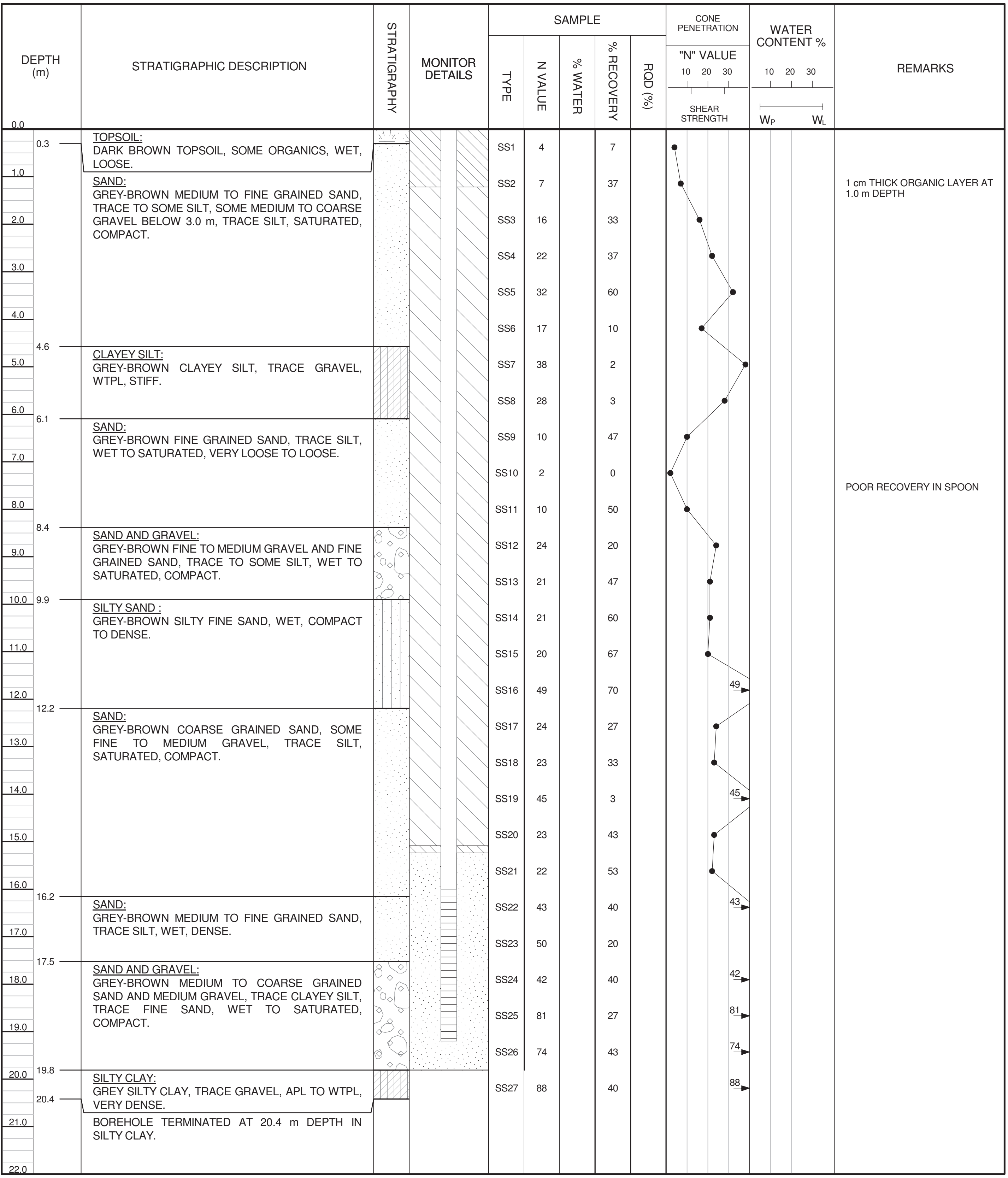
DJR

PROJECT NO. 11602-2

# BOREHOLE NO. BH39

**PAGE 1 of 1**

**PROJECT NAME:** HOLBROOK LANDFILL
**PROJECT NO.:** 111-53037-00 132-00
**CLIENT:** COUNTY OF OXFORD
**DATE COMPLETED:** Jul 18, 2013
**BOREHOLE TYPE:** 210 mm HOLLOW STEM AUGER
**SUPERVISOR:** TJB
**GROUND ELEVATION:** TO BE DETERMINED
**REVIEWER:** KJF



| DEPTH (m) | STRATIGRAPHIC DESCRIPTION |
|---|---|
| 0.0 – 0.3 | TOPSOIL: DARK BROWN TOPSOIL, SOME ORGANICS, WET, LOOSE. |
| 0.3 – 4.6 | SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE TO SOME SILT, SOME MEDIUM TO COARSE GRAVEL BELOW 3.0 m, TRACE SILT, SATURATED, COMPACT. |
| 4.6 – 6.1 | CLAYEY SILT: GREY-BROWN CLAYEY SILT, TRACE GRAVEL, WTPL, STIFF. |
| 6.1 – 8.4 | SAND: GREY-BROWN FINE GRAINED SAND, TRACE SILT, WET TO SATURATED, VERY LOOSE TO LOOSE. |
| 8.4 – 9.9 | SAND AND GRAVEL: GREY-BROWN FINE TO MEDIUM GRAVEL AND FINE GRAINED SAND, TRACE TO SOME SILT, WET TO SATURATED, COMPACT. |
| 9.9 – 12.2 | SILTY SAND : GREY-BROWN SILTY FINE SAND, WET, COMPACT TO DENSE. |
| 12.2 – 16.2 | SAND: GREY-BROWN COARSE GRAINED SAND, SOME FINE TO MEDIUM GRAVEL, TRACE SILT, SATURATED, COMPACT. |
| 16.2 – 17.5 | SAND: GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE SILT, WET, DENSE. |
| 17.5 – 19.8 | SAND AND GRAVEL: GREY-BROWN MEDIUM TO COARSE GRAINED SAND AND MEDIUM GRAVEL, TRACE CLAYEY SILT, TRACE FINE SAND, WET TO SATURATED, COMPACT. |
| 19.8 – 20.4 | SILTY CLAY: GREY SILTY CLAY, TRACE GRAVEL, APL TO WTPL, VERY DENSE. |
| 20.4 | BOREHOLE TERMINATED AT 20.4 m DEPTH IN SILTY CLAY. |

| SAMPLE TYPE | N VALUE | % WATER | % RECOVERY | RQD (%) | REMARKS |
|---|---|---|---|---|---|
| SS1 | 4 | | 7 | | |
| SS2 | 7 | | 37 | | 1 cm THICK ORGANIC LAYER AT 1.0 m DEPTH |
| SS3 | 16 | | 33 | | |
| SS4 | 22 | | 37 | | |
| SS5 | 32 | | 60 | | |
| SS6 | 17 | | 10 | | |
| SS7 | 38 | | 2 | | |
| SS8 | 28 | | 3 | | |
| SS9 | 10 | | 47 | | |
| SS10 | 2 | | 0 | | POOR RECOVERY IN SPOON |
| SS11 | 10 | | 50 | | |
| SS12 | 24 | | 20 | | |
| SS13 | 21 | | 47 | | |
| SS14 | 21 | | 60 | | |
| SS15 | 20 | | 67 | | |
| SS16 | 49 | | 70 | | |
| SS17 | 24 | | 27 | | |
| SS18 | 23 | | 33 | | |
| SS19 | 45 | | 3 | | |
| SS20 | 23 | | 43 | | |
| SS21 | 22 | | 53 | | |
| SS22 | 43 | | 40 | | |
| SS23 | 50 | | 20 | | |
| SS24 | 42 | | 40 | | |
| SS25 | 81 | | 27 | | |
| SS26 | 74 | | 43 | | |
| SS27 | 88 | | 40 | | |

# BOREHOLE NO. BH40

PAGE 1 of 1

**PROJECT NAME:** HOLBROOK LANDFILL

**PROJECT NO.:** 111-53037-00 132-00

**CLIENT:** COUNTY OF OXFORD

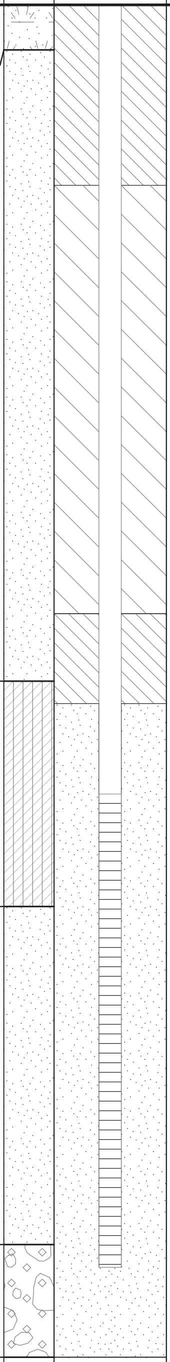
**DATE COMPLETED:** Jul 22, 2013

**BOREHOLE TYPE:** 210 mm HOLLOW STEM AUGER

**SUPERVISOR:** TJB

**GROUND ELEVATION:** TO BE DETERMINED

**REVIEWER:** KJF



| DEPTH (m) | STRATIGRAPHIC DESCRIPTION | STRATIGRAPHY | MONITOR DETAILS | SAMPLE TYPE | SAMPLE N VALUE | SAMPLE % WATER | SAMPLE % RECOVERY | SAMPLE RQD (%) | CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH | WATER CONTENT % 10 20 30 WP WL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | TOPSOIL:<br>DARK BROWN TOPSOIL, SOME ORGANICS, WET, LOOSE. | | | | | | | | | | STRATIGRAPHY BASED ON ADJACENT DEEP BOREHOLE 39. |
| 0.3 | SAND:<br>GREY-BROWN MEDIUM TO FINE GRAINED SAND, TRACE TO SOME SILT, SOME MEDIUM TO COARSE GRAVEL BELOW 3.0 m, TRACE SILT, SATURATED, COMPACT. | | | | | | | | | | 1 cm THICK ORGANIC LAYER AT 1.0 m DEPTH |
| 4.6 | CLAYEY SILT:<br>GREY-BROWN CLAYEY SILT, TRACE GRAVEL, WTPL, STIFF. | | | | | | | | | | |
| 6.1 | SAND:<br>GREY-BROWN FINE GRAINED SAND, TRACE SILT, WET TO SATURATED, VERY LOOSE TO LOOSE. | | | | | | | | | | POOR RECOVERY IN SPOON |
| 8.4 | SAND AND GRAVEL:<br>GREY-BROWN FINE TO MEDIUM GRAVEL AND FINE GRAINED SAND, TRACE TO SOME SILT, WET TO SATURATED, COMPACT. | | | | | | | | | | |
| 9.1 | BOREHOLE TERMINATED AT 9.1 m DEPTH IN SAND AND GRAVEL. | | | | | | | | | | |
| 10.0 | | | | | | | | | | | |

# BOREHOLE NO. BH41

PAGE 1 of 1

**PROJECT NAME:** HOLBROOK LANDFILL

**PROJECT NO.:** 111-53037-00 132-00

**CLIENT:** COUNTY OF OXFORD

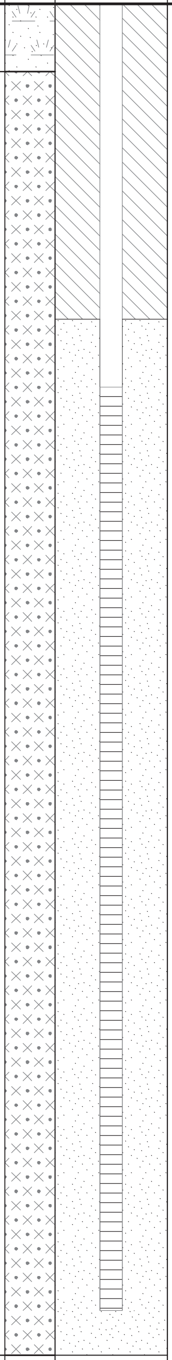
**DATE COMPLETED:** Jul 22, 2013

**BOREHOLE TYPE:** 210 mm HOLLOW STEM AUGER

**SUPERVISOR:** TJB

**GROUND ELEVATION:** TO BE DETERMINED

**REVIEWER:** RFK



| DEPTH (m) | STRATIGRAPHIC DESCRIPTION | STRATIGRAPHY | MONITOR DETAILS | SAMPLE TYPE | SAMPLE N VALUE | SAMPLE % WATER | SAMPLE % RECOVERY | SAMPLE RQD (%) | CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH | WATER CONTENT % 10 20 30 WP WL | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | TOPSOIL AND CLAY CAP | | | | | | | | | | |
| 0.5 | WASTE | | | | | | | | | | |
| | WASTE BECOMING WET | | | | | | | | | | |
| | WASTE BECOMING SATURATED | | | | | | | | | | |
| 9.1 | BOREHOLE TERMINATED AT 9.1 m DEPTH IN WASTE. | | | | | | | | | | |

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

GENIVAR GEOLOGIC B/W (METRIC) HOLBROOK.GPJ JAGGER HIMS BASIC.GDT 9/6/13

# LOG OF BOREHOLE 42

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/07
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | SAMPLE: Type | SAMPLE: SPT N-Value<br>Core Recovery | Elevation Scale (mASL) | Penetration Test Values (Blows / 0.3m)<br>× Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa)<br>○ Unconfined + Field Vane<br>● Pocket Penetrometer ■ Lab Vane<br>40 80 120 160 | Water Content (%) & Plasticity<br>PL MC LL<br>10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **GROUND SURFACE** | | | | | | | | | | |
| | Dark brown **TOPSOIL**, some organics, wet, loose. | | | | | | | | | | |
| 0.3 | Grey-brown medium to fine grained **SAND**, trace to some silt, some medium to coarse gravel below 3.0 m, trace silt, saturated, compact. | | | | | | | | | | |
| 4.6 | Grey-brown **CLAYEY SILT**, trace gravel, WTPL, stiff. | | | | | | | | | | |
| 6.1 | Grey-brown fine grained **SAND**, trace silt, wet to saturated, very loose to loose. | | | | | | | | | | |
| 8.4 | Grey-brown fine to medium **GRAVEL** and fine grained **SAND**, trace to some silt, wet to saturated, compact. | | | | | | | | | | |
| 9.9 | Grey-brown **SILTY FINE SAND**, wet, compact to dense. | | | | | | | | | | |
| 12.2 | Grey-brown coarse grained **SAND**, some fine to medium gravel, trace silt, saturated, compact. | | | | | | | | | | |

*(continued next page)*

# LOG OF BOREHOLE 42

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

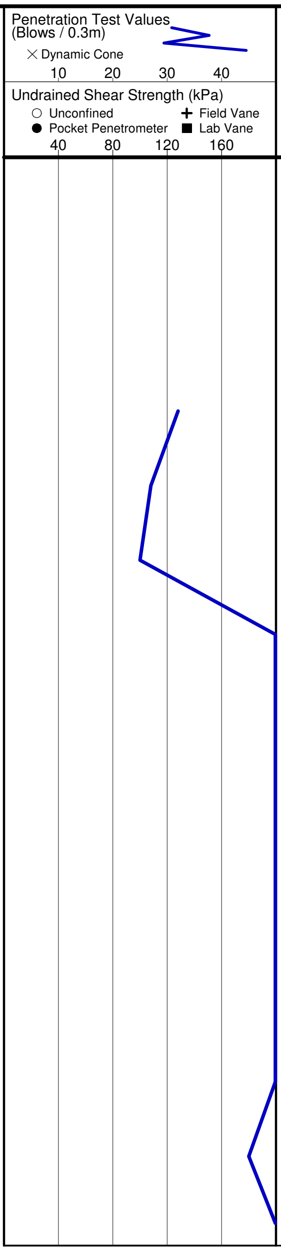
**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/07
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE *(continued)*

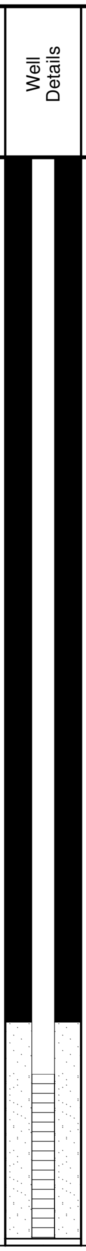
| Elev Depth (m) | STRATIGRAPHY | SAMPLE Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|
| 16.2 | Grey-brown medium to fine grained **SAND**, trace silt, wet, dense. | | | |
| 17.5 | Grey-brown medium to coarse grained **SAND** and medium **GRAVEL**, trace clayey silt, trace fine sand, wet to saturated, compact. | 1 | SS | 32 |
| 19.1 | Grey **CLAYEY SILT**, trace gravel, APL, very stiff. | 2 | SS | 27 |
| | | 3 | SS | 25 |
| 20.4 | Grey **CLAYEY SILT**, trace fine to coarse sand, increasing sand content with depth, DTPL to APL, hard. | 4 | SS | >100 |
| | | 5 | SS | >100 |
| | | 6 | SS | >100 |
| | | 7 | SS | >100 |
| | | 8 | SS | 96 |
| | | 9 | SS | >100 |
| | | 10 | SS | >100 |
| 25.9 | Grey medium to coarse grained **SAND**, trace silt, wet, dense to very dense. | 11 | SS | 45 |
| | | 12 | SS | 80 |
| 27.1 | **END OF BOREHOLE** | | | |

Stratigraphy to 18.3 m depth inferred from adjacent BH39.



Water Content (%) & Plasticity: PL 10, MC 20, LL 30

PID Readings



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

# LOG OF BOREHOLE 43

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

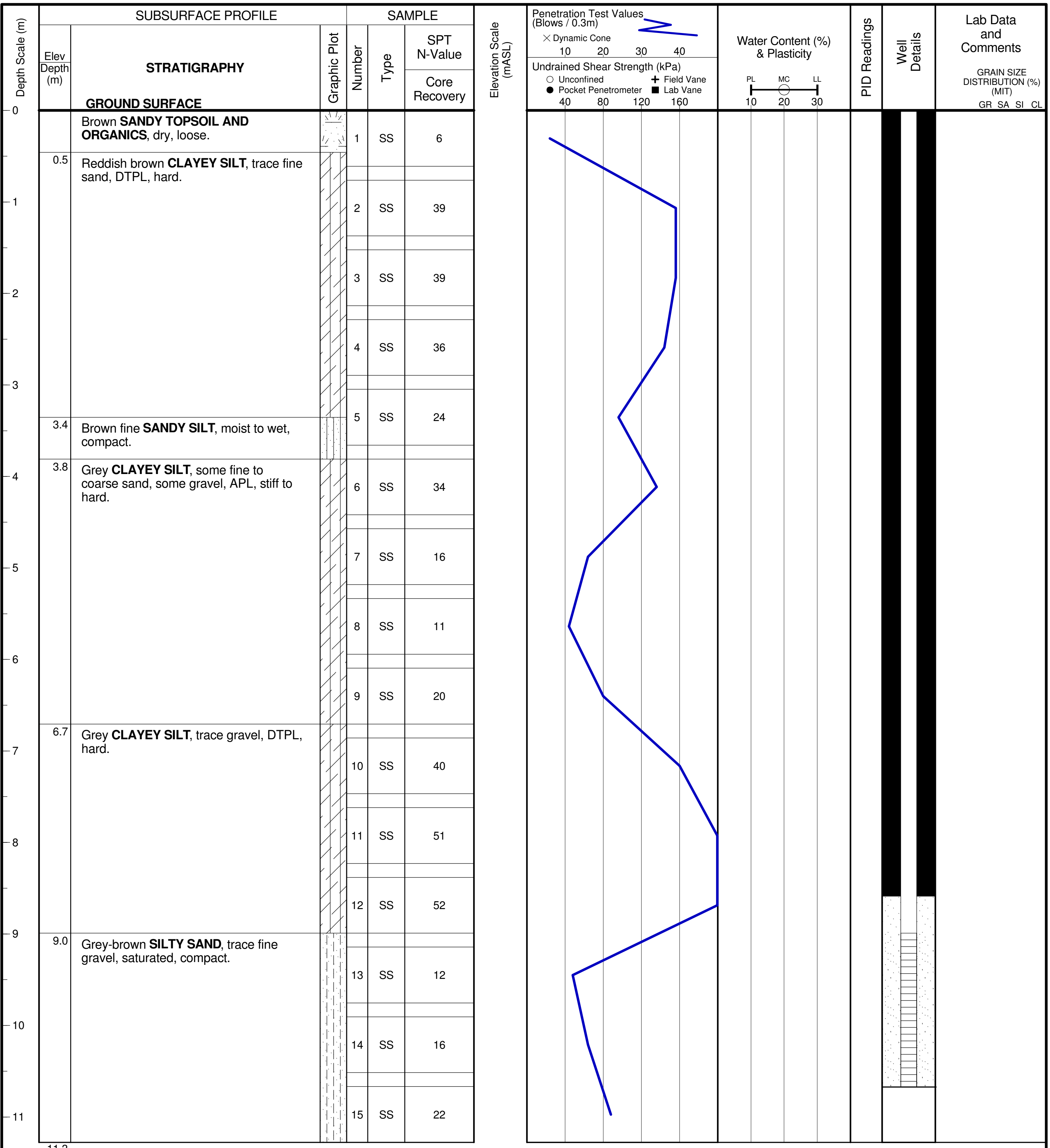
**date started |** 2015/07/21
**supervisor |** MEQ
**reviewer |** AMS

**SUBSURFACE PROFILE**

| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| | **GROUND SURFACE** |
| 0 | Brown **SANDY TOPSOIL AND ORGANICS**, dry, loose. |
| 0.5 | Reddish brown **CLAYEY SILT**, trace fine sand, DTPL, hard. |
| 3.4 | Brown fine **SANDY SILT**, moist to wet, compact. |
| 3.8 | Grey **CLAYEY SILT**, some fine to coarse sand, some gravel, APL, stiff to hard. |
| 6.7 | Grey **CLAYEY SILT**, trace gravel, DTPL, hard. |
| 9.0 | Grey-brown **SILTY SAND**, trace fine gravel, saturated, compact. |
| 11.3 | **END OF BOREHOLE** |

**SAMPLE**

| Number | Type | SPT N-Value / Core Recovery |
|---|---|---|
| 1 | SS | 6 |
| 2 | SS | 39 |
| 3 | SS | 39 |
| 4 | SS | 36 |
| 5 | SS | 24 |
| 6 | SS | 34 |
| 7 | SS | 16 |
| 8 | SS | 11 |
| 9 | SS | 20 |
| 10 | SS | 40 |
| 11 | SS | 51 |
| 12 | SS | 52 |
| 13 | SS | 12 |
| 14 | SS | 16 |
| 15 | SS | 22 |



library: genivar - library.glb report: gen log v1 file: bhlogs.gpj

# LOG OF BOREHOLE 44

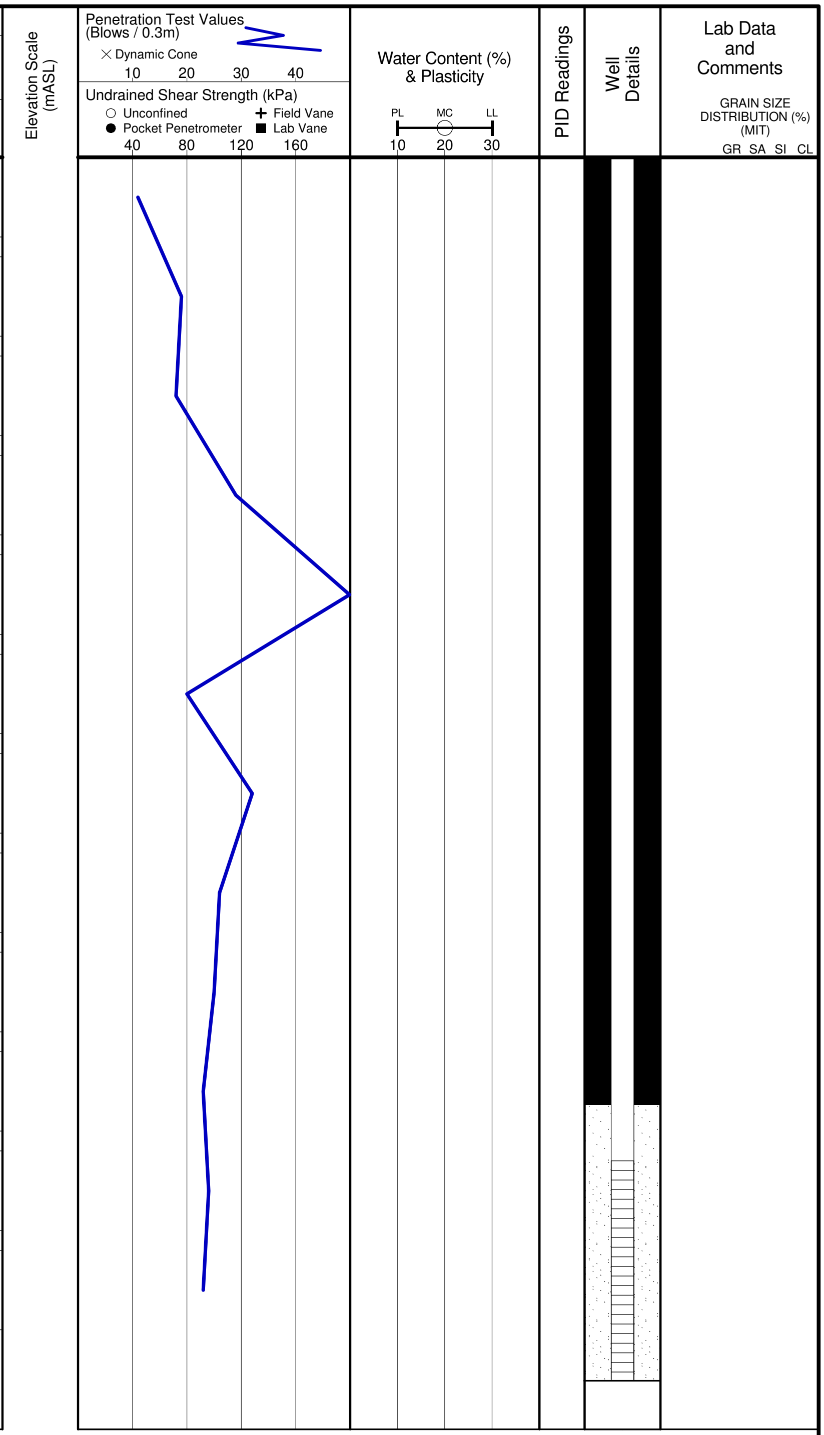
**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/08/04
**supervisor |** MEQ
**reviewer |** AMS

SUBSURFACE PROFILE

| Elev Depth (m) | STRATIGRAPHY | Number | Type | SPT N-Value | Core Recovery |
|---|---|---|---|---|---|
| | **GROUND SURFACE** | | | | |
| 0 | Dark brown **TOPSOIL AND ORGANICS**, dry, loose. | 1 | SS | 11 | |
| 0.3 | Reddish brown fine **SAND**, trace fine gravel, dry, compact. | 2 | SS | 19 | |
| | | 3 | SS | 18 | |
| 2.3 | Brown fine to medium **SILTY SAND**, some fine to medium gravel, moist, dense to very dense. | 4 | SS | 29 | |
| | | 5 | SS | >100 | |
| 3.8 | Brown coarse **SAND**, some fine gravel, trace silt, moist to wet, compact. | 6 | SS | 20 | |
| | | 7 | SS | 32 | |
| 5.2 | Grey **CLAYEY SILT**, trace fine gravel and coarse sand, weakly dilatent, DTPL to APL, very stiff. | 8 | SS | 26 | |
| | | 9 | SS | 25 | |
| | | 10 | SS | 23 | |
| | | 11 | SS | 24 | |
| 8.4 | Brown coarse **SILTY SAND**, some fine gravel, wet, compact. | 12 | SS | 23 | |
| 9.1 | Grey **CLAYEY SILT**, trace fine gravel, APL to DTPL, stiff. | 13 | SS | | |
| 9.8 | **END OF BOREHOLE** | | | | |



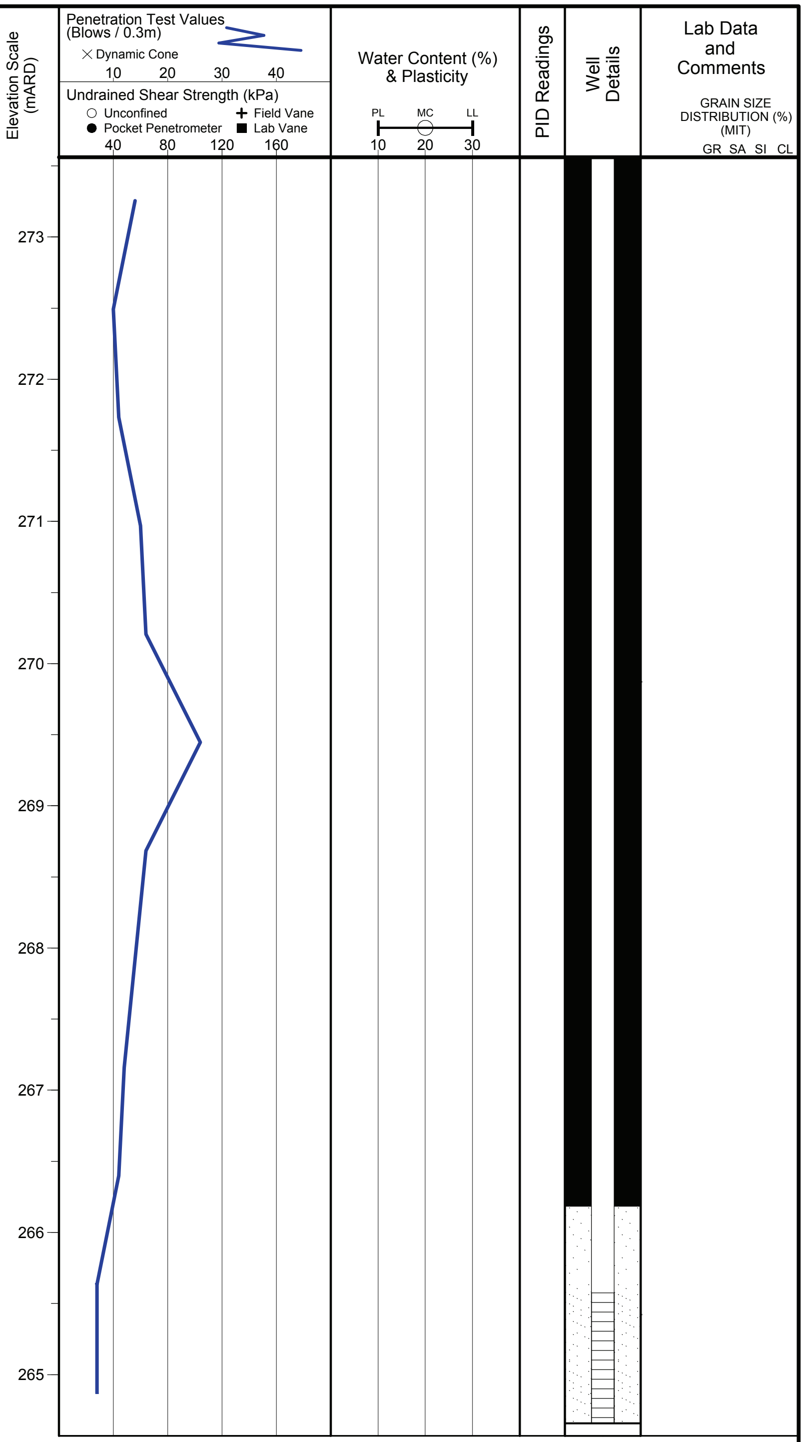
# LOG OF BOREHOLE BH45

**project no. |** 111-53037-03
**date started |** 2019/08/15
**supervisor |** MEQ
**reviewer |** AMS

**project |** Holbrook Landfill Site
**client |** County of Oxford
**location |** Holbrook, Ontario

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

| SUBSURFACE PROFILE | | SAMPLE | | |
|---|---|---|---|---|
| Elev<br>Depth<br>(m) | STRATIGRAPHY | Number | Type | SPT N-Value / Core Recovery |
| 273.6 | **GROUND SURFACE** | | | |
| | Light brown **SANDY SILT**, some fine to coarse gravel, some organics and topsoil, trace clay, dry to moist, loose. | 1 | SS | 14 |
| | | 2 | SS | 10 |
| 272.4<br>1.2 | Reddish-brown medium to coarse **SILTY SAND**, trace coarse gravel, trace clay, moist, loose. | 3 | SS | 11 |
| 271.3<br>2.3 | Reddish-brown **CLAYEY SILT**, some fine sand, some fine to medium gravel, APL, stiff. | 4 | SS | 15 |
| 270.7<br>2.9 | Grey **CLAYEY SILT**, trace to some subangular gravel, trace fine to coarse sand, occasional cobble, APL, stiff to very stiff. | 5 | SS | 16 |
| | | 6 | SS | 26 |
| | | 7 | SS | 16 |
| 268.6<br>5.0 | Grey medium to coarse **SILTY SAND**, some fine to coarse gravel, wet, loose to compact. | 8 | SS | 14 |
| 268.0<br>5.6 | Grey **CLAYEY SILT**, trace fine to coarse sand, APL, stiff to very stiff. | 9 | SS | 12 |
| 267.0<br>6.6 | Grey-brown fine to medium **SILTY SAND**, saturated, loose to compact. | 10 | SS | 11 |
| | | 11 | SS | 7 |
| | | 12 | SS | 7 |
| 264.6<br>9.0 | **END OF BOREHOLE** | | | |



# LOG OF BOREHOLE BH46

**project no. |** 111-53037-03

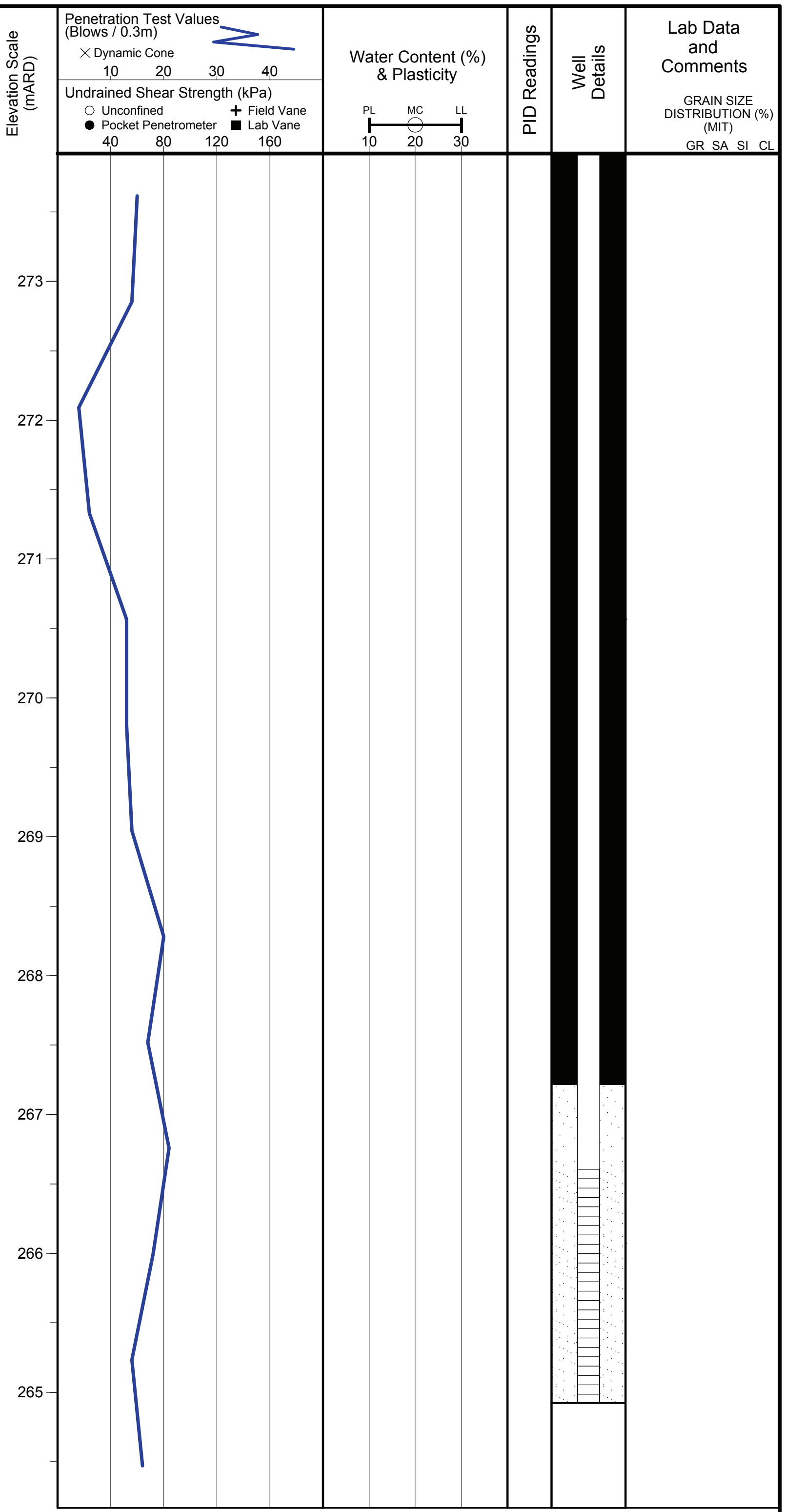
**project |** Holbrook Landfill Site
**client |** County of Oxford
**location |** Holbrook, Ontario

**rig type |** CME 75, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2019/08/15
**supervisor |** MEQ
**reviewer |** AMS

| Elev Depth (m) | STRATIGRAPHY |
|---|---|
| 273.9 | **GROUND SURFACE** |
| | Light brown coarse **SAND** and fine to coarse **GRAVEL**, some organics and topsoil, occasional cobble, dry, loose. |
| 273.3<br>0.6 | Brown to reddish-brown medium to coarse **GRAVELLY SAND**, trace silt, occasional cobble, moist, loose to compact. |
| 271.8<br>2.1 | Reddish-brown medium **SILTY SAND**, trace clay, wet, loose to compact. |
| 270.7<br>3.2 | Reddish-brown **CLAYEY SILT**, some fine sand, some fine to medium subrounded gravel, APL, firm. |
| 270.4<br>3.5 | Reddish-brown coarse **SAND**, some fine to coarse subrounded gravel, wet, loose. |
| 270.2<br>3.7 | Grey **CLAYEY SILT**, trace to some subangular gravel, trace fine to coarse sand, APL, stiff to very stiff. |
| 265.7<br>8.2 | Grey medium to coarse **SILTY SAND**, some fine to coarse gravel, trace clay, wet to saturate, loose to compact. |
| 264.9<br>9.0 | Grey **SILTY CLAY**, APL, very stiff. |
| 264.1<br>9.8 | **END OF BOREHOLE** |

| Number | Type | SPT N-Value |
|---|---|---|
| 1 | SS | 15 |
| 2 | SS | 14 |
| 3 | SS | 4 |
| 4 | SS | 6 |
| 5 | SS | 13 |
| 6 | SS | 13 |
| 7 | SS | 14 |
| 8 | SS | 20 |
| 9 | SS | 17 |
| 10 | SS | 21 |
| 11 | SS | 18 |
| 12 | SS | 14 |
| 13 | SS | 16 |



# LOG OF BOREHOLE 104 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-00*

**rig type |** CME 75, track-mounted

**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2014/09/17

**supervisor |** MEQ

**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value / Core Recovery | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 279.8 | **GROUND SURFACE** | | | | | | | | | | |
| 1 | | | | | | | 279 | | | | | |
| 2 | | | | | | | 278 | | | | | |
| 3 | | | | | | | 277 | | | | | |
| 4 | | | | | | | 276 | | | | | |
| | 275.4<br>4.4 | **END OF BOREHOLE**<br>No original borehole log information available. | | | | | | | | | | |

# LOG OF BOREHOLE 301 Decommissioning

**project** | Holbrook Landfill Site

**client** | Oxford County

**location** | Holbrook, ON

**project no.** | *111-53037-00 132-00*

**rig type** | CME 75, track-mounted

**method** | Hollow stem augers, 215 mm dia.

**coring** | *n/a*

**date started** | 2014/09/26

**supervisor** | MEQ

**reviewer** | AMS

| Depth Scale (m) | SUBSURFACE PROFILE | | | SAMPLE | | | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value<br>Core Recovery | | | | | | |
| 0 | 278.1 | **GROUND SURFACE** | | | | | | | | | | |
| | | | | | | | 278 | | | | | |
| 1 | | | | | | | 277 | | | | | |
| 2 | | | | | | | 276 | | | | | |
| 3 | | | | | | | 275 | | | | | |
| 4 | | | | | | | 274 | | | | | |
| | 273.3<br>4.8 | | | | | | | | | | | |

**END OF BOREHOLE**

No original borehole log information available.

# LOG OF BOREHOLE SP3 Decommissioning

WSP

**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, ON
**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/22
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | SUBSURFACE PROFILE |  |  | SAMPLE |  |  | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40<br>Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160 | Water Content (%) & Plasticity PL MC LL 10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Elev Depth (m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value<br>Core Recovery |  |  |  |  |  |  |
| 0 | 280.4 | **GROUND SURFACE** |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | 280 |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 279.2<br>1.2 | **END OF BOREHOLE**<br>No original borehole log information available. |  |  |  |  |  |  |  |  |  |  |

# LOG OF BOREHOLE SP3R

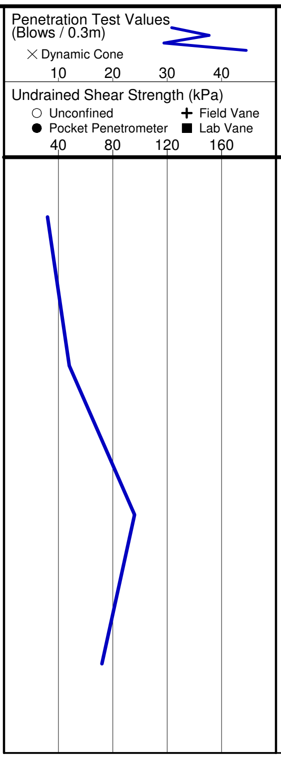
**project |** Holbrook Landfill Site
**client |** Oxford County
**location |** Holbrook, Oxford County
**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted
**method |** Hollow stem augers, 215 mm dia.
**coring |** *n/a*

**date started |** 2015/07/24
**supervisor |** MEQ
**reviewer |** AMS

| Depth Scale (m) | Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | Graphic Plot | SAMPLE: Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|---|---|
| | | **GROUND SURFACE** | | | | |
| 0 | | Dark brown **TOPSOIL**, some fine sand, rootlets, moist, loose. | | 1 | SS | 8 |
| 1 | 0.6 | Reddish brown **CLAYEY SILT**, some fine to medium sand, trace clay, trace rootlets, moist, compact. | | 2 | SS | 12 |
| 2 | | | | 3 | SS | 24 |
| 3 | 2.3 | Grey-brown **CLAYEY SILT**, trace fine to coarse sand, trace gravel, DTPL to APL, stiff to very stiff. | | 4 | SS | 18 |
| | 3.1 | **END OF BOREHOLE**<br>Stratigraphy inferred from adjacent borehole 25R. | | | | |

Elevation Scale (mASL)

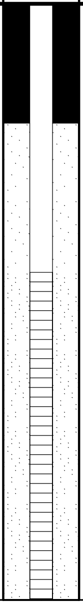


Water Content (%) & Plasticity

PL MC LL
10 20 30

PID Readings

Well Details



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

**library:** genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# LOG OF BOREHOLE SP4 Decommissioning

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, ON

**project no. |** *111-53037-00 132-02*

**rig type |** Acker Soil-Max, track-mounted

**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

**date started |** 2015/07/10

**supervisor |** MEQ

**reviewer |** AMS

| Depth Scale (m) | SUBSURFACE PROFILE | | | SAMPLE | | | | Elevation Scale (mARD) | Penetration Test Values (Blows / 0.3m)<br>× Dynamic Cone<br>10 20 30 40<br>Undrained Shear Strength (kPa)<br>○ Unconfined + Field Vane<br>● Pocket Penetrometer ■ Lab Vane<br>40 80 120 160 | Water Content (%) & Plasticity<br>PL MC LL<br>10 20 30 | PID Readings | Well Details | Lab Data and Comments<br>GRAIN SIZE DISTRIBUTION (%) (MIT)<br>GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Elev<br>Depth<br>(m) | STRATIGRAPHY | Graphic Plot | Number | Type | SPT N-Value | Core Recovery | | | | | | |
| 0 | 279.6 | **GROUND SURFACE** | | | | | | | | | | | |
| | | | | | | | | 279 | | | | | |
| 1 | | | | | | | | | | | | | |
| | | | | | | | | 278 | | | | | |
| | 277.7<br>1.9 | **END OF BOREHOLE**<br>No original borehole log information available. | | | | | | | | | | | |

# LOG OF BOREHOLE SP4R

**project |** Holbrook Landfill Site

**client |** Oxford County

**location |** Holbrook, Oxford County

**project no. |** *111-53037-00 132-02*

**rig type |** ACKER SOIL-MAX, track-mounted

**method |** Hollow stem augers, 215 mm dia.

**coring |** *n/a*

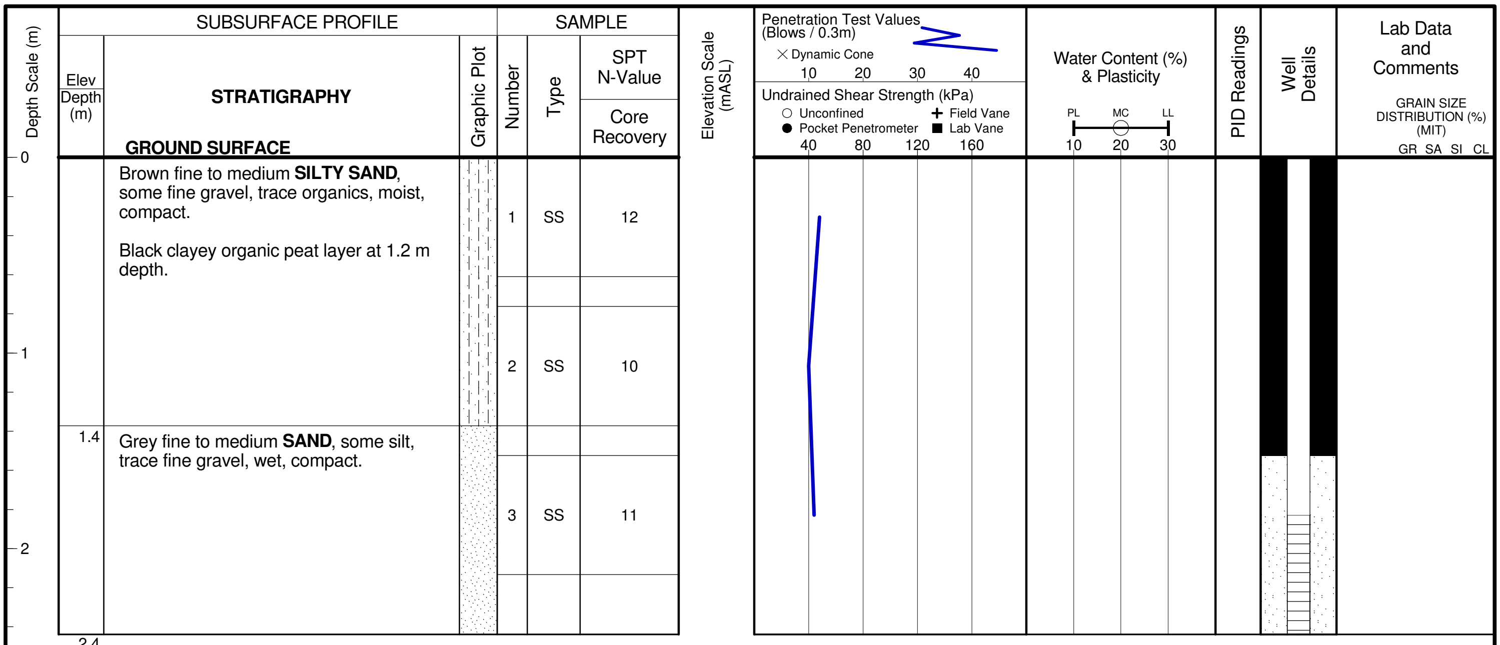
**date started |** 2015/07/13

**supervisor |** SM

**reviewer |** AMS

| Elev Depth (m) | SUBSURFACE PROFILE: STRATIGRAPHY | SAMPLE Number | Type | SPT N-Value / Core Recovery |
|---|---|---|---|---|
| 0 | **GROUND SURFACE** | | | |
| | Brown fine to medium **SILTY SAND**, some fine gravel, trace organics, moist, compact.<br>Black clayey organic peat layer at 1.2 m depth. | 1 | SS | 12 |
| | | 2 | SS | 10 |
| 1.4 | Grey fine to medium **SAND**, some silt, trace fine gravel, wet, compact. | 3 | SS | 11 |
| 2.4 | **END OF BOREHOLE** | | | |

Stratigraphy inferred from adjacent borehole 24R.



library: genivar - library.glb **report:** gen log v1 **file:** bhlogs.gpj

# APPENDIX

# C

## GROUNDWATER ELEVATION DATA

## Table C-1: Monitoring Well Details
## Holbrook Landfill Site

| Observation Well | Installation Date | Ground Surface Elevation (m ASL) (1) | Measuring Point Elevation (1) (m ASL) | Stickup (m) | Riser Inside Diameter (mm) | Screen Length (m) | Screened Interval | | Well Depth (mbTOP) | Flow System (2) | Well Condition Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (m bgs) | (m ASL) | | | |
| 2 | 01-May-79 | 276.47 | 277.57 | 1.10 | 51 | 0.50 | 8.64 - 9.14 | 270.96 - 270.46 | 10.51 | SFS | Decommissioned in 2014 |
| 4 | 01-May-79 | 279.32 | 280.34 | 1.02 | 51 | 0.50 | 5.60 - 6.10 | 273.40 - 272.90 | 7.09 | SFS | Decommissioned in 2014 |
| 4R | 24-Sep-14 | 278.91 | 280.12 | 1.21 | 51 | 1.67 | 4.55 - 6.22 | 274.36 - 272.69 | 7.43 | SFS | ✓ |
| 5 | 01-May-79 | 279.15 | 280.12 | 0.97 | 51 | 0.50 | 7.60 - 8.10 | 271.10 - 270.60 | 9.13 | SFS | Decommissioned in 2014 |
| 5R | 24-Sep-14 | 279.26 | 280.46 | 1.20 | 51 | 1.68 | 7.06 - 8.74 | 272.20 - 270.52 | 9.94 | SFS | ✓ |
| 6 | 01-May-79 | 279.15 | 279.78 | 0.63 | 51 | 0.50 | 3.16 - 3.66 | 275.54 - 275.04 | 4.39 | SFS | Decommissioned in 2014 |
| 10 | 03-May-79 | 281.63 | 282.48 | 0.85 | 51 | 0.50 | 2.85 - 3.35 | 277.15 - 276.65 | 4.30 | SFS | Decommissioned in 2015 |
| 10R | 09-Jul-15 | 281.52 | 282.55 | 1.04 | 51 | 1.67 | 2.90 - 4.57 | 278.62 - 276.95 | 5.61 | SFS | ✓ |
| 11 | 03-May-79 | 280.79 | 281.99 | 1.20 | 51 | 0.50 | 4.00 - 4.50 | 276.50 - 276.00 | 5.78 | SFS | Decommissioned in 2015 |
| 11R | 24-Jul-15 | 283.02 | 284.11 | 1.09 | 51 | 1.67 | 6.71 - 8.38 | 276.31 - 274.64 | 9.47 | SFS/SCL | ✓ |
| 12 | 03-May-79 | 280.69 | 281.85 | 1.16 | 51 | 0.50 | 7.27 - 7.77 | 273.23 - 272.73 | 8.78 | SFS/SCL | Decommissioned in 2015 |
| 13 | 13-Jun-79 | 274.08 | 274.89 | 0.81 | 51 | 0.50 | 7.27 - 7.77 | 266.53 - 266.03 | 8.65 | SFS/SCL | Decommissioned in 2014 |
| 13R | 25-Sep-14 | 274.16 | 275.26 | 1.10 | 51 | 1.67 | 5.92 - 7.59 | 268.24 - 266.57 | 8.69 | SFS/SCL | ✓ |
| 14 | 13-Jun-79 | 275.85 | 277.40 | 1.55 | 51 | 0.50 | 4.50 - 5.00 | 271.00 - 270.50 | 6.23 | SFS | Decommissioned in 2014 |
| 14R | 17-Sep-14 | 275.69 | 276.65 | 0.97 | 51 | 1.68 | 3.96 - 5.64 | 271.73 - 270.05 | 6.61 | SFS | ✓ |
| 14A | 13-Jun-79 | 275.94 | 277.47 | 1.53 | 51 | 0.50 | 2.24 - 2.74 | 273.26 - 272.76 | 4.13 | SFS | Decommissioned in 2014 |
| 15 | 13-Jun-79 | 278.29 | 279.30 | 1.01 | 51 | 0.50 | 15.50 - 16.00 | 262.40 - 261.90 | 17.18 | DFS | Decommissioned in 2014 |
| 15A | 14-Jun-79 | 278.31 | 279.28 | 0.97 | 51 | 0.50 | 8.00 - 8.50 | 270.10 - 269.60 | 9.13 | SFS/SCL | ✓ |
| 16 | 14-Jun-79 | 278.19 | 279.24 | 1.05 | 51 | 0.50 | 15.35 - 15.85 | 262.45 - 261.95 | 17.02 | DFS | Decommissioned in 2014 |
| 16R | 19-Sep-14 | 277.98 | 279.23 | 1.26 | 51 | 1.67 | 14.05 - 15.72 | 263.93 - 262.26 | 16.98 | DFS | ✓ |
| 16A | 14-Jun-79 | 278.19 | 279.50 | 1.31 | 51 | 0.50 | 8.34 - 8.84 | 269.46 - 268.96 | 10.22 | SFS/SCL | Decommissioned in 2014 |
| 16AR | 22-Sep-14 | 278.14 | 279.29 | 1.15 | 51 | 1.67 | 7.75 - 9.42 | 270.39 - 268.72 | 10.57 | SFS/SCL | ✓ |
| 17 | 29-Jun-79 | 278.84 | 279.43 | 0.59 | 51 | 0.50 | 5.60 - 6.10 | 273.00 - 272.50 | 7.14 | SFS/SCL | Decommissioned in 2013 |
| 18 | 14-Sep-81 | 279.78 | 281.31 | 1.53 | 51 | 1.50 | 4.14 - 5.64 | 275.86 - 274.36 | 6.63 | SFS/SCL | Decommissioned in 2014 |
| 18R | 16-Sep-14 | 279.57 | 280.76 | 1.19 | 51 | 1.68 | 4.04 - 5.72 | 275.53 - 273.85 | 6.91 | SFS | ✓ |
| 19 | 14-Sep-81 | 274.95 | 276.05 | 1.10 | 51 | 1.50 | 3.68 - 5.18 | 271.02 - 269.52 | 6.15 | SFS/SCL | Decommissioned in 2014 |
| 19R | 26-Sep-14 | 274.89 | 276.11 | 1.21 | 51 | 1.65 | 3.58 - 5.23 | 271.31 - 269.66 | 6.44 | SFS/SCL | ✓ |
| 21 | 16-Oct-81 | 277.78 | 278.86 | 1.08 | 51 | 1.20 | 14.34 - 15.54 | 263.16 - 261.96 | 16.59 | DFS | Decommissioned in 2015 |
| 21R | 29-Sep-14 | 277.75 | 278.90 | 1.15 | 51 | 1.70 | 14.15 - 15.85 | 263.60 - 261.90 | 17.00 | DFS | ✓ |
| 23 | 23-Oct-81 | 278.94 | 280.15 | 1.21 | 51 | 2.10 | 18.32 - 20.42 | 260.08 - 257.98 | 21.54 | DFS | Decommissioned in 2015 |
| 24 | 11-Feb-82 | 279.73 | 280.35 | 0.62 | 51 | 1.00 | 19.42 - 20.42 | 259.78 - 258.78 | 20.98 | DFS | Decommissioned in 2015 |
| 24R | 15-Jul-15 | 280.25 | 281.00 | 0.74 | 51 | 1.67 | 18.75 - 20.42 | 261.50 - 259.83 | 21.16 | DFS | ✓ |
| 24A | 11-Feb-82 | 279.72 | 280.84 | 1.12 | 51 | 1.00 | 3.27 - 4.27 | 275.93 - 274.93 | 5.35 | SCL | Decommissioned in 2015 |
| 24AR | 13-Jul-15 | 279.95 | 281.11 | 1.15 | 51 | 0.91 | 3.66 - 4.57 | 276.29 - 275.38 | 5.72 | SFS | ✓ |
| 25 | 12-Feb-82 | 280.42 | 280.84 | 0.42 | 51 | 1.00 | 18.20 - 19.20 | 261.70 - 260.70 | 19.81 | DFS | Decommissioned in 2015 |
| 25R | 23-Jul-15 | 280.72 | 281.83 | 1.10 | 51 | 1.68 | 17.98 - 19.66 | 262.74 - 261.06 | 20.76 | DFS | ✓ |
| 25A | 12-Feb-82 | 280.41 | 281.30 | 0.89 | 51 | 1.00 | 2.50 - 3.50 | 277.40 - 276.40 | 4.48 | SFS/SCL | Decommissioned in 2015 |
| 26 | 16-Jan-83 | 272.07 | 272.21 | 0.14 | 51 | 1.80 | 2.70 - 4.50 | 269.10 - 267.30 | 4.50 | SFS | Decommissioned in 2015 |
| 26R | 07-Aug-15 | 272.03 | 272.91 | 0.88 | 51 | 0.61 | 5.49 - 6.10 | 266.54 - 265.93 | 6.98 | SFS | Artesian |
| 27 | 24-Jan-83 | 272.20 | 272.35 | 0.15 | 51 | 2.40 | 10.86 - 13.26 | 260.84 - 258.44 | 13.26 | DFS | Artesian |

*Notes:* · All elevations in metres above sea level
· (1) Elevations based on 2012 well network survey, with the exception of wells 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16R, 16AR, 18R, 19R, 21R, 24R, 24AR, 25R, 26R, 27, 28R, 32R, 31, 33R, 35, 37R, 38, 39, 40, 41, 42, 43, 44, SP3R, SP4R, and SP5 which were surveyed in 2015.
· (2) Flow system estimated based on borehole log interpretation.

· SFS - Shallow Flow System
· SFS/SCL - Shallow Flow System / Shallow Confining Layer (possibly screened between two units)
· DFS - Deep Flow System
· ✓ Surface seal in good condition and well is capped.

## Table C-1: Monitoring Well Details
## Holbrook Landfill Site

| Observation Well | Installation Date | Ground Surface Elevation (m ASL) $^{(1)}$ | Measuring Point Elevation $^{(1)}$ (m ASL) | Stickup (m) | Riser Inside Diameter (mm) | Screen Length (m) | Screened Interval | | Well Depth (mbTOP) | Flow System $^{(2)}$ | Well Condition Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (m bgs) | (m ASL) | | | |
| 28 | 17-Jan-83 | 277.65 | 278.52 | 0.87 | 51 | 1.50 | 7.64 - 9.14 | 269.76 - 268.26 | 9.94 | SFS/SCL | Decommissioned in 2015 |
| 28R | 21-Jul-15 | 277.72 | 278.78 | 1.06 | 51 | 1.68 | 8.23 - 9.91 | 269.49 - 267.81 | 10.97 | SFS/SCL | ✓ |
| 30 | 19-Jan-83 | 279.10 | 280.63 | 1.53 | 51 | 3.00 | 8.00 - 11.00 | 270.90 - 267.90 | 12.44 | SFS/SCL | Decommissioned in 2014 |
| 31 | 03-Feb-83 | 279.14 | 280.06 | 0.92 | 51 | 3.00 | 14.68 - 17.68 | 264.22 - 261.22 | 18.49 | DFS | ✓ |
| 32 | 19-Jan-83 | 280.08 | 280.26 | 0.18 | 51 | 1.80 | 2.77 - 4.57 | 276.83 - 275.03 | 5.46 | SFS | Decommissioned in 2015 |
| 32R | 10-Jul-15 | 280.12 | 281.09 | 0.96 | 51 | 1.67 | 3.28 - 4.95 | 276.84 - 275.17 | 5.91 | SFS | ✓ |
| 33 | 19-Jan-83 | 280.23 | 280.78 | 0.55 | 51 | 1.80 | 10.30 - 12.10 | 269.60 - 267.80 | 12.86 | SFS/SCL | Decommissioned in 2015 |
| 33R | 23-Jul-15 | 280.67 | 281.85 | 1.18 | 51 | 1.67 | 10.01 - 11.68 | 270.66 - 268.99 | 12.86 | SFS/SCL | ✓ |
| 35 | 27-Jan-83 | 278.11 | 279.03 | 0.81 | 51 | 1.80 | 12.83 - 14.63 | 264.97 - 263.17 | 15.47 | DFS | ✓ |
| 37 | 15-Jan-83 | 274.97 | 276.41 | 1.44 | 51 | 3.00 | 19.71 - 22.71 | 255.05 - 252.05 | 24.43 | DFS | Decommissioned in 2015 |
| 37R | 06-Aug-15 | 275.15 | 276.24 | 1.09 | 51 | 1.68 | 19.05 - 20.73 | 256.10 - 254.42 | 21.82 | DFS | ✓ |
| 38 | 17-Feb-83 | 282.52 | 283.66 | 1.14 | 51 | 3.00 | 22.50 - 25.50 | 259.77 - 256.77 | 26.83 | DFS | ✓ |
| 39 | 18-Jul-13 | 278.03 | 278.94 | 0.91 | 51 | 3.05 | 16.00 - 19.05 | 262.12 - 259.07 | 19.84 | DFS | ✓ |
| 40 | 22-Jul-13 | 277.95 | 279.14 | 1.19 | 51 | 3.05 | 5.33 - 8.38 | 272.65 - 269.60 | 9.25 | SFS | ✓ |
| 41 | 22-Jul-13 | 286.53 | 287.63 | 1.09 | 51 | 6.10 | 2.59 - 8.69 | 284.14 - 278.04 | 9.68 | LEACHATE | ✓ |
| 42 | 08-Jul-15 | 278.02 | 279.05 | 1.03 | 51 | 1.68 | 25.37 - 27.05 | 252.65 - 250.97 | 28.08 | DFS | ✓ |
| 43 | 21-Jul-15 | 280.62 | 281.66 | 1.04 | 51 | 1.68 | 8.99 - 10.67 | 271.63 269.95 | 11.71 | SFS/SCL | ✓ |
| 44 | 04-Aug-15 | 282.26 | 283.36 | 1.10 | 51 | 1.67 | 7.70 - 9.37 | 274.56 - 272.89 | 10.47 | SFS/SCL | ✓ |
| 45 | 16-Aug-19 | 273.56 | 274.56 | 1.00 | 51 | 0.91 | 7.99 - 8.90 | 265.57 264.66 | 9.90 | SFS/SCL | ✓ |
| 46 | 15-Aug-19 | 273.92 | 274.88 | 0.96 | 51 | 1.67 | 7.29 - 8.96 | 266.63 - 264.96 | 9.92 | SFS/SCL | ✓ |
| SP3 | | 280.38 | 280.73 | 0.35 | 32 | | | | | SFS | Decommissioned in 2015 |
| SP3R | 24-Jul-15 | 280.75 | 281.81 | 1.06 | 51 | 1.68 | 1.37 - 3.05 | 279.38 - 277.70 | 4.11 | SFS | ✓ |
| SP4 | | 279.57 | 279.82 | 0.25 | 32 | | | | | SFS | Decommissioned in 2015 |
| SP4R | 13-Jul-15 | 279.93 | 280.86 | 0.93 | 51 | 0.61 | 1.83 - 2.44 | 278.10 - 277.49 | 3.37 | SFS | ✓ |
| SP5 | | 281.64 | 282.30 | 0.66 | 32 | | | | 2.83 | SFS | ✓ |
| 104 | | 279.80 | 281.91 | 2.11 | 51 | | | | | SFS | Decommissioned in 2014 |
| 301 | | 278.12 | 279.31 | 1.19 | 51 | | | | | SFS | Decommissioned in 2014 |

*Notes:* · All elevations in metres above sea level

· (1) Elevations based on 2012 well network survey, with the exception of wells 4R, 5R, 10R, 11R, 13R, 14R, 15A, 16R, 16AR, 18R, 19R, 21R, 24R, 24AR, 25R, 26R, 27, 28R, 32R, 31, 33R, 35, 37R, 38, 39, 40, 41, 42, 43, 44, SP3R, SP4R, and SP5 which were surveyed in 2015.

· (2) Flow system estimated based on borehole log interpretation.

· SFS - Shallow Flow System

· SFS/SCL - Shallow Flow System / Shallow Confining Layer (possibly screened between two units)

· DFS - Deep Flow System

· ✓ Surface seal in good condition and well is capped.

# Table C-2: Groundwater Level Elevations
## Holbrook Landfill Site

| Well Number | Measuring Point Elevation | Ground Elevation | May-79 | Jun-79 | Oct-79 | Mar-80 | May-80 | Sep-80 | Feb-81 | Oct-81 | Oct-81 | Jan-82 | Jan-82 | Jan-82 | Feb-82 | Feb-82 | Apr-82 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 277.57 | 276.47 | 277.00 | 276.70 | 276.60 | 276.90 | 277.00 | 276.60 | 276.70 | | | 277.10 | | 276.89 | | 276.80 | 277.24 |
| 4 | 280.34 | 279.32 | 277.10 | 276.60 | 276.50 | 276.80 | 277.00 | 276.50 | 276.60 | | 276.94 | 276.90 | | 276.73 | | 276.64 | 277.03 |
| 4R | 280.12 | 278.91 | | | | | | | | | | | | | | | |
| 5 | 280.12 | 279.15 | 278.10 | 277.70 | 277.30 | 278.00 | 278.10 | 277.50 | 277.60 | | 278.02 | 278.02 | | 277.90 | | 277.78 | 278.37 |
| 5R | 280.46 | 279.26 | | | | | | | | | | | | | | | |
| 6 | 279.78 | 279.15 | 278.10 | 277.70 | 277.30 | 278.00 | 278.10 | 277.60 | 277.60 | | 278.02 | 278.01 | | 277.88 | | 277.75 | 278.39 |
| 10 | 282.48 | 281.63 | 279.60 | 279.20 | 278.90 | 279.40 | 279.30 | 278.80 | 279.00 | | 279.33 | 279.28 | | 279.16 | | 279.07 | 279.51 |
| 10R | 282.55 | 281.52 | | | | | | | | | | | | | | | |
| 11 | 281.99 | 280.79 | 279.70 | 279.10 | 279.80 | 279.70 | 279.60 | 279.60 | 279.60 | | 279.55 | 279.50 | | 279.01 | | 279.56 | 279.00 |
| 11R | 284.11 | 283.02 | | | | | | | | | | | | | | | |
| 12 | 281.85 | 280.69 | 278.60 | 278.30 | 278.00 | 278.40 | 278.70 | 278.30 | 278.20 | | 278.45 | 278.43 | | 278.36 | | 278.30 | 278.81 |
| 13 | 274.89 | 274.08 | | 271.60 | 272.90 | 272.90 | 273.00 | 272.50 | 272.70 | | 273.20 | 273.37 | | 273.24 | | 273.15 | 273.39 |
| 13R | 275.26 | 274.16 | | | | | | | | | | | | | | | |
| 14 | 277.40 | 275.85 | | 276.20 | 276.10 | 276.30 | 276.50 | 276.10 | frozen | | 276.54 | frozen | | frozen | | frozen | 276.70 |
| 14R | 276.65 | 275.69 | | | | | | | | | | | | | | | |
| 14A | 277.47 | 275.94 | | | | | | | | | | | | | | | |
| 15 | 279.30 | 278.29 | | 276.30 | 276.10 | 276.40 | 276.60 | 276.10 | 276.20 | 276.48 | 276.64 | 276.57 | 276.48 | 276.44 | 276.37 | 276.38 | 276.75 |
| 15A | 279.28 | 278.31 | | 276.30 | 276.20 | 276.40 | 276.60 | 276.10 | 276.20 | | 276.60 | 276.54 | | 276.40 | | 276.31 | 276.64 |
| 16 | 279.24 | 278.19 | | 275.90 | 275.70 | 276.00 | 276.20 | 275.70 | 275.80 | 276.08 | 276.25 | 276.19 | 276.11 | 276.05 | 275.95 | 275.95 | 276.31 |
| 16R | 279.23 | 277.98 | | | | | | | | | | | | | | | |
| 16A | 279.50 | 278.19 | | 276.00 | 276.00 | 276.10 | 276.40 | 275.90 | 276.10 | | 276.43 | 276.34 | | 276.23 | | 276.13 | 276.50 |
| 16AR | 279.29 | 278.14 | | | | | | | | | | | | | | | |
| 17 | 279.43 | 278.84 | | 277.10 | | 277.20 | 277.40 | 276.80 | 277.00 | | 277.40 | 277.33 | | 277.17 | | 277.07 | 277.52 |
| 18 | 281.31 | 279.78 | | | | | | | | | 277.56 | 277.42 | | 277.21 | | 277.13 | 277.60 |
| 18R | 280.76 | 279.57 | | | | | | | | | | | | | | | |
| 19 | 276.05 | 274.95 | | | | | | | | | | frozen | | frozen | | frozen | |
| 19R | 276.11 | 274.89 | | | | | | | | | | | | | | | |
| 21 | 278.86 | 277.78 | | | | | | | | | 276.22 | 276.17 | 276.08 | 276.03 | 275.95 | 275.95 | 276.34 |
| 21R | 278.90 | 277.75 | | | | | | | | | | | | | | | |
| 23 | 280.15 | 278.94 | | | | | | | | | 278.66 | 276.13 | 276.01 | 276.04 | 275.93 | 275.94 | 276.48 |
| 24 | 280.35 | 279.73 | | | | | | | | | | | | | 275.97 | 275.97 | 276.35 |
| 24R | 280.35 | 279.73 | | | | | | | | | | | | | | | |
| 24A | 280.84 | 279.72 | | | | | | | | | | | | | | 278.73 | 278.92 |
| 24AR | 281.11 | 279.95 | | | | | | | | | | | | | | | |
| 25 | 280.84 | 280.42 | | | | | | | | | | | | | 276.22 | 276.07 | 276.26 |
| 25R | 281.83 | 280.72 | | | | | | | | | | | | | | | |
| 25A | 281.30 | 280.41 | | | | | | | | | | | | | | 279.85 | 279.49 |
| 26 | 272.21 | 272.07 | | | | | | | | | | | | | | | |

*Notes:*
- All elevations in metres above sea level.
- Blank indicates data not available.
- 2001 through 2011 water level evelvations calculated using 2012 survey data.
- (1) Data based on field measurements during 2012 well network survey.

# Table C-2: Groundwater Level Elevations
# Holbrook Landfill Site

| Well Number | Measuring Point Elevation | Ground Elevation | May-79 | Jun-79 | Oct-79 | Mar-80 | May-80 | Sep-80 | Feb-81 | Oct-81 | Oct-81 | Jan-82 | Jan-82 | Jan-82 | Feb-82 | Feb-82 | Apr-82 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26R | 272.91 | 272.03 | | | | | | | | | | | | | | | |
| 27 | 272.35 | 272.20 | | | | | | | | | | | | | | | |
| 28 | 278.52 | 277.65 | | | | | | | | | | | | | | | |
| 28R | 278.78 | 277.72 | | | | | | | | | | | | | | | |
| 30 | 280.63 | 279.10 | | | | | | | | | | | | | | | |
| 31 | 280.06 | 279.14 | | | | | | | | | | | | | | | |
| 32 | 280.26 | 280.08 | | | | | | | | | | | | | | | |
| 32R | 281.09 | 280.12 | | | | | | | | | | | | | | | |
| 33 | 280.78 | 280.23 | | | | | | | | | | | | | | | |
| 33R | 281.85 | 280.67 | | | | | | | | | | | | | | | |
| 35 | 279.03 | 278.11 | | | | | | | | | | | | | | | |
| 37 | 276.41 | 274.97 | | | | | | | | | | | | | | | |
| 37R | 276.24 | 275.15 | | | | | | | | | | | | | | | |
| 38 | 283.66 | 282.52 | | | | | | | | | | | | | | | |
| 39 | 278.94 | 278.03 | | | | | | | | | | | | | | | |
| 40 | 279.14 | 277.95 | | | | | | | | | | | | | | | |
| 41 | 287.63 | 286.53 | | | | | | | | | | | | | | | |
| 42 | 279.05 | 278.02 | | | | | | | | | | | | | | | |
| 43 | 281.66 | 280.62 | | | | | | | | | | | | | | | |
| 44 | 283.36 | 282.26 | | | | | | | | | | | | | | | |
| 45 | 274.56 | 273.56 | | | | | | | | | | | | | | | |
| 46 | 274.88 | 273.92 | | | | | | | | | | | | | | | |
| SP3 | 280.73 | 280.38 | | | | | | | | | | | | | | | |
| SP3R | 281.81 | 280.75 | | | | | | | | | | | | | | | |
| SP4 | 279.82 | 279.57 | | | | | | | | | | | | | | | |
| SP4R | 280.86 | 279.93 | | | | | | | | | | | | | | | |
| SP5 | 282.30 | 281.64 | | | | | | | | | | | | | | | |
| 104 | 281.91 (1) | 279.80 | | | | | | | | | | | | | | | |
| 301 | 279.31 | 278.12 | | | | | | | | | | | | | | | |
| SG1 | 273.41 | 272.49 | | | | | | | | | | | | | | | |

*Notes:* · All elevations in metres above sea level.
· Blank indicates data not available.
· 2001 through 2011 water level evelvations calculated using 2012 survey data.
· (1) Data based on field measurements during 2012 well network survey.

# Table C-2:  Groundwater Level Elevations
# Holbrook Landfill Site

| Well Number | Measuring Point Elevation | Ground Elevation | Jun-82 | Aug-82 | Mar-83 | Apr-83 | Jun-83 | Aug-83 | Dec-83 | Jun-01 | Jun-02 | Jun-03 | Jun-04 | Jun-05 | Jun-06 | May-07 | Jun-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 277.57 | 276.47 | 277.14 | 276.62 | 277.17 | 277.09 | 277.07 | 277.13 | 276.57 | 275.60 | 273.52 | 275.61 | 275.68 | 275.64 | 275.70 | 275.63 | 275.67 |
| 4 | 280.34 | 279.32 | 276.90 | 276.44 | 276.93 | 276.89 | 276.92 | 277.27 | 276.65 | 276.05 | 276.18 | 276.11 | 276.74 | 276.19 | 276.19 | 276.07 | 276.05 |
| 4R | 280.12 | 278.91 | | | | | | | | | | | | | | | |
| 5 | 280.12 | 279.15 | 278.07 | 277.48 | 278.21 | 278.20 | | 278.46 | | 278.90 | 278.94 | 278.96 | 278.92 | 278.90 | 278.86 | 278.77 | 278.90 |
| 5R | 280.46 | 279.26 | | | | | | | | | | | | | | | |
| 6 | 279.78 | 279.15 | 278.09 | 277.41 | 278.23 | 278.23 | 278.29 | 278.44 | 277.83 | 277.82 | 277.82 | 278.08 | 278.81 | 278.32 | 278.28 | 278.02 | 278.19 |
| 10 | 282.48 | 281.63 | 279.28 | 278.78 | 279.33 | 279.31 | 279.27 | 279.56 | 279.51 | 279.68 | 280.26 | 279.83 | 280.15 | 279.77 | 279.72 | 279.65 | 279.71 |
| 10R | 282.55 | 281.52 | | | | | | | | | | | | | | | |
| 11 | 281.99 | 280.79 | | 277.98 | 279.79 | 279.88 | | 277.54 | 279.83 | 280.23 | 280.51 | 280.32 | 280.20 | 280.11 | 280.48 | 279.70 | 280.30 |
| 11R | 284.11 | 283.02 | | | | | | | | | | | | | | | |
| 12 | 281.85 | 280.69 | 278.64 | 277.53 | | 278.57 | | 278.45 | | 278.63 | 278.75 | 278.57 | 279.17 | 278.91 | 278.83 | 278.75 | 278.84 |
| 13 | 274.89 | 274.08 | 273.37 | 272.80 | | 273.44 | | | | | | | | | | | |
| 13R | 275.26 | 274.16 | | | | | | | | | | | | | | | |
| 14 | 277.40 | 275.85 | 276.47 | 276.02 | | 276.50 | | 276.61 | | 275.42 | 275.45 | 275.41 | 275.67 | 275.42 | 275.40 | 275.36 | 275.32 |
| 14R | 276.65 | 275.69 | | | | | | | | | | | | | | | |
| 14A | 277.47 | 275.94 | | | | 275.18 | | 275.19 | | 275.47 | 275.47 | 275.56 | 275.35 | 275.23 | 275.69 | 275.96 | 275.32 |
| 15 | 279.30 | 278.29 | 276.60 | 276.17 | | 276.59 | | 276.73 | | 275.48 | 275.53 | 275.46 | 275.79 | 275.52 | 275.51 | 275.45 | 275.44 |
| 15A | 279.28 | 278.31 | 276.54 | 276.07 | 276.59 | 276.55 | 276.57 | 276.68 | 276.06 | 275.74 | 275.77 | 275.73 | 276.02 | 275.75 | 275.77 | 275.68 | 275.69 |
| 16 | 279.24 | 278.19 | 276.21 | 275.70 | 276.24 | 276.20 | 276.17 | 276.27 | 275.81 | 275.26 | 275.30 | 275.21 | 275.56 | 275.25 | 275.27 | 275.21 | 275.18 |
| 16R | 279.23 | 277.98 | | | | | | | | | | | | | | | |
| 16A | 279.50 | 278.19 | 276.37 | 275.81 | | 276.48 | | 276.48 | | 275.66 | 275.68 | 275.60 | 275.71 | 275.65 | 275.70 | 275.58 | 275.50 |
| 16AR | 279.29 | 278.14 | | | | | | | | | | | | | | | |
| 17 | 279.43 | 278.84 | 277.32 | 276.81 | | 277.37 | | 277.58 | | | | | | | | 276.54 | 276.56 |
| 18 | 281.31 | 279.78 | 277.44 | 276.93 | | 277.43 | | 277.42 | | 276.06 | 276.06 | 276.12 | 276.33 | 276.13 | 276.17 | 276.09 | 276.13 |
| 18R | 280.76 | 279.57 | | | | | | | | | | | | | | | |
| 19 | 276.05 | 274.95 | | 275.21 | | flowing | | flowing | | 274.92 | 274.94 | 274.90 | 275.13 | 274.88 | 274.99 | 274.85 | 275.05 |
| 19R | 276.11 | 274.89 | | | | | | | | | | | | | | | |
| 21 | 278.86 | 277.78 | 276.22 | 275.69 | 276.09 | 276.20 | 276.19 | 276.30 | 275.90 | 275.43 | 275.47 | 275.37 | 275.75 | 275.44 | 275.44 | 275.35 | 275.34 |
| 21R | 278.90 | 277.75 | | | | | | | | | | | | | | | |
| 23 | 280.15 | 278.94 | 276.24 | 275.71 | 276.24 | 276.20 | 276.20 | | 275.87 | 275.47 | 275.52 | 275.38 | 275.77 | 275.46 | 275.43 | 275.39 | 275.33 |
| 24 | 280.35 | 279.73 | 276.24 | 275.73 | 276.26 | 276.23 | 276.24 | 276.33 | 275.90 | 275.53 | 276.96 | 275.45 | 275.83 | 275.53 | 275.50 | 275.44 | 275.42 |
| 24R | 280.35 | 279.73 | | | | | | | | | | | | | | | |
| 24A | 280.84 | 279.72 | 278.90 | 278.52 | 278.98 | 278.93 | 278.81 | 279.13 | 279.17 | 279.30 | 279.56 | 279.33 | 279.61 | 279.26 | 278.88 | 279.14 | 279.24 |
| 24AR | 281.11 | 279.95 | | | | | | | | | | | | | | | |
| 25 | 280.84 | 280.42 | 276.23 | 275.71 | 276.22 | 279.19 | 276.12 | 276.28 | 275.85 | 275.41 | 275.49 | 275.38 | 275.76 | 275.46 | 275.45 | 275.38 | 275.35 |
| 25R | 281.83 | 280.72 | | | | | | | | | | | | | | | |
| 25A | 281.30 | 280.41 | 279.60 | 279.54 | | 279.66 | 279.53 | 279.70 | 279.76 | 280.03 | 280.08 | 280.13 | 280.14 | 280.10 | 280.14 | 280.07 | 280.16 |
| 26 | 272.21 | 272.07 | | | | flowing | 275.40 | 276.33 | 274.84 | flowing | flowing | flowing | flowing | flowing | flowing | flowing | flowing |

*Notes:* · All elevations in metres above sea level.
· Blank indicates data not available.
· 2001 through 2011 water level evelvations calculated using 2012 survey data.
· (1) Data based on field measurements during 2012 well network survey.

# Table C-2: Groundwater Level Elevations
## Holbrook Landfill Site

| Well Number | Measuring Point Elevation | Ground Elevation | Jun-82 | Aug-82 | Mar-83 | Apr-83 | Jun-83 | Aug-83 | Dec-83 | Jun-01 | Jun-02 | Jun-03 | Jun-04 | Jun-05 | Jun-06 | May-07 | Jun-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26R | 272.91 | 272.03 | | | | | | | | | | | | | | | |
| 27 | 272.35 | 272.20 | | | | flowing | 275.03 | 276.16 | 274.46 | flowing | flowing | flowing | flowing | flowing | flowing | flowing | flowing |
| 28 | 278.52 | 277.65 | | | 275.09 | 274.94 | 275.52 | 274.89 | 274.38 | 274.61 | 274.72 | 274.43 | 275.12 | 274.67 | 274.64 | 274.53 | 274.53 |
| 28R | 278.78 | 277.72 | | | | | | | | | | | | | | | |
| 30 | 280.63 | 279.10 | | | | 277.51 | 277.26 | 277.41 | 275.33 | 275.94 | 275.96 | 275.96 | 276.07 | 276.01 | 276.01 | 275.98 | 276.02 |
| 31 | 280.06 | 279.14 | | | | 276.25 | 276.24 | 276.34 | 275.95 | 275.45 | 275.48 | 275.38 | 275.76 | 275.46 | 275.48 | 275.42 | 275.41 |
| 32 | 280.26 | 280.08 | | | | 278.96 | 278.89 | 279.13 | 279.15 | 279.09 | 279.56 | 279.59 | 279.78 | 279.56 | 279.53 | 279.46 | 279.49 |
| 32R | 281.09 | 280.12 | | | | | | | | | | | | | | | |
| 33 | 280.78 | 280.23 | | | 276.56 | 276.54 | 276.59 | 276.55 | 276.45 | 276.03 | 276.03 | 275.96 | 276.40 | 276.04 | 276.51 | 275.97 | 275.95 |
| 33R | 281.85 | 280.67 | | | | | | | | | | | | | | | |
| 35 | 279.03 | 278.11 | | | | 276.00 | 276.63 | 276.72 | 276.07 | 275.45 | 275.49 | 275.43 | 275.76 | 275.48 | 275.49 | 275.42 | 275.41 |
| 37 | 276.41 | 274.97 | | | | 275.39 | 275.32 | 275.37 | 275.23 | 274.96 | 274.98 | 274.75 | 275.31 | 274.90 | 274.88 | 274.78 | 274.75 |
| 37R | 276.24 | 275.15 | | | | | | | | | | | | | | | |
| 38 | 283.66 | 282.52 | | | | 275.46 | 275.44 | 275.47 | 275.33 | 270.49 | 270.51 | 274.86 | 275.38 | 274.96 | 274.97 | 274.90 | 274.85 |
| 39 | 278.94 | 278.03 | | | | | | | | | | | | | | | |
| 40 | 279.14 | 277.95 | | | | | | | | | | | | | | | |
| 41 | 287.63 | 286.53 | | | | | | | | | | | | | | | |
| 42 | 279.05 | 278.02 | | | | | | | | | | | | | | | |
| 43 | 281.66 | 280.62 | | | | | | | | | | | | | | | |
| 44 | 283.36 | 282.26 | | | | | | | | | | | | | | | |
| 45 | 274.56 | 273.56 | | | | | | | | | | | | | | | |
| 46 | 274.88 | 273.92 | | | | | | | | | | | | | | | |
| SP3 | 280.73 | 280.38 | | | | | | | | 280.61 | 280.63 | 280.53 | 280.58 | 280.50 | 280.50 | 280.40 | 280.58 |
| SP3R | 281.81 | 280.75 | | | | | | | | | | | | | | | |
| SP4 | 279.82 | 279.57 | | | | | | | | 278.26 | 279.34 | 278.29 | 279.34 | 278.41 | 279.65 | 279.08 | 279.15 |
| SP4R | 280.86 | 279.93 | | | | | | | | | | | | | | | |
| SP5 | 282.30 | 281.64 | | | | | | | | dry | 278.51 | 279.98 | 280.24 | 279.85 | 279.85 | 279.95 | 279.77 |
| 104 | 281.91 (1) | 279.80 | | | 280.06 | 280.06 | 279.42 | 279.40 | | | | | | | | | |
| 301 | 279.31 | 278.12 | | | | 277.35 | 276.64 | 275.73 | | | | | | | | | |
| SG1 | 273.41 | 272.49 | | | | | | | | | | | | | | | |

*Notes:*
- · All elevations in metres above sea level.
- · Blank indicates data not available.
- · 2001 through 2011 water level evelvations calculated using 2012 survey data.
- · (1) Data based on field measurements during 2012 well network survey.

## Table C-2: Groundwater Level Elevations
## Holbrook Landfill Site

| Well Number | Measuring Point Elevation | Ground Elevation | Jun-09 | May-10 | Jun-11 | May-12 | May-13 | May-14 | May-15 | May-16 | May-17 | May-18 | May-19 | May-20 | May-21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 277.57 | 276.47 | 275.73 | 275.71 | 275.74 | 275.69 | 275.76 | 275.81 | (2) | | | | | | |
| 4 | 280.34 | 279.32 | 276.36 | 276.24 | 276.48 | 276.03 | 276.39 | 276.39 | (2) | | | | | | |
| 4R | 280.12 | 278.91 | | | | | | | 276.16 | 276.43 | 277.14 | 276.84 | 277.06 | 276.66 | 276.26 |
| 5 | 280.12 | 279.15 | 278.99 | 278.98 | 278.97 | 278.89 | 278.98 | 278.07 | (2) | | | | | | |
| 5R | 280.46 | 279.26 | | | | | | | 278.11 | 278.55 | 278.93 | 279.01 | 279.07 | 278.88 | 278.20 |
| 6 | 279.78 | 279.15 | 279.78 | 278.17 | 278.67 | 277.92 | 278.70 | 278.73 | (2) | | | | | | |
| 10 | 282.48 | 281.63 | 279.88 | 279.76 | 279.99 | 279.48 | 280.03 | 279.58 | 279.63 | (2) | | | | | |
| 10R | 282.55 | 281.52 | | | | | | | | 279.86 | 280.37 | 280.26 | 280.33 | 280.07 | 279.71 |
| 11 | 281.99 | 280.79 | 280.17 | 280.49 | 280.08 | 279.58 | 280.02 | 280.15 | 279.59 | (2) | | | | | |
| 11R | 284.11 | 283.02 | | | | | | | | 280.34 | 280.69 | 280.60 | 280.61 | 280.41 | 280.12 |
| 12 | 281.85 | 280.69 | 279.04 | 278.66 | 279.21 | 278.71 | 279.01 | 279.03 | 278.61 | (2) | | | | | |
| 13 | 274.89 | 274.08 | | 273.11 | 272.86 | 272.67 | 272.89 | 272.82 | (2) | | | | | | |
| 13R | 275.26 | 274.16 | | | | | | | 273.42 | 273.59 | 274.06 | 273.96 | 274.14 | 273.89 | 273.65 |
| 14 | 277.40 | 275.85 | 275.45 | 275.39 | 275.49 | 275.36 | 275.43 | 275.51 | (2) | | | | | | |
| 14R | 276.65 | 275.69 | | | | | | | 275.47 | 275.68 | 276.05 | 275.94 | 275.97 | 275.81 | 275.63 |
| 14A | 277.47 | 275.94 | 275.61 | 275.72 | 273.50 | 275.17 | 275.01 | 275.31 | (2) | | | | | | |
| 15 | 279.30 | 278.29 | 274.60 | 275.53 | 275.67 | 275.47 | 275.62 | 275.69 | (2) | | | | | | |
| 15A | 279.28 | 278.31 | 275.85 | 275.78 | 275.90 | 275.68 | 275.82 | 275.89 | 275.69 | 275.91 | 276.33 | 276.20 | 276.24 | 276.06 | 275.85 |
| 16 | 279.24 | 278.19 | 275.35 | 275.26 | 275.41 | 275.17 | 275.37 | 275.46 | (2) | | | | | | |
| 16R | 279.23 | 277.98 | | | | | | | 275.22 | 275.43 | 275.82 | 275.70 | 275.77 | 275.56 | 275.33 |
| 16A | 279.50 | 278.19 | 275.71 | 275.70 | 275.78 | 275.53 | 275.76 | 275.90 | (2) | | | | | | |
| 16AR | 279.29 | 278.14 | | | | | | | 275.64 | 275.89 | 276.26 | 276.15 | 276.23 | 276.03 | 275.80 |
| 17 | 279.43 | 278.84 | 276.90 | 276.73 | 277.01 | <277.07 | <277.63 | (2) | | | | | | | |
| 18 | 281.31 | 279.78 | 276.29 | 276.24 | 276.37 | 276.14 | 276.42 | 276.51 | (2) | | | | | | |
| 18R | 280.76 | 279.57 | | | | | | | 276.07 | 276.43 | 277.31 | 276.92 | 278.13 | 277.64 | 277.44 |
| 19 | 276.05 | 274.95 | 274.96 | 274.95 | 275.38 | 274.95 | 275.31 | 275.26 | (2) | | | | | | |
| 19R | 276.11 | 274.89 | | | | | | | 274.82 | 274.86 | 275.23 | 275.13 | 275.29 | 275.04 | 274.82 |
| 21 | 278.86 | 277.78 | 275.53 | 275.44 | 275.58 | 275.28 | 275.53 | 275.62 | 275.28 | (2) | | | | | |
| 21R | 278.90 | 277.75 | | | | | | | 275.33 | 275.55 | 275.94 | 275.81 | 275.92 | 275.69 | 275.43 |
| 23 | 280.15 | 278.94 | 275.55 | 275.45 | 275.64 | 275.33 | 275.57 | 275.63 | 275.33 | (2) | | | | | |
| 24 | 280.35 | 279.73 | 275.62 | 275.53 | 275.68 | 275.37 | 275.62 | 275.71 | 275.37 | (2) | | | | | |
| 24R | 280.35 | 279.73 | | | | | | | | 275.05 | 275.44 | 275.31 | 275.41 | 275.19 | 274.93 |
| 24A | 280.84 | 279.72 | 279.58 | 279.57 | 279.62 | 279.06 | 279.60 | 279.68 | 279.10 | (2) | | | | | |
| 24AR | 281.11 | 279.95 | | | | | | | | 279.35 | 279.81 | 279.79 | 279.77 | 279.64 | 279.39 |
| 25 | 280.84 | 280.42 | 275.64 | 275.45 | 275.60 | 275.31 | 275.54 | 275.37 | (2) | (2) | | | | | |
| 25R | 281.83 | 280.72 | | | | | | | | 275.63 | 276.02 | 275.90 | 275.97 | 275.85 | 275.53 |
| 25A | 281.30 | 280.41 | 280.16 | 280.20 | 280.18 | 280.09 | 280.17 | 280.03 | 280.07 | (2) | | | | | |
| 26 | 272.21 | 272.07 | flowing | flowing | flowing | flowing | 275.09 | 275.22 | 275.06 | (2) | | | | | |

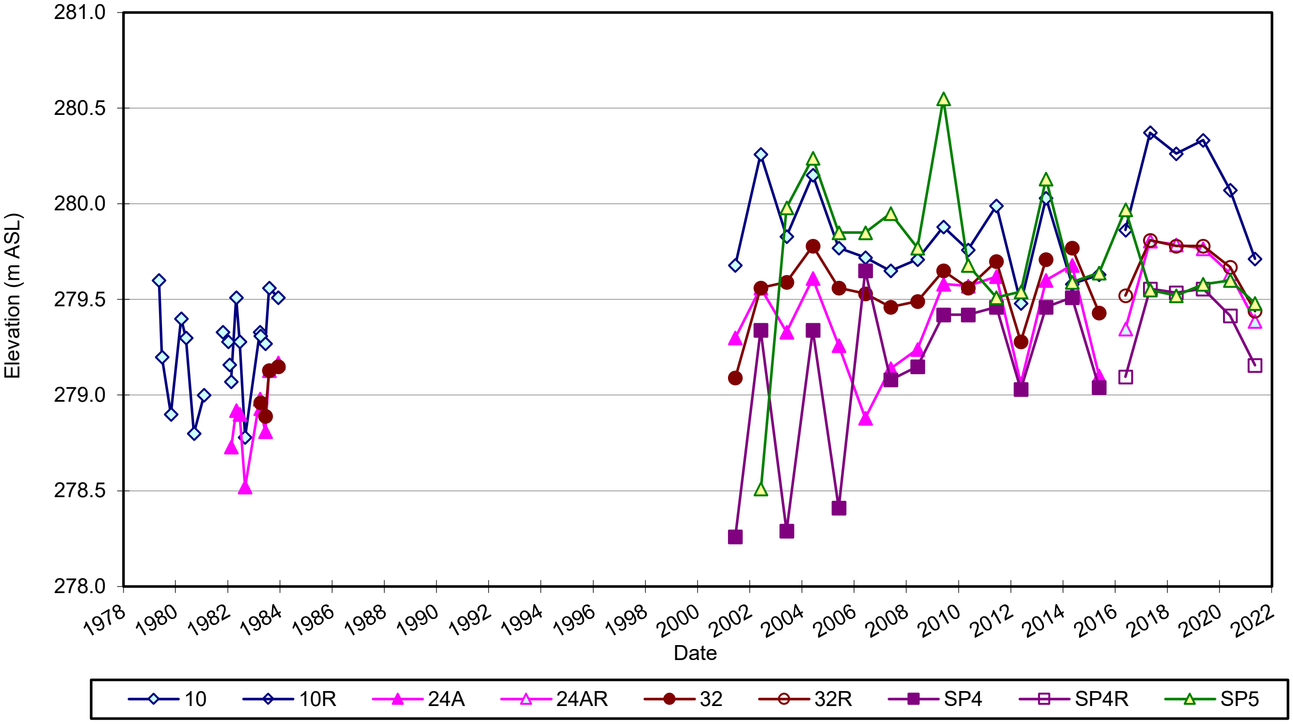
*Notes:*
- All elevations in metres above sea level.
- Blank indicates data not available.
- 2001 through 2011 water level evelvations calculated using 2012 survey data.
- (1) Data based on field measurements during 2012 well network survey.
- (2) Well decommissioned.

# Table C-2: Groundwater Level Elevations
## Holbrook Landfill Site

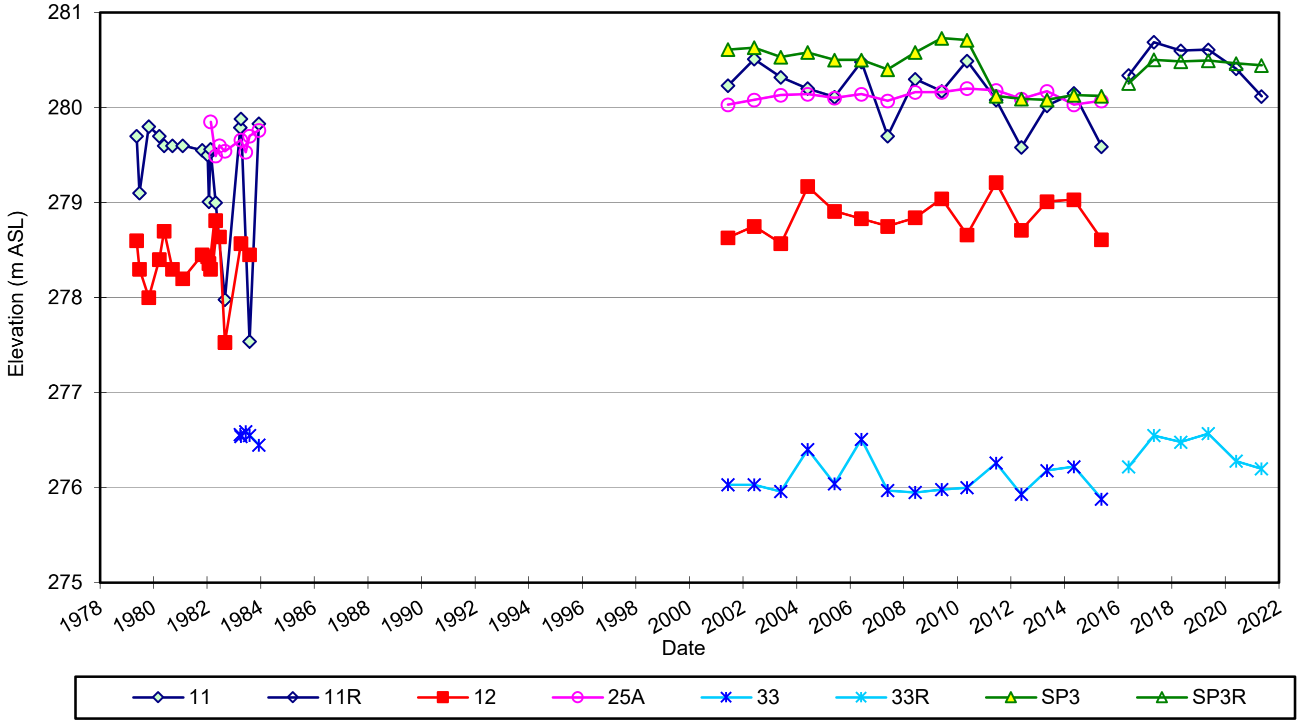
| Well Number | Measuring Point Elevation | Ground Elevation | Jun-09 | May-10 | Jun-11 | May-12 | May-13 | May-14 | May-15 | May-16 | May-17 | May-18 | May-19 | May-20 | May-21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26R | 272.91 | 272.03 | | | | | | | | 275.18 | 276.01 | 275.51 | 275.19 | 274.82 | 274.66 |
| 27 | 272.35 | 272.20 | flowing | flowing | flowing | flowing | 274.99 | 275.13 | 275.14 | 275.03 | 275.45 | 275.17 | 275.45 | 274.71 | 274.08 |
| 28 | 278.52 | 277.65 | 274.88 | 274.67 | 275.08 | 274.51 | 274.91 | 274.99 | 274.36 | (2) | | | | | |
| 28R | 278.78 | 277.72 | | | | | | | | 275.55 | 275.30 | 275.21 | 275.30 | 275.05 | 274.95 |
| 30 | 280.63 | 279.10 | 276.09 | 276.18 | 276.13 | 276.04 | 276.15 | 276.18 | (2) | | | | | | |
| 31 | 280.06 | 279.14 | 275.60 | 275.53 | 275.67 | 275.41 | 275.66 | 275.73 | 275.58 | 275.82 | 276.17 | 276.06 | 276.16 | 275.96 | 275.74 |
| 32 | 280.26 | 280.08 | 279.65 | 279.56 | 279.70 | 279.28 | 279.71 | 279.77 | 279.43 | (2) | | | | | |
| 32R | 281.09 | 280.12 | | | | | | | | 279.52 | 279.81 | 279.78 | 279.78 | 279.67 | 279.44 |
| 33 | 280.78 | 280.23 | 275.98 | 276.00 | 276.26 | 275.93 | 276.18 | 276.22 | 275.88 | (2) | | | | | |
| 33R | 281.85 | 280.67 | | | | | | | | 276.22 | 276.55 | 276.48 | 276.57 | 276.28 | 276.20 |
| 35 | 279.03 | 278.11 | 275.57 | 275.50 | 275.63 | 275.44 | 275.59 | 275.66 | 275.55 | 275.76 | 276.16 | 276.03 | 276.09 | 275.90 | 275.70 |
| 37 | 276.41 | 274.97 | 275.01 | 274.97 | 275.01 | 274.55 | 274.95 | 275.07 | 275.22 | (2) | | | | | |
| 37R | 276.24 | 275.15 | | | | | | | | 274.99 | 275.40 | 275.19 | 275.38 | 275.15 | 275.04 |
| 38 | 283.66 | 282.52 | 275.12 | 274.99 | 275.10 | 274.65 | 275.05 | 275.50 | 274.82 | 275.04 | 275.46 | 275.26 | 275.43 | 275.23 | 275.16 |
| 39 | 278.94 | 278.03 | | | | | | 278.02 | 277.43 | 277.67 | 278.47 | 278.18 | 278.44 | 277.94 | 277.51 |
| 40 | 279.14 | 277.95 | | | | | | 277.65 | 277.36 | 277.65 | 278.44 | 278.11 | 278.36 | 278.16 | 277.44 |
| 41 | 287.63 | 286.53 | | | | | | 283.29 | 282.58 | 283.33 | 283.68 | 283.73 | 283.65 | 283.45 | 283.38 |
| 42 | 279.05 | 278.02 | | | | | | | | 277.64 | 278.20 | 278.00 | 278.17 | 277.78 | 277.45 |
| 43 | 281.66 | 280.62 | | | | | | | | 275.09 | 275.47 | 275.38 | 275.52 | 275.31 | 275.26 |
| 44 | 283.36 | 282.26 | | | | | | | | 276.68 | 276.90 | 276.92 | 277.21 | 276.42 | 276.37 |
| 45 | 274.56 | 273.56 | | | | | | | | | | | | 274.66 | 274.29 |
| 46 | 274.88 | 273.92 | | | | | | | | | | | | 274.52 | 274.18 |
| SP3 | 280.73 | 280.38 | 280.73 | 280.71 | 280.12 | 280.09 | 280.08 | 280.13 | 280.12 | (2) | | | | | |
| SP3R | 281.81 | 280.75 | | | | | | | | 280.25 | 280.50 | 280.48 | 280.49 | 280.46 | 280.44 |
| SP4 | 279.82 | 279.57 | 279.42 | 279.42 | 279.46 | 279.03 | 279.46 | 279.51 | 279.04 | (2) | | | | | |
| SP4R | 280.86 | 279.93 | | | | | | | | 279.10 | 279.56 | 279.54 | 279.56 | 279.42 | 279.16 |
| SP5 | 282.30 | 281.64 | 280.55 | 279.68 | 279.51 | 279.54 | 280.13 | 279.59 | 279.64 | 279.97 | 279.55 | 279.52 | 279.58 | 279.60 | 279.48 |
| 104 | 281.91 (1) | 279.80 | | | | | | | (2) | | | | | | |
| 301 | 279.31 | 278.12 | | | | 275.83 | | | (2) | | | | | | |
| SG1 | 273.41 | 272.49 | | | | | | | 272.67 | 272.61 | 272.67 | 272.63 | 272.64 | 272.61 | 272.62 |

*Notes:* · All elevations in metres above sea level.
· Blank indicates data not available.
· 2001 through 2011 water level evelvations calculated using 2012 survey data.
· (1) Data based on field measurements during 2012 well network survey.
· (2) Well decommissioned.

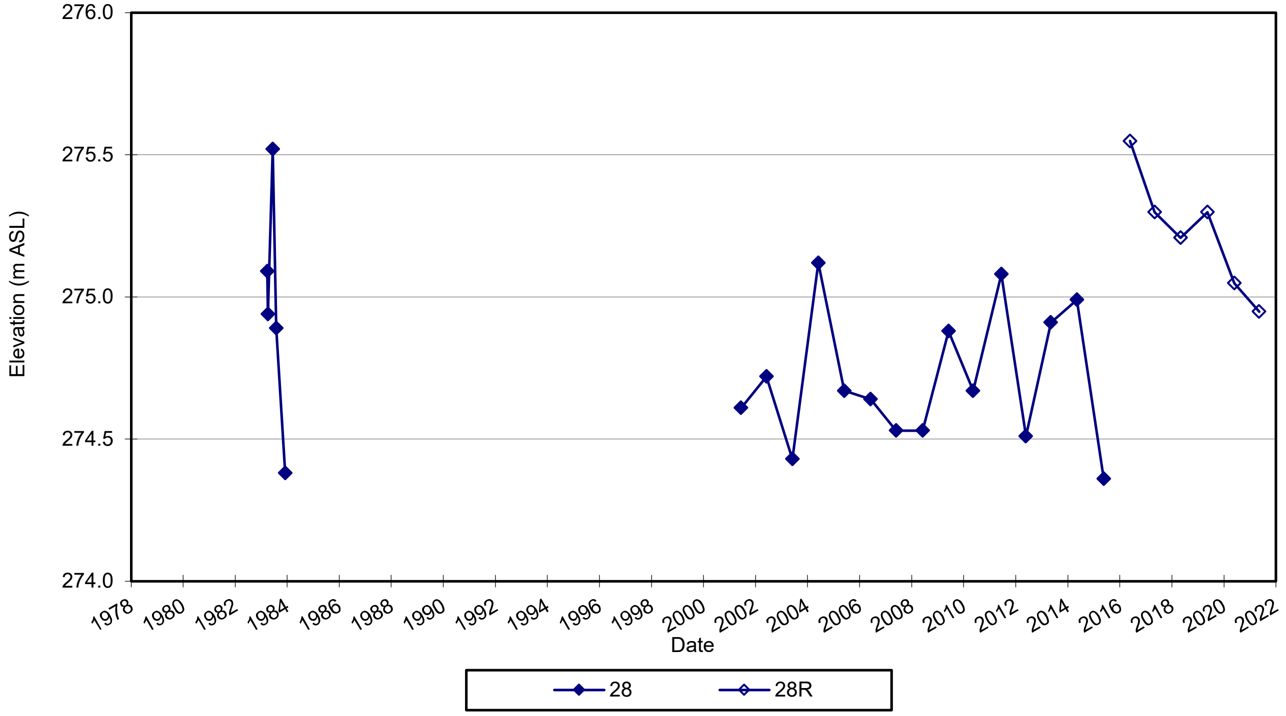
## Figure C-1
## Groundwater Hydrograph - Adjacent Northeast
## Holbrook Landfill Site - Shallow Aquifer



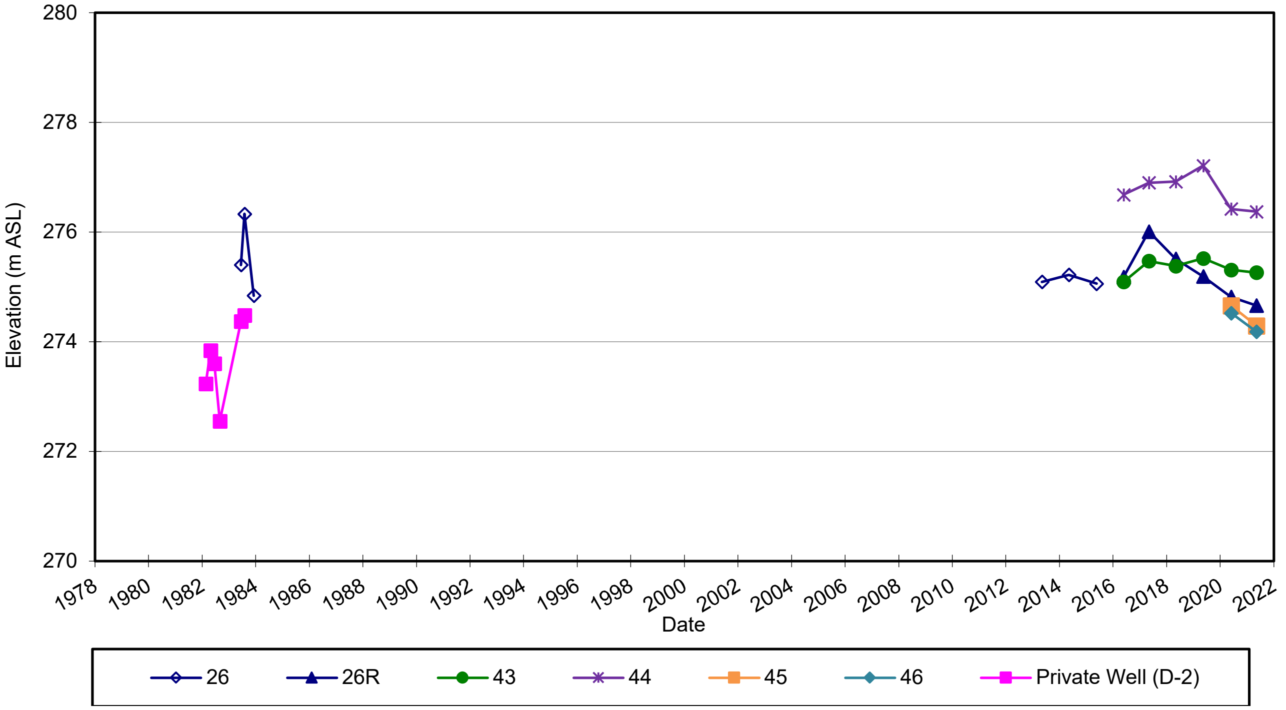
## Figure C-2
## Groundwater Hydrograph - Adjacent East
## Holbrook Landfill Site - Shallow Aquifer



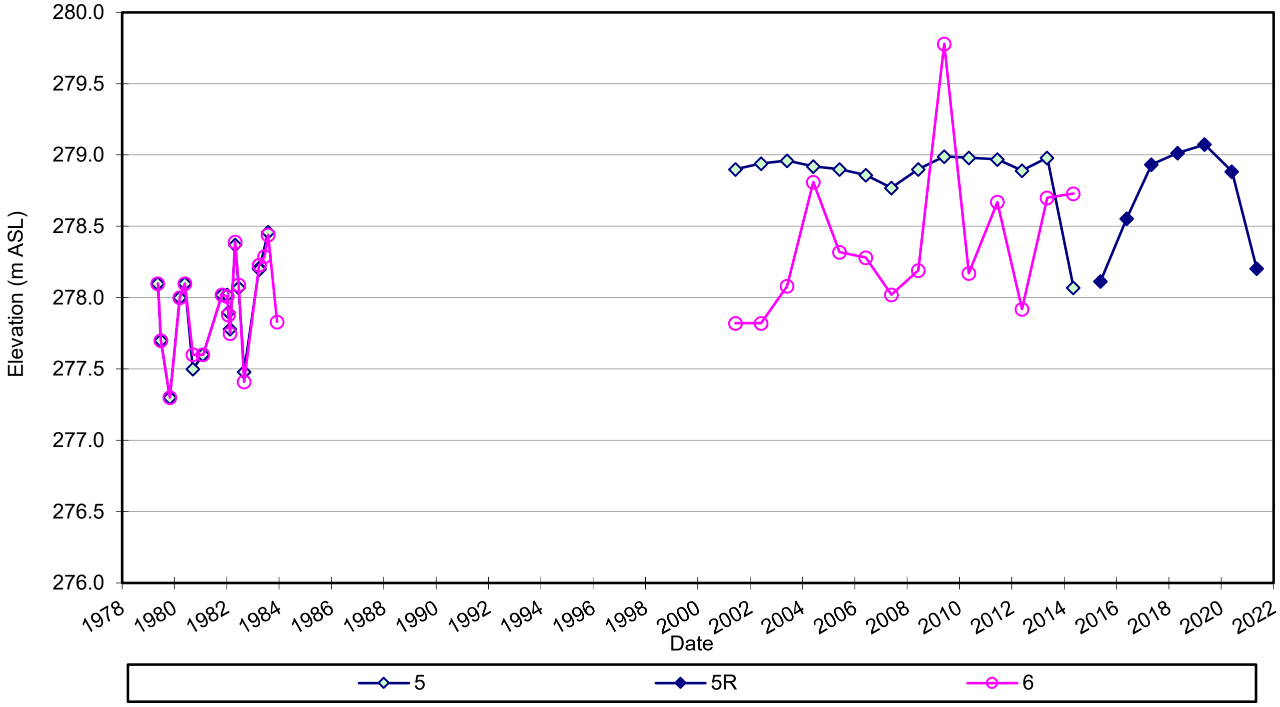
## Figure C-3
## Groundwater Hydrograph - Adjacent Southeast
## Holbrook Landfill Site - Shallow Aquifer



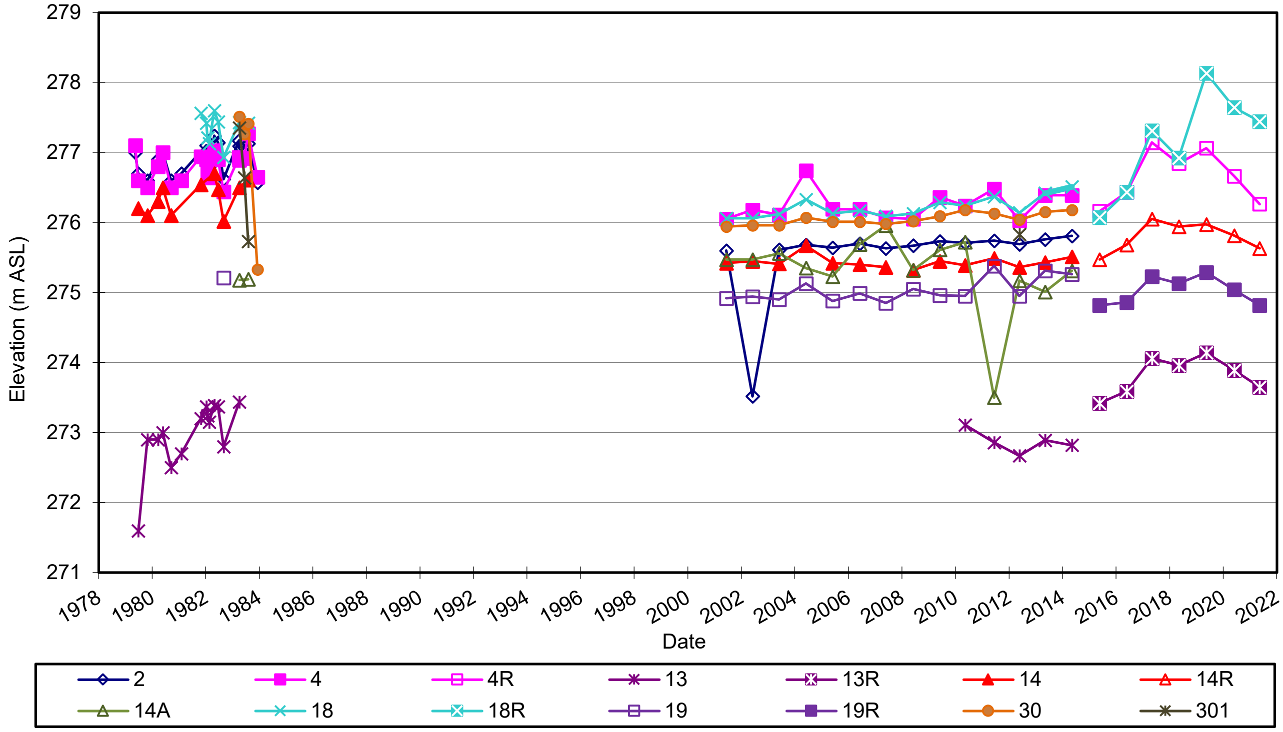
## Figure C-4
## Groundwater Hydrograph - Downgradient South & Cross-Gradient Southeast
## Holbrook Landfill Site - Shallow Aquifer



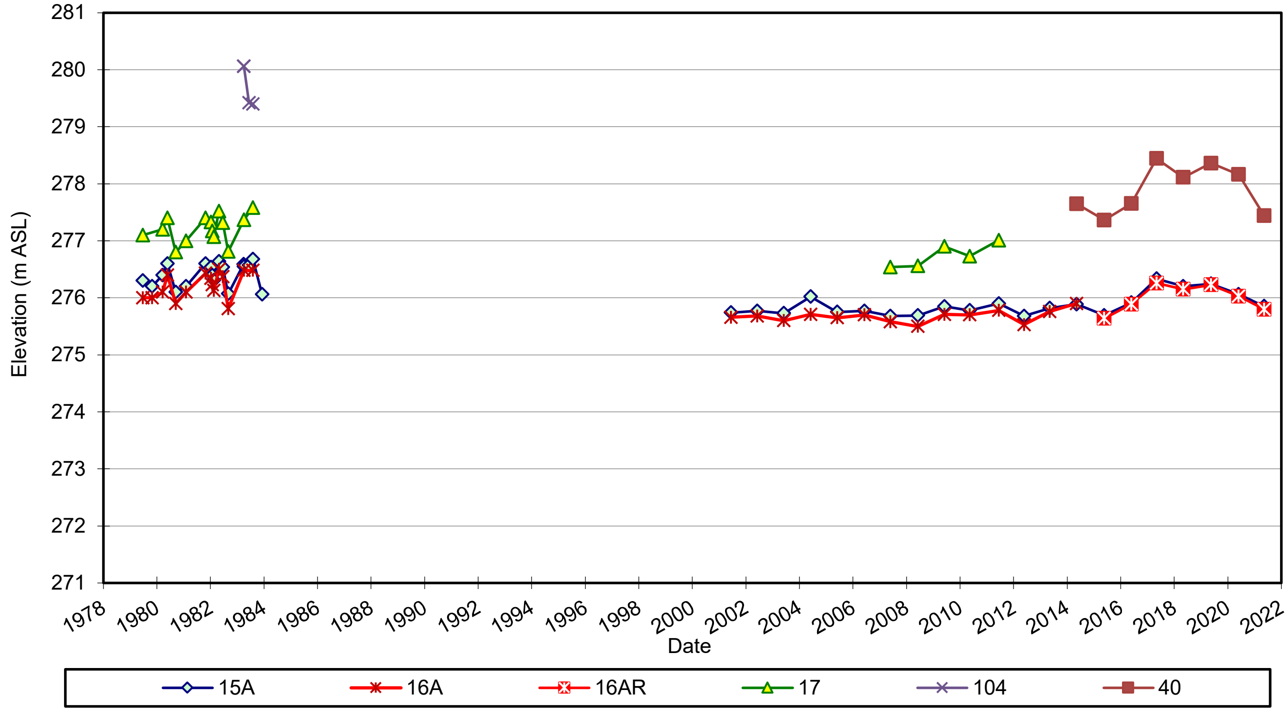
## Figure C-5
## Groundwater Hydrograph - Adjacent Northwest
## Holbrook Landfill Site - Shallow Aquifer



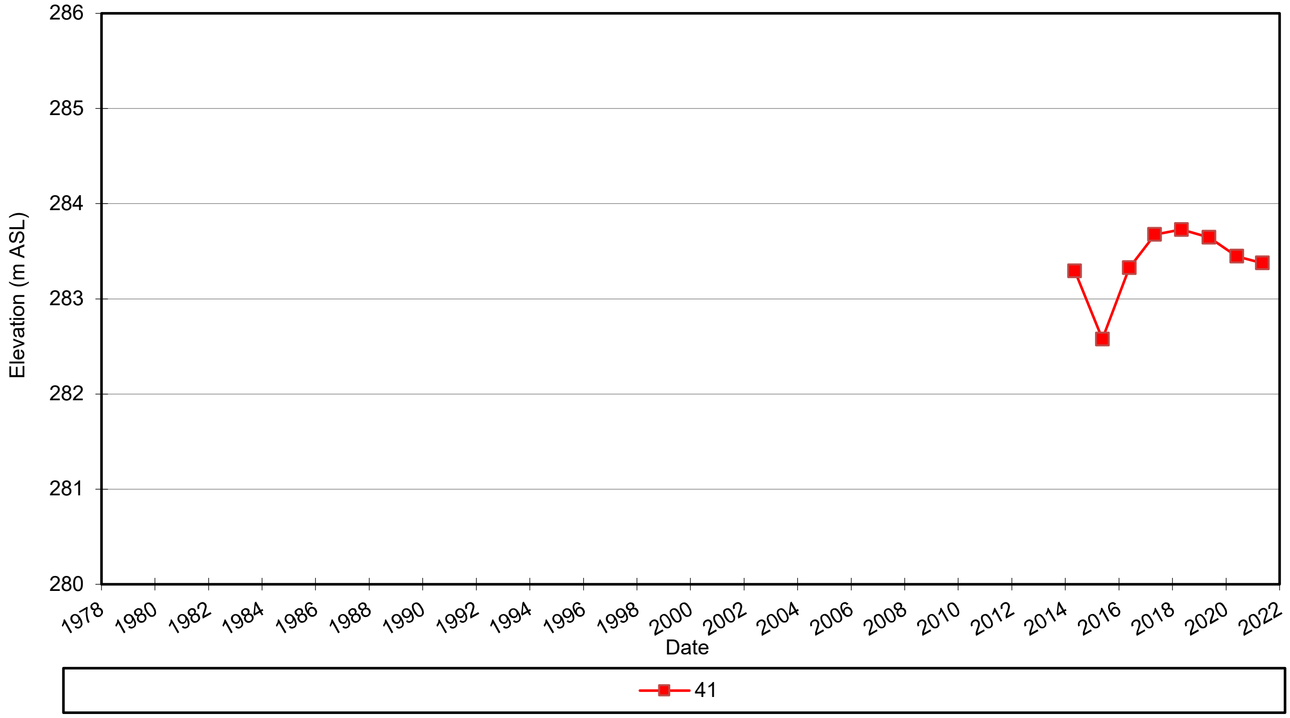
## Figure C-6
## Groundwater Hydrograph - Downgradient West
## Holbrook Landfill Site - Shallow Aquifer



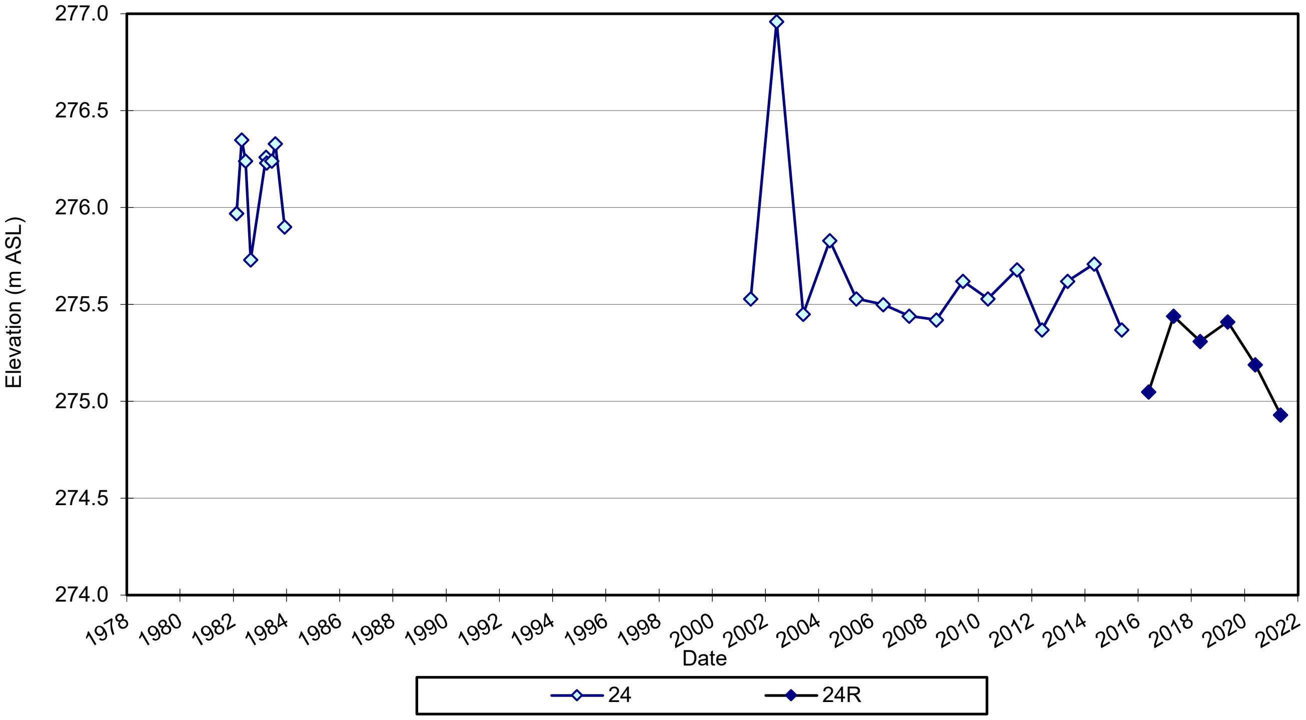
## Figure C-7
## Groundwater Hydrograph - Cross-Gradient/Upgradient West
## Holbrook Landfill Site - Shallow Aquifer



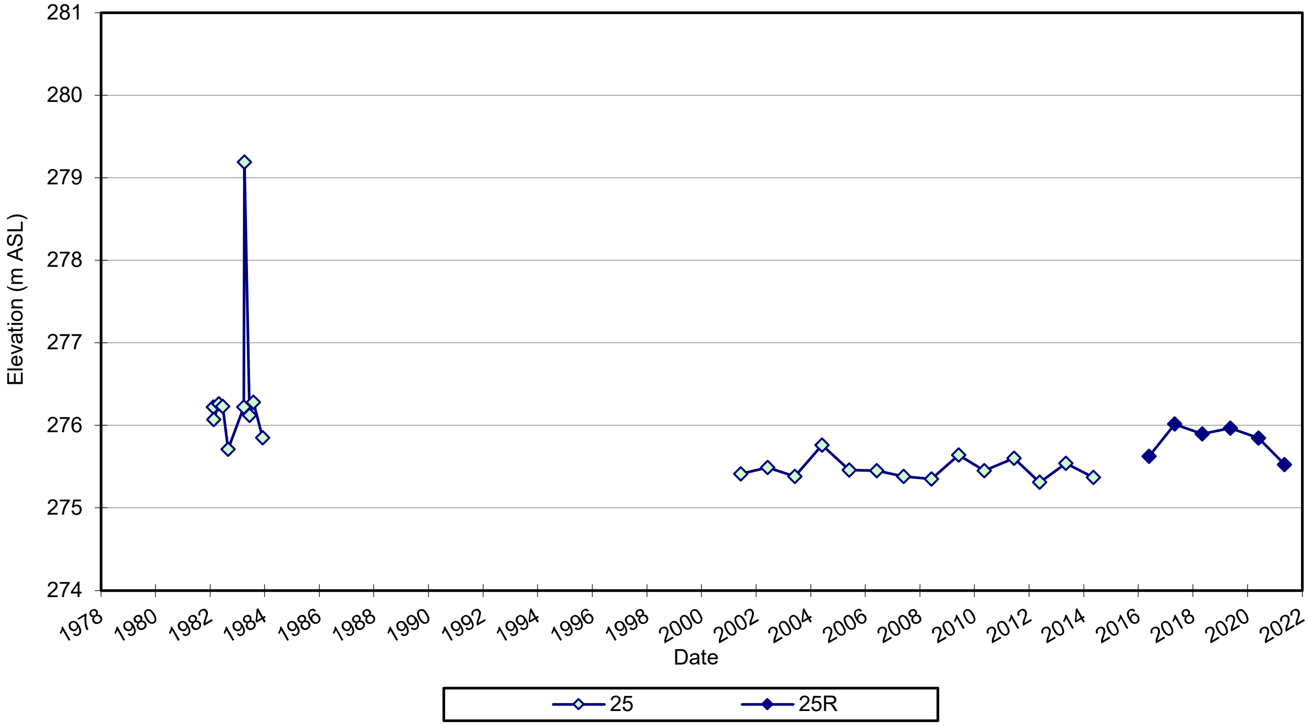
## Figure C-8
## Groundwater Hydrograph - Landfill Mound
## Holbrook Landfill Site - Refuse



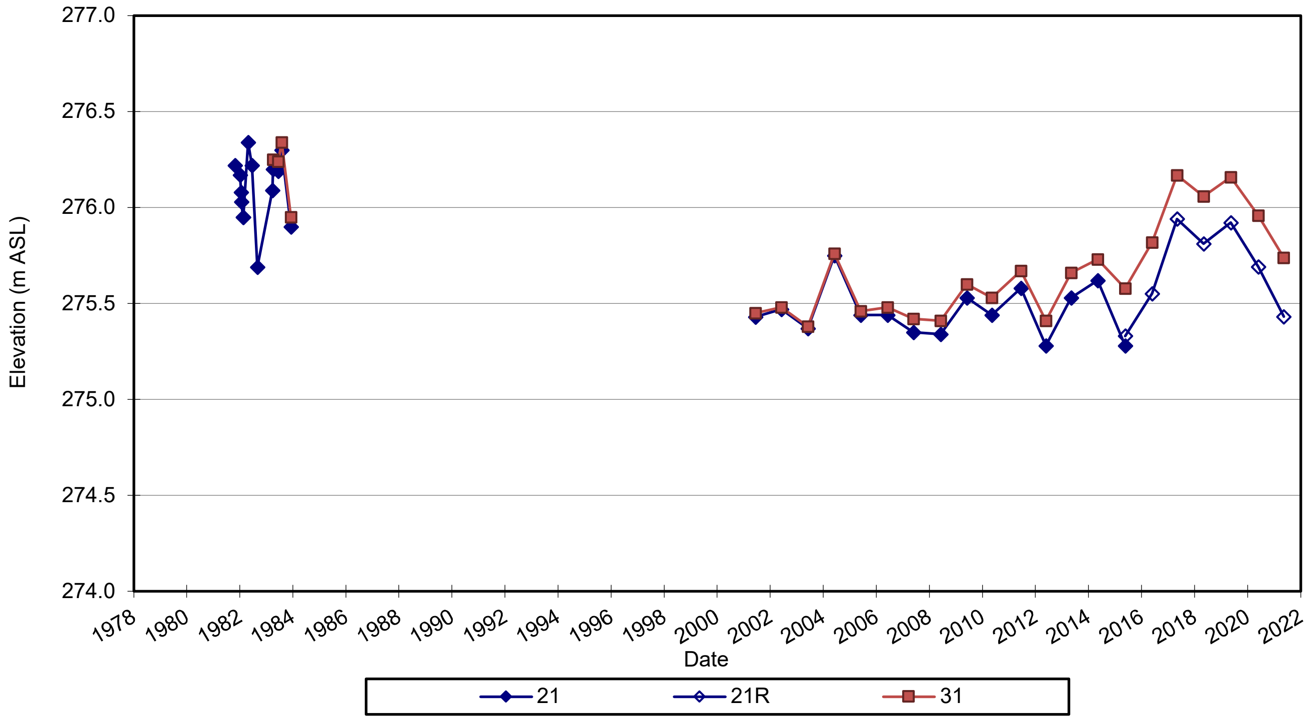
## Figure C-9
## Groundwater Hydrograph - Adjacent Northeast
## Holbrook Landfill Site - Deep Aquifer



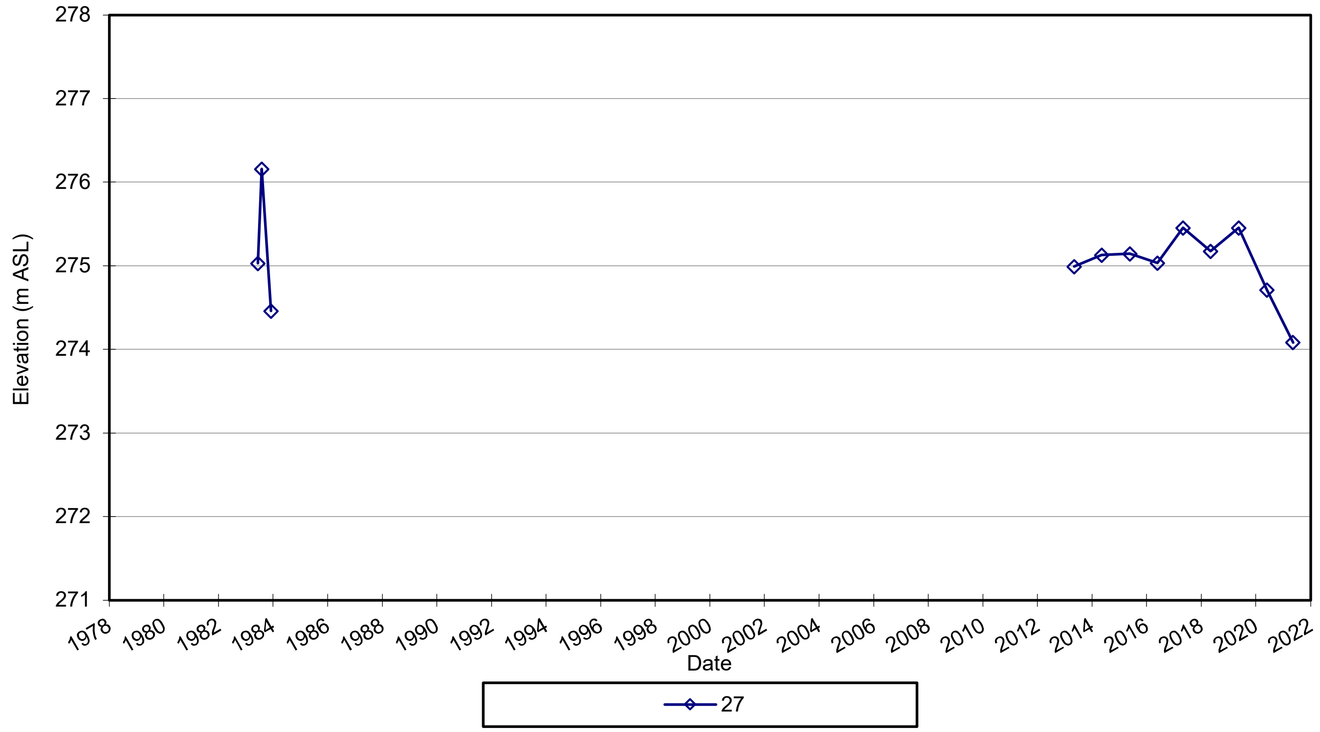
## Figure C-10
## Groundwater Hydrograph - Adjacent East
## Holbrook Landfill Site - Deep Aquifer



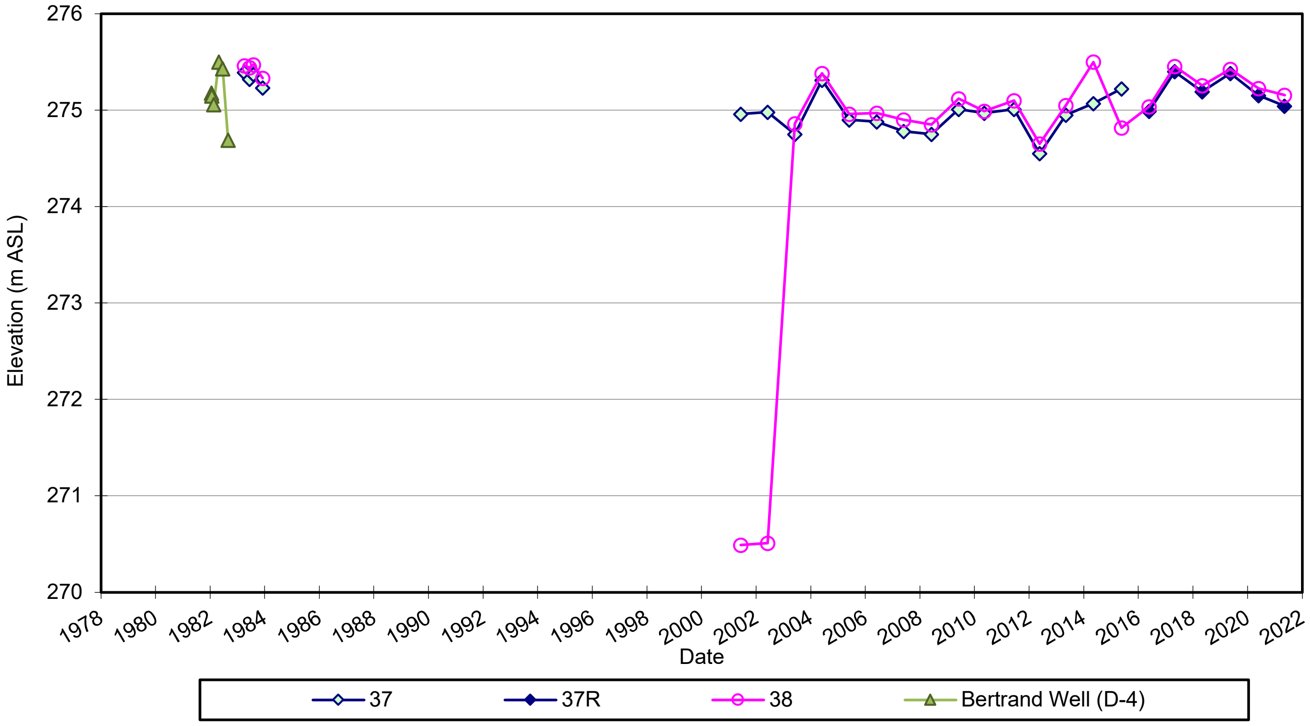
## Figure C-11
## Groundwater Hydrograph - Adjacent West
## Holbrook Landfill Site - Deep Aquifer



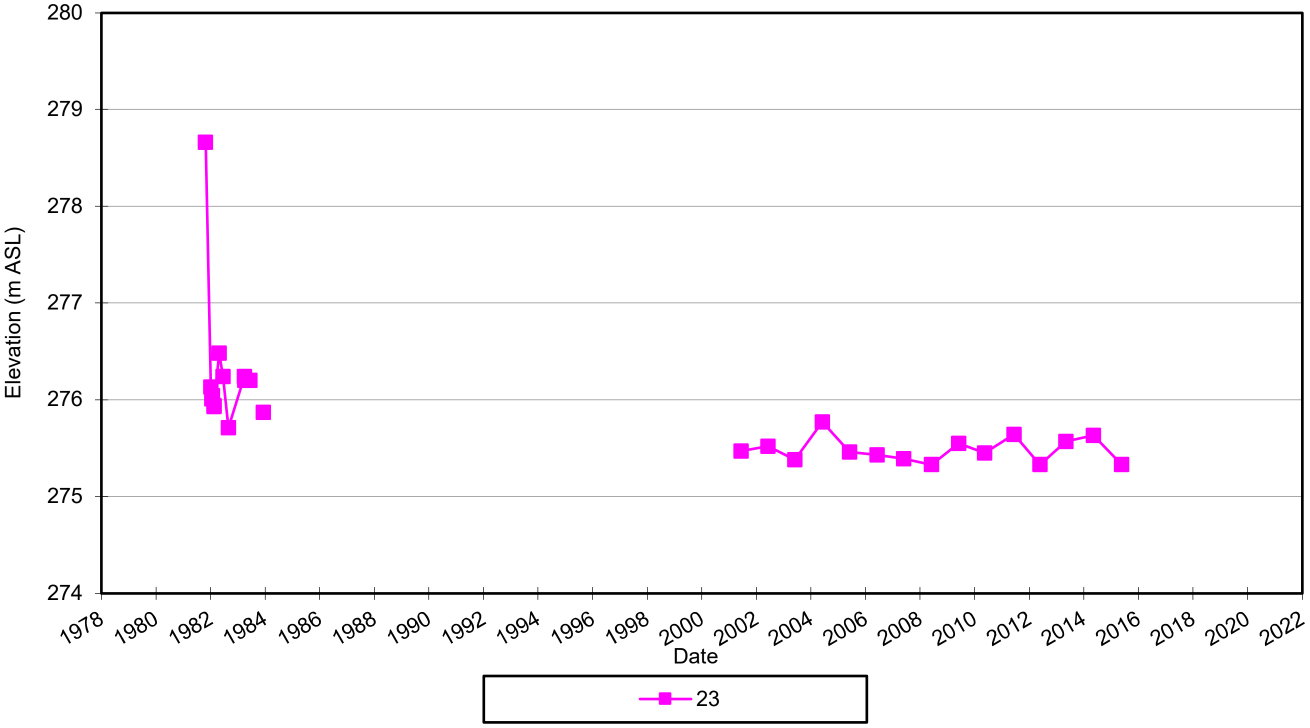
## Figure C-12
## Groundwater Hydrograph - Downgradient South
## Holbrook Landfill Site - Deep Aquifer



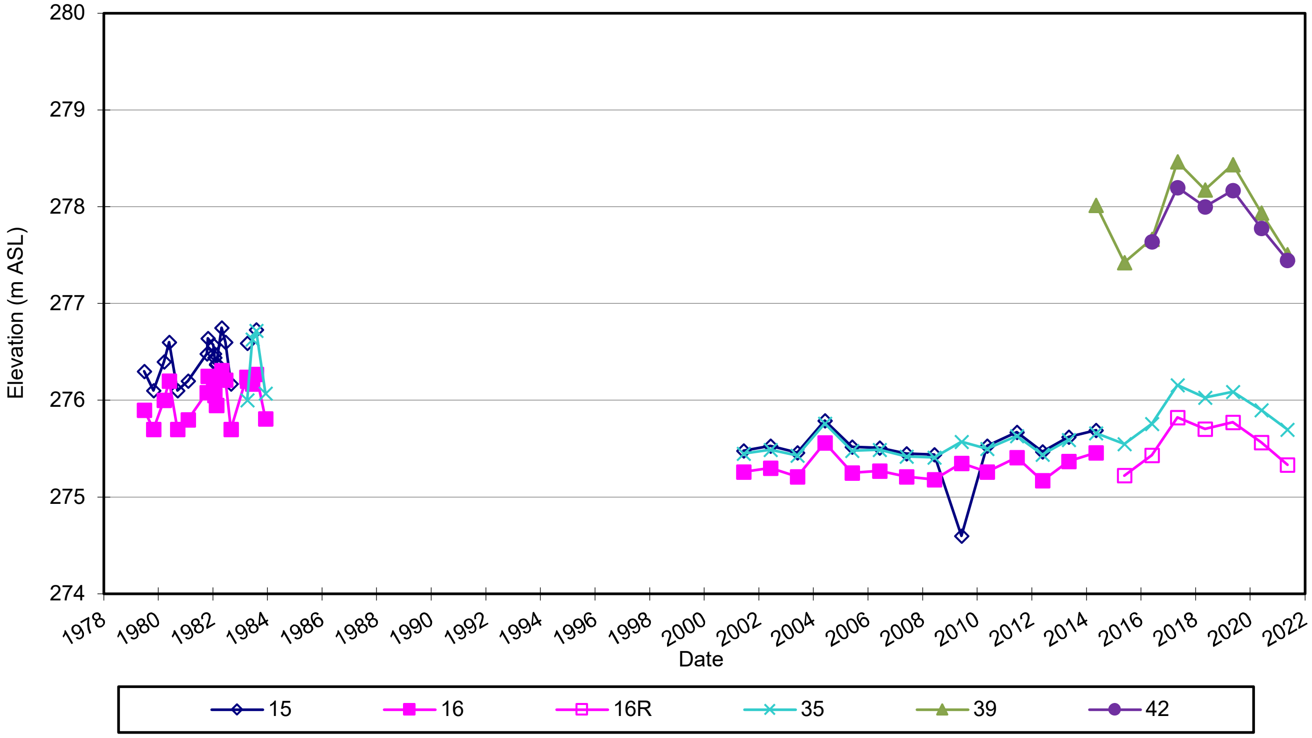
## Figure C-13
## Groundwater Hydrograph - Downgradient Southeast
## Holbrook Landfill Site - Deep Aquifer



## Figure C-14
## Groundwater Hydrograph - Adjacent Northwest
## Holbrook Landfill Site - Deep Aquifer



# Figure C-15
# Groundwater Hydrograph - Cross-Gradient West
# Holbrook Landfill Site - Deep Aquifer



# APPENDIX

# D

## GROUNDWATER CHEMISTRY

| ***Notation*** | ***Description*** | | |
|---|---|---|---|
| | all units in mg/L unless otherwise noted | EC | Electrical Conductivity |
| mg/L | milligrams per Litre | TKN | Total Kjeldahl Nitrogen |
| µg/L | micrograms per Litre | DOC | Dissolved Organic Carbon |
| SU | Scientific Units | T | Temperature |
| µS/cm | microSiemens per centimetre | | |
| ºC | degrees Celsius | | |
| **ODWQS** | Ontario Drinking Water Quality Standards (June 2003) | | |
| *MAC* | Maximum Acceptable Concentration | | |
| *IMAC* | Interim Maximum Acceptable Concentration | | |
| *AO* | Aesthetic objective | | |
| *OG* | Operational Guideline | | |
| *nc* | no OWDWS criteria | | |
| em | equipment malfunction - field parameter data not available | | |
| DRY | sampling location dry at the time of sampling | | |
| - or blank | parameter not analysed during sampling event | | |
| < value | parameter not detected above associated laboratory reported detection limit | | |
| * | estimated / anomalous value - result interpreted with caution or considered questionable | | |

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **11** | 16-May-79 | | | | 7.9 | 290 | | 5.0 | | 105 | | | | | | | | | |
| | 27-Jun-79 | | | | 7.9 | 310 | 168 | 3.9 | | 150 | | | | | | | | | 7.8 |
| | 30-Oct-79 | | | | 7.6 | 670 | 348 | 9.5 | | | 79.5 | 36.2 | | | | | | | |
| | 20-Mar-80 | | | | 7.7 | 630 | 335 | 13.5 | | | 77.5 | 34.4 | | | | | | | |
| | 27-May-80 | | | | 8.2 | 432 | 225 | 10.0 | | | 52.5 | 22.8 | | | | | | | |
| | 18-Sep-80 | | | | 7.5 | 630 | 334 | 11.5 | | | 76.0 | 35.0 | | | | | | | |
| | 6-Feb-81 | | | | 7.7 | 690 | 367 | 17.5 | | | 83.0 | 38.8 | | | | | | | |
| | 28-Jan-82 | | | | 7.7 | 600 | 396 | 12.0 | | 260 | | | | | | | | | 2.3 |
| | 29-Apr-82 | | | | 7.5 | 620 | 396 | 14.0 | | | | | | | | | | | 1.7 |
| | 2-Sep-82 | | | | 7.8 | 640 | 340 | 13.5 | | | 80.5 | 33.6 | | | | | | | 2.9 |
| | 30-Mar-83 | | | | 7.3 | 610 | 390 | 19.0 | | | | | | | | | | | 2.1 |
| | 13-Jun-83 | | | | 7.3 | 390 | 456 | 26.0 | | | | | | | | | | | 1.7 |
| | 14-Sep-83 | | | | 7.3 | 700 | 424 | 24.0 | | | | | | | | | | | 1.4 |
| | 7-Dec-83 | | | | 7.7 | 730 | 570 | 25.0 | | | | | | | | | | | 2.1 |
| | 1-May-84 | | | | 7.2 | 920 | 504 | 33.0 | | | | | | | | | | | 1.5 |
| | 6-Nov-84 | | | | 6.9 | 1040 | 615 | 27.0 | | 308 | 139 | 65.0 | | | | | | | 1.1 |
| | 30-Apr-85 | | | | 7.31 | 875 | 445 | 27.5 | | 284 | 105 | 44.4 | | | | | | | 3.0 |
| | 21-Oct-85 | | | | 7.58 | 1020 | 519 | 27.0 | | 156 | 125 | 50.0 | | | | | | | 2.5 |
| | 30-Apr-86 | | | | 7.23 | 434 | 270 | 14.5 | | 208 | 67.5 | 24.6 | | | | | | | 4.6 |
| | 14-Oct-86 | | | | 7.31 | 805 | 420 | 18.0 | | 324 | 102.0 | 40.0 | | | | | | | 2.8 |
| | 20-Apr-87 | | | | 7.33 | 845 | 452 | 20.5 | | | 110 | 43.0 | | | | | | | 3.2 |
| | 6-Oct-87 | | | | 7.43 | 750 | 373 | 17.8 | | 349 | 92.9 | 34.2 | | | | | | | 3.7 |
| | 10-May-88 | | | | 7.29 | 1040 | 591 | 24.8 | | 355 | 148 | 53.7 | | | | | | | 3.1 |
| | 12-Oct-88 | | | | 7.20 | 1040 | 671 | 29.0 | | 556 | 163 | 64.0 | | | | | | | 9.0 |
| | 23-Jan-89 | | | | 7.07 | 1296 | 669 | 35.3 | | 473 | 162 | 63.6 | | | | | | | |
| | 30-Oct-89 | | | | 7.21 | 1320 | 712 | 29.0 | | 546 | 176 | 66.0 | | | | | | | 2.4 |
| | 7-May-90 | | | | 7.46 | 1011 | 556 | 21.6 | | 442 | 139 | 50.0 | | | | | | | |
| | 29-Oct-90 | | | | 7.76 | 1030 | 542 | 19.5 | | 503 | 140 | 46.6 | | | | | | | 4.6 |
| | 6-May-91 | | | | 7.44 | 949 | 488 | 20.6 | | 462 | 122 | 44.4 | | | | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **11** | 16-May-79 | | | | | | | |
| | 27-Jun-79 | | | 0.04 | | | | |
| | 30-Oct-79 | | | 0.62 | | | | |
| | 20-Mar-80 | | | 0.89 | | | | |
| | 27-May-80 | | | 0.15 | | | | |
| | 18-Sep-80 | | | 0.03 | | | | |
| | 6-Feb-81 | | | 0.01 | | | | |
| | 28-Jan-82 | | | 0.02 | | | | |
| | 29-Apr-82 | | | | | | | |
| | 2-Sep-82 | | | | | | | |
| | 30-Mar-83 | | | | | | | |
| | 13-Jun-83 | | | | | | | |
| | 14-Sep-83 | | | | | | | |
| | 7-Dec-83 | | | | | | | |
| | 1-May-84 | | | | | | | |
| | 6-Nov-84 | | | 0.18 | | | | |
| | 30-Apr-85 | | | 0.80 | | | | |
| | 21-Oct-85 | | | 0.80 | | | | |
| | 30-Apr-86 | | | 0.64 | | | | |
| | 14-Oct-86 | | | 0.66 | | | | |
| | 20-Apr-87 | | | 0.01 | | | | |
| | 6-Oct-87 | | | 0.20 | | | | |
| | 10-May-88 | | | 0.94 | | | | |
| | 12-Oct-88 | | | 0.06 | | | | |
| | 23-Jan-89 | | | 0.41 | | | | |
| | 30-Oct-89 | | | 0.96 | | | | |
| | 7-May-90 | | | 0.65 | | | | |
| | 29-Oct-90 | | | 0.09 | | | | |
| | 6-May-91 | | | 0.19 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters |  |  | General Parameters |  |  | Major and Minor Ions |  |  |  |  |  |  | Nutrients and Organic Indicators |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
|  | Units | SU | µS/cm | ºC | SU | µS/cm |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **11** | 26-May-92 |  |  |  | 7.36 | 843 | 454 | 17.3 |  | 376 | 118 | 38.5 |  |  |  |  |  |  | 4.1 |
| **cont'd** | 6-Oct-92 |  |  |  | 7.55 | 745 | 398 | 15.0 |  | 332 | 104 | 33.7 |  |  |  |  |  |  | 5.0 |
|  | 3-May-93 |  |  |  | 7.26 | 897 | 438 | 12.0 |  | 465 | 107 | 41.1 |  |  |  |  |  |  | 3.3 |
|  | 26-Oct-93 |  |  |  | 7.26 | 991 | 502 | 14.4 |  | 487 | 128 | 44.0 |  |  |  |  |  |  | 4.2 |
|  | 25-Apr-94 |  |  |  | 7.70 | 877 | 474 | 11.6 |  | 432 | 123 | 39.8 |  |  |  |  |  |  | 3.6 |
|  | 25-Oct-94 |  |  |  | 7.38 | 782 | 416 | 11.0 |  | 359 | 112 | 32.7 |  |  |  |  |  |  | 3.7 |
|  | 16-May-95 |  |  |  | 7.37 | 820 | 440 | 9.9 |  | 355 | 114 | 37.5 |  |  |  |  |  |  | 3.8 |
|  | 15-Jun-97 |  |  |  | 7.60 | 714 | 415 | 7.6 |  | 386 | 112 | 32.9 | 2.40 | 7.8 |  |  |  |  |  |
|  | 15-Jun-98 |  |  |  | 7.36 | 760 | 487 | 8.0 |  | 210 | 137 | 35.1 | 3.14 | 7.87 |  |  |  |  |  |
|  | 15-Jun-99 |  |  |  | 7.27 | 885 | 527 | 13.0 |  | 308 | 154 | 34.7 | 3.27 | 9.35 |  |  |  |  |  |
|  | 15-Jun-00 |  |  |  | 7.86 | 930 | 537 | 8.0 |  | 440 | 153 | 37.7 | 1.38 | 14.9 |  |  |  |  |  |
|  | 15-Jun-01 |  |  |  | 7.32 | 993 | 547 | 10.0 |  | 565 | 160 | 35.7 | 0.75 | 17.5 |  |  |  |  |  |
|  | 15-Jun-02 |  |  |  | 7.12 | 844 | 427 | 10.0 |  | 438 | 124 | 28.4 | 2.06 | 7.16 |  |  |  |  |  |
|  | 15-Jun-03 |  |  |  | 7.34 | 868 | 509 | 15.0 |  | 450 | 147 | 34.5 | 1.40 | 11.2 |  |  |  |  |  |
|  | 15-Jun-04 |  |  |  | 7.65 | 927 | 448 | 9.0 |  | 491 | 125 | 33.1 | 1.28 | 19.8 |  |  |  |  |  |
|  | 15-Jun-05 |  |  |  | 8.05 | 796 | 575 | 9.9 |  | 517 | 160 | 40.2 | 2.5 | 9.5 |  |  |  |  |  |
|  | 15-Jun-06 |  |  |  | 7.24 | 854 | 510 | 9.0 |  | 450 | 148 | 33.8 | 2.0 | 7.3 |  |  |  |  |  |
|  | 29-May-07 |  |  |  | 6.88 | 933 | 390 | 6.0 |  | 530 | 118 | 22.9 | 3.0 | 6.3 |  |  |  |  |  |
|  | 5-Jun-08 |  |  |  | 7.45 | 973 | 120 | 8.0 |  | 450 | 36.4 | 6.5 | 2.0 | 3.9 |  |  |  |  |  |
|  | 4-Jun-09 |  |  |  | 7.38 | 889 | 305 | 5.4 |  | 477 | 91.5 | 18.7 | 2.7 | 4.44 |  |  |  |  |  |
|  | 13-May-10 | 7.10 | 620 | 8.0 | 7.62 | 970 | 664 | 5.06 |  | 600 | 198 | 41.2 | 2.53 | 6.77 |  |  |  |  |  |
|  | 15-Jun-11 | 7.33 | 776 | 11.8 | 7.81 | 922 | 579 | 5.14 |  | 565 | 175 | 34.5 | 2.31 | 5.88 |  |  |  |  |  |
|  | 23-May-12 | 6.97 | 788 | 11.1 | 7.73 | 957 | 557 | 5.82 |  | 549 | 163 | 36.4 | 2.28 | 5.86 |  |  |  |  |  |
|  | 9-May-13 | 2.34 | 1163 | 9.5 | 7.99 | 1060 | 634 | 16.7 |  | 502 | 186 | 41.1 | 2.22 | 7.06 |  |  |  |  |  |
|  | 9-May-14 | 7.31 | 1079 | 8.2 | 7.92 | 1000 | 478 | 13.3 |  | 501 | 130 | 37.2 | 1.99 | 7.68 |  |  |  |  |  |
|  | 27-May-15 | 6.98 | 573 | 14.3 | 7.60 | 997 | 448 | 9.53 | 29.9 | 522 | 121 | 35.5 | 2.00 | 8.02 |  |  |  |  |  |

Note:  refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **11** | 26-May-92 | | | 0.41 | | | | |
| cont'd | 6-Oct-92 | | | 0.14 | | | | |
| | 3-May-93 | | | 0.85 | | | | |
| | 26-Oct-93 | | | 0.08 | | | | |
| | 25-Apr-94 | | | 1.03 | | | | |
| | 25-Oct-94 | | | 0.29 | | | | |
| | 16-May-95 | | | 0.64 | | | | |
| | 15-Jun-97 | | | 0.15 | 0.110 | | | |
| | 15-Jun-98 | | | 1.17 | 0.170 | | | |
| | 15-Jun-99 | | | 0.08 | 0.180 | | | |
| | 15-Jun-00 | | | 1.29 | 0.410 | | | |
| | 15-Jun-01 | | | <0.02 | 0.180 | | | |
| | 15-Jun-02 | | | 0.26 | 0.180 | | | |
| | 15-Jun-03 | | | 0.19 | 0.210 | | | |
| | 15-Jun-04 | | | 0.03 | 0.060 | | | |
| | 15-Jun-05 | | | <0.05 | 0.058 | | | |
| | 15-Jun-06 | | | 0.06 | 0.161 | | | |
| | 29-May-07 | | | 0.27 | 0.203 | | | |
| | 5-Jun-08 | | | 1.74 | 0.048 | | | |
| | 4-Jun-09 | | | 0.273 | 0.094 | | | |
| | 13-May-10 | | | 0.216 | 0.178 | | | |
| | 15-Jun-11 | | | 0.291 | 0.148 | | | |
| | 23-May-12 | | | 0.550 | 0.227 | | | |
| | 9-May-13 | | | 0.636 | 0.313 | | | |
| | 9-May-14 | | | 1.30 | 0.432 | | | |
| | 27-May-15 | | | 0.169 | 0.078 | | | |

Note: refer to notation page for groundwater notation details

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **11R** | 25-May-16 | 7.00 | 1062 | 11.9 | 8.10 | 1440 | 664 | 76.4 | 7.34 | 735 | 163 | 62.5 | 4.92 | 45.1 | | | | | |
| | 1-Nov-16 | 7.26 | 1415 | 12.2 | 7.78 | 1450 | - | 78.4 | 4.65 | 758 | 163 | 60.3 | 4.24 | 43.4 | 0.72 | 2.56 | <0.25 | <0.25 | 12.9 |
| | 4-May-17 | 7.31 | 1590 | 8.08 | 7.93 | 1650 | 724 | 85.7 | 4.32 | 776 | 178 | 67.9 | 5.67 | 53.9 | 5.00 | 6.29 | <0.25 | <0.25 | 10.5 |
| | 10-May-18 | 7.09 | 1350 | 10.23 | 7.74 | 1540 | 700 | 104 | 3.12 | 827 | 172 | 65.8 | 6.33 | 58.1 | 5.74 | 6.95 | <0.25 | <0.25 | 19.7 |
| | 17-May-19 | 7.24 | 1380 | 10.73 | 6.94 | 1430 | 825 | 102 | 3.4 | 753 | 202 | 78.1 | 5.62 | 60.5 | 3.96 | 5.08 | <0.10 | <0.050 | 20.5 |
| | 12-May-20 | 7.46 | 1300 | 9.61 | 7.19 | 1530 | 777 | 100 | 2.6 | 715 | 185 | 76.8 | 3.58 | 59.6 | 1.13 | 2.38 | <0.10 | <0.050 | 17.3 |
| | 12-May-21 | 7.21 | 1620 | 10.1 | 7.98 | 1550 | 761 | 120 | 4 | 715 | 194 | 66.8 | 3.09 | 54.7 | 3.3 | 4.6 | 0.12 | <0.03 | 16.9 |
| **16AR** | 10-May-18 | 7.87 | 557 | 9.43 | 7.84 | 605 | 276 | 23.3 | 54.5 | 277 | 59.8 | 30.7 | 2.38 | 23.3 | <0.02 | <0.10 | <0.05 | <0.05 | 1.3 |
| | 16-May-19 | 7.86 | 506 | 9.95 | 7.99 | 571 | 305 | 24.2 | 59.0 | 268 | 68.6 | 32.5 | 1.64 | 22.1 | 0.045 | 0.36 | 0.073 | <0.010 | 1.81 |
| | 11-May-20 | 7.90 | 577 | 8.10 | 7.75 | 635 | 297 | 23.8 | 56.4 | 273 | 67.7 | 31.0 | 1.30 | 22.2 | 0.046 | 1.13 | 0.087 | <0.010 | 2.62 |
| | 12-May-21 | 7.70 | 683 | 10.5 | 8.15 | 619 | 319 | 27 | 86 | 244 | 72.9 | 33.3 | 1.42 | 24.4 | <0.1 | <0.5 | 0.09 | <0.03 | 1.1 |
| **19R** | 1-Nov-16 | 8.33 | 494 | 11.5 | 8.01 | 466 | | 4.19 | 26.6 | 223 | 39.9 | 18.4 | 1.65 | 27.3 | 0.12 | 0.34 | 0.06 | <0.05 | 1.9 |
| | 4-May-17 | 8.34 | 459 | 8.46 | 8.27 | 504 | 190 | 2.64 | 27.8 | 230 | 40.9 | 21.3 | 1.57 | 20.5 | 0.16 | 0.88 | <0.05 | <0.05 | 2.8 |
| | 10-May-18 | 8.28 | 447 | 9.65 | 7.43 | 432 | 191 | 1.96 | 27.7 | 232 | 41.1 | 21.4 | 1.42 | 17.2 | <0.02 | 0.19 | 0.13 | <0.05 | 0.9 |
| | 16-May-19 | 8.04 | 359 | 9.17 | 7.87 | 385 | 210 | 1.76 | 26.0 | 214 | 47.2 | 22.3 | 1.31 | 15.5 | <0.010 | 1.8 | 0.105 | <0.010 | 1.72 |
| | 11-May-20 | 8.15 | 389 | 7.74 | 7.98 | 424 | 207 | 1.55 | 25.5 | 213 | 48.7 | 20.6 | 1.29 | 13.8 | 0.034 | 0.19 | 0.223 | <0.010 | 1.83 |
| | 11-May-21 | 8.05 | 442 | 9.8 | 8.27 | 432 | 245 | 2 | 30 | 205 | 61.0 | 22.6 | 1.44 | 14.4 | <0.1 | <0.5 | 0.23 | <0.03 | 3.6 |
| **26** | 15-Jun-97 | | | | 8.04 | 606 | 343 | 15.8 | | 276 | 93.3 | 26.8 | 1.1 | 8.6 | | | | | |
| | 15-Jun-98 | | | | 7.97 | 595 | 339 | 17.0 | | 268 | 93.7 | 25.6 | 1.45 | 8.11 | | | | | |
| | 15-Jun-99 | | | | 7.97 | 729 | 400 | 46.0 | | 223 | 107 | 32.3 | 1.43 | 27.6 | | | | | |
| | 15-Jun-00 | | | | 8.10 | 760 | 388 | 45.0 | | 360 | 101 | 32.9 | 1.56 | 29.7 | | | | | |
| | 15-Jun-01 | | | | 7.64 | 821 | 442 | 51.0 | | 357 | 117 | 36.5 | 1.36 | 30.8 | | | | | |
| | 15-Jun-02 | | | | 7.54 | 916 | 451 | 71.0 | | 384 | 115 | 39.8 | 1.39 | 33.2 | | | | | |
| | 15-Jun-03 | | | | 7.59 | | 501 | 85.0 | | 419 | 129 | 43.5 | 1.35 | 36.6 | | | | | |
| | 15-Jun-04 | | | | 7.54 | 1110 | 503 | 30.0 | | 261 | 129 | 44.0 | 1.64 | 63.9 | | | | | |
| | 15-Jun-05 | | | | 8.13 | 1360 | 568 | 192 | | 468 | 160 | 49.3 | 2.1 | 80.0 | | | | | |
| | 15-Jun-06 | | | | 7.21 | 1540 | 610 | 237 | | 470 | 155 | 54.3 | 2.0 | 93.5 | | | | | |
| | 29-May-07 | | | | 7.24 | 1600 | 580 | 235 | | 510 | 143 | 54.0 | 2.0 | 120 | | | | | |
| | 5-Jun-08 | | | | 7.69 | 1730 | 570 | 260 | | 550 | 145 | 51.5 | 2.0 | 126 | | | | | |
| | 4-Jun-09 | | | | 7.60 | 1810 | 599 | 242 | | 555 | 148 | 55.9 | 2.7 | 149 | | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **11R** | 25-May-16 | | | 7.68 | 0.086 | | | |
| | 1-Nov-16 | 0.203 | <0.003 | 6.36 | 0.068 | 2.2 | <0.20 | <0.10 |
| | 4-May-17 | 0.264 | <0.003 | 8.70 | 0.072 | 2.6 | 0.22 | <0.10 |
| | 10-May-18 | 0.272 | 0.008 | 7.81 | 0.063 | | | |
| | 17-May-19 | 0.258 | 0.00284 | 8.96 | 0.130 | | | |
| | 12-May-20 | 0.215 | <0.00050 | 1.56 | 0.062 | | | |
| | 12-May-21 | 0.204 | 0.00042 | 2.67 | 0.059 | | | |
| **16AR** | 10-May-18 | 0.045 | <0.003 | <0.010 | 0.026 | | | |
| | 16-May-19 | 0.037 | <0.00050 | 0.178 | 0.0311 | | | |
| | 11-May-20 | 0.032 | <0.00050 | 0.013 | 0.0176 | | | |
| | 12-May-21 | 0.040 | 0.00013 | 0.03 | 0.024 | | | |
| **19R** | 1-Nov-16 | 0.061 | <0.003 | 0.313 | 0.084 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.053 | <0.003 | <0.010 | 0.009 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.044 | <0.003 | <0.010 | 0.003 | | | |
| | 16-May-19 | 0.041 | <0.00050 | 0.020 | 0.00272 | | | |
| | 11-May-20 | 0.039 | <0.00050 | 0.067 | 0.00081 | | | |
| | 11-May-21 | 0.050 | 0.00017 | <0.007 | 0.0002 | | | |
| **26** | 15-Jun-97 | | | 0.38 | 0.060 | | | |
| | 15-Jun-98 | | | 0.19 | 0.060 | | | |
| | 15-Jun-99 | | | 0.48 | 0.030 | | | |
| | 15-Jun-00 | | | 0.61 | 0.030 | | | |
| | 15-Jun-01 | | | 0.58 | 0.040 | | | |
| | 15-Jun-02 | | | 0.67 | 0.040 | | | |
| | 15-Jun-03 | | | 0.77 | 0.050 | | | |
| | 15-Jun-04 | | | 0.92 | 0.060 | | | |
| | 15-Jun-05 | | | 1.40 | 0.078 | | | |
| | 15-Jun-06 | | | 1.15 | 0.078 | | | |
| | 29-May-07 | | | 0.25 | 0.118 | | | |
| | 5-Jun-08 | | | 0.64 | 0.096 | | | |
| | 4-Jun-09 | | | 1.59 | 0.090 | | | |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **26R** | 13-May-10 | 7.11 | 1650 | 10.2 | 7.81 | 1680 | 346 | 300 | | 594 | 85.8 | 31.9 | 1.33 | 80.5 | | | | | |
| | 15-Jun-11 | 7.35 | 1458 | 9.5 | 7.81 | 1650 | 639 | 300 | | 581 | 158 | 59.3 | 3.05 | 171 | | | | | |
| | 23-May-12 | 7.95 | 1465 | 10.0 | 7.81 | 1790 | 648 | 294 | | 600 | 161 | 59.7 | 2.70 | 174 | | | | | |
| | 1-Nov-16 | 7.40 | 1820 | 14.6 | 7.95 | 2030 | | 319 | 17.3 | 705 | 133 | 65.3 | 3.20 | 208 | 0.06 | 0.88 | <0.25 | <0.25 | 11.1 |
| | 4-May-17 | 7.27 | 2050 | 8.79 | 8.08 | 2210 | 578 | 302 | 18.0 | 739 | 134 | 59.1 | 2.78 | 208 | 0.11 | 1.05 | <0.5 | <0.5 | 13.0 |
| | 11-May-18 | 6.99 | 1710 | 10.25 | 7.99 | 1840 | 580 | 286 | 17.1 | 702 | 136 | 58.4 | 2.75 | 202 | 0.07 | 0.85 | <0.5 | <0.5 | 12.1 |
| | 16-May-19 | 7.31 | 1470 | 11.43 | 7.41 | 1750 | 607 | 278 | 16.7 | 652 | 142 | 61.0 | 2.61 | 192 | 0.042 | 0.89 | <0.10 | <0.050 | 10.9 |
| | 11-May-20 | 7.15 | 1710 | 8.83 | 7.29 | 1770 | 601 | 265 | 14.8 | 658 | 151 | 54.1 | 2.51 | 182 | 0.048 | 0.86 | <0.10 | <0.050 | 10.6 |
| | 11-May-21 | 7.32 | 1823 | 9.2 | 8.08 | 1790 | 657 | 260 | 21 | 601 | 172 | 55.4 | 2.95 | 183 | <0.1 | 0.6 | <0.06 | <0.03 | 9.8 |
| **28** | 5-Apr-83 | | | | 7.8 | 390 | 216 | 5.0 | | 211 | 50.0 | 25.0 | | | | | | | 13.4 |
| | 13-Jun-83 | | | | 7.5 | 390 | 252 | 2.0 | | 234 | 54.0 | 27.0 | | | | | | | 6.5 |
| | 13-Sep-83 | | | | 7.6 | 400 | 220 | 2.0 | | | | | | | | | | | 3.2 |
| | 8-Dec-83 | | | | 7.5 | 420 | 270 | 5.0 | | | | | | | | | | | 1.8 |
| | 1-May-84 | | | | 7.5 | 510 | 258 | 2.0 | | | | | | | | | | | 1.5 |
| | 5-Nov-84 | | | | 7.3 | 510 | 258 | 2.0 | | 224 | 54.0 | 30.0 | | | | | | | 0.6 |
| | 29-Apr-85 | | | | 7.79 | 560 | 242 | 3.5 | | 243 | 47.5 | 30.0 | | | | | | | 2.6 |
| | 21-Oct-85 | | | | 8.05 | 510 | 224 | 3.0 | | 233 | 43.5 | 28.0 | | | | | | | 1.5 |
| | 30-Apr-86 | | | | 7.77 | 424 | 257 | 3.5 | | 258 | 49.0 | 32.6 | | | | | | | 3.9 |
| | 14-Oct-86 | | | | 7.68 | 455 | 211 | 2.5 | | 212 | 40.5 | 26.6 | | | | | | | 1.3 |
| | 20-Apr-87 | | | | 7.61 | 520 | 238 | 2.5 | | 237 | 45.0 | 30.4 | | | | | | | 2.4 |
| | 6-Oct-87 | | | | 7.84 | 458 | 246 | 1.6 | | 230 | 48.4 | 30.4 | | | | | | | 1.6 |
| | 10-May-88 | | | | 7.70 | 520 | 270 | 2.9 | | 156 | 53.0 | 33.4 | | | | | | | 1.2 |
| | 12-Oct-88 | | | | 7.70 | 380 | 184 | 3.0 | | 150 | 39.0 | 21.0 | | | | | | | 1.2 |
| | 30-Oct-89 | | | | 7.73 | 501 | 237 | 3.8 | | 235 | 45.6 | 29.9 | | | | | | | 1.1 |
| | 7-May-90 | | | | 7.84 | 546 | 266 | 6.4 | | 244 | 51.1 | 33.6 | | | | | | | 0.8 |
| | 29-Oct-90 | | | | 7.73 | 495 | 227 | 4.1 | | 235 | 45.6 | 27.5 | | | | | | | 1.2 |
| | 6-May-91 | | | | 7.76 | 469 | 221 | 3.6 | | 225 | 45.2 | 26.2 | | | | | | | |
| | 4-Nov-91 | | | | 7.94 | 435 | 207 | 2.7 | | 195 | 41.1 | 25.2 | | | | | | | 2.0 |
| | 26-May-92 | | | | 7.66 | 457 | 227 | 2.3 | | 215 | 45.0 | 27.8 | | | | | | | 1.7 |
| | 6-Oct-92 | | | | 7.83 | 551 | 295 | 5.9 | | 255 | 58.9 | 35.9 | | | | | | | 3.6 |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **26R** | 13-May-10 | | | 1.92 | 0.089 | | | |
| | 15-Jun-11 | | | 1.85 | 0.089 | | | |
| | 23-May-12 | | | 1.79 | 0.083 | | | |
| | 1-Nov-16 | 1.80 | <0.003 | 2.16 | 0.050 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 1.85 | <0.003 | 2.14 | 0.041 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 1.80 | 0.012 | 2.03 | 0.042 | <0.68 | <0.80 | <0.40 |
| | 16-May-19 | 1.71 | <0.0050 | 2.03 | 0.0409 | <0.50 | <0.50 | <0.50 |
| | 11-May-20 | 1.73 | <0.0050 | 2.06 | 0.0406 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 1.41 | 0.00053 | 2.19 | 0.045 | <0.2 | <0.5 | <0.5 |
| **28** | 5-Apr-83 | | | 0.35 | | | | |
| | 13-Jun-83 | | | 0.57 | | | | |
| | 13-Sep-83 | | | | | | | |
| | 8-Dec-83 | | | | | | | |
| | 1-May-84 | | | | | | | |
| | 5-Nov-84 | | | <0.04 | | | | |
| | 29-Apr-85 | | | 1.66 | | | | |
| | 21-Oct-85 | | | 0.01 | | | | |
| | 30-Apr-86 | | | 0.03 | | | | |
| | 14-Oct-86 | | | 0.04 | | | | |
| | 20-Apr-87 | | | 0.02 | | | | |
| | 6-Oct-87 | | | 0.03 | | | | |
| | 10-May-88 | | | 0.03 | | | | |
| | 12-Oct-88 | | | <.05 | | | | |
| | 30-Oct-89 | | | <0.01 | | | | |
| | 7-May-90 | | | <0.01 | | | | |
| | 29-Oct-90 | | | 1.60 | | | | |
| | 6-May-91 | | | 0.01 | | | | |
| | 4-Nov-91 | | | 0.15 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.14 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **28** | 3-May-93 | | | | 7.69 | 553 | 280 | 3.5 | | 789 | 55.0 | 35.4 | | | | | | | 1.0 |
| cont'd | 26-Oct-93 | | | | 7.79 | 535 | 260 | 2.7 | | 292 | 51.3 | 31.9 | | | | | | | 1.3 |
| | 25-Apr-94 | | | | 7.81 | 542 | 282 | 3.5 | | 275 | 57.4 | 33.5 | | | | | | | 2.3 |
| | 25-Oct-94 | | | | 7.88 | 523 | 262 | 4.0 | | 264 | 54.9 | 30.4 | | | | | | | 1.4 |
| | 16-May-95 | | | | 7.94 | 529 | 274 | 3.1 | | 255 | 56.7 | 32.2 | | | | | | | 1.3 |
| | 15-Jun-97 | | | | | 382 | 210 | 1.8 | | 185 | 47.2 | | 1.4 | 6.6 | | | | | |
| | 15-Jun-98 | | | | | 420 | 219 | 3.0 | | 214 | 48.8 | | 2.10 | 6.80 | | | | | |
| | 15-Jun-99 | | | | | 497 | 232 | 3.0 | | 240 | 51.5 | | 2.01 | 8.62 | | | | | |
| | 15-Jun-00 | | | | | 539 | 257 | 3.0 | | 265 | 55.7 | | 1.21 | 23.7 | | | | | |
| | 15-Jun-01 | | | | | 582 | 347 | 3.0 | | 301 | 78.1 | | 0.81 | 14.5 | | | | | |
| | 15-Jun-02 | | | | | 581 | 327 | 3.0 | | 292 | 68.8 | | 1.73 | 9.0 | | | | | |
| | 15-Jun-03 | | | | | 662 | 382 | 5.0 | | 308 | 80.7 | | 1.18 | 13.1 | | | | | |
| | 15-Jun-04 | | | | | 580 | 272 | 6.0 | | 311 | 58.8 | | 0.66 | 16.7 | | | | | |
| | 15-Jun-05 | | | | | 529 | 334 | 3.23 | | 261 | 71.2 | | 1.9 | 11.0 | | | | | |
| | 15-Jun-06 | | | | | 544 | 350 | 4.0 | | 270 | 82.9 | | 2.0 | 8.8 | | | | | |
| | 29-May-07 | | | | 7.35 | 597 | 300 | 4.0 | | 290 | 64.2 | 35.1 | 2.0 | 10.7 | | | | | |
| | 5-Jun-08 | | | | 7.93 | 569 | 310 | 4.0 | | 270 | 70.5 | 31.9 | 2.0 | 9.6 | | | | | |
| | 4-Jun-09 | | | | 7.98 | 588 | 309 | 2.7 | | 297 | 68.2 | 33.7 | 1.9 | 8.24 | | | | | |
| | 13-May-10 | 7.74 | 480 | 9.2 | 8.05 | 568 | 354 | 2.68 | | 320 | 75.3 | 40.4 | 2.01 | 10.9 | | | | | |
| | 15-Jun-11 | 8.03 | 451 | 10.7 | 8.11 | 516 | 287 | 2.44 | | 272 | 60.1 | 33.2 | 1.90 | 12.1 | | | | | |
| | 23-May-12 | 7.41 | 451 | 11.4 | 8.07 | 521 | 271 | 3.32 | | 275 | 55.9 | 32.0 | 1.75 | 13.4 | | | | | |
| | 9-May-13 | 7.92 | 613 | 9.7 | 8.23 | 581 | 302 | 3.16 | | 262 | 61.5 | 36.1 | 1.95 | 13.8 | | | | | |
| | 9-May-14 | 7.70 | 623 | 9.4 | 7.89 | 589 | 296 | 2.98 | | 267 | 61.4 | 34.6 | 2.58 | 12.5 | | | | | |
| | 27-May-15 | 7.95 | 380 | 14.6 | 8.00 | 593 | 282 | 3.49 | 31.0 | 280 | 59.6 | 32.3 | 2.94 | 12.1 | | | | | |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **28** | 3-May-93 | | | 0.13 | | | | |
| **cont'd** | 26-Oct-93 | | | 0.21 | | | | |
| | 25-Apr-94 | | | 0.02 | | | | |
| | 25-Oct-94 | | | <0.01 | | | | |
| | 16-May-95 | | | 0.04 | | | | |
| | 15-Jun-97 | | | <0.02 | 0.050 | | | |
| | 15-Jun-98 | | | 0.17 | 0.330 | | | |
| | 15-Jun-99 | | | 0.09 | 0.110 | | | |
| | 15-Jun-00 | | | 0.02 | 0.170 | | | |
| | 15-Jun-01 | | | <0.02 | 0.100 | | | |
| | 15-Jun-02 | | | 0.06 | 0.100 | | | |
| | 15-Jun-03 | | | 0.11 | 0.070 | | | |
| | 15-Jun-04 | | | 0.02 | 0.190 | | | |
| | 15-Jun-05 | | | <0.05 | <0.02 | | | |
| | 15-Jun-06 | | | 0.06 | 0.627 | | | |
| | 29-May-07 | | | <0.05 | 0.009 | | | |
| | 5-Jun-08 | | | <0.05 | 0.572 | | | |
| | 4-Jun-09 | | | <0.050 | 0.012 | | | |
| | 13-May-10 | | | 0.042 | 0.133 | | | |
| | 15-Jun-11 | | | 0.080 | 0.141 | | | |
| | 23-May-12 | | | 0.060 | 0.086 | | | |
| | 9-May-13 | | | 0.080 | 0.092 | | | |
| | 9-May-14 | | | 0.225 | 0.113 | | | |
| | 27-May-15 | | | 0.015 | 0.156 | | | |

Note: refer to notation page for groundwater notation details

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **28R** | 25-May-16 | 7.63 | 408 | 13.5 | 8.17 | 533 | 219 | 6.10 | 37.8 | 263 | 44.7 | 26.1 | 2.49 | 25.0 | | | | | |
| | 1-Nov-16 | 8.39 | 535 | 12.0 | 8.05 | 541 | | 4.50 | 30.7 | 272 | 46.2 | 24.5 | 2.00 | 25.6 | 0.11 | 0.25 | <0.05 | <0.05 | 2.9 |
| | 4-May-17 | 8.15 | 325 | 9.82 | 8.29 | 567 | 221 | 2.75 | 31.1 | 270 | 44.8 | 26.4 | 2.33 | 28.4 | 0.10 | 0.33 | <0.05 | <0.05 | 1.6 |
| | 10-May-18 | 7.85 | 313 | 9.76 | 8.01 | 517 | 222 | 3.06 | 32.6 | 284 | 45.6 | 26.3 | 2.04 | 28.2 | 0.06 | 0.15 | 0.09 | <0.05 | 1.1 |
| | 16-May-19 | 7.60 | 221 | 10.45 | 8.04 | 467 | 234 | 2.48 | 29.9 | 268 | 48.1 | 27.7 | 1.45 | 25.8 | 0.16 | 51.9* | <0.020 | <0.010 | 1.75 |
| | 12-May-20 | 8.19 | 406 | 9.15 | 7.95 | 516 | 242 | 2.51 | 25.9 | 270 | 51.0 | 27.8 | 1.72 | 23.9 | 0.10 | 0.43 | <0.020 | <0.010 | 1.96 |
| | 12-May-21 | 8.03 | 475 | 9.9 | 8.00 | 480 | 232 | 3 | 67 | 239 | 51.4 | 25.1 | 1.47 | 22.3 | 0.10 | <0.5 | <0.06 | <0.03 | 2.0 |
| **32** | 5-Apr-83 | | | | 7.7 | 300 | 176 | | | 167 | 48.0 | 16.0 | | | | | | | 1.1 |
| | 14-Jun-83 | | | | 7.5 | 270 | 148 | | | 168 | 41.0 | 14.0 | | | | | | | 1.2 |
| | 19-Aug-83 | | | | 7.9 | 310 | | | | | | | | | | | | | |
| | 13-Sep-83 | | | | 7.6 | 320 | 182 | | | | | | | | | | | | 0.6 |
| | 7-Dec-83 | | | | 7.7 | 220 | 232 | | | | | | | | | | | | 1.3 |
| | 1-May-84 | | | | 7.5 | 380 | 200 | | | | | | | | | | | | 0.9 |
| | 6-Nov-84 | | | | 7.4 | 420 | 212 | | | 182 | 57.0 | 17.0 | | | | | | | 0.3 |
| | 30-Apr-85 | | | | 7.85 | 427 | 210 | 1.5 | | 204 | 54.5 | 17.8 | | | | | | | 1.3 |
| | 21-Oct-85 | | | | 7.95 | 434 | 212 | 1.5 | | | 58.0 | 16.2 | | | | | | | 3.7 |
| | 30-Apr-86 | | | | 7.77 | 314 | 201 | 1.0 | | 195 | 52.5 | 17.0 | | | | | | | 2.5 |
| | 14-Oct-86 | | | | 7.69 | 403 | 204 | 1.0 | | 195 | 54.5 | 16.4 | | | | | | | 1.3 |
| | 20-Apr-87 | | | | 7.65 | 398 | 207 | 1.5 | | 194 | 54.0 | 17.4 | | | | | | | 2.3 |
| | 6-Oct-87 | | | | 7.82 | 382 | 223 | 2.7 | | 200 | 59.8 | 17.9 | | | | | | | 2.0 |
| | 10-May-88 | | | | 7.74 | 390 | 217 | 1.1 | | 177 | 59.4 | 16.6 | | | | | | | 1.2 |
| | 12-Oct-88 | | | | 7.80 | 370 | 185 | 4.0 | | 194 | 51.0 | 14.0 | | | | | | | 1.4 |
| | 30-Oct-89 | | | | 7.73 | 432 | 217 | 6.7 | | 205 | 59.8 | 16.4 | | | | | | | 1.3 |
| | 7-May-90 | | | | 7.86 | 419 | 212 | 4.1 | | 202 | 55.9 | 17.5 | | | | | | | 0.6 |
| | 29-Oct-90 | | | | 7.77 | 465 | 223 | 8.7 | | 221 | 61.3 | 17.0 | | | | | | | 1.3 |
| | 6-May-91 | | | | 7.90 | 413 | 199 | 3.7 | | 204 | 52.3 | 16.6 | | | | | | | |
| | 4-Nov-91 | | | | 7.86 | 496 | 238 | 12.5 | | 227 | 62.4 | 20.0 | | | | | | | 2.5 |
| | 26-May-92 | | | | 7.76 | 455 | 236 | 6.7 | | 216 | 61.4 | 20.0 | | | | | | | 2.1 |
| | 6-Oct-92 | | | | 7.84 | 475 | 252 | 9.6 | | 213 | 67.0 | 20.5 | | | | | | | 2.2 |
| | 3-May-93 | | | | 7.75 | 440 | 222 | 6.3 | | 228 | 58.0 | 18.6 | | | | | | | 1.2 |

Note:  refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **28R** | 25-May-16 | | | <0.010 | 0.023 | | | |
| | 1-Nov-16 | 0.074 | <0.003 | <0.010 | 0.023 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.09 | <0.003 | 0.167 | 0.021 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.08 | <0.003 | <0.010 | 0.018 | | | |
| | 16-May-19 | 0.084 | <0.00050 | 0.255 | 0.0194 | | | |
| | 12-May-20 | 0.073 | <0.00050 | 0.055 | 0.0177 | | | |
| | 12-May-21 | 0.085 | 0.00018 | 0.27 | 0.019 | | | |
| **32** | 5-Apr-83 | | | 0.23 | | | | |
| | 14-Jun-83 | | | 0.65 | | | | |
| | 19-Aug-83 | | | | | | | |
| | 13-Sep-83 | | | | | | | |
| | 7-Dec-83 | | | | | | | |
| | 1-May-84 | | | | | | | |
| | 6-Nov-84 | | | <0.04 | | | | |
| | 30-Apr-85 | | | 2.56 | | | | |
| | 21-Oct-85 | | | 0.18 | | | | |
| | 30-Apr-86 | | | 0.01 | | | | |
| | 14-Oct-86 | | | 0.02 | | | | |
| | 20-Apr-87 | | | 0.03 | | | | |
| | 6-Oct-87 | | | 0.01 | | | | |
| | 10-May-88 | | | 0.03 | | | | |
| | 12-Oct-88 | | | <.05 | | | | |
| | 30-Oct-89 | | | 0.01 | | | | |
| | 7-May-90 | | | 0.01 | | | | |
| | 29-Oct-90 | | | 0.02 | | | | |
| | 6-May-91 | | | 0.09 | | | | |
| | 4-Nov-91 | | | 0.10 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.05 | | | | |
| | 3-May-93 | | | 0.08 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **32** | 26-Oct-93 | | | | 7.88 | 509 | 250 | 11.7 | | 252 | 67.0 | 20.1 | | | | | | | 2.7 |
| **cont'd** | 25-Apr-94 | | | | 8.05 | 451 | 242 | 7.4 | | 235 | 64.3 | 19.7 | | | | | | | 2.4 |
| | 25-Oct-94 | | | | 7.89 | 498 | 246 | 8.8 | | 237 | 65.6 | 19.9 | | | | | | | 4.3 |
| | 16-May-95 | | | | 7.86 | 472 | 240 | 7.5 | | 250 | 62.9 | 20.0 | | | | | | | 1.8 |
| | 15-Jun-97 | | | | 8.17 | 437 | 235 | 5.3 | | 191 | 59.3 | 21.1 | 0.70 | 7.40 | | | | | |
| | 15-Jun-98 | | | | 8.06 | 439 | 275 | 8.0 | | 208 | 75.1 | 21.2 | 1.13 | 7.17 | | | | | |
| | 15-Jun-99 | | | | 7.57 | 530 | 311 | 8.0 | | 228 | 83.4 | 24.9 | 0.84 | 8.46 | | | | | |
| | 15-Jun-00 | | | | 8.07 | 515 | 267 | 7.0 | | 240 | 70.7 | 22.0 | 0.53 | 19.7 | | | | | |
| | 15-Jun-01 | | | | 7.80 | 518 | 312 | 7.0 | | 250 | 83.4 | 25.1 | 0.42 | 22.5 | | | | | |
| | 15-Jun-02 | | | | 7.60 | 472 | 244 | 6.0 | | 233 | 63.9 | 20.7 | 0.86 | 6.15 | | | | | |
| | 15-Jun-03 | | | | 7.84 | 509 | 288 | 7.0 | | 264 | 75.6 | 24.1 | 0.38 | 9.15 | | | | | |
| | 15-Jun-04 | | | | 7.89 | 460 | 225 | 7.0 | | 234 | 56.6 | 19.8 | 0.36 | 15.9 | | | | | |
| | 15-Jun-05 | | | | 8.25 | 433 | 256 | 6.8 | | 216 | 66.8 | 21.6 | 0.8 | 8.3 | | | | | |
| | 15-Jun-06 | | | | 7.72 | 455 | 290 | 8.0 | | 250 | 79.4 | 22.8 | <1 | 6.7 | | | | | |
| | 29-May-07 | | | | 7.30 | 458 | 200 | 6.0 | | 230 | 54.3 | 15.9 | 1.0 | 6.8 | | | | | |
| | 5-Jun-08 | | | | 7.99 | 457 | 150 | 7.0 | | 230 | 40.9 | 11.8 | 2.0 | 6.3 | | | | | |
| | 4-Jun-09 | | | | 7.99 | 492 | 157 | 6.8 | | 243 | 43.1 | 11.9 | 1.8 | 4.0 | | | | | |
| | 13-May-10 | 8.08 | 430 | 7.8 | 7.86 | 536 | 335 | 10.6 | | 274 | 88.6 | 27.6 | 0.98 | 7.72 | | | | | |
| | 15-Jun-11 | 8.13 | 427 | 10.5 | 8.08 | 511 | 291 | 9.32 | | 270 | 76.7 | 24.2 | 1.09 | 7.34 | | | | | |
| | 23-May-12 | 6.66 | 430 | 9.0 | 7.93 | 543 | 291 | 9.39 | | 266 | 76.4 | 24.3 | 1.11 | 7.35 | | | | | |
| | 9-May-13 | 7.80 | 592 | 8.9 | 8.16 | 562 | 301 | 8.63 | | 244 | 78.5 | 25.6 | 0.94 | 7.64 | | | | | |
| | 9-May-14 | 7.99 | 569 | 7.0 | 8.13 | 527 | 273 | 8.15 | | 231 | 69.9 | 23.9 | 0.94 | 7.36 | | | | | |
| | 27-May-15 | 7.51 | 343 | 15.3 | 8.04 | 548 | 252 | 9.37 | 27.4 | 252 | 63.6 | 22.6 | 0.98 | 8.39 | | | | | |
| **32R** | 25-May-16 | 7.80 | 235 | 11.3 | 8.09 | 558 | 274 | 10.9 | 33.2 | 271 | 70.5 | 23.7 | 1.01 | 7.9 | | | | | |
| | 1-Nov-16 | 8.23 | 630 | 12.5 | 8.07 | 582 | | 10.6 | 29.8 | 278 | 78 | 23.3 | 1.27 | 7.98 | <0.02 | 0.12 | <0.05 | <0.05 | 1.6 |
| | 4-May-17 | 7.92 | 535 | 7.27 | 8.19 | 598 | 275 | 8.74 | 31.3 | 271 | 70.5 | 24.1 | 1.22 | 8.13 | 0.04 | 0.28 | 0.06 | <0.05 | 1.6 |
| | 11-May-18 | 7.72 | 477 | 7.42 | 7.92 | 507 | 270 | 8.42 | 29.1 | 271 | 69.7 | 23.4 | 1.17 | 7.93 | 0.04 | <0.10 | 0.11 | <0.05 | 1.2 |
| | 16-May-19 | 8.10 | 421 | 10.02 | 7.87 | 508 | 293 | 9.87 | 37.1 | 284 | 76.4 | 24.9 | 0.808 | 7.80 | 0.06 | 124* | <0.020 | <0.010 | 1.99 |
| | 12-May-20 | 7.94 | 462 | 7.40 | 7.65 | 542 | 275 | 8.82 | 25.0 | 235 | 71.7 | 23.4 | 0.783 | 7.97 | 0.064 | 0.85 | 0.024 | <0.010 | 2.43 |
| | 11-May-21 | 7.75 | 620 | 7.7 | 8.14 | 519 | 351 | 14 | 39 | 245 | 95.4 | 27.5 | 0.920 | 8.47 | <0.1 | <0.5 | 0.08 | <0.03 | 2.7 |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **32** | 26-Oct-93 | | | 0.01 | | | | |
| **cont'd** | 25-Apr-94 | | | 0.03 | | | | |
| | 25-Oct-94 | | | 0.21 | | | | |
| | 16-May-95 | | | 0.13 | | | | |
| | 15-Jun-97 | | | 0.02 | 0.110 | | | |
| | 15-Jun-98 | | | 0.07 | 0.380 | | | |
| | 15-Jun-99 | | | 0.10 | 0.020 | | | |
| | 15-Jun-00 | | | <0.02 | 0.060 | | | |
| | 15-Jun-01 | | | <0.02 | 0.120 | | | |
| | 15-Jun-02 | | | 0.12 | 0.070 | | | |
| | 15-Jun-03 | | | 0.10 | 0.050 | | | |
| | 15-Jun-04 | | | 0.04 | 0.050 | | | |
| | 15-Jun-05 | | | 0.09 | 0.033 | | | |
| | 15-Jun-06 | | | 0.97 | 0.083 | | | |
| | 29-May-07 | | | 0.17 | 0.073 | | | |
| | 5-Jun-08 | | | 0.06 | 0.040 | | | |
| | 4-Jun-09 | | | <0.050 | 0.039 | | | |
| | 13-May-10 | | | 0.579 | 0.057 | | | |
| | 15-Jun-11 | | | 0.366 | 0.058 | | | |
| | 23-May-12 | | | 0.400 | 0.053 | | | |
| | 9-May-13 | | | 0.429 | 0.050 | | | |
| | 9-May-14 | | | 0.353 | 0.049 | | | |
| | 27-May-15 | | | <0.010 | 0.032 | | | |
| **32R** | 25-May-16 | | | 0.267 | 0.04 | | | |
| | 1-Nov-16 | 0.043 | <0.003 | 0.099 | 0.049 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.029 | <0.003 | 0.156 | 0.036 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.032 | <0.003 | 0.130 | 0.041 | <0.17 | <0.20 | <0.10 |
| | 16-May-19 | 0.030 | <0.00050 | 0.170 | 0.0391 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.028 | <0.00050 | 0.258 | 0.0446 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.043 | 0.0001 | 0.747 | 0.0389 | <0.2 | <0.5 | <0.5 |

Note: refer to notation page for groundwater notation details

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **33R** | 16-May-19 | 8.35 | 381 | 11.19 | 8.02 | 437 | 195 | 3.76 | 29.4 | 244 | 50.1 | 16.9 | 4.24 | 30.7 | 0.085 | 2.44 | 0.496 | <0.010 | 3.53 |
| **40** | 9-May-14 | 7.18 | 786 | 9.5 | 8.05 | 728 | 381 | 16.5 | | 348 | 113 | 24.0 | 1.15 | 10.7 | | | | | |
| | 27-May-15 | 6.99 | 476 | 10.7 | 7.90 | 734 | 365 | 17.8 | 37.5 | 341 | 110 | 22.0 | 0.89 | 12.0 | | | | | |
| | 24-May-16 | 7.22 | 556 | 10.2 | 8.07 | 722 | 384 | 16.7 | 41 | 349 | 115 | 23.5 | 0.97 | 11 | | | | | |
| | 1-Nov-16 | 7.66 | 711 | 9.9 | 7.88 | 714 | | 22.2 | 40.1 | 328 | 106 | 20.1 | 0.99 | 10.7 | 0.19 | 0.57 | <0.25 | <0.25 | 6.6 |
| | 4-May-17 | 7.45 | 719 | 9.07 | 8.15 | 782 | 364 | 18.8 | 38.4 | 346 | 109 | 22.3 | 1.13 | 11.1 | 0.16 | 0.65 | <0.05 | <0.05 | 7.3 |
| | 10-May-18 | 7.25 | 642 | 9.86 | 7.86 | 692 | 359 | 18.2 | 34.5 | 369 | 108 | 21.6 | 0.96 | 11.2 | 0.20 | 0.60 | <0.25 | <0.25 | 6.8 |
| | 16-May-19 | 7.45 | 589 | 10.11 | 7.24 | 658 | 385 | 20.3 | 37.8 | 345 | 116 | 23.4 | 0.951 | 11.3 | 0.224 | 1.48 | <0.020 | <0.010 | 7.06 |
| | 11-May-20 | 7.94 | 462 | 7.40 | 7.29 | 707 | 368 | 19.7 | 40.7 | 333 | 113 | 21.2 | 0.919 | 10.5 | 0.187 | 0.79 | 0.021 | <0.010 | 8.06 |
| | 11-May-21 | 7.50 | 758 | 8.7 | 8.15 | 722 | 450 | 20 | 45 | 337 | 142 | 23.2 | 1.02 | 10.4 | 0.3 | <0.5 | <0.06 | <0.03 | 6.8 |
| **41** | 9-May-14 | 6.41 | 2980 | 11.9 | 7.66 | 2590 | 501 | 166 | | 1110 | 121 | 48.3 | 84.7 | 103 | | | | | |
| | 27-May-15 | 6.81 | 1954 | 15.3 | 7.41 | 2840 | 614 | 167 | 2 | 1240 | 145 | 61.1 | 110 | 123 | | | | | |
| | 25-May-16 | 6.75 | 2930 | 13.3 | 7.79 | 2600 | 587 | 156 | 1.8 | 1190 | 150 | 51.7 | 84.9 | 97.6 | | | | | |
| | 1-Nov-16 | 6.80 | 3430 | 15.7 | 7.58 | 3670 | | 267 | 3.8 | 1590 | 134 | 61.3 | 132 | 151 | 195 | 212 | <0.5 | <0.5 | 75.7 |
| | 4-May-17 | 6.76 | 2820 | 14.50 | 7.57 | 2210 | 569 | 83.3 | 2.61 | 1060 | 158 | 42.3 | 55.8 | 62.5 | 87.0 | 86.5 | <0.25 | <0.25 | 35.0 |
| | 10-May-18 | 6.60 | 2100 | 13.93 | 7.49 | 1870 | 546 | 66.9 | 3.5 | 1010 | 155 | 38.6 | 50.2 | 55.1 | 75.0 | 84.3 | <0.5 | <0.5 | 30.4 |
| | 16-May-19 | 6.38 | 1760 | 10.19 | 6.46 | 1840 | 633 | 75.2 | <3.0 | 820 | 178 | 45.6 | 54.2 | 54.1 | 72.8 | 89.5 | <0.20 | <0.10 | 27.4 |
| | 12-May-20 | 6.52 | 1950 | 9.23 | 6.48 | 2160 | 626 | 74.0 | <1.5 | 301 | 178 | 44.2 | 58.7 | 58.6 | 99.2 | 92.8 | <0.10 | <0.050 | 31.9 |
| | 12-May-21 | 6.77 | 2050 | 10.2 | 7.63 | 2160 | 685 | 80 | 22 | 1030 | 199 | 45.9 | 66.5 | 63.3 | 99.1 | 95.8 | <0.06 | <0.03 | 146 |
| **43** | 25-May-16 | 8.03 | 225 | 11.7 | 8.11 | 348 | 125 | 2.57 | 16.2 | 175 | 23.4 | 16.2 | 1.67 | 23.1 | | | | | |
| | 4-May-17 | 8.41 | 338 | 9.40 | 7.53 | 365 | 127 | 1.35 | 10.6 | 174 | 23.6 | 16.5 | 1.73 | 22.0 | 0.06 | 0.36 | <0.05 | <0.05 | 2.2 |
| | 11-May-18 | 8.38 | 285 | 9.90 | 7.71 | 331 | 122 | 2.53 | 12.4 | 184 | 22.5 | 16.1 | 1.78 | 23.9 | 0.14 | 0.20 | <0.05 | <0.05 | 2.0 |
| | 17-May-19 | 8.03 | 287 | 10.75 | 8.25 | 321 | 130 | 5.61 | 17.4 | 183 | 26.0 | 15.8 | 1.12 | 29.4 | 0.085 | 2.37 * | 0.088 | 0.030 | 2.42 |
| | 12-May-20 | 8.59 | 356 | 10.36 | 8.13 | 421 | 117 | 14.6 | 25.2 | 202 | 23.9 | 13.9 | 1.29 | 49.0 | 0.063 | 0.20 | 0.151 | 0.022 | 2.51 |
| | 12-May-21 | 7.93 | 210 | 11.5 | 8.24 | 394 | 110 | 16 | 59 | 172 | 23.5 | 12.5 | 1.2 | 49.4 | 0.1 | 0.6 | 0.20 | 0.08 | 1.6 |

Note:  refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **33R** | 16-May-19 | 0.062 | <0.00050 | 0.368 | 0.0279 | | | |
| **40** | 9-May-14 | | | 3.80 | 0.268 | | | |
| | 27-May-15 | | | 2.99 | 0.249 | | | |
| | 24-May-16 | | | 3.15 | 0.211 | | | |
| | 1-Nov-16 | 0.022 | <0.003 | 2.96 | 0.212 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.024 | 0.005 | 9.96 | 0.931 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.020 | 0.004 | 2.79 | 0.219 | <0.68 | <0.80 | <0.40 |
| | 16-May-19 | 0.019 | <0.00050 | 2.80 | 0.225 | <0.50 | <0.50 | <0.50 |
| | 11-May-20 | 0.019 | <0.00050 | 2.85 | 0.218 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.036 | 0.00029 | 3.19 | 0.242 | <0.2 | <0.5 | <0.5 |
| **41** | 9-May-14 | | | 54.7 | 0.361 | | | |
| | 27-May-15 | | | 49.2 | 0.278 | | | |
| | 25-May-16 | | | 63.7 | 0.328 | | | |
| | 1-Nov-16 | 4.85 | 0.006 | 43.6 | 0.179 | 0.90 | 25 | 71 |
| | 4-May-17 | 1.70 | 0.004 | 60.5 | 0.436 | 1.2 | 19 | 21 |
| | 10-May-18 | 1.71 | 0.011 | 55.7 | 0.484 | <6.80 | <8.00 | <4.00 |
| | 16-May-19 | 1.94 | <0.0050 | 59.4 | 0.486 | <0.50 | 17.5 | 14.5 |
| | 12-May-20 | 1.63 | <0.0050 | 59.3 | 0.448 | <0.50 | 15.4 | 12.1 |
| | 12-May-21 | 1.90 | 0.00306 | 60.6 | 0.391 | 0.5 | 18.8 | 17.9 |
| **43** | 25-May-16 | | | 0.039 | 0.010 | | | |
| | 4-May-17 | 0.153 | <0.003 | <0.010 | 0.009 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.14 | <0.003 | 0.027 | 0.010 | <0.68 | <0.80 | <0.40 |
| | 17-May-19 | 0.133 | <0.00050 | 0.034 | 0.00864 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.166 | <0.00050 | 0.145 | 0.01230 | <0.50 | <0.50 | <0.50 |
| | 12-May-21 | 0.162 | 0.00012 | 0.01 | <0.002 | <0.2 | <0.5 | <0.5 |

Note: refer to notation page for groundwater notation details

# Table D-1: Groundwater Chemical Results - Shallow Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **44** | 24-May-16 | 7.40 | 617 | 11.3 | 8.11 | 800 | 362 | 13.9 | 46.0 | 269 | 87.4 | 34.8 | 1.35 | 6.58 | | | | | |
| | 5-May-17 | 7.81 | 788 | 9.00 | 8.22 | 840 | 385 | 12.3 | 45.8 | 262 | 96.0 | 35.3 | 1.37 | 6.21 | 0.07 | <0.10 | 27.4 | <0.25 | 1.9 |
| | 11-May-18 | 7.66 | 713 | 9.12 | 7.93 | 738 | 384 | 12.5 | 41.6 | 286 | 96.9 | 34.4 | 1.32 | 6.23 | <0.02 | <0.10 | 27.4 | <0.25 | 0.8 |
| | 17-May-19 | 7.78 | 626 | 10.63 | 7.62 | 708 | 395 | 13.8 | 42.0 | 274 | 98.7 | 35.9 | 1.26 | 6.35 | <0.010 | 0.46 | 24.1 | <0.010 | 3.12 |
| | 12-May-20 | 7.83 | 661 | 9.24 | 7.58 | 762 | 384 | 13.6 | 37.7 | 302 | 98.4 | 33.6 | 1.27 | 6.29 | 0.016 | <0.15 | 20.7 | <0.010 | 2.17 |
| | 12-May-21 | 7.89 | 750 | 10.3 | 7.98 | 667 | 342 | 16 | 61 | 229 | 86.8 | 30.5 | 1.39 | 7.22 | <0.1 | <0.5 | 15.4 | <0.03 | 1.2 |
| **45** | 28-Aug-19 | 8.20 | 310 | 13.89 | 8.24 | 385 | 146 | 3.23 | 36.1 | 171 | 34.0 | 14.8 | 2.27 | 32.5 | 0.137 | 18.4 | <0.020 | <0.010 | 2.48 |
| | 12-May-20 | 8.50 | 290 | 9.13 | 7.90 | 334 | 143 | 1.14 | 19.4 | 157 | 33.3 | 14.6 | 1.62 | 28.2 | 0.131 | 0.22 | <0.020 | 0.048 | 4.30 |
| | 11-May-21 | 8.15 | 3.5 | 8.8 | 8.24 | 328 | 184 | <1 | 25 | 153 | 50.1 | 14.3 | 1.05 | 24.6 | <0.1 | <0.5 | 0.11 | <0.03 | 1.8 |
| **46** | 28-Aug-19 | 8.01 | 208 | 12.95 | 7.99 | 471 | 245 | 4.55 | 24.9 | 236 | 62.2 | 21.9 | 2.01 | 15.9 | 0.072 | 9.3 | <0.020 | <0.010 | 5.62 |
| | 12-May-20 | 8.25 | 330 | 9.43 | 7.88 | 430 | 247 | 2.97 | 14.8 | 222 | 63.4 | 21.4 | 1.10 | 4.35 | 0.052 | 0.56 | <0.020 | <0.010 | 2.59 |
| | 11-May-21 | 8.18 | 385 | 10.4 | 8.20 | 391 | 262 | 2 | 33 | 198 | 71.4 | 20.3 | 1.02 | 2.36 | <0.1 | <0.5 | <0.06 | <0.03 | 3.1 |

Note: refer to notation page for groundwater notation details

# Table D-1:  Groundwater Chemical Results - Shallow Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **44** | 24-May-16 | | | <0.010 | 0.003 | | | |
| | 5-May-17 | 0.04 | <0.003 | <0.010 | <0.002 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.03 | 0.003 | <0.010 | <0.002 | <0.17 | <0.20 | <0.10 |
| | 17-May-19 | 0.023 | 0.00078 | 0.010 | 0.00086 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.022 | 0.00092 | 0.034 | 0.00124 | <0.50 | <0.50 | <0.50 |
| | 12-May-21 | 0.032 | 0.00040 | 0.01 | <0.002 | <0.2 | <0.5 | <0.5 |
| **45** | 28-Aug-19 | 0.127 | <0.00050 | 0.020 | 0.0378 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.133 | <0.00050 | 0.050 | 0.0293 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.118 | 0.00015 | 0.049 | 0.0193 | <0.2 | <0.5 | <0.5 |
| **46** | 28-Aug-19 | 0.016 | <0.00050 | 0.509 | 0.0199 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.013 | <0.00050 | 0.667 | 0.0181 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.015 | 0.00014 | 0.562 | 0.0177 | <0.4 | <1 | <1 |

Note:  refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **21** | 27-Oct-81 | | | | 7.7 | 510 | | 10.0 | | | | | | | | | | | |
| | 29-Oct-81 | | | | 8.0 | 510 | | 8.0 | | | | | | | | | | | |
| | 28-Jan-82 | | | | 7.9 | 490 | 304 | 5.0 | | 240 | | | | | | | | | 2.1 |
| | 29-Apr-82 | | | | 7.1 | 445 | 340 | 8.0 | | | | | | | | | | | 9.3 |
| | 2-Sep-82 | | | | 7.7 | 550 | 283 | 9.5 | | | 76.0 | 22.6 | | | | | | | 3.2 |
| | 30-Mar-83 | | | | 7.5 | 450 | 276 | 8.0 | | | | | | | | | | | 1.3 |
| | 14-Jun-83 | | | | 7.4 | 490 | 280 | 7.0 | | | | | | | | | | | 1.3 |
| | 14-Sep-83 | | | | 7.3 | 480 | 278 | 9.0 | | | | | | | | | | | 1.1 |
| | 8-Dec-83 | | | | 7.4 | 480 | 440 | 11.0 | | | | | | | | | | | 1.8 |
| | 30-Apr-84 | | | | 7.3 | 570 | 298 | 9.0 | | | | | | | | | | | 0.9 |
| | 5-Nov-84 | | | | 7.1 | 550 | 296 | 8.0 | | 231 | 79.0 | 24.0 | | | | | | | 1.2 |
| | 29-Apr-85 | | | | 7.87 | 575 | 267 | 10.0 | | 246 | 70.0 | 22.4 | | | | | | | 1.6 |
| | 21-Oct-85 | | | | 7.94 | 555 | 271 | 10.0 | | 261 | 71.0 | 22.8 | | | | | | | 3.6 |
| | 30-Apr-86 | | | | 7.72 | 460 | 284 | 14.0 | | 261 | 77.0 | 22.2 | | | | | | | 2.4 |
| | 14-Oct-86 | | | | 7.66 | 580 | 286 | 13.5 | | 255 | 76.5 | 23.0 | | | | | | | 2.3 |
| | 20-Apr-87 | | | | 7.76 | 540 | 260 | 12.5 | | | 67.0 | 22.4 | | | | | | | 2.6 |
| | 6-Oct-87 | | | | 7.72 | 495 | 259 | 9.4 | | 223 | 69.3 | 20.8 | | | | | | | 2.4 |
| | 10-May-88 | | | | 7.70 | 510 | 265 | 10.5 | | 190 | 71.2 | 21.2 | | | | | | | 1.6 |
| | 12-Oct-88 | | | | 7.60 | 510 | 263 | 14.0 | | 242 | 69.0 | 22.0 | | | | | | | 2.7 |
| | 30-Oct-89 | | | | 7.71 | 555 | 276 | 14.7 | | 260 | 73.2 | 22.5 | | | | | | | 1.5 |
| | 7-May-90 | | | | 7.93 | 534 | 279 | 13.8 | | 251 | 73.9 | 22.9 | | | | | | | 1.1 |
| | 29-Oct-90 | | | | 7.60 | 532 | 254 | 13.3 | | 243 | 69.0 | 19.8 | | | | | | | 6.0 |
| | 6-May-91 | | | | 7.74 | 517 | 251 | 11.8 | | 241 | 68.6 | 19.0 | | | | | | | |
| | 26-May-92 | | | | 7.56 | 428 | 210 | 9.2 | | 196 | 57.3 | 16.3 | | | | | | | 2.0 |
| | 6-Oct-92 | | | | 7.51 | 409 | 214 | 9.4 | | 181 | 59.6 | 15.7 | | | | | | | 2.5 |
| | 3-May-93 | | | | 7.57 | 459 | 220 | 10.7 | | 221 | 60.3 | 16.9 | | | | | | | 1.6 |
| | 26-Oct-93 | | | | 7.41 | 453 | 227 | 12.7 | | 230 | 63.3 | 16.7 | | | | | | | 2.5 |
| | 25-Apr-94 | | | | 7.84 | 499 | 257 | 11.4 | | 246 | 70.0 | 19.9 | | | | | | | 2.2 |
| | 25-Oct-94 | | | | 7.61 | 491 | 240 | 11.4 | | 231 | 65.3 | 18.6 | | | | | | | 1.9 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| **Well** | **Date** | **Boron** | **Chromium** | **Iron** | **Manganese** | **Vinyl Chloride** | **Benzene** | **1,4 Dichlorobenzene** |
| | **Units** | | | | | **µg/L** | **µg/L** | **µg/L** |
| | **ODWQS** | **5.0 *IMAC*** | **0.05 *MAC*** | **0.3 *AO*** | **0.05 *AO*** | **1 *MAC*** | **1 *MAC*** | **5 *MAC* 1 *AO*** |
| **21** | 27-Oct-81 | | | | | | | |
| | 29-Oct-81 | | | | | | | |
| | 28-Jan-82 | | | <0.02 | | | | |
| | 29-Apr-82 | | | | | | | |
| | 2-Sep-82 | | | | | | | |
| | 30-Mar-83 | | | | | | | |
| | 14-Jun-83 | | | | | | | |
| | 14-Sep-83 | | | | | | | |
| | 8-Dec-83 | | | | | | | |
| | 30-Apr-84 | | | | | | | |
| | 5-Nov-84 | | | 0.04 | | | | |
| | 29-Apr-85 | | | 1.06 | | | | |
| | 21-Oct-85 | | | <0.01 | | | | |
| | 30-Apr-86 | | | 0.07 | | | | |
| | 14-Oct-86 | | | <0.01 | | | | |
| | 20-Apr-87 | | | 0.12 | | | | |
| | 6-Oct-87 | | | 0.01 | | | | |
| | 10-May-88 | | | 0.02 | | | | |
| | 12-Oct-88 | | | <.05 | | | | |
| | 30-Oct-89 | | | 0.02 | | | | |
| | 7-May-90 | | | 0.02 | | | | |
| | 29-Oct-90 | | | 0.45 | | | | |
| | 6-May-91 | | | 0.02 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.02 | | | | |
| | 3-May-93 | | | 0.02 | | | | |
| | 26-Oct-93 | | | 0.04 | | | | |
| | 25-Apr-94 | | | 0.01 | | | | |
| | 25-Oct-94 | | | 0.33 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | μS/cm | ºC | SU | μS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **21** | 16-May-95 | | | | 7.64 | 502 | 257 | 11.1 | | 257 | 69.9 | 19.9 | | | | | | | 1.6 |
| **cont'd** | 15-Jun-97 | | | | 8.10 | 555 | 316 | 13.5 | | 253 | 85.2 | 25.0 | 1.20 | | | | | | |
| | 15-Jun-98 | | | | 7.58 | 441 | 250 | 10.0 | | 200 | 69.7 | 18.5 | 2.31 | | | | | | |
| | 15-Jun-99 | | | | 7.84 | 498 | 294 | 12.0 | | 200 | 84.0 | 20.5 | 1.81 | | | | | | |
| | 15-Jun-00 | | | | 8.20 | 517 | 275 | 12.0 | | 248 | 75.1 | 21.3 | 0.56 | | | | | | |
| | 15-Jun-01 | | | | 7.70 | 514 | 300 | 13.0 | | 231 | 82.1 | 23.1 | 0.45 | | | | | | |
| | 15-Jun-02 | | | | 7.64 | 559 | 294 | 15.0 | | 257 | 78.2 | 24.0 | 1.41 | | | | | | |
| | 15-Jun-03 | | | | 7.78 | 536 | 298 | 16.0 | | 265 | 80.3 | 23.7 | 1.57 | | | | | | |
| | 15-Jun-04 | | | | 7.84 | 565 | 271 | 17.0 | | 262 | 71.6 | 22.3 | 0.40 | | | | | | |
| | 15-Jun-05 | | | | 8.19 | 542 | 308 | 17.4 | | 253 | 83.7 | 24.1 | 1.9 | | | | | | |
| | 15-Jun-06 | | | | 7.53 | 526 | 320 | 20.0 | | 260 | 92.6 | 22.2 | 2.0 | | | | | | |
| | 29-May-07 | | | | 7.24 | 544 | 260 | 17.0 | | 260 | 68.6 | 21.9 | 2.0 | 8.1 | | | | | |
| | 5-Jun-08 | | | | 7.90 | 594 | 290 | 29.0 | | 270 | 77.8 | 23.6 | 2.0 | 10.2 | | | | | |
| | 4-Jun-09 | | | | 7.95 | 566 | 282 | 18.3 | | 248 | 76.6 | 22.1 | 1.9 | 8.12 | | | | | |
| | 14-May-10 | 7.72 | 580 | 10.9 | 7.96 | 579 | 347 | 28.6 | | 270 | 95.5 | 26.4 | 1.59 | 10.0 | | | | | |
| | 15-Jun-11 | 7.89 | 468 | 11.1 | 8.06 | 562 | 312 | 27.0 | | 261 | 86.7 | 23.1 | 1.48 | 10.0 | | | | | |
| | 23-May-12 | 7.31 | 485 | 11.0 | 7.85 | 592 | 304 | 25.9 | | 265 | 84.2 | 22.8 | 1.55 | 10.2 | | | | | |
| | 9-May-13 | 7.71 | 650 | 9.5 | 8.14 | 601 | 324 | 25.4 | | 237 | 88.2 | 25.1 | 1.59 | 10.7 | | | | | |
| | 9-May-14 | 7.71 | 650 | 9.5 | 8.11 | 606 | 303 | 24.7 | | 252 | 81.5 | 24.1 | 1.66 | 10.7 | | | | | |
| **21R** | 25-May-16 | 7.52 | 408 | 11.9 | 8.26 | 536 | 210 | 20.1 | 33.2 | 237 | 50.2 | 20.6 | 1.92 | 27.5 | | | | | |
| | 1-Nov-16 | 8.07 | 637 | 10.2 | 8.14 | 547 | | 22.8 | 24.9 | 240 | 60.0 | 20.5 | 1.60 | 19.1 | 0.15 | 0.38 | <0.05 | <0.05 | 1.4 |
| | 4-May-17 | 7.94 | 555 | 9.96 | 8.22 | 602 | 238 | 23.4 | 27.4 | 253 | 59.4 | 21.7 | 1.61 | 23.0 | 0.20 | 0.34 | <0.05 | <0.05 | 1.1 |
| | 10-May-18 | 7.61 | 504 | 11.10 | 7.83 | 541 | 236 | 22.1 | 24.1 | 269 | 59.4 | 21.2 | 1.70 | 25.1 | 0.09 | 0.34 | <0.05 | <0.05 | 1.4 |
| | 16-May-19 | 7.73 | 477 | 10.28 | 7.70 | 517 | 268 | 25.3 | 20.9 | 261 | 67.4 | 24.2 | 1.51 | 21.9 | 0.093 | 0.45 | <0.020 | <0.010 | 1.97 |
| | 11-May-20 | 7.85 | 513 | 9.00 | 7.78 | 556 | 260 | 26.3 | 15.0 | 262 | 66.5 | 22.8 | 1.59 | 17.4 | 0.105 | 0.18 | <0.020 | <0.010 | 2.36 |
| | 11-May-21 | 7.66 | 630 | 9.8 | 8.22 | 609 | 312 | 36 | 14 | 266 | 83.6 | 25.2 | 1.63 | 15.0 | 0.1 | <0.5 | <0.06 | <0.03 | 1.7 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **21** | 16-May-95 | | | 0.03 | | | | |
| **cont'd** | 15-Jun-97 | | | <0.02 | 0.250 | | | |
| | 15-Jun-98 | | | <0.02 | <0.02 | | | |
| | 15-Jun-99 | | | 0.04 | 0.090 | | | |
| | 15-Jun-00 | | | <0.02 | 0.030 | | | |
| | 15-Jun-01 | | | <0.02 | <0.02 | | | |
| | 15-Jun-02 | | | <0.02 | <0.02 | | | |
| | 15-Jun-03 | | | <0.02 | <0.02 | | | |
| | 15-Jun-04 | | | <0.02 | <0.02 | | | |
| | 15-Jun-05 | | | 0.06 | <0.02 | | | |
| | 15-Jun-06 | | | <0.05 | 0.009 | | | |
| | 29-May-07 | | | <0.05 | 0.003 | | | |
| | 5-Jun-08 | | | <0.05 | 0.147 | | | |
| | 4-Jun-09 | | | <0.050 | 0.004 | | | |
| | 14-May-10 | | | 0.852 | 0.135 | | | |
| | 15-Jun-11 | | | 0.601 | 0.110 | | | |
| | 23-May-12 | | | 0.280 | 0.093 | | | |
| | 9-May-13 | | | 0.591 | 0.122 | | | |
| | 9-May-14 | | | 0.532 | 0.200 | | | |
| **21R** | 25-May-16 | | | 0.645 | 0.024 | | | |
| | 1-Nov-16 | 0.046 | <0.003 | 0.814 | 0.032 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.047 | <0.003 | 0.752 | 0.035 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.049 | <0.003 | 0.741 | 0.036 | | | |
| | 16-May-19 | 0.050 | 0.00054 | 0.933 | 0.0382 | | | |
| | 11-May-20 | 0.046 | <0.00050 | 0.905 | 0.0302 | | | |
| | 11-May-21 | 0.066 | 0.00008 | 1.08 | 0.0449 | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **24** | 19-Feb-82 | | | | 8.1 | 430 | 215 | 15.0 | | 180 | | | | | | | | | 230 |
| | 29-Apr-82 | | | | 7.8 | 345 | 212 | 2.0 | | | | | | | | | | | 14.0 |
| | 30-Apr-82 | | | | 8.1 | 377 | 182 | 1.6 | | | | | | | | | | | 14.3 |
| | 4-May-82 | | | | 8.1 | 372 | 177 | 1.5 | | | 36.0 | 21.0 | | | | | | | |
| | 2-Sep-82 | | | | 7.3 | 372 | 179 | 0.5 | | | 37.5 | 20.8 | | | | | | | 8.9 |
| | 30-Mar-83 | | | | 7.7 | 340 | 196 | | | | | | | | | | | | 8.8 |
| | 13-Jun-83 | | | | 7.7 | 860 | 200 | | | | | | | | | | | | 3.3 |
| | 13-Sep-83 | | | | 7.7 | 350 | 188 | 1.0 | | | | | | | | | | | 4.1 |
| | 7-Dec-83 | | | | 7.7 | 330 | 235 | | | | | | | | | | | | 3.2 |
| | 1-May-84 | | | | 7.7 | 390 | 188 | 1.0 | | | | | | | | | | | 5.4 |
| | 6-Nov-84 | | | | 7.4 | 385 | 172 | | | 188 | 39.0 | 18.0 | | | | | | | 2.6 |
| | 30-Apr-85 | | | | 7.27 | 920 | 404 | 65.5 | | 348 | 118 | 26.4 | | | | | | | 3.8 |
| | 21-Oct-85 | | | | 8.02 | 382 | 182 | | | 218 | 40.0 | 19.8 | | | | | | | 3.5 |
| | 30-Apr-86 | | | | 7.75 | 304 | 167 | 2.0 | | 204 | 37.5 | 17.8 | | | | | | | 5.3 |
| | 15-Oct-86 | | | | 7.40 | 350 | 188 | | | 206 | 44.0 | 19.0 | | | | | | | 3.6 |
| | 20-Apr-87 | | | | 7.61 | 383 | 177 | 1.0 | | 206 | 38.5 | 19.6 | | | | | | | 4.2 |
| | 6-Oct-87 | | | | 7.69 | 371 | 185 | 1.4 | | 202 | 40.1 | 20.6 | | | | | | | 4.1 |
| | 10-May-88 | | | | 7.46 | 348 | 152 | 4.3 | | 141 | 34.6 | 15.9 | | | | | | | 4.3 |
| | 12-Oct-88 | | | | 7.40 | 340 | 137 | 4.0 | | 174 | 30.0 | 15.0 | | | | | | | 4.1 |
| | 30-Oct-89 | | | | 7.47 | 366 | 143 | 3.5 | | 197 | 31.7 | 15.5 | | | | | | | 3.7 |
| | 7-May-90 | | | | 7.64 | 369 | 149 | 3.3 | | 198 | 34.2 | 15.3 | | | | | | | 3.6 |
| | 29-Oct-90 | | | | 7.45 | 366 | 143 | 3.0 | | 196 | 32.4 | 15.0 | | | | | | | 4.4 |
| | 6-May-91 | | | | 7.53 | 357 | 146 | 1.3 | | 195 | 32.5 | 15.6 | | | | | | | |
| | 4-Nov-91 | | | | 7.95 | 390 | 176 | 1.1 | | 197 | 37.3 | 20.0 | | | | | | | 3.6 |
| | 26-May-92 | | | | 7.67 | 394 | 189 | 0.5 | | 214 | 41.0 | 20.9 | | | | | | | 3.2 |
| | 6-Oct-92 | | | | 7.79 | 391 | 202 | 0.9 | | 199 | 44.7 | 21.9 | | | | | | | 3.6 |
| | 3-May-93 | | | | 7.75 | 379 | 171 | 1.6 | | 216 | 37.8 | 18.6 | | | | | | | 3.6 |
| | 26-Oct-93 | | | | 7.96 | 383 | 181 | 2.2 | | 226 | 41.6 | 18.8 | | | | | | | 3.8 |
| | 25-Apr-94 | | | | 7.65 | 342 | 147 | 2.4 | | 190 | 34.3 | 14.9 | | | | | | | 4.6 |

Note: refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **24** | 19-Feb-82 | | | <0.05 | | | | |
| | 29-Apr-82 | | | | | | | |
| | 30-Apr-82 | | | | | | | |
| | 4-May-82 | | | | | | | |
| | 2-Sep-82 | | | | | | | |
| | 30-Mar-83 | | | | | | | |
| | 13-Jun-83 | | | | | | | |
| | 13-Sep-83 | | | | | | | |
| | 7-Dec-83 | | | | | | | |
| | 1-May-84 | | | | | | | |
| | 6-Nov-84 | | | <0.04 | | | | |
| | 30-Apr-85 | | | 6.10 | | | | |
| | 21-Oct-85 | | | 0.02 | | | | |
| | 30-Apr-86 | | | 0.03 | | | | |
| | 15-Oct-86 | | | 0.03 | | | | |
| | 20-Apr-87 | | | 0.05 | | | | |
| | 6-Oct-87 | | | 0.05 | | | | |
| | 10-May-88 | | | 0.04 | | | | |
| | 12-Oct-88 | | | <.05 | | | | |
| | 30-Oct-89 | | | 0.06 | | | | |
| | 7-May-90 | | | 0.05 | | | | |
| | 29-Oct-90 | | | 0.17 | | | | |
| | 6-May-91 | | | 0.31 | | | | |
| | 4-Nov-91 | | | 0.01 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.07 | | | | |
| | 3-May-93 | | | 0.03 | | | | |
| | 26-Oct-93 | | | 0.45 | | | | |
| | 25-Apr-94 | | | 0.26 | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **24** | 25-Oct-94 | | | | 7.98 | 401 | 186 | 1.2 | | 219 | 40.3 | 20.6 | | | | | | | 3.2 |
| **cont'd** | 16-May-95 | | | | 7.97 | 390 | 192 | 1.2 | | 214 | 42.9 | 20.6 | | | | | | | 3.9 |
| | 15-Jun-97 | | | | 8.09 | 369 | 187 | 2.1 | | 202 | 42.4 | 19.8 | 1.20 | 13.4 | | | | | |
| | 15-Jun-98 | | | | 8.00 | 333 | 175 | 2.0 | | 178 | 40.4 | 18.0 | 2.13 | 12.7 | | | | | |
| | 15-Jun-99 | | | | 8.16 | 382 | 203 | 1.0 | | 199 | 46.9 | 20.8 | 0.99 | 11.3 | | | | | |
| | 15-Jun-00 | | | | 8.24 | 382 | 184 | 1.0 | | 205 | 40.9 | 19.9 | 0.58 | 16.3 | | | | | |
| | 15-Jun-01 | | | | 7.96 | 373 | 221 | 1.0 | | 201 | 51.2 | 22.5 | 0.48 | 15.0 | | | | | |
| | 15-Jun-02 | | | | 7.77 | 382 | 193 | 1.0 | | 209 | 41.6 | 21.7 | 0.84 | 11.9 | | | | | |
| | 15-Jun-03 | | | | 7.89 | 383 | 203 | 1.0 | | 213 | 44.9 | 22.0 | 0.78 | 12.8 | | | | | |
| | 15-Jun-04 | | | | 7.97 | 401 | 178 | 2.0 | | 212 | 38.6 | 19.8 | 0.62 | 13.9 | | | | | |
| | 15-Jun-05 | | | | 8.36 | 384 | 207 | 1.7 | | 211 | 45.7 | 22.5 | 1.1 | 13.0 | | | | | |
| | 15-Jun-06 | | | | 7.79 | 288 | 130 | 3.0 | | 170 | 28.3 | 15.2 | 2.0 | 15.4 | | | | | |
| | 29-May-07 | | | | 7.60 | 375 | 230 | 2.0 | | 200 | 57.8 | 20.5 | 2.0 | 11.2 | | | | | |
| | 5-Jun-08 | | | | 8.07 | 391 | 190 | <2 | | 200 | 44.8 | 20.0 | 2.0 | 12.6 | | | | | |
| | 4-Jun-09 | | | | 8.08 | 385 | 199 | <2.0 | | 207 | 46.2 | 20.3 | 1.8 | 11.0 | | | | | |
| | 13-May-10 | 7.94 | 290 | 8.9 | 8.05 | 368 | 216 | 1.29 | | 208 | 48.9 | 22.9 | 1.05 | 11.4 | | | | | |
| | 15-Jun-11 | 8.03 | 315 | 10.6 | 8.16 | 364 | 195 | 1.39 | | 204 | 43.9 | 20.7 | 1.00 | 10.9 | | | | | |
| | 23-May-12 | 7.42 | 323 | 9.7 | 7.97 | 387 | 192 | 2.15 | | 207 | 43.1 | 20.5 | 0.96 | 10.9 | | | | | |
| | 23-May-12 | 7.42 | 323 | 9.7 | 8.05 | 390 | 194 | 2.1 | | 207 | 43.5 | 20.7 | 1.0 | 10.9 | | | | | |
| | 9-May-13 | 7.90 | 417 | 9.1 | 8.31 | 424 | 201 | 1.68 | | 205 | 44.7 | 21.6 | 1.07 | 11.1 | | | | | |
| | 9-May-14 | 7.73 | 422 | 9.2 | 8.23 | 396 | 192 | 1.78 | | 197 | 42.1 | 21.0 | 1.03 | 10.9 | | | | | |
| | 27-May-15 | 7.29 | 260 | 11.3 | 8.14 | 404 | 193 | 1.84 | 13.4 | 203 | 44.3 | 19.9 | 0.92 | 11.1 | | | | | |
| **24R** | 25-May-16 | 7.77 | 401 | 12.3 | 7.68 | 500 | 184 | 10.8 | 41.2 | 220 | 35.3 | 23.2 | 2.59 | 32.4 | | | | | |
| | 1-Nov-16 | 8.50 | 418 | 10.2 | 8.02 | 415 | - | 2.92 | 18.2 | 207 | 38.3 | 20.0 | 1.63 | 15.3 | 0.19 | 0.48 | <0.05 | <0.05 | 2.9 |
| | 4-May-17 | 8.10 | 417 | 8.67 | 8.31 | 460 | 186 | 2.64 | 14.2 | 209 | 38.8 | 21.7 | 1.87 | 12.4 | 0.42 | 0.59 | <0.05 | <0.05 | 3.3 |
| | 11-May-18 | 7.93 | 360 | 9.05 | 7.79 | 396 | 188 | 1.59 | 15.4 | 222 | 40.8 | 20.9 | 1.26 | 11.1 | 0.32 | 0.39 | <0.05 | <0.05 | 3.1 |
| | 16-May-19 | 7.52 | 335 | 9.68 | 7.97 | 366 | 205 | 1.58 | 14.1 | 215 | 46.5 | 21.7 | 1.07 | 11.2 | 0.333 | 0.75 | 0.031 | <0.010 | 3.85 |
| | 12-May-20 | 7.98 | 365 | 9.07 | 7.90 | 418 | 206 | 1.91 | 14.7 | 206 | 47.4 | 21.2 | 1.16 | 11.0 | 0.013 | 0.25 | 0.296 | <0.010 | 4.36 |
| | 11-May-21 | 7.77 | 432 | 8.8 | 8.29 | 410 | 238 | 2 | 12 | 208 | 59.5 | 21.8 | 1.18 | 11.5 | 0.4 | <0.5 | 2.48 | <0.03 | 3.7 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **24** | 25-Oct-94 | | | 0.02 | | | | |
| **cont'd** | 16-May-95 | | | 0.04 | | | | |
| | 15-Jun-97 | | | 0.30 | 0.100 | | | |
| | 15-Jun-98 | | | 0.15 | 0.020 | | | |
| | 15-Jun-99 | | | 0.13 | 0.030 | | | |
| | 15-Jun-00 | | | 0.15 | 0.020 | | | |
| | 15-Jun-01 | | | 0.12 | 0.020 | | | |
| | 15-Jun-02 | | | 0.40 | 0.020 | | | |
| | 15-Jun-03 | | | 0.40 | 0.020 | | | |
| | 15-Jun-04 | | | 0.30 | 0.020 | | | |
| | 15-Jun-05 | | | 0.06 | 0.022 | | | |
| | 15-Jun-06 | | | <0.05 | 0.033 | | | |
| | 29-May-07 | | | 0.27 | 0.077 | | | |
| | 5-Jun-08 | | | <0.05 | 0.021 | | | |
| | 4-Jun-09 | | | 0.371 | 0.027 | | | |
| | 13-May-10 | | | 0.622 | 0.019 | | | |
| | 15-Jun-11 | | | 0.595 | 0.014 | | | |
| | 23-May-12 | | | 0.510 | 0.013 | | | |
| | 23-May-12 | | | 0.54 | 0.013 | | | |
| | 9-May-13 | | | 0.584 | 0.017 | | | |
| | 9-May-14 | | | 0.574 | 0.015 | | | |
| | 27-May-15 | | | 0.551 | 0.016 | | | |
| **24R** | 25-May-16 | | | 0.042 | 0.011 | | | |
| | 1-Nov-16 | 0.051 | <0.003 | 0.17 | 0.012 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.046 | <0.003 | 0.33 | 0.014 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.053 | <0.003 | 0.368 | 0.014 | | | |
| | 16-May-19 | 0.045 | <0.00050 | 0.459 | 0.0148 | | | |
| | 12-May-20 | 0.045 | <0.00050 | <0.010 | <0.00050 | | | |
| | 11-May-21 | 0.043 | <0.00008 | 0.567 | 0.0168 | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | μS/cm | °C | SU | μS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| 25 | 19-Feb-82 | | | | 8.1 | 510 | 243 | 21.0 | | 190 | | | | | | | | | 100 |
| | 29-Apr-82 | | | | 7.5 | 580 | 372 | 26.0 | | | | | | | | | | | 2.7 |
| | 30-Apr-82 | | | | 7.9 | 623 | 326 | 26.8 | | | | | | | | | | | 1.5 |
| | 4-May-82 | | | | 7.9 | 602 | 281 | 33.0 | | | 61.0 | 31.2 | | | | | | | |
| | 2-Sep-82 | | | | 7.8 | 600 | 311 | 25.0 | | | 70.5 | 70.5 | | | | | | | 4.0 |
| | 30-Mar-83 | | | | 7.5 | 490 | 300 | 18.0 | | | | | | | | | | | 0.6 |
| | 13-Jun-83 | | | | 7.2 | 490 | 288 | 17.0 | | | | | | | | | | | 1.3 |
| | 13-Sep-83 | | | | 7.5 | 520 | 302 | 21.0 | | | | | | | | | | | 1.3 |
| | 13-Dec-83 | | | | 7.2 | 560 | 326 | 21.0 | | | | | | | | | | | 1.1 |
| | 1-May-84 | | | | 7.4 | 600 | 310 | 20.0 | | | | | | | | | | | 0.6 |
| | 6-Nov-84 | | | | 7.1 | 590 | 297 | 18.0 | | 230 | 71.0 | 29.0 | | | | | | | 0.7 |
| | 30-Apr-85 | | | | 7.74 | 540 | 265 | 19.5 | | 238 | 59.5 | 28.2 | | | | | | | 1.7 |
| | 21-Oct-85 | | | | 7.91 | 520 | 252 | 17.5 | | 240 | 57.5 | 26.2 | | | | | | | 3.5 |
| | 30-Apr-86 | | | | 7.15 | 399 | 227 | 15.0 | | 227 | 50.5 | 24.4 | | | | | | | 2.2 |
| | 15-Oct-86 | | | | 7.40 | 465 | 231 | 13.0 | | 226 | 53.0 | 24.0 | | | | | | | 1.6 |
| | 20-Apr-87 | | | | 7.63 | 438 | 211 | 10.5 | | 214 | 46.5 | 23.0 | | | | | | | 2.4 |
| | 6-Oct-87 | | | | 7.84 | 433 | 239 | 7.6 | | 216 | 54.0 | 25.3 | | | | | | | 1.9 |
| | 10-May-88 | | | | 7.59 | 434 | 226 | 8.3 | | 180 | 51.7 | 23.4 | | | | | | | 1.4 |
| | 12-Oct-88 | | | | 7.60 | 430 | 199 | 10.0 | | 207 | 45.0 | 21.0 | | | | | | | 1.5 |
| | 30-Oct-89 | | | | 7.66 | 432 | 205 | 6.0 | | 218 | 48.2 | 20.4 | | | | | | | 1.1 |
| | 7-May-90 | | | | 8.02 | 445 | 211 | 5.3 | | 231 | 49.7 | 21.0 | | | | | | | 0.7 |
| | 29-Oct-90 | | | | 7.56 | 377 | 171 | 6.9 | | 188 | 40.9 | 16.6 | | | | | | | 2.3 |
| | 6-May-91 | | | | 7.50 | 389 | 186 | 5.9 | | 200 | 43.7 | 18.6 | | | | | | | |
| | 4-Nov-91 | | | | 7.48 | 343 | 155 | 6.5 | | 154 | 35.3 | 16.2 | | | | | | | 3.1 |
| | 26-May-92 | | | | 7.40 | 356 | 174 | 6.2 | | 182 | 40.5 | 17.7 | | | | | | | 2.0 |
| | 6-Oct-92 | | | | 7.70 | 443 | 230 | 4.9 | | 221 | 55.8 | 22.0 | | | | | | | 1.3 |
| | 3-May-93 | | | | 7.79 | 430 | 206 | 4.8 | | 233 | 51.0 | 19.0 | | | | | | | 1.3 |
| | 26-Oct-93 | | | | 7.77 | 414 | 194 | 4.5 | | 234 | 49.0 | 17.3 | | | | | | | 2.3 |
| | 25-Apr-94 | | | | 7.44 | 283 | 133 | 4.4 | | 143 | 32.4 | 12.5 | | | | | | | 2.6 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* *1 AO* |
| **25** | 19-Feb-82 | | | <0.05 | | | | |
| | 29-Apr-82 | | | | | | | |
| | 30-Apr-82 | | | | | | | |
| | 4-May-82 | | | | | | | |
| | 2-Sep-82 | | | | | | | |
| | 30-Mar-83 | | | | | | | |
| | 13-Jun-83 | | | | | | | |
| | 13-Sep-83 | | | | | | | |
| | 13-Dec-83 | | | | | | | |
| | 1-May-84 | | | | | | | |
| | 6-Nov-84 | | | 0.11 | | | | |
| | 30-Apr-85 | | | 0.58 | | | | |
| | 21-Oct-85 | | | 0.27 | | | | |
| | 30-Apr-86 | | | 0.20 | | | | |
| | 15-Oct-86 | | | 0.05 | | | | |
| | 20-Apr-87 | | | 0.01 | | | | |
| | 6-Oct-87 | | | 0.01 | | | | |
| | 10-May-88 | | | 0.09 | | | | |
| | 12-Oct-88 | | | <0.05 | | | | |
| | 30-Oct-89 | | | 0.06 | | | | |
| | 7-May-90 | | | 0.01 | | | | |
| | 29-Oct-90 | | | 0.54 | | | | |
| | 6-May-91 | | | 0.08 | | | | |
| | 4-Nov-91 | | | 0.10 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.03 | | | | |
| | 3-May-93 | | | 0.01 | | | | |
| | 26-Oct-93 | | | 0.43 | | | | |
| | 25-Apr-94 | | | 0.01 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **25** | 25-Oct-94 | | | | 8.00 | 433 | 211 | 3.6 | | 228 | 53.2 | 18.9 | | | | | | | 1.1 |
| **cont'd** | 16-May-95 | | | | 7.37 | 286 | 138 | 4.0 | | 150 | 34.5 | 12.6 | | | | | | | 2.5 |
| | 15-Jun-97 | | | | 8.18 | 402 | 208 | 3.1 | | 188 | 52.6 | 18.5 | 2.0 | 11.1 | | | | | |
| | 15-Jun-98 | | | | 8.16 | 370 | 197 | 4.0 | | 200 | 50.6 | 17.1 | 2.33 | 9.76 | | | | | |
| | 15-Jun-99 | | | | 7.65 | 270 | 147 | 4.0 | | 138 | 40.7 | 11.0 | 2.05 | 6.13 | | | | | |
| | 15-Jun-00 | | | | 8.13 | 442 | 222 | 7.0 | | 225 | 59.1 | 18.1 | 1.06 | 25.3 | | | | | |
| | 15-Jun-01 | | | | 7.47 | 514 | 294 | 10.0 | | 256 | 83.4 | 20.8 | 0.95 | 20.0 | | | | | |
| | 15-Jun-02 | | | | 7.15 | 537 | 279 | 14.0 | | 264 | 76.1 | 21.5 | 2.09 | 12.6 | | | | | |
| | 15-Jun-03 | | | | 7.38 | 785 | 355 | 63.0 | | 335 | 96.7 | 27.6 | 6.27 | 35.5 | | | | | |
| | 15-Jun-04 | | | | 7.26 | 634 | 253 | 37.0 | | 299 | 69.0 | 19.6 | 2.62 | 296 | | | | | |
| | 15-Jun-05 | | | | 7.95 | 949 | 393 | 91.4 | | 363 | 110 | 32.9 | 1.1 | 62.0 | | | | | |
| | 15-Jun-06 | | | | 6.99 | 687 | 370 | 53.0 | | 300 | 109 | 23.4 | 5.0 | 29.3 | | | | | |
| | 29-May-07 | | | | 6.93 | 1518 | 500 | 213 | | 500 | 120 | 47.9 | 15.0 | 88.0 | | | | | |
| | 5-Jun-08 | | | | 7.49 | 1040 | 370 | 107 | | 390 | 95.4 | 31.9 | 11.0 | 60.8 | | | | | |
| | 4-Jun-09 | | | | 7.40 | 835 | 341 | 59.3 | | 345 | 92.4 | 26.9 | 7.4 | 42.2 | | | | | |
| | 13-May-10 | 7.47 | 540 | 10.0 | 8.00 | 547 | 314 | 28.1 | | 261 | 85.3 | 24.5 | 2.44 | 15.4 | | | | | |
| | 15-Jun-11 | 7.49 | 500 | 11.9 | 8.02 | 541 | 278 | 27.3 | | 252 | 75.5 | 21.8 | 2.15 | 14.6 | | | | | |
| | 23-May-12 | 6.93 | 520 | 12.0 | 7.87 | 616 | 290 | 34.5 | | 269 | 77.3 | 23.5 | 3.89 | 22.0 | | | | | |
| | 9-May-13 | 7.21 | 732 | 9.3 | 8.22 | 702 | 325 | 38.0 | | 286 | 88.4 | 25.4 | 2.68 | 20.1 | | | | | |
| | 9-May-14 | 6.92 | 1890 | 11.5 | 8.14 | 789 | 327 | 72.1 | | 276 | 83.0 | 29.1 | 2.47 | 37.8 | | | | | |
| | 27-May-15 | 7.02 | 2208 | 14.1 | 7.60 * | 3640 * | 910 * | 571 * | 2.8 * | 1210 * | 183 * | 110 * | 35.5 * | 353 * | | | | | |
| **25R** | 25-May-16 | 7.70 | 331 | 12.5 | 7.97 | 418 | 172 | 7.00 | 12.7 | 212 | 41.7 | 16.4 | 1.62 | 16.5 | | | | | |
| | 1-Nov-16 | 8.40 | 398 | 12.8 | 7.70 | 392 | - | 5.37 | 8.48 | 195 | 39.9 | 15.9 | 1.65 | 15.5 | 0.18 | 0.18 | <0.05 | <0.05 | 1.9 |
| | 4-May-17 | 8.02 | 404 | 10.53 | 8.10 | 444 | 184 | 6.60 | 8.31 | 212 | 45.1 | 17.3 | 1.55 | 12.6 | 0.19 | 0.35 | <0.05 | <0.05 | 1.9 |
| | 10-May-18 | 7.75 | 359 | 11.98 | 7.89 | 415 | 188 | 8.86 | 8.46 | 224 | 46.9 | 17.3 | 1.38 | 12.1 | 0.12 | 0.12 | <0.05 | <0.05 | 1.8 |
| | 17-May-19 | 7.88 | 353 | 12.49 | 7.86 | 408 | 218 | 12.8 | 10.0 | 218 | 56.1 | 19.0 | 1.31 | 12.5 | 0.147 | 0.32 | <0.020 | <0.010 | 2.25 |
| | 12-May-20 | 8.17 | 357 | 10.33 | 7.93 | 405 | 160 | 8.69 | 4.20 | 219 | 35.9 | 17.1 | 1.64 | 27.2 | 0.060 | <0.15 | <0.020 | <0.010 | 5.42 |
| | 12-May-21 | 7.83 | 444 | 12.0 | 8.32 | 427 | 206 | 13 | 9 | 206 | 53.8 | 17.4 | 1.30 | 13.1 | 0.2 | <0.5 | 0.22 | <0.03 | 2.3 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **25** | 25-Oct-94 | | | 0.01 | | | | |
| **cont'd** | 16-May-95 | | | 0.02 | | | | |
| | 15-Jun-97 | | | 0.02 | 0.100 | | | |
| | 15-Jun-98 | | | 0.14 | 0.090 | | | |
| | 15-Jun-99 | | | 0.07 | 0.060 | | | |
| | 15-Jun-00 | | | 0.28 | 0.130 | | | |
| | 15-Jun-01 | | | 0.30 | 0.160 | | | |
| | 15-Jun-02 | | | 0.15 | 0.100 | | | |
| | 15-Jun-03 | | | 0.20 | 0.360 | | | |
| | 15-Jun-04 | | | 0.02 | 0.190 | | | |
| | 15-Jun-05 | | | <0.05 | 0.150 | | | |
| | 15-Jun-06 | | | 0.12 | 0.165 | | | |
| | 29-May-07 | | | 0.07 | 0.825 | | | |
| | 5-Jun-08 | | | <0.05 | 0.244 | | | |
| | 4-Jun-09 | | | <0.050 | 0.184 | | | |
| | 13-May-10 | | | 1.90 | 0.074 | | | |
| | 15-Jun-11 | | | 1.78 | 0.053 | | | |
| | 23-May-12 | | | 1.71 | 0.068 | | | |
| | 9-May-13 | | | 1.79 | 0.110 | | | |
| | 9-May-14 | | | 1.39 | 0.082 | | | |
| | 27-May-15 | | | 15.6 * | 1.58 * | | | |
| **25R** | 25-May-16 | | | 0.384 | 0.026 | | | |
| | 1-Nov-16 | 0.069 | <0.003 | 0.394 | 0.025 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.061 | <0.003 | 0.350 | 0.025 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.057 | <0.003 | 0.474 | 0.026 | | | |
| | 17-May-19 | 0.047 | <0.00050 | 0.563 | 0.0258 | | | |
| | 12-May-20 | 0.068 | <0.00050 | 0.182 | 0.00549 | | | |
| | 12-May-21 | 0.057 | 0.00013 | 0.70 | 0.026 | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **27** | 5-Apr-83 | | | | 7.2 | 500 | 318 | 10.0 | | 265 | 89.0 | 26.0 | | | | | | | 0.3 |
| | 15-Jun-83 | | | | 7.3 | 550 | 312 | 12.0 | | 258 | 75.0 | 22.0 | | | | | | | 0.8 |
| | 4-Aug-83 | | | | 7.3 | 400 | | 13.0 | | | | | | | | | | | |
| | 19-Aug-83 | | | | 7.7 | 545 | | 12.0 | | | | | | | | | | | |
| | 3-Sep-83 | | | | | | | | | | | | | | | | | | |
| | 13-Sep-83 | | | | 7.3 | 550 | 328 | 12.0 | | | | | | | | | | | 0.5 |
| | 7-Dec-83 | | | | 7.3 | 510 | 344 | 13.0 | | | | | | | | | | | 1.0 |
| | 30-Apr-84 | | | | 7.3 | 630 | 342 | 13.0 | | | | | | | | | | | 0.7 |
| | 5-Nov-84 | | | | 7.1 | 630 | 335 | 12.0 | | 257 | 93.0 | 25.0 | | | | | | | 0.4 |
| | 29-Apr-85 | | | | 7.56 | 650 | 333 | 14.5 | | 272 | 91.5 | 25.2 | | | | | | | 0.8 |
| | 21-Oct-85 | | | | 7.76 | 620 | 338 | 14.5 | | 266 | 92.0 | 26.2 | | | | | | | 1.2 |
| | 30-Apr-86 | | | | 7.53 | 484 | 323 | 15.5 | | 272 | 89.0 | 24.4 | | | | | | | 1.9 |
| | 15-Oct-86 | | | | 7.00 | 620 | 329 | 12.0 | | 278 | 92.0 | 24.0 | | | | | | | 1.3 |
| | 20-Apr-87 | | | | 7.43 | 635 | 318 | 15.5 | | 275 | 87.0 | 24.4 | | | | | | | 2.0 |
| | 6-Oct-87 | | | | 7.65 | 615 | 357 | 15.5 | | 283 | 98.3 | 27.0 | | | | | | | 1.5 |
| | 10-May-88 | | | | 7.52 | 645 | 358 | 19.1 | | 236 | 99.7 | 26.5 | | | | | | | 1.1 |
| | 12-Oct-88 | | | | 7.60 | 610 | 326 | 20.0 | | 272 | 91.0 | 24.0 | | | | | | | 0.5 |
| | 30-Oct-89 | | | | 7.62 | 646 | 335 | 19.7 | | 288 | 92.8 | 25.0 | | | | | | | 0.9 |
| | 7-May-90 | | | | 7.84 | 631 | 324 | 19.1 | | 285 | 88.7 | 24.7 | | | | | | | 0.6 |
| | 29-Oct-90 | | | | 7.85 | 643 | 327 | 19.4 | | 286 | 91.1 | 24.1 | | | | | | | 1.1 |
| | 6-May-91 | | | | 7.66 | 624 | 330 | 17.9 | | 281 | 91.6 | 24.5 | | | | | | | |
| | 4-Nov-91 | | | | 7.75 | 644 | 298 | 19.5 | | 274 | 77.6 | 25.3 | | | | | | | 1.5 |
| | 26-May-92 | | | | 7.58 | 642 | 330 | 17.8 | | 268 | 88.7 | 26.3 | | | | | | | 1.4 |
| | 6-Oct-92 | | | | 7.70 | 645 | 348 | 19.9 | | 273 | 94.1 | 27.3 | | | | | | | 1.2 |
| | 3-May-93 | | | | 7.54 | 632 | 311 | 17.9 | | 297 | 83.4 | 24.8 | | | | | | | 0.8 |
| | 26-Oct-93 | | | | 7.71 | | 299 | 20.2 | | 309 | 80.0 | 24.1 | | | | | | | 2.4 |
| | 25-Apr-94 | | | | 7.85 | 644 | 339 | 18.2 | | 304 | 92.9 | 25.8 | | | | | | | 1.8 |
| | 25-Oct-94 | | | | 7.71 | 644 | 335 | 18.3 | | 271 | 92.4 | 25.2 | | | | | | | 1.0 |
| | 16-May-95 | | | | 7.57 | 628 | 318 | 17.2 | | 273 | 85.5 | 25.2 | | | | | | | 1.2 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **27** | 5-Apr-83 | | | 0.64 | | | | |
| | 15-Jun-83 | | | 0.73 | | | | |
| | 4-Aug-83 | | | | | | | |
| | 19-Aug-83 | | | | | | | |
| | 3-Sep-83 | | | | | | | |
| | 13-Sep-83 | | | | | | | |
| | 7-Dec-83 | | | | | | | |
| | 30-Apr-84 | | | | | | | |
| | 5-Nov-84 | | | <0.04 | | | | |
| | 29-Apr-85 | | | 0.76 | | | | |
| | 21-Oct-85 | | | 0.62 | | | | |
| | 30-Apr-86 | | | 0.62 | | | | |
| | 15-Oct-86 | | | 0.83 | | | | |
| | 20-Apr-87 | | | 0.68 | | | | |
| | 6-Oct-87 | | | 0.61 | | | | |
| | 10-May-88 | | | 0.71 | | | | |
| | 12-Oct-88 | | | 0.57 | | | | |
| | 30-Oct-89 | | | 0.63 | | | | |
| | 7-May-90 | | | 0.65 | | | | |
| | 29-Oct-90 | | | 0.79 | | | | |
| | 6-May-91 | | | 0.72 | | | | |
| | 4-Nov-91 | | | 0.59 | | | | |
| | 26-May-92 | | | 0.43 | | | | |
| | 6-Oct-92 | | | 0.53 | | | | |
| | 3-May-93 | | | 0.65 | | | | |
| | 26-Oct-93 | | | 0.71 | | | | |
| | 25-Apr-94 | | | 0.80 | | | | |
| | 25-Oct-94 | | | 0.75 | | | | |
| | 16-May-95 | | | 0.81 | | | | |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters |  |  | General Parameters |  |  | Major and Minor Ions |  |  |  |  |  |  | Nutrients and Organic Indicators |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
|  | Units | SU | µS/cm | ºC | SU | µS/cm |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **27** | 24-Oct-12 | 7.35 | 568 | 9.5 | 8.14 | 620 | 341 | 37.2 |  | 285 | 93.7 | 26.1 | 1.27 | 14.4 |  |  |  |  |  |
| **cont'd** | 9-May-13 | 7.45 | 907 | 9.6 | 8.31 | 843 | 384 | 58.3 |  | 307 | 104 | 30.3 | 1.45 | 29.3 |  |  |  |  |  |
|  | 9-May-14 | 7.63 | 659 | 9.5 | 8.08 | 778 | 360 | 49.5 |  | 301 | 96.7 | 28.7 | 1.40 | 24.0 |  |  |  |  |  |
|  | 9-May-14 | - | - | - | 8.15 | 773 | 355 | 48.6 |  | 289 | 95.0 | 28.7 | 1.41 | 24.2 |  |  |  |  |  |
|  | 27-May-15 | 7.72 | 410 | 12.5 | 7.97 | 684 | 308 | 35.2 | 40.8 | 272 | 83.1 | 24.3 | 1.31 | 12.5 |  |  |  |  |  |
|  | 24-May-16 | 7.81 | 630 | 12.5 | 8.08 | 756 | 362 | 51.3 | 42.1 | 306 | 99.9 | 27.4 | 5.32 | 22.5 |  |  |  |  |  |
|  | 1-Nov-16 | 8.22 | 736 | 13.1 | 7.87 | 677 |  | 38.9 | 38.1 | 278 | 89.1 | 22.7 | 1.23 | 12.1 | <0.02 | <0.10 | <0.25 | <0.25 | 1.0 |
|  | 4-May-17 | 7.51 | 767 | 9.42 | 7.93 | 905 | 359 | 62.7 | 35.9 | 331 | 96.1 | 29.0 | 1.51 | 33.6 | 0.10 | 0.26 | <0.05 | <0.05 | 2.4 |
|  | 11-May-18 | 7.34 | 698 | 11.35 | 7.79 | 761 | 350 | 55.0 | 31.8 | 340 | 95.8 | 26.8 | 1.40 | 28.6 | 0.04 | 0.10 | <0.25 | <0.25 | 1.9 |
|  | 16-May-19 | 7.58 | 565 | 10.87 | 7.55 | 625 | 352 | 39.4 | 32.3 | 289 | 96.6 | 27.0 | 1.37 | 14.7 | 0.034 | 0.63 | <0.020 | <0.010 | 1.74 |
|  | 11-May-20 | 7.97 | 676 | 8.98 | 7.67 | 659 | 329 | 38.3 | 29.5 | 293 | 93.4 | 23.2 | 1.35 | 13.9 | 0.044 | <0.15 | <0.020 | <0.010 | 2.99 |
|  | 12-May-21 | 7.55 | 700 | 11.0 | 8.07 | 686 | 361 | 41 | 34 | 284 | 104 | 24.4 | 1.42 | 15.1 | <0.1 | <0.5 | <0.06 | <0.03 | 1.2 |
| **37** | 5-Apr-83 |  |  |  | 7.8 | 480 | 304 | 10.0 |  | 247 | 81.0 | 26.0 |  |  |  |  |  |  | 10.6 |
|  | 15-Jun-83 |  |  |  | 7.3 | 545 | 292 | 12.0 |  | 260 | 71.0 | 24.0 |  |  |  |  |  |  | 1.9 |
|  | 4-Aug-83 |  |  |  | 7.3 | 410 |  | 12.0 |  |  |  |  |  |  |  |  |  |  |  |
|  | 15-Aug-83 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 19-Aug-83 |  |  |  | 7.6 | 530 |  | 13.0 |  |  |  |  |  |  |  |  |  |  |  |
|  | 3-Sep-83 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 14-Sep-83 |  |  |  | 7.3 | 540 | 326 | 13.0 |  |  |  |  |  |  |  |  |  |  | 0.6 |
|  | 8-Dec-83 |  |  |  | 7.3 | 525 | 335 | 15.0 |  |  |  |  |  |  |  |  |  |  | 1.2 |
|  | 30-Apr-84 |  |  |  | 7.3 | 610 | 332 | 13.0 |  |  |  |  |  |  |  |  |  |  | 0.6 |
|  | 5-Nov-84 |  |  |  | 7.2 | 630 | 329 | 11.0 |  | 254 | 89.0 | 26.0 |  |  |  |  |  |  | 0.5 |
|  | 29-Apr-85 |  |  |  | 7.70 | 655 | 303 | 14.0 |  | 271 | 78.0 | 26.2 |  |  |  |  |  |  | 1.0 |
|  | 21-Oct-85 |  |  |  | 7.80 | 630 | 324 | 14.0 |  | 290 | 85.5 | 26.8 |  |  |  |  |  |  | 4.9 |
|  | 30-Apr-86 |  |  |  | 7.89 | 394 | 252 | 17.0 |  | 247 | 63.0 | 23.0 |  |  |  |  |  |  | 3.6 |
|  | 15-Oct-86 |  |  |  | 7.10 | 610 | 319 | 13.0 |  | 276 | 85.0 | 26.0 |  |  |  |  |  |  | 1.3 |
|  | 16-Oct-86 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 20-Apr-87 |  |  |  | 7.50 | 640 | 325 | 17.0 |  | 273 | 85.5 | 27.0 |  |  |  |  |  |  | 2.6 |
|  | 10-May-88 |  |  |  | 7.65 | 640 | 346 | 16.7 |  | 271 | 92.3 | 28.0 |  |  |  |  |  |  | 2.4 |

Note: refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **27** | 24-Oct-12 | | | 0.87 | 0.057 | | | |
| **cont'd** | 9-May-13 | | | 1.09 | 0.063 | | | |
| | 9-May-14 | | | 1.01 | 0.063 | | | |
| | 9-May-14 | | | 1.03 | 0.064 | | | |
| | 27-May-15 | | | 0.78 | 0.063 | | | |
| | 24-May-16 | | | 0.925 | 0.054 | | | |
| | 1-Nov-16 | 0.099 | <0.003 | 0.718 | 0.050 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.225 | <0.003 | 1.01 | 0.058 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.266 | 0.005 | 1.01 | 0.065 | <0.17 | <0.20 | <0.10 |
| | 16-May-19 | 0.087 | <0.00050 | 0.920 | 0.0586 | <0.50 | <0.50 | <0.50 |
| | 11-May-20 | 0.083 | <0.00050 | 0.833 | 0.0564 | <0.50 | <0.50 | <0.50 |
| | 12-May-21 | 0.084 | 0.00012 | 0.92 | 0.062 | <0.2 | <0.5 | <0.5 |
| **37** | 5-Apr-83 | | | 0.10 | | | | |
| | 15-Jun-83 | | | 0.21 | | | | |
| | 4-Aug-83 | | | | | | | |
| | 15-Aug-83 | | | | | | | |
| | 19-Aug-83 | | | | | | | |
| | 3-Sep-83 | | | | | | | |
| | 14-Sep-83 | | | | | | | |
| | 8-Dec-83 | | | | | | | |
| | 30-Apr-84 | | | | | | | |
| | 5-Nov-84 | | | <0.04 | | | | |
| | 29-Apr-85 | | | 0.68 | | | | |
| | 21-Oct-85 | | | 0.11 | | | | |
| | 30-Apr-86 | | | 0.13 | | | | |
| | 15-Oct-86 | | | 0.24 | | | | |
| | 16-Oct-86 | | | 0.24 | | | | |
| | 20-Apr-87 | | | 0.26 | | | | |
| | 10-May-88 | | | 0.15 | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | °C | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **37** | 12-Oct-88 | | | | 7.80 | 560 | 298 | 18.0 | | 254 | 78.0 | 25.0 | | | | | | | 1.8 |
| **cont'd** | 30-Oct-89 | | | | 7.74 | 617 | 316 | 17.6 | | 277 | 84.4 | 25.6 | | | | | | | 0.8 |
| | 7-May-90 | | | | 7.85 | 615 | 325 | 17.5 | | 271 | 87.8 | 25.6 | | | | | | | 0.5 |
| | 29-Oct-90 | | | | 7.75 | 611 | 298 | 16.9 | | 276 | 80.1 | 23.7 | | | | | | | 1.4 |
| | 6-May-91 | | | | 7.80 | 552 | 280 | 15.3 | | 268 | 62.9 | 25.9 | | | | | | | |
| | 26-May-92 | | | | 7.74 | 613 | 318 | 16.3 | | 261 | 81.9 | 27.4 | | | | | | | 1.5 |
| | 6-Oct-92 | | | | 7.78 | 619 | 318 | 21.3 | | 264 | 80.2 | 28.5 | | | | | | | 1.1 |
| | 3-May-93 | | | | 7.56 | 615 | 315 | 16.9 | | 283 | 83.3 | 25.8 | | | | | | | 0.8 |
| | 26-Oct-93 | | | | 7.68 | 616 | 291 | 19.7 | | 283 | 68.6 | 28.9 | | | | | | | 1.0 |
| | 25-Apr-94 | | | | 7.99 | 597 | 320 | 14.7 | | 285 | 85.3 | 26.0 | | | | | | | 1.6 |
| | 25-Oct-94 | | | | 7.79 | 631 | 326 | 13.8 | | 273 | 86.2 | 26.7 | | | | | | | 1.6 |
| | 16-May-95 | | | | 7.77 | 599 | 295 | 14.9 | | 235 | 75.4 | 25.8 | | | | | | | 1.3 |
| | 15-Jun-97 | | | | 7.96 | 586 | 328 | 12.0 | | 263 | 85.4 | 27.8 | 1.0 | 7.5 | | | | | |
| | 15-Jun-98 | | | | 8.02 | 542 | 306 | 12.0 | | 260 | 80.9 | 25.3 | 1.24 | 7.09 | | | | | |
| | 15-Jun-99 | | | | 7.72 | 546 | 320 | 14.0 | | 264 | 84.6 | 26.4 | 1.58 | 7.46 | | | | | |
| | 15-Jun-00 | | | | 8.14 | 535 | 281 | 10.0 | | 280 | 74.1 | 23.2 | 0.32 | 8.48 | | | | | |
| | 15-Jun-01 | | | | 7.84 | 567 | 330 | 11.0 | | 254 | 88.8 | 26.2 | <0.02 | 13.8 | | | | | |
| | 15-Jun-02 | | | | 7.64 | 560 | 300 | 11.0 | | 260 | 77.9 | 25.5 | 0.92 | 7.42 | | | | | |
| | 15-Jun-03 | | | | 7.79 | 533 | 303 | 11.0 | | 268 | 80.3 | 25.0 | 0.87 | 7.56 | | | | | |
| | 15-Jun-04 | | | | 7.84 | 557 | 283 | 12.0 | | 266 | 73.2 | 24.3 | 0.80 | 10.2 | | | | | |
| | 15-Jun-05 | | | | 8.24 | 523 | 317 | 12.1 | | 278 | 83.5 | 26.3 | 1.2 | 9.2 | | | | | |
| | 15-Jun-06 | | | | 7.70 | 520 | 310 | 12.0 | | 260 | 85.1 | 22.9 | 1.0 | 7.5 | | | | | |
| | 29-May-07 | | | | 7.48 | 553 | 270 | 13.0 | | 270 | 68.8 | 23.0 | 1.0 | 7.9 | | | | | |
| | 5-Jun-08 | | | | 7.98 | 574 | 290 | 15.0 | | 270 | 77.3 | 23.9 | 1.0 | 10.2 | | | | | |
| | 4-Jun-09 | | | | 8.03 | 589 | 327 | 15.9 | | 265 | 88.3 | 25.9 | 1.5 | 8.9 | | | | | |
| | 14-May-10 | 7.76 | 550 | 11.2 | 8.00 | 544 | 335 | 18.7 | | 272 | 89.7 | 27.0 | 1.26 | 9.27 | | | | | |
| | 15-Jun-11 | 7.89 | 468 | 11.3 | 8.10 | 538 | 295 | 20.6 | | 264 | 78.7 | 23.8 | 1.22 | 9.25 | | | | | |
| | 23-May-12 | 7.49 | 477 | 11.5 | 8.08 | 575 | 294 | 20.4 | | 264 | 78.5 | 23.8 | 1.20 | 9.34 | | | | | |
| | 9-May-13 | 7.80 | 674 | 9.8 | 8.32 | 640 | 323 | 21.7 | | 257 | 85.9 | 26.4 | 1.28 | 10.2 | | | | | |

Note: refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **37** | 12-Oct-88 | | | 0.34 | | | | |
| **cont'd** | 30-Oct-89 | | | 0.37 | | | | |
| | 7-May-90 | | | 0.57 | | | | |
| | 29-Oct-90 | | | 0.46 | | | | |
| | 6-May-91 | | | 0.43 | | | | |
| | 26-May-92 | | | 0.16 | | | | |
| | 6-Oct-92 | | | 0.65 | | | | |
| | 3-May-93 | | | 0.13 | | | | |
| | 26-Oct-93 | | | 0.42 | | | | |
| | 25-Apr-94 | | | 0.12 | | | | |
| | 25-Oct-94 | | | 0.27 | | | | |
| | 16-May-95 | | | 0.19 | | | | |
| | 15-Jun-97 | | | 0.25 | 0.030 | | | |
| | 15-Jun-98 | | | 0.30 | 0.040 | | | |
| | 15-Jun-99 | | | 0.02 | 0.040 | | | |
| | 15-Jun-00 | | | 0.32 | 0.040 | | | |
| | 15-Jun-01 | | | 0.18 | 0.040 | | | |
| | 15-Jun-02 | | | 0.48 | 0.040 | | | |
| | 15-Jun-03 | | | 0.40 | 0.040 | | | |
| | 15-Jun-04 | | | 0.62 | 0.030 | | | |
| | 15-Jun-05 | | | 0.20 | 0.036 | | | |
| | 15-Jun-06 | | | 0.33 | 0.037 | | | |
| | 29-May-07 | | | 0.52 | 0.045 | | | |
| | 5-Jun-08 | | | <0.05 | 0.045 | | | |
| | 4-Jun-09 | | | 0.427 | 0.049 | | | |
| | 14-May-10 | | | 0.571 | 0.039 | | | |
| | 15-Jun-11 | | | 0.606 | 0.040 | | | |
| | 23-May-12 | | | 0.490 | 0.031 | | | |
| | 9-May-13 | | | 0.604 | 0.041 | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **37** | 9-May-14 | 7.61 | 658 | 10.0 | 8.14 | 612 | 310 | 22.8 | | 250 | 81.8 | 25.7 | 1.22 | 9.92 | | | | | |
| **cont'd** | 27-May-15 | 7.85 | 402 | 13.4 | 8.04 | 617 | 278 | 25.1 | 39.2 | 253 | 72.3 | 23.7 | 1.22 | 10.5 | | | | | |
| **37R** | 24-May-16 | 7.33 | 491 | 11.2 | 8.15 | 611 | 317 | 24.9 | 44.5 | 265 | 83.9 | 26.0 | 1.54 | 11.3 | | | | | |
| | 5-May-17 | 7.83 | 623 | 9.40 | 8.19 | 615 | 304 | 29.2 | 42.6 | 217 | 80.5 | 24.9 | 1.30 | 10.8 | 0.15 | 0.20 | <0.25 | <0.25 | 0.8 |
| | 11-May-18 | 7.68 | 556 | 10.25 | 7.94 | 605 | 306 | 28.4 | 39.3 | 280 | 81.3 | 24.9 | 1.31 | 11.1 | 0.05 | <0.10 | <0.05 | <0.05 | 1.0 |
| | 17-May-19 | 7.63 | 509 | 10.90 | 7.74 | 576 | 493 | 30.1 | 40.3 | 268 | 140* | 34.6 | 1.75 | 11.4 | 0.062 | 0.37 | 0.022 | <0.010 | 2.26 |
| | 12-May-20 | 7.83 | 566 | 9.12 | 7.77 | 649 | 320 | 32.2 | 35.8 | 286 | 85.7 | 25.7 | 1.37 | 11.8 | 0.061 | 0.18 | <0.020 | <0.010 | 2.11 |
| | 12-May-21 | 7.78 | 690 | 10.1 | 8.05 | 596 | 316 | 35 | 41 | 238 | 87.1 | 24 | 1.29 | 12.0 | <0.1 | <0.5 | <0.06 | <0.03 | <1.0 |
| **38** | 5-Apr-83 | | | | 7.5 | 500 | 314 | 12.0 | | 266 | 83.0 | 27.0 | | | | | | | 0.8 |
| | 15-Jun-83 | | | | 7.3 | 540 | 284 | 12.0 | | 270 | 59.0 | 24.0 | | | | | | | 1.5 |
| | 4-Aug-83 | | | | 7.6 | 290 | | 15.0 | | | | | | | | | | | |
| | 15-Aug-83 | | | | | | | | | | | | | | | | | | |
| | 19-Aug-83 | | | | 7.7 | 540 | | 13.0 | | | | | | | | | | | |
| | 3-Sep-83 | | | | | | | | | | | | | | | | | | |
| | 14-Sep-83 | | | | 7.3 | 530 | 318 | 11.0 | | | | | | | | | | | 0.5 |
| | 19-Oct-83 | | | | | | | | | | | | | | | | | | |
| | 8-Dec-83 | | | | 7.5 | 520 | 330 | 15.0 | | | | | | | | | | | 1.1 |
| | 30-Apr-84 | | | | 7.4 | 590 | 314 | 13.0 | | | | | | | | | | | 0.7 |
| | 5-Nov-84 | | | | 7.3 | 600 | 318 | 12.0 | | 250 | 86.0 | 25.0 | | | | | | | 0.3 |
| | 29-Apr-85 | | | | 7.70 | 630 | 302 | 14.5 | | 263 | 78.5 | 25.6 | | | | | | | 1.0 |
| | 21-Oct-85 | | | | 7.87 | 600 | 306 | 14.0 | | 280 | 80.5 | 25.4 | | | | | | | 3.7 |
| | 30-Apr-86 | | | | 7.62 | 493 | 315 | 15.5 | | 267 | 83.5 | 25.8 | | | | | | | 1.8 |
| | 15-Oct-86 | | | | 7.30 | 355 | 173 | 8.0 | | 164 | 48.0 | 13.0 | | | | | | | 3.3 |
| | 16-Oct-86 | | | | | | | | | | | | | | | | | | |
| | 20-Apr-87 | | | | 7.45 | 377 | 180 | 9.5 | | 175 | 47.5 | 14.8 | | | | | | | 4.1 |
| | 10-May-88 | | | | 7.53 | 430 | 227 | 10.9 | | 158 | 61.3 | 17.9 | | | | | | | 3.0 |
| | 12-Oct-88 | | | | 7.60 | 410 | 203 | 14.0 | | 200 | 55.0 | 16.0 | | | | | | | 2.2 |
| | 30-Oct-89 | | | | 7.77 | 525 | 257 | 14.5 | | 254 | 65.4 | 22.7 | | | | | | | 1.1 |
| | 7-May-90 | | | | 7.81 | 528 | 271 | 14.4 | | 256 | 68.8 | 24.1 | | | | | | | 1.5 |

Note: refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **37** | 9-May-14 | | | 0.591 | 0.040 | | | |
| **cont'd** | 27-May-15 | | | 0.550 | 0.042 | | | |
| **37R** | 24-May-16 | | | 0.597 | 0.033 | | | |
| | 5-May-17 | 0.052 | <0.003 | 0.660 | 0.039 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.056 | 0.004 | 0.660 | 0.041 | <0.17 | <0.20 | <0.10 |
| | 17-May-19 | 0.048 | 0.0031 | 3.27 | 0.211 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.048 | <0.00050 | 0.718 | 0.0427 | <0.50 | <0.50 | <0.50 |
| | 12-May-21 | 0.056 | 0.00009 | 0.72 | 0.041 | <0.2 | <0.5 | <0.5 |
| **38** | 5-Apr-83 | | | 0.27 | | | | |
| | 15-Jun-83 | | | 0.19 | | | | |
| | 4-Aug-83 | | | | | | | |
| | 15-Aug-83 | | | | | | | |
| | 19-Aug-83 | | | | | | | |
| | 3-Sep-83 | | | | | | | |
| | 14-Sep-83 | | | | | | | |
| | 19-Oct-83 | | | | | | | |
| | 8-Dec-83 | | | | | | | |
| | 30-Apr-84 | | | | | | | |
| | 5-Nov-84 | | | <0.04 | | | | |
| | 29-Apr-85 | | | 3.05 | | | | |
| | 21-Oct-85 | | | 0.22 | | | | |
| | 30-Apr-86 | | | 0.21 | | | | |
| | 15-Oct-86 | | | 0.03 | | | | |
| | 16-Oct-86 | | | 0.01 | | | | |
| | 20-Apr-87 | | | 0.07 | | | | |
| | 10-May-88 | | | 0.02 | | | | |
| | 12-Oct-88 | | | <.05 | | | | |
| | 30-Oct-89 | | | 0.15 | | | | |
| | 7-May-90 | | | 0.04 | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| | | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **38** | 29-Oct-90 | | | | 7.83 | 527 | 252 | 14.5 | | 251 | 64.5 | 22.1 | | | | | | | 1.6 |
| **cont'd** | 6-May-91 | | | | 7.88 | 515 | 254 | 13.5 | | 256 | 64.4 | 22.6 | | | | | | | |
| | 26-May-92 | | | | 7.70 | 507 | 241 | 6.9 | | 242 | 66.6 | 21.7 | | | | | | | 1.8 |
| | 6-Oct-92 | | | | 7.80 | 506 | 259 | 8.1 | | 229 | 68.5 | 21.3 | | | | | | | 1.5 |
| | 3-May-93 | | | | 7.66 | 491 | 242 | 6.5 | | 248 | 64.2 | 19.8 | | | | | | | 0.7 |
| | 26-Oct-93 | | | | 7.75 | 482 | 240 | 7.3 | | 252 | 59.4 | 22.1 | | | | | | | 2.5 |
| | 25-Apr-94 | | | | 8.00 | 480 | 249 | 5.5 | | 245 | 66.3 | 20.1 | | | | | | | 2.1 |
| | 25-Oct-94 | | | | 7.91 | 486 | 243 | 5.7 | | 235 | 64.1 | 20.0 | | | | | | | 1.5 |
| | 16-May-95 | | | | 7.84 | 465 | 239 | 5.0 | | 232 | 63.6 | 19.5 | | | | | | | 1.3 |
| | 15-Jun-97 | | | | 8.06 | 453 | 232 | 3.5 | | 215 | 60.8 | 19.5 | 1.0 | 10.4 | | | | | |
| | 15-Jun-98 | | | | 7.99 | 413 | 231 | 4.0 | | 210 | 61.7 | 18.8 | 1.38 | 9.92 | | | | | |
| | 15-Jun-99 | | | | 8.03 | 414 | 262 | 4.0 | | 196 | 74.9 | 18.3 | 1.05 | 10.5 | | | | | |
| | 15-Jun-00 | | | | 8.30 | 415 | 217 | 3.0 | | 210 | 57.7 | 17.7 | 0.59 | 24.5 | | | | | |
| | 15-Jun-01 | | | | 7.92 | 426 | 237 | 3.0 | | 208 | 64.0 | 18.7 | 0.44 | 17.2 | | | | | |
| | 15-Jun-02 | | | | 7.74 | 430 | 217 | 4.0 | | 217 | 56.8 | 18.3 | 0.99 | 11.0 | | | | | |
| | 15-Jun-03 | | | | 7.90 | 433 | 221 | 5.0 | | 228 | 59.0 | 17.9 | 0.57 | 12.0 | | | | | |
| | 15-Jun-04 | | | | 7.99 | 450 | 215 | 6.0 | | 228 | 56.9 | 17.8 | 0.54 | 16.8 | | | | | |
| | 15-Jun-05 | | | | 8.31 | 455 | 234 | 7.0 | | 232 | 62.8 | 18.7 | 1.1 | 13.0 | | | | | |
| | 15-Jun-06 | | | | 7.75 | 416 | 220 | 8.0 | | 220 | 61.7 | 17.2 | <1 | 10.8 | | | | | |
| | 29-May-07 | | | | 7.59 | 447 | 300 | 7.0 | | 230 | 86.8 | 19.7 | 1.0 | 12.3 | | | | | |
| | 5-Jun-08 | | | | 8.01 | 471 | 240 | 9.0 | | 220 | 65.3 | 18.8 | 2.0 | 15.1 | | | | | |
| | 4-Jun-09 | | | | 8.09 | 473 | 240 | 8.6 | | 227 | 66.2 | 18.0 | 1.2 | 12.1 | | | | | |
| | 13-May-10 | 7.94 | 390 | 9.4 | 8.00 | 445 | 258 | 11.1 | | 224 | 69.7 | 20.5 | 1.13 | 12.3 | | | | | |
| | 15-Jun-11 | 7.54 | 389 | 10.7 | 8.26 | 442 | 231 | 11.9 | | 219 | 62.0 | 18.5 | 1.05 | 12.2 | | | | | |
| | 15-Jun-11 | 7.54 | 389 | 10.7 | 8.13 | 429 | 228 | 11.1 | | 218 | 61.4 | 18.2 | 1.1 | 11.8 | | | | | |
| | 23-May-12 | 7.61 | 393 | 11.2 | 8.08 | 465 | 239 | 11.9 | | 228 | 64.1 | 19.1 | 1.07 | 12.5 | | | | | |
| | 9-May-13 | 7.88 | 541 | 9.8 | 8.32 | 500 | 248 | 12.7 | | 212 | 65.7 | 20.5 | 1.14 | 12.8 | | | | | |
| | 9-May-13 | 7.88 | 541 | 9.8 | 8.34 | 515 | 249 | 12.8 | | 223 | 66.5 | 20.1 | 1.09 | 12.7 | | | | | |
| | 9-May-14 | 7.89 | 525 | 10.3 | 8.09 | 493 | 237 | 13.3 | | 216 | 62.9 | 19.5 | 1.04 | 12.4 | | | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2:  Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| Well | Date | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | µg/L | µg/L | µg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **38** | 29-Oct-90 | | | 0.02 | | | | |
| **cont'd** | 6-May-91 | | | <0.01 | | | | |
| | 26-May-92 | | | <0.01 | | | | |
| | 6-Oct-92 | | | 0.60 | | | | |
| | 3-May-93 | | | 0.02 | | | | |
| | 26-Oct-93 | | | 0.41 | | | | |
| | 25-Apr-94 | | | <0.01 | | | | |
| | 25-Oct-94 | | | 0.30 | | | | |
| | 16-May-95 | | | 0.01 | | | | |
| | 15-Jun-97 | | | <0.02 | 0.050 | | | |
| | 15-Jun-98 | | | <0.02 | <0.02 | | | |
| | 15-Jun-99 | | | 0.03 | 0.060 | | | |
| | 15-Jun-00 | | | <0.02 | 0.040 | | | |
| | 15-Jun-01 | | | <0.02 | 0.050 | | | |
| | 15-Jun-02 | | | <0.02 | 0.040 | | | |
| | 15-Jun-03 | | | 0.05 | 0.050 | | | |
| | 15-Jun-04 | | | <0.02 | 0.050 | | | |
| | 15-Jun-05 | | | 0.07 | 0.056 | | | |
| | 15-Jun-06 | | | 0.08 | 0.076 | | | |
| | 29-May-07 | | | <0.05 | 0.093 | | | |
| | 5-Jun-08 | | | 0.18 | 0.042 | | | |
| | 4-Jun-09 | | | <0.050 | 0.051 | | | |
| | 13-May-10 | | | 0.499 | 0.042 | | | |
| | 15-Jun-11 | | | 0.529 | 0.041 | | | |
| | 15-Jun-11 | | | 0.55 | 0.042 | | | |
| | 23-May-12 | | | 0.450 | 0.038 | | | |
| | 9-May-13 | | | 0.555 | 0.049 | | | |
| | 9-May-13 | | | 0.530 | 0.044 | | | |
| | 9-May-14 | | | 0.579 | 0.043 | | | |

Note:  refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **38** | 27-May-15 | 7.89 | 329 | 15.4 | 8.10 | 493 | 228 | 13.6 | 22.2 | 219 | 60.5 | 18.6 | 1.06 | 13.0 | | | | | |
| **cont'd** | 24-May-16 | 7.62 | 405 | 11.1 | 8.15 | 497 | 245 | 16.2 | 25.6 | 230 | 64.8 | 20.1 | 1.13 | 13.9 | | | | | |
| | 5-May-17 | 7.91 | 517 | 9.19 | 8.18 | 562 | 237 | 18.7 | 23.1 | 237 | 62.7 | 19.6 | 1.10 | 13.1 | 0.13 | 0.22 | <0.05 | <0.05 | 1.3 |
| | 11-May-18 | 7.80 | 481 | 9.00 | 7.91 | 514 | 242 | 20.8 | 23.0 | 260 | 64.7 | 19.6 | 1.08 | 13.6 | 0.07 | <0.10 | <0.05 | <0.05 | 1.2 |
| | 17-May-19 | 7.63 | 443 | 10.49 | 7.81 | 502 | 259 | 23.3 | 22.6 | 240 | 68.9 | 21.2 | 1.10 | 14.4 | 0.089 | <0.15 | <0.020 | <0.010 | 2.10 |
| | 12-May-20 | 8.00 | 474 | 9.72 | 7.80 | 551 | 264 | 23.0 | 21.1 | 234 | 70.4 | 21.3 | 1.15 | 14.9 | 0.089 | <0.15 | <0.020 | <0.010 | 2.37 |
| | 12-May-21 | 7.85 | 520 | 11.7 | 8.08 | 553 | 260 | 27 | 24 | 237 | 71.2 | 19.9 | 1.10 | 14.5 | <0.1 | <0.5 | <0.06 | <0.03 | 1.3 |
| **39** | 9-May-14 | 7.73 | 770 | 9.8 | 8.10 | 722 | 336 | 37.3 | | 280 | 90.2 | 27.0 | 1.83 | 21.7 | | | | | |
| | 27-May-15 | 7.41 | 463 | 12.0 | 8.01 | 716 | 294 | 37.8 | 45.1 | 281 | 76.3 | 25.2 | 1.73 | 21.8 | | | | | |
| | 24-May-16 | 7.62 | 405 | 11.1 | 8.14 | 711 | 340 | 36.1 | 47.7 | 300 | 90.3 | 27.8 | 1.70 | 23.1 | | | | | |
| | 1-Nov-16 | 7.94 | 711 | 9.8 | 8.06 | 703 | | 39.8 | 44.7 | 289 | 86.8 | 23.5 | 1.55 | 20.0 | 0.04 | <0.10 | <0.25 | <0.25 | 1.2 |
| | 4-May-17 | 7.90 | 705 | 9.08 | 8.18 | 773 | 326 | 36.8 | 44.5 | 312 | 87.7 | 25.9 | 1.64 | 21.2 | 0.11 | 0.36 | 0.14 | <0.05 | 1.2 |
| | 10-May-18 | 7.45 | 635 | 9.95 | 7.93 | 680 | 324 | 33.9 | 41.9 | 315 | 88.5 | 25.0 | 1.65 | 21.0 | 0.05 | 0.27 | <0.25 | <0.25 | 1.2 |
| | 16-May-19 | 7.58 | 593 | 10.10 | 7.52 | 666 | 354 | 38.5 | 45.2 | 307 | 98.0 | 26.7 | 1.62 | 21.8 | 0.082 | 0.36 | 0.494 | 0.054 | 3.65 |
| | 11-May-20 | 7.71 | 643 | 7.78 | 7.67 | 703 | 331 | 37.2 | 44.2 | 303 | 93.1 | 24.0 | 1.61 | 20.3 | 0.057 | 0.33 | 0.67 | 0.048 | 2.00 |
| | 11-May-21 | 7.10 | 730 | 8.9 | 8.16 | 684 | 374 | 38 | 50 | 275 | 107 | 25.7 | 1.82 | 21.7 | <0.1 | <0.5 | 0.39 | 0.04 | 2.0 |
| **42** | 24-May-16 | 7.73 | 770 | 9.8 | 8.20 | 394 | 177 | 2.12 | 5.50 | 217 | 31.3 | 24.0 | 1.45 | 21.3 | | | | | |
| | 1-Nov-16 | 8.59 | 425 | 10.1 | 7.92 | 389 | | 1.09 | 3.64 | 211 | 29.2 | 20.6 | 1.17 | 18.3 | 0.34 | 0.32 | <0.05 | <0.05 | 1.2 |
| | 4-May-17 | 8.38 | 387 | 8.91 | 8.21 | 422 | 163 | 0.60 | 5.69 | 217 | 28.2 | 22.6 | 1.19 | 18.8 | 0.42 | 0.51 | <0.05 | <0.05 | 0.9 |
| | 10-May-18 | 8.13 | 382 | 9.13 | 7.42 | 379 | 161 | 0.81 | 4.20 | 228 | 28.2 | 21.9 | 1.18 | 18.7 | 0.29 | 0.29 | <0.05 | <0.05 | 1.2 |
| | 16-May-19 | 8.06 | 314 | 10.25 | 8.06 | 347 | 281 | 0.51 | 1.61 | 220 | 64.6* | 29.0 | 1.33 | 18.0 | 0.307 | 1.09 | <0.020 | <0.010 | 2.44 |
| | 11-May-20 | 8.37 | 361 | 8.00 | 8.02 | 379 | 173 | 0.57 | 1.45 | 269 | 34.4 | 21.1 | 1.06 | 18.0 | 0.301 | 0.49 | 0.031 | <0.010 | 1.92 |
| | 11-May-21 | 7.60 | 400 | 9.1 | 8.22 | 386 | 198 | <1 | 2 | 213 | 42.3 | 22.5 | 1.21 | 19.2 | 0.4 | <0.5 | <0.06 | <0.03 | 1.5 |

Note: refer to notation page for groundwater notation details

# Table D-2: Groundwater Chemical Results - Deep Flow System

| | | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| **Well** | **Date** | **Boron** | **Chromium** | **Iron** | **Manganese** | **Vinyl Chloride** | **Benzene** | **1,4 Dichlorobenzene** |
| | **Units** | | | | | **µg/L** | **µg/L** | **µg/L** |
| | **ODWQS** | **5.0 *IMAC*** | **0.05 *MAC*** | **0.3 *AO*** | **0.05 *AO*** | **1 *MAC*** | **1 *MAC*** | **5 *MAC* 1 *AO*** |
| **38** | 27-May-15 | | | 0.439 | 0.042 | | | |
| **cont'd** | 24-May-16 | | | 0.456 | 0.039 | | | |
| | 5-May-17 | 0.048 | <0.003 | 0.464 | 0.042 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.048 | <0.003 | 0.494 | 0.046 | <0.17 | <0.20 | <0.10 |
| | 17-May-19 | 0.043 | <0.00050 | 0.554 | 0.0442 | <0.50 | <0.50 | <0.50 |
| | 12-May-20 | 0.044 | <0.00050 | 0.592 | 0.0473 | <0.50 | <0.50 | <0.50 |
| | 12-May-21 | 0.068 | <0.00008 | 0.56 | 0.047 | <0.2 | <0.5 | <0.5 |
| **39** | 9-May-14 | | | 0.183 | 0.156 | | | |
| | 27-May-15 | | | 0.236 | 0.182 | | | |
| | 24-May-16 | | | 0.259 | 0.133 | | | |
| | 1-Nov-16 | 0.025 | <0.003 | 0.271 | 0.131 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.026 | <0.003 | 0.268 | 0.145 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.026 | 0.004 | 0.249 | 0.143 | <0.17 | <0.20 | <0.10 |
| | 16-May-19 | 0.029 | <0.00050 | 0.195 | 0.149 | <0.50 | <0.50 | <0.50 |
| | 11-May-20 | 0.027 | <0.00050 | 0.239 | 0.16 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.034 | 0.00008 | 0.316 | 0.165 | <0.2 | <0.5 | <0.5 |
| **42** | 24-May-16 | | | 0.038 | 0.011 | | | |
| | 1-Nov-16 | 0.051 | <0.003 | 0.070 | 0.012 | <0.17 | <0.20 | <0.10 |
| | 4-May-17 | 0.056 | <0.003 | 0.059 | 0.010 | <0.17 | <0.20 | <0.10 |
| | 10-May-18 | 0.063 | <0.003 | 0.088 | 0.011 | <0.17 | <0.20 | <0.10 |
| | 16-May-19 | 0.053 | 0.00218 | 1.77 | 0.106 | <0.50 | <0.50 | <0.50 |
| | 11-May-20 | 0.052 | <0.00050 | 0.173 | 0.010 | <0.50 | <0.50 | <0.50 |
| | 11-May-21 | 0.048 | 0.00017 | 0.177 | 0.011 | <0.2 | <0.5 | <0.5 |

Note: refer to notation page for groundwater notation details

# Table D-3:  Groundwater Chemical Results - Private Wells

| Well | Date | Field Parameters | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | TKN | Nitrate | Nitrite | DOC |
| | Units | SU | µS/cm | ºC | SU | µS/cm | | | | | | | | | | | | | |
| | ODWQS | 6.5 - 8.5 *OG* | nc | 15 *AO* | 6.5 - 8.5 *OG* | nc | 80-100 *OG* | 250 *AO* | 500 *AO* | 30 - 500 *OG* | nc | nc | nc | 200 *AO* | nc | nc | 10.0 *MAC* | 1.0 *MAC* | 5 *AO* |
| **D2** | 27-Feb-79 | | | | 8.33 | 515 | 220 | 15.0 | | | 53.5 | 21.0 | 1.1 | 24.0 | | | | | |
| **(Roswell)** | 16-Jul-79 | | | | 7.35 | | 208 | 10.5 | | 210 | 49.0 | 20.8 | 0.95 | 21.4 | | | | | |
| | 24-Apr-80 | | | | 7.82 | 790 | 356 | 39.5 | | 288 | 97.0 | 27.6 | 1.85 | 31.8 | | | | | |
| | 30-Sep-80 | | | | 7.83 | 585 | 256 | 16.5 | | 244 | 65.0 | 22.6 | 1.2 | 26.2 | | | | | |
| | 17-Jun-81 | | | | 7.84 | 615 | 284 | 26.0 | | 243 | 75.0 | 23.4 | | 28.5 | | | | | |
| | 14-May-82 | | | | 7.75 | 587 | 256 | 24.5 | | 237 | 67.0 | 21.4 | 1.0 | 29.0 | | | | | |
| | 13-Jul-82 | | | | 7.60 | 525 | 226 | 15.0 | | 224 | 57.5 | 20.0 | | | | | | | |
| | 15-Jun-97 | | | | 8.04 | 636 | 294 | 27.9 | | 279 | 77.7 | 24.4 | 1.80 | 36.1 | | | | | |
| | 15-Jun-99 | | | | 7.44 | 709 | 326 | 35.0 | | 300 | 88.9 | 25.2 | 1.92 | 37.4 | | | | | |
| | 15-Jun-00 | | | | 8.36 | 770 | 336 | 47.0 | | 320 | 95.3 | 23.8 | 3.11 | 42.7 | | | | | |
| | 15-Jun-01 | | | | 7.74 | 625 | 320 | 23.0 | | 257 | 85.2 | 26.1 | 1.36 | 32.2 | | | | | |
| | 15-Jun-02 | | | | 7.90 | 398 | 200 | 1.0 | | 216 | 42.9 | 22.5 | 1.05 | 12.4 | | | | | |
| | 15-Jun-03 | | | | 7.74 | 666 | 323 | 32.0 | | 304 | 84.9 | 26.9 | 1.32 | 32.4 | | | | | |
| | 15-Jun-04 | | | | 7.81 | 854 | 347 | 37.0 | | 364 | 101.0 | 23.0 | 1.92 | 51.5 | | | | | |
| | 15-Jun-05 | | | | 8.27 | 668 | 321 | 28.7 | | 295 | 83.7 | 27.0 | 1.5 | 34.0 | | | | | |
| | 15-Jun-06 | | | | 7.30 | 749 | 360 | 42.0 | | 330 | 101.0 | 26.3 | 2.0 | 35.7 | | | | | |
| | 29-May-07 | | | | 7.41 | 888 | 430 | 44.0 | | 370 | 122.0 | 31.6 | 2.0 | 41.4 | | | | | |
| | 5-Jun-08 | | | | 7.87 | 853 | 360 | 39.0 | | 340 | 99.2 | 27.4 | 2.0 | 37.2 | | | | | |
| | 4-Jun-09 | | | | 7.99 | 665 | 292 | 24.0 | | 275 | 76.7 | 24.5 | 1.5 | 33.5 | | | | | |
| | 14-May-10 | 7.75 | 610 | 20.1 | 8.09 | 541 | 280 | 20.5 | | 242 | 72.4 | 24.1 | 1.36 | 25.9 | | | | | |
| | 23-May-12 | 8.48 | 547 | 15.0 | 8.23 | 663 | <10 | 24.8 | | 274 | 0.07 | <0.05 | 0.16 | 163 | | | | | |
| | 15-May-13 | 7.64 | - | 18.6 | 8.02 | 653 | <10 | 28.7 | | 243 | 0.99 | 0.41 | 0.61 | 149 | | | | | |
| **(Pearce)** | 27-May-15 | 7.64 | 421 | 17.1 | 8.17 | 641 | 306 | 29.1 | 42.0 | 259 | 82.3 | 24.3 | 1.24 | 11.0 | | | | | |
| | 25-May-16 | 8.32 | 519 | 11.3 | 8.38 | 698 | 1.7 | 34.2 | 43.0 | 285 | 0.48 | 0.11 | 0.43 | 152 | | | | | |
| | 9-May-17 | 8.25 | 750 | 8.90 | 8.17 | 756 | 4.4 | 31.8 | 38.5 | 286 | 1.05 | 0.42 | 1.01 | 150 | 0.12 | <0.05 | <0.25 | <0.25 | 1.7 |
| | 11-May-18 | 7.50 | 667 | 16.80 | 8.14 | 684 | 1.0 | 30.8 | 33.1 | 305 | 0.29 | 0.06 | 1.30 | 160 | <0.02 | <0.10 | <0.25 | <0.25 | 1.4 |
| | 17-May-19 | 8.14 | 549 | 14.70 | 8.17 | 641 | <0.50 | 35.4 | 32.5 | 285 | 0.134 | <0.050 | 0.17 | 159 | <0.010 | <0.15 | <0.020 | <0.010 | 2.19 |
| | 12-May-20 | 8.46 | 604 | 12.73 | 8.15 | 702 | <0.50 | 34.4 | 30.0 | 279 | 0.089 | <0.050 | 0.08 | 168 | <0.010 | 0.25 | <0.020 | <0.010 | 3.54 |
| | 12-May-21 | 8.38 | 730 | 15.9 | 8.19 | 689 | 2.2 | 37 | 35 | 278 | 0.50 | 0.236 | 0.824 | 160 | <0.1 | 0.5 | <0.06 | <0.03 | 1.2 |

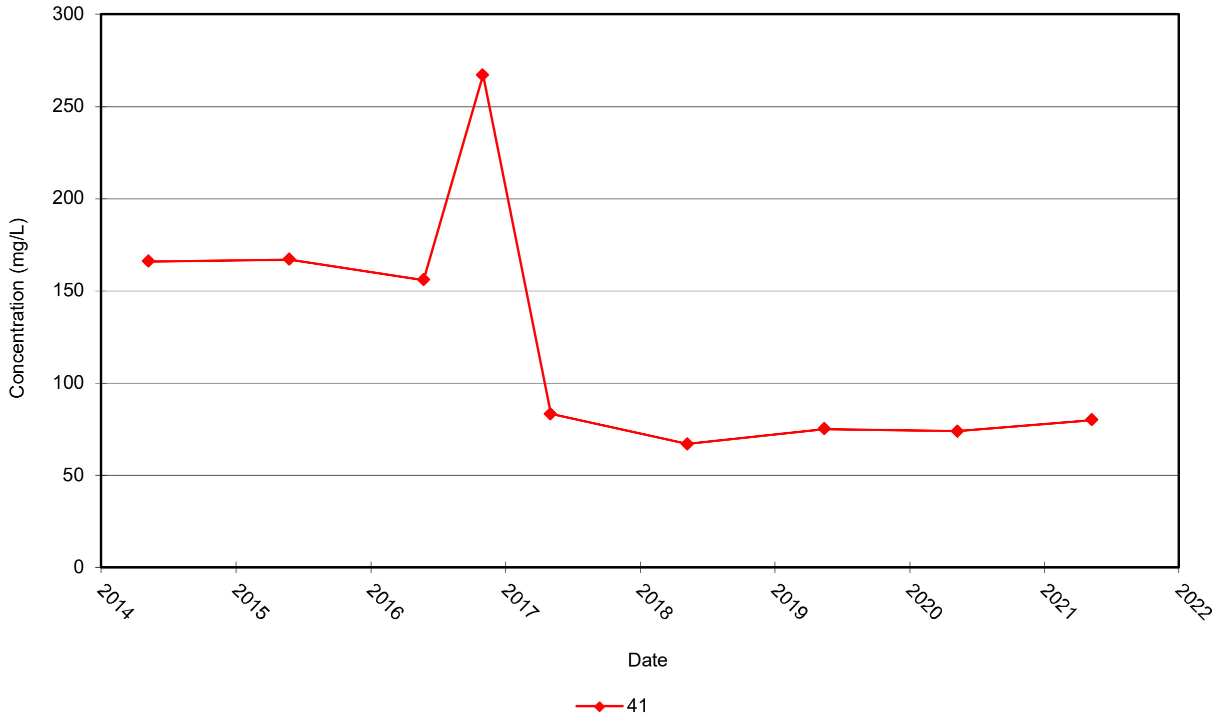
Note:  refer to notation page for groundwater notation details

# Table D-3: Groundwater Chemical Results - Private Wells

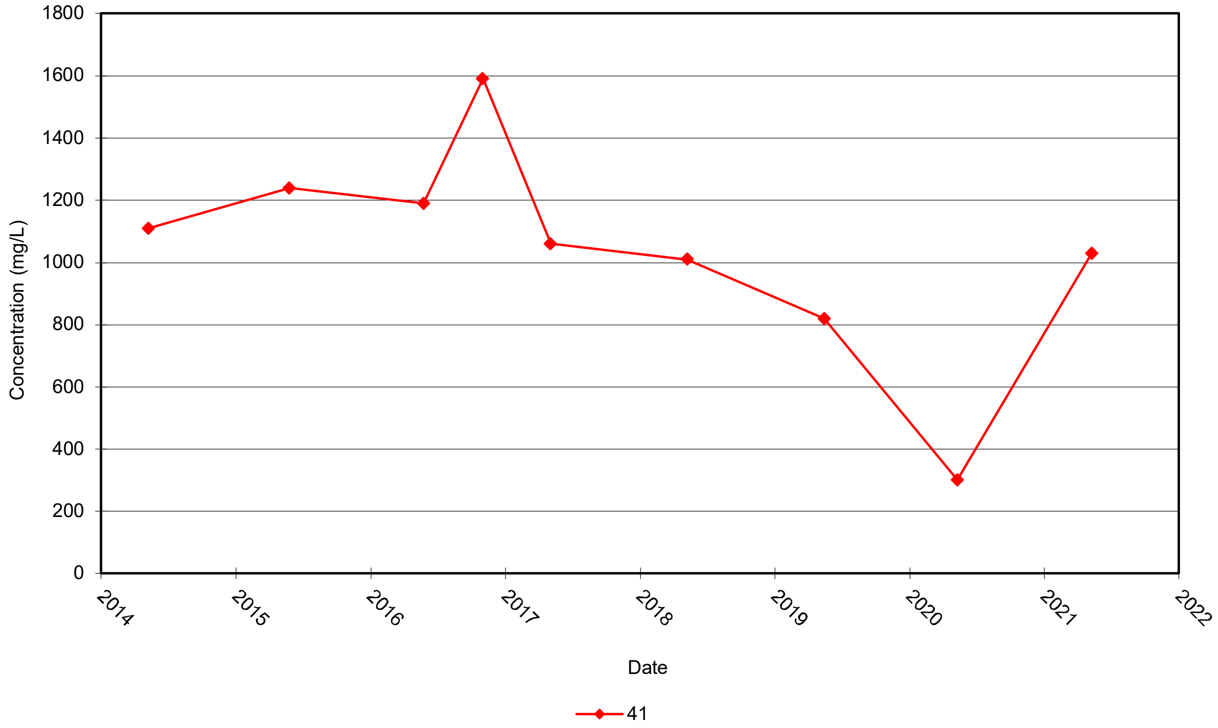
| Well | Date | Metals | | | | Volatile Organic Compounds | | |
|---|---|---|---|---|---|---|---|---|
| | | Boron | Chromium | Iron | Manganese | Vinyl Chloride | Benzene | 1,4 Dichlorobenzene |
| | Units | | | | | μg/L | μg/L | μg/L |
| | ODWQS | 5.0 *IMAC* | 0.05 *MAC* | 0.3 *AO* | 0.05 *AO* | 1 *MAC* | 1 *MAC* | 5 *MAC* 1 *AO* |
| **D2** | 27-Feb-79 | | | 0.08 | | | | |
| **(Roswell)** | 16-Jul-79 | | | 0.09 | | | | |
| | 24-Apr-80 | | | 0.14 | 0.020 | | | |
| | 30-Sep-80 | | | 0.08 | 0.020 | | | |
| | 17-Jun-81 | | | 0.01 | 0.007 | | | |
| | 14-May-82 | | | 0.08 | | | | |
| | 13-Jul-82 | | | 0.04 | | | | |
| | 15-Jun-97 | | | <0.02 | <0.01 | | | |
| | 15-Jun-99 | | | 0.04 | <0.02 | | | |
| | 15-Jun-00 | | | 0.09 | <0.02 | | | |
| | 15-Jun-01 | | | <0.02 | <0.02 | | | |
| | 15-Jun-02 | | | 0.51 | <0.02 | | | |
| | 15-Jun-03 | | | 0.02 | <0.02 | | | |
| | 15-Jun-04 | | | <0.02 | <0.02 | | | |
| | 15-Jun-05 | | | 0.09 | 0.004 | | | |
| | 15-Jun-06 | | | <0.05 | 0.002 | | | |
| | 29-May-07 | | | <0.05 | 0.025 | | | |
| | 5-Jun-08 | | | <0.05 | 0.002 | | | |
| | 4-Jun-09 | | | <0.050 | 0.0036 | | | |
| | 14-May-10 | | | <0.010 | <0.002 | | | |
| | 23-May-12 | | | <0.01 | 0.002 | | | |
| | 15-May-13 | | | 0.033 | 0.006 | | | |
| **(Pearce)** | 27-May-15 | | | 1.89 | 0.054 | | | |
| | 25-May-16 | | | <0.010 | <0.002 | | | |
| | 9-May-17 | 0.051 | <0.003 | <0.010 | <0.002 | <0.17 | <0.20 | <0.10 |
| | 11-May-18 | 0.060 | 0.004 | <0.010 | 0.005 | | | |
| | 17-May-19 | 0.053 | <0.00050 | <0.010 | <0.00050 | | | |
| | 12-May-20 | 0.052 | <0.00050 | 0.017 | <0.00050 | | | |
| | 12-May-21 | 0.051 | 0.00033 | 0.09 | <0.002 | | | |

Note: refer to notation page for groundwater notation details

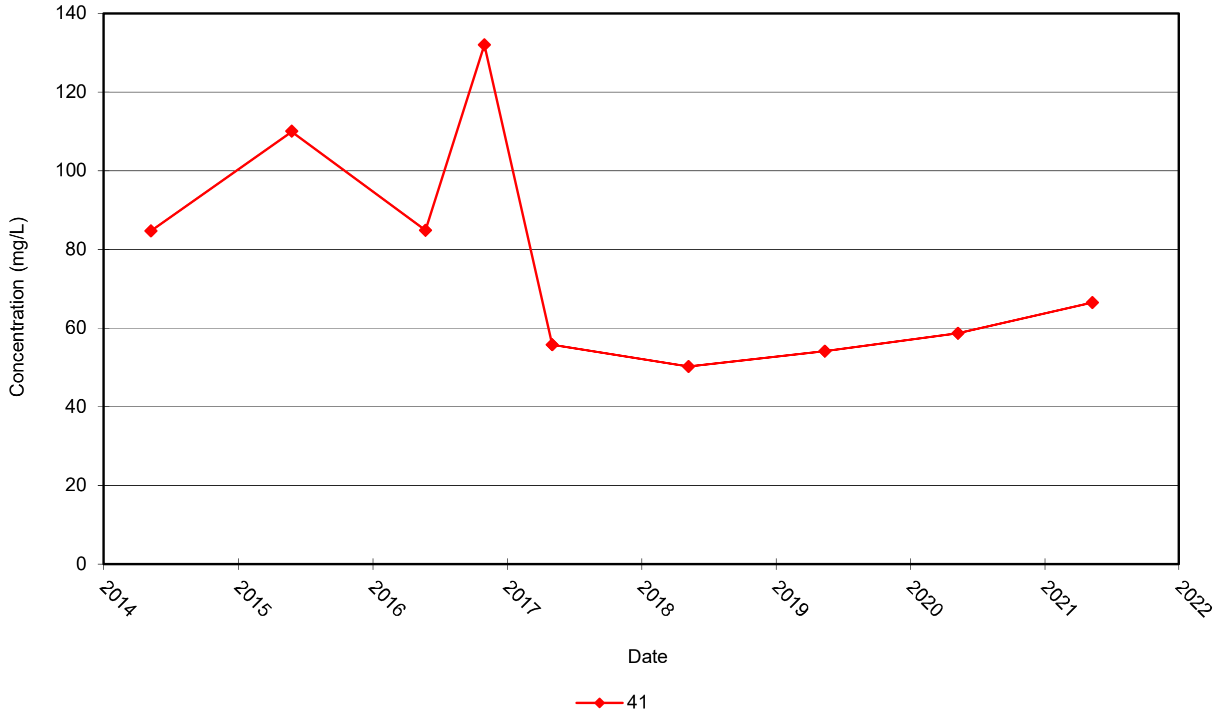
# FIGURE D-1
## TIME-CONCENTRATION GRAPH - CHLORIDE
## HOLBROOK LANDFILL - LEACHATE



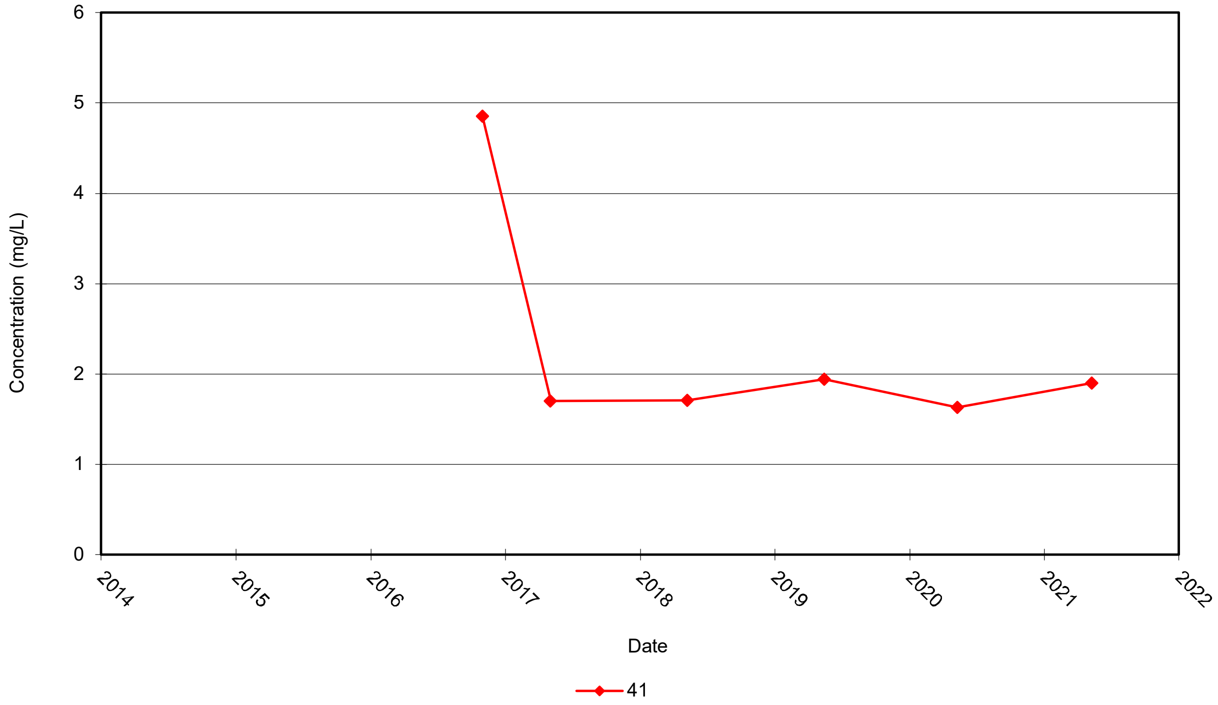
# FIGURE D-2
## TIME-CONCENTRATION GRAPH - ALKALINITY
## HOLBROOK LANDFILL - LEACHATE



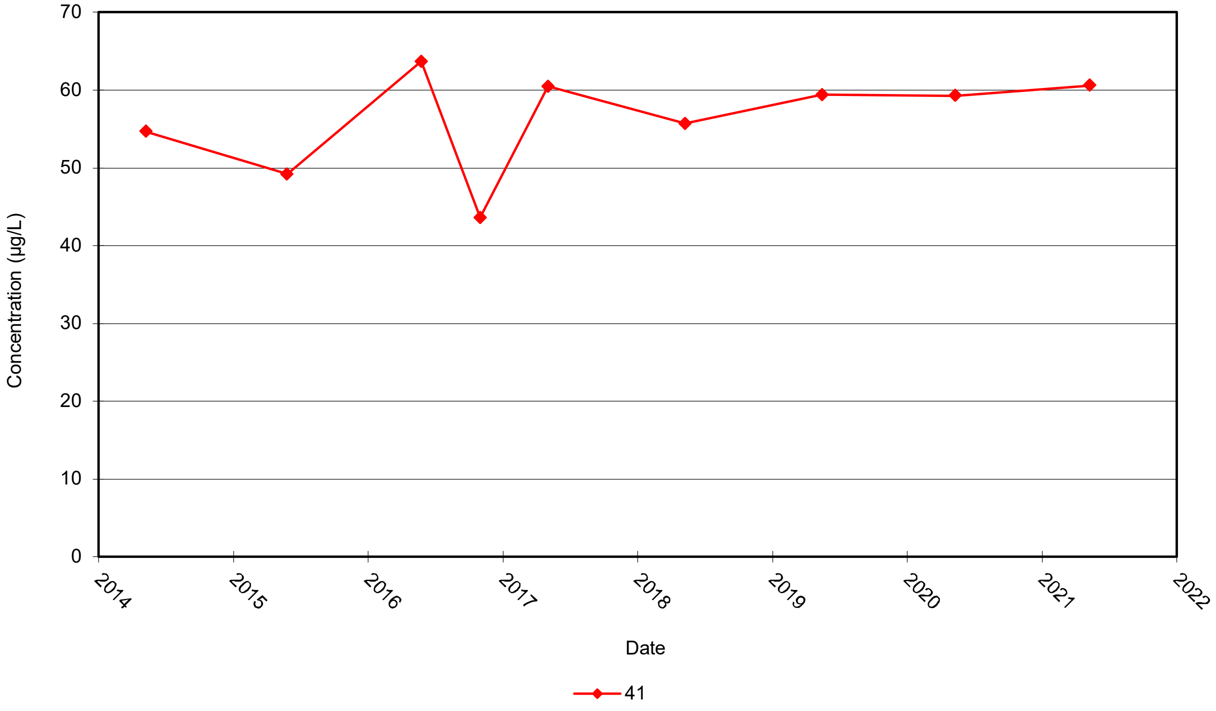
## FIGURE D-3
## TIME-CONCENTRATION GRAPH - POTASSIUM
## HOLBROOK LANDFILL - LEACHATE



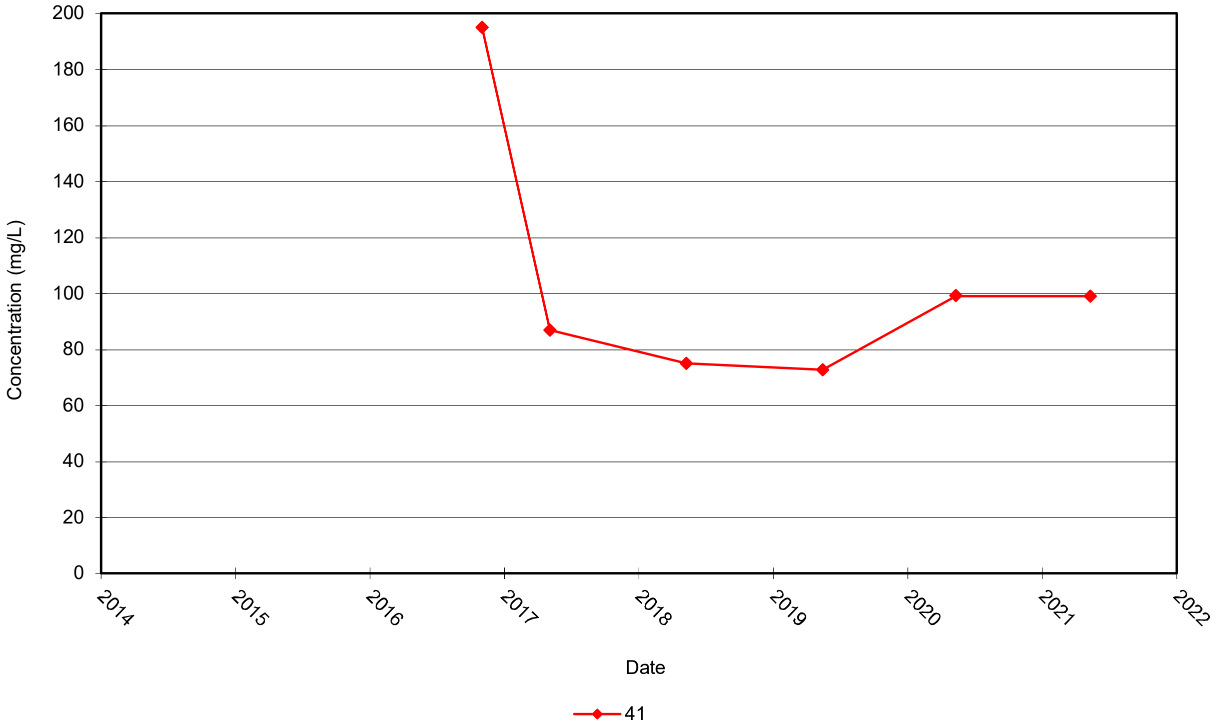
## FIGURE D-4
## TIME-CONCENTRATION GRAPH - BORON
## HOLBROOK LANDFILL - LEACHATE



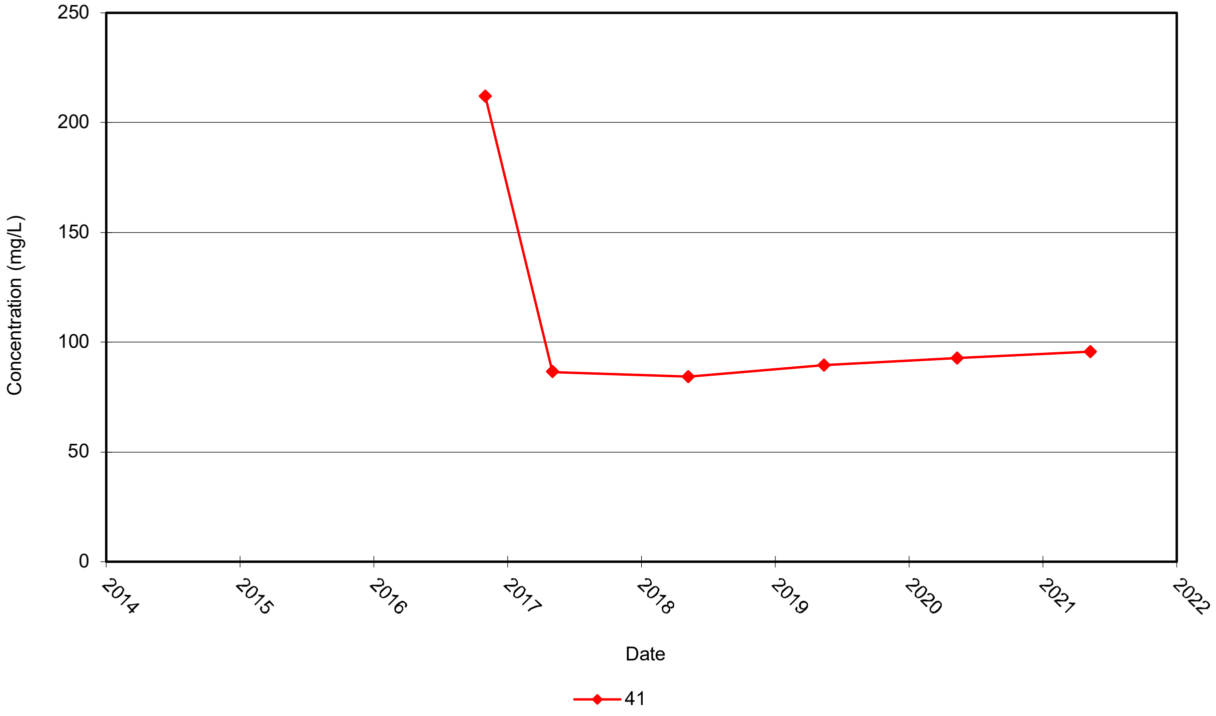
## FIGURE D-5
## TIME-CONCENTRATION GRAPH - IRON
## HOLBROOK LANDFILL - LEACHATE



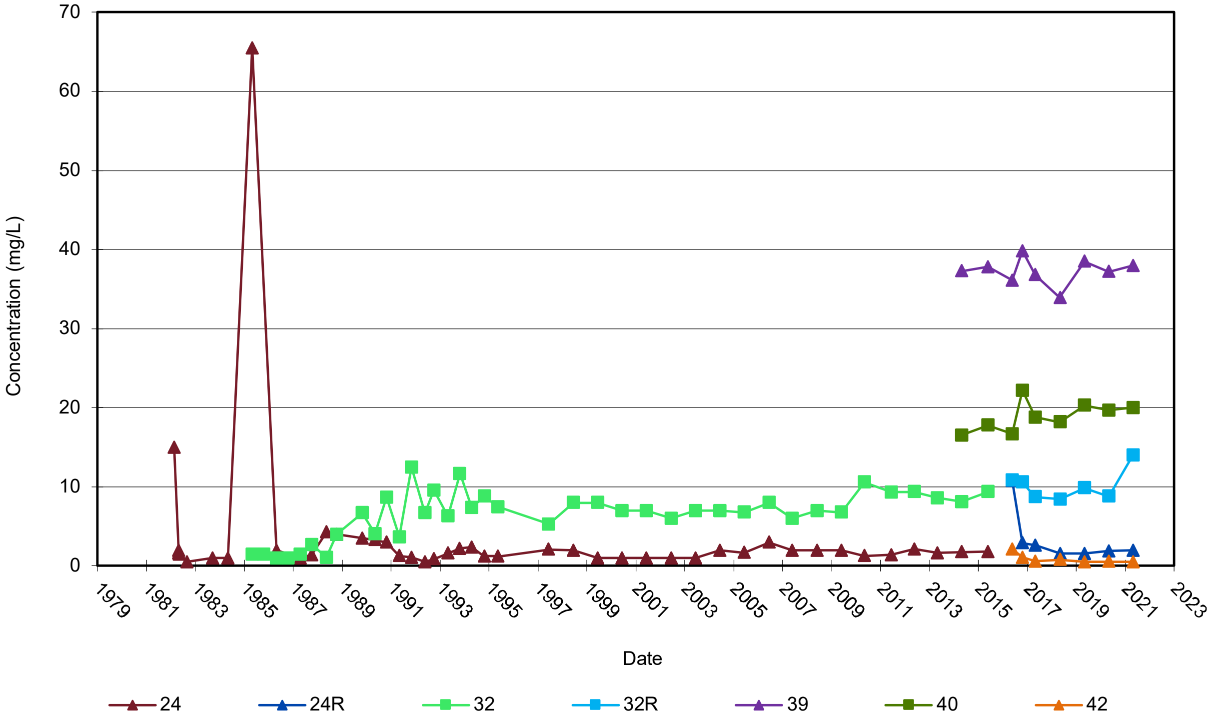
## FIGURE D-6
## TIME-CONCENTRATION GRAPH - AMMONIA
## HOLBROOK LANDFILL - LEACHATE



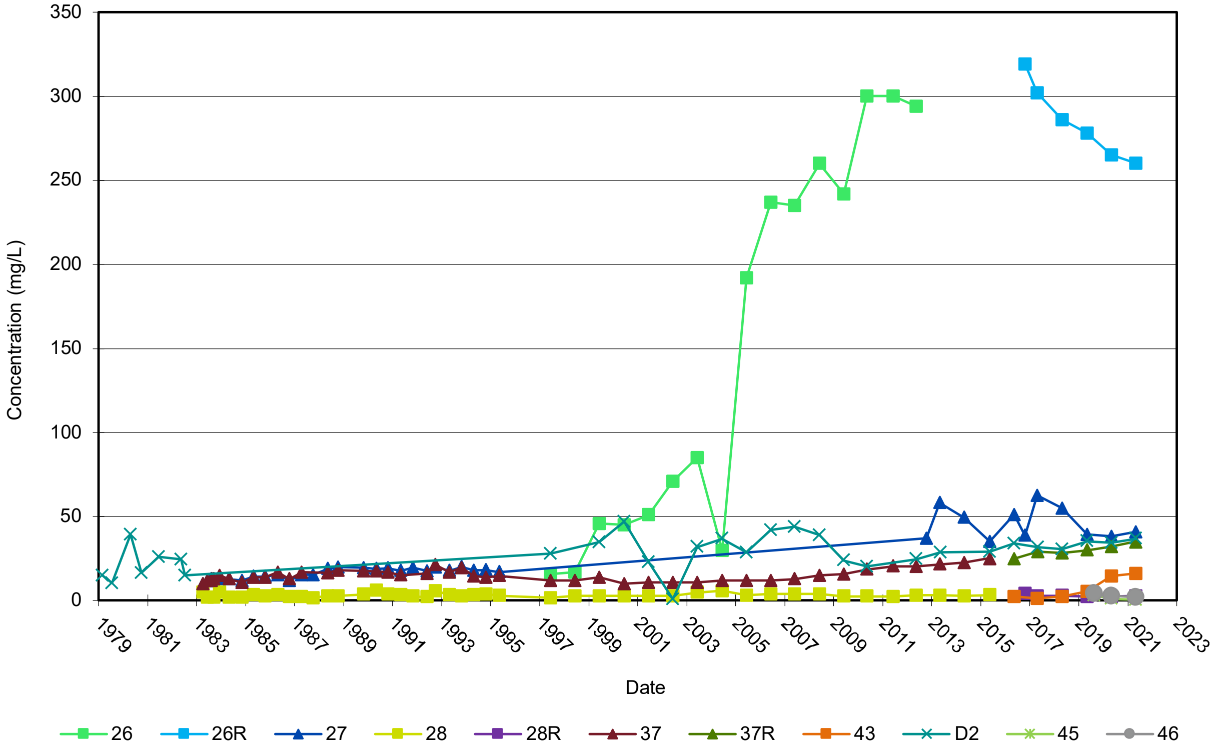
## FIGURE D-7
## TIME-CONCENTRATION GRAPH - TKN
## HOLBROOK LANDFILL - LEACHATE



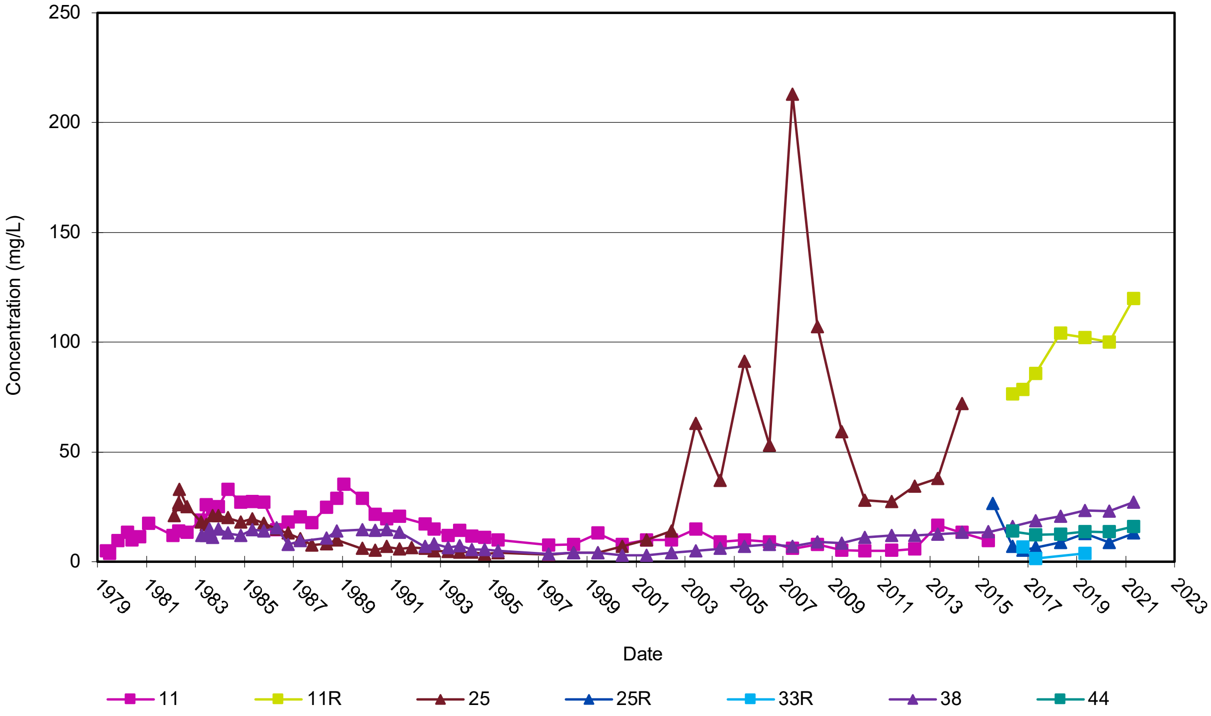
## FIGURE D-8
## TIME-CONCENTRATION GRAPH - CHLORIDE
## HOLBROOK LANDFILL - NORTH SIDE



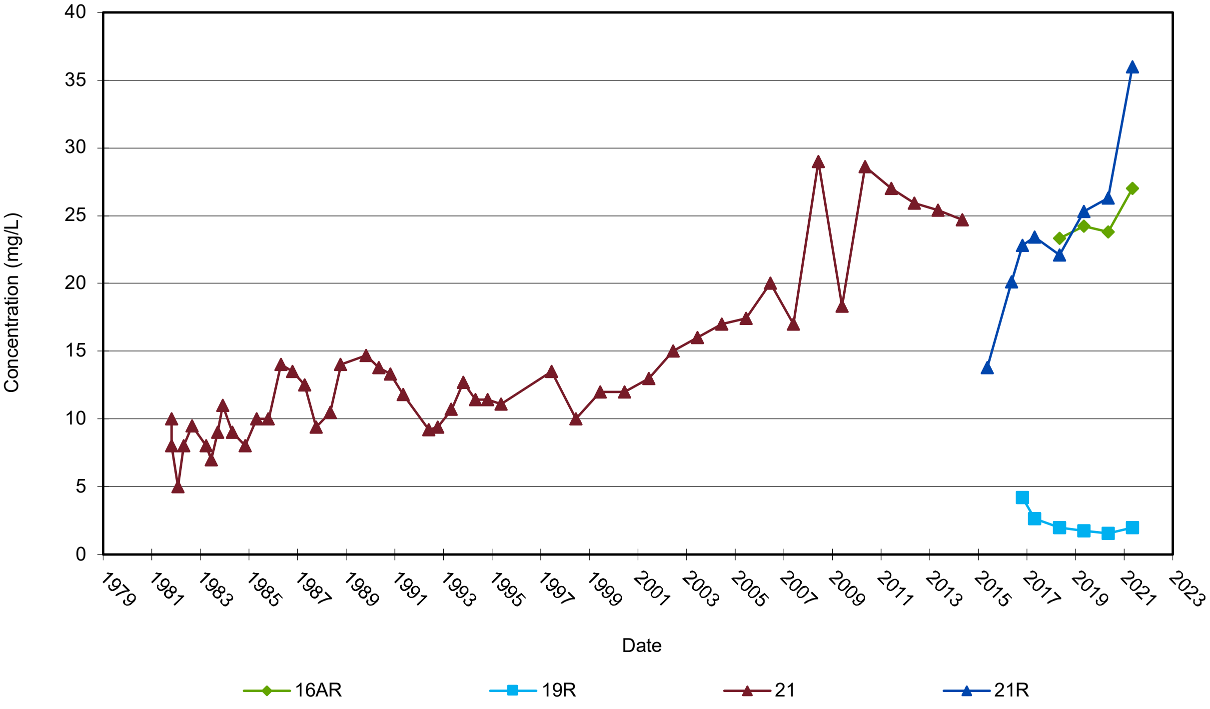
## FIGURE D-9
## TIME-CONCENTRATION GRAPH - CHLORIDE
## HOLBROOK LANDFILL - SOUTH SIDE



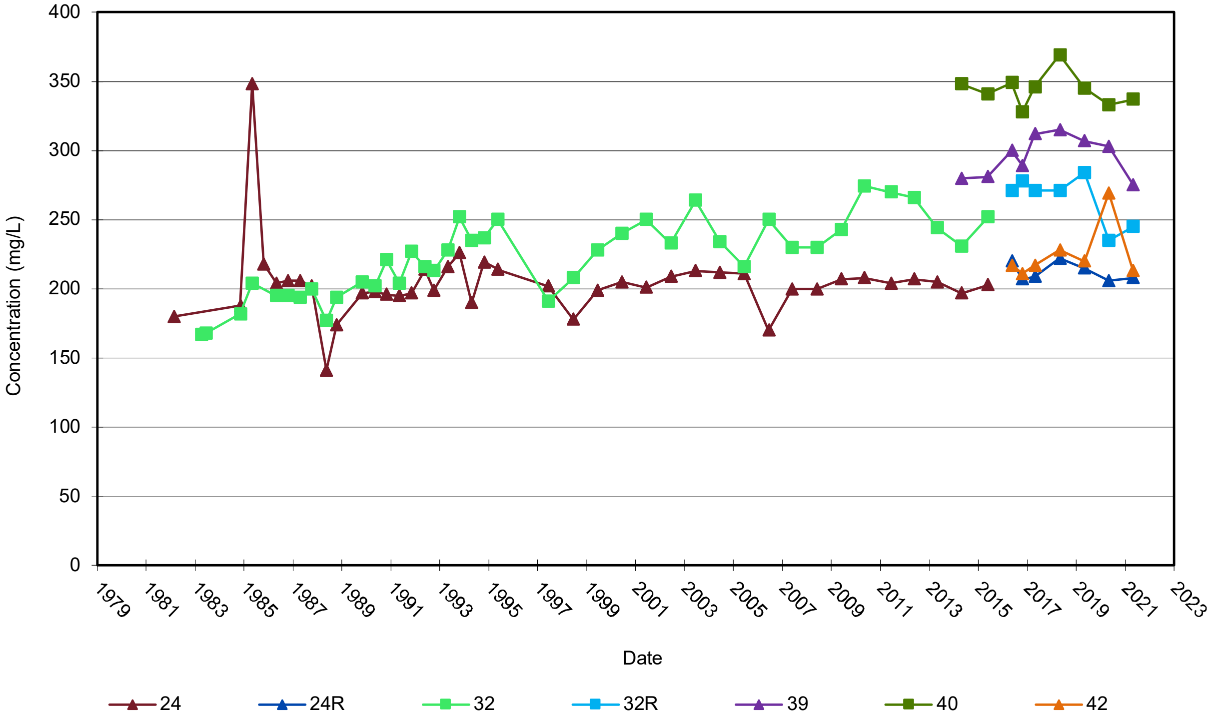
## FIGURE D-10
## TIME-CONCENTRATION GRAPH - CHLORIDE
## HOLBROOK LANDFILL - EAST SIDE



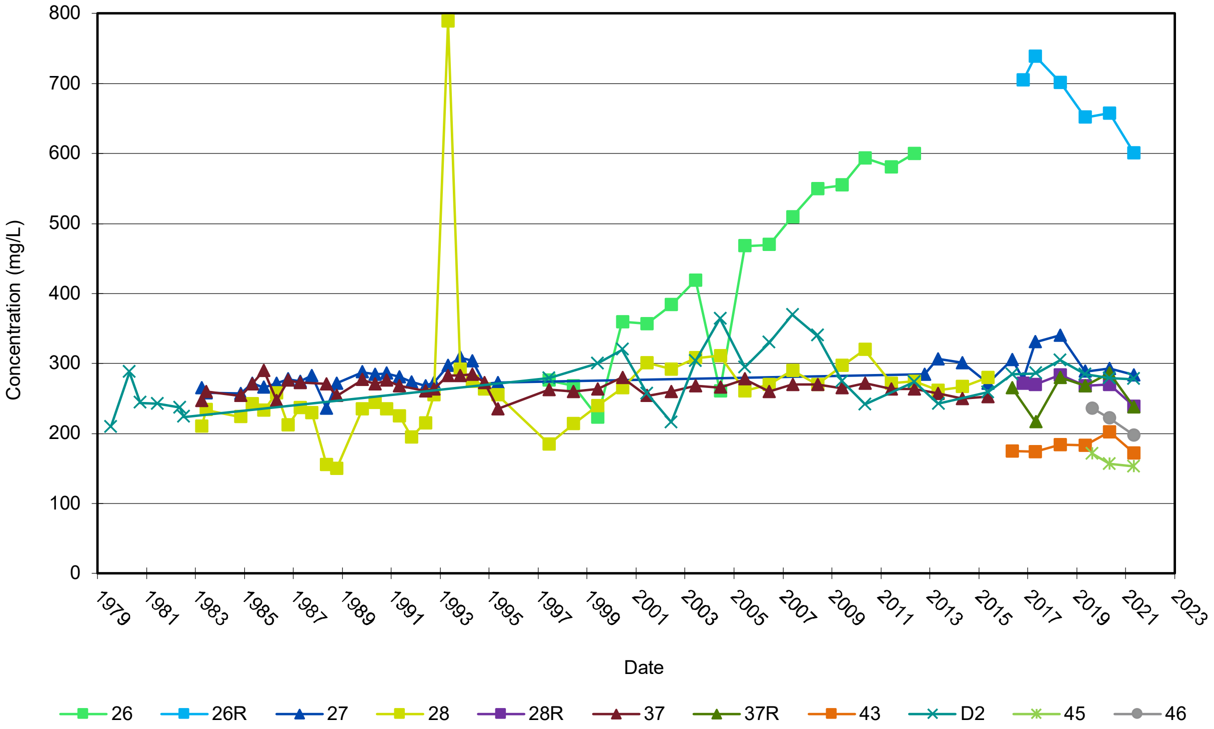
## FIGURE D-11
## TIME-CONCENTRATION GRAPH - CHLORIDE
## HOLBROOK LANDFILL - WEST SIDE



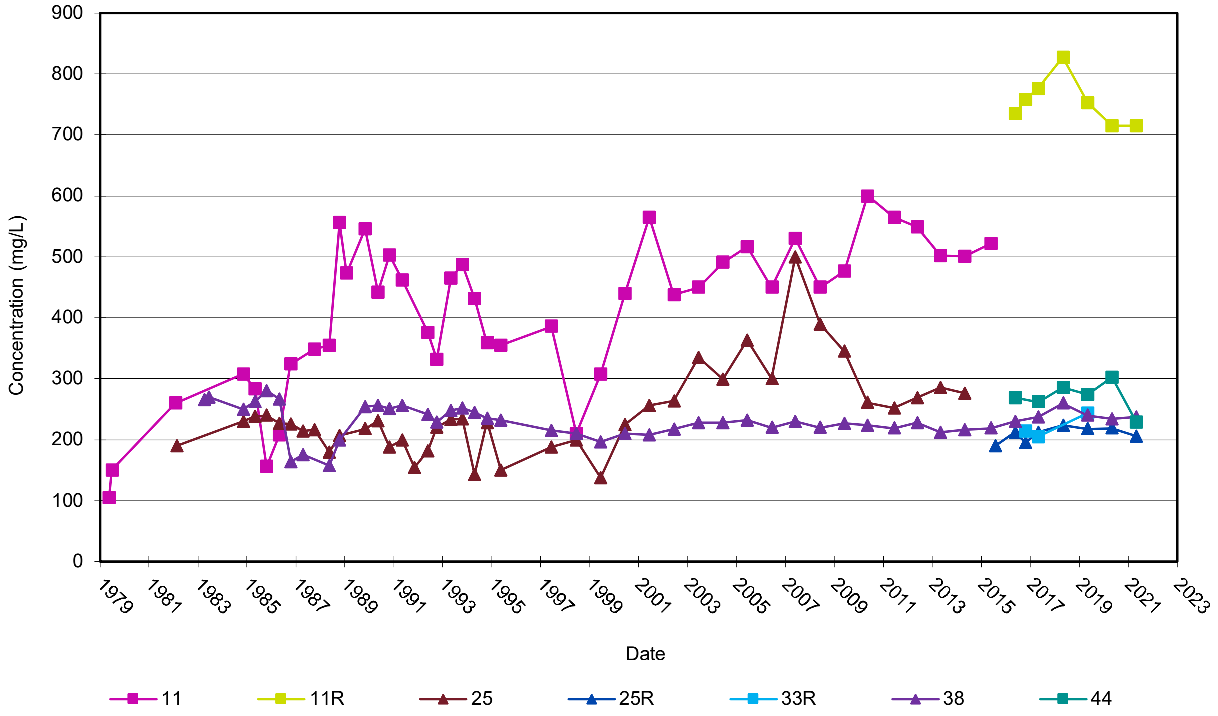
## FIGURE D-12
## TIME-CONCENTRATION GRAPH - ALKALINITY
## HOLBROOK LANDFILL - NORTH SIDE



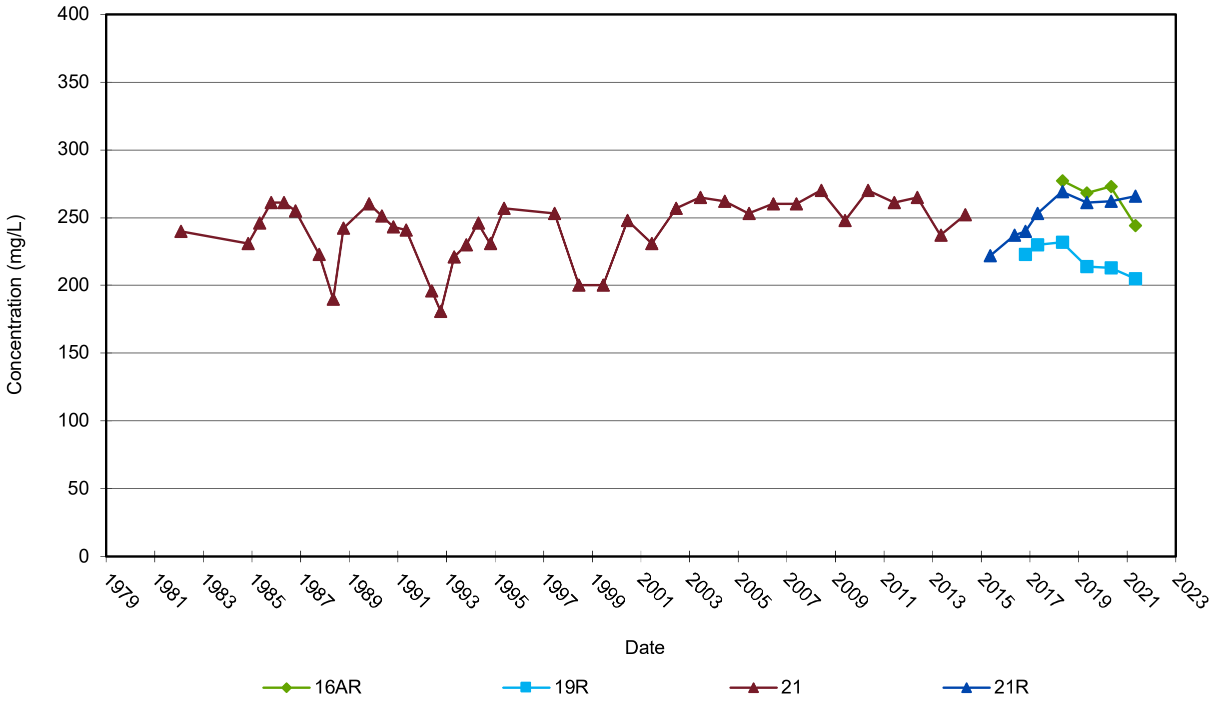
## FIGURE D-13
## TIME-CONCENTRATION GRAPH - ALKALINITY
## HOLBROOK LANDFILL - SOUTH SIDE



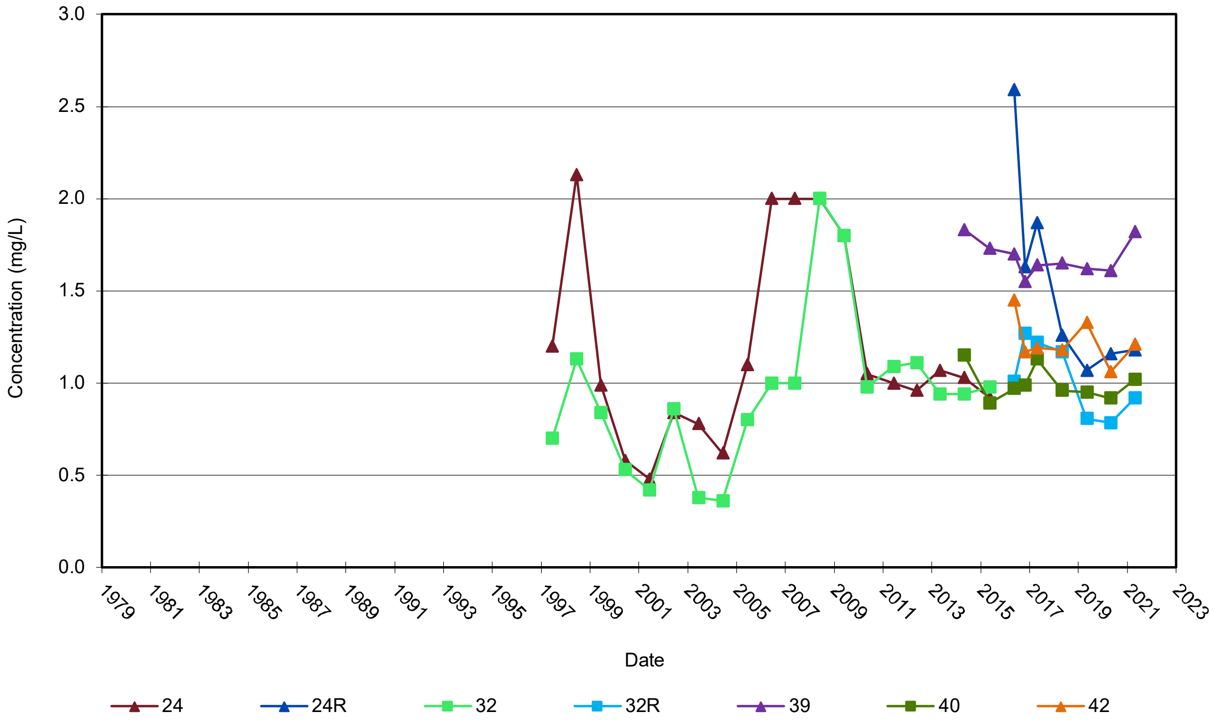
## FIGURE D-14
## TIME-CONCENTRATION GRAPH - ALKALINITY
## HOLBROOK LANDFILL - EAST SIDE



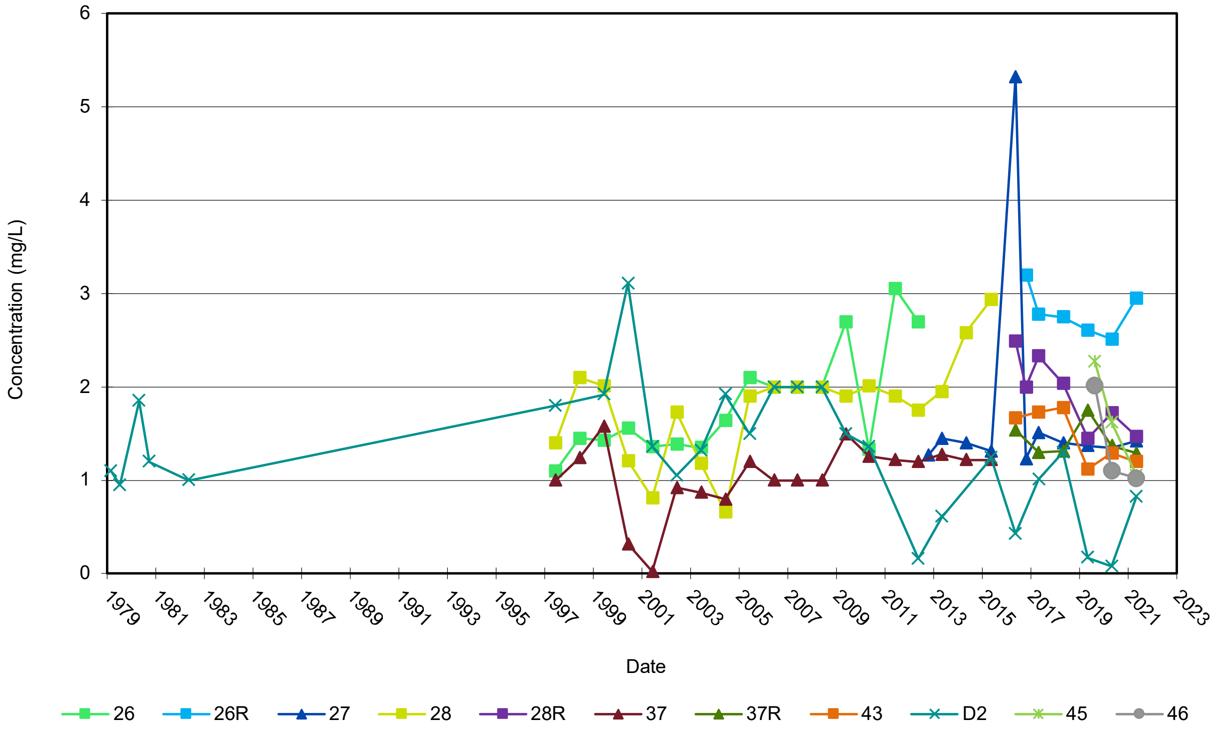
## FIGURE D-15
## TIME-CONCENTRATION GRAPH - ALKALINITY
## HOLBROOK LANDFILL - WEST SIDE



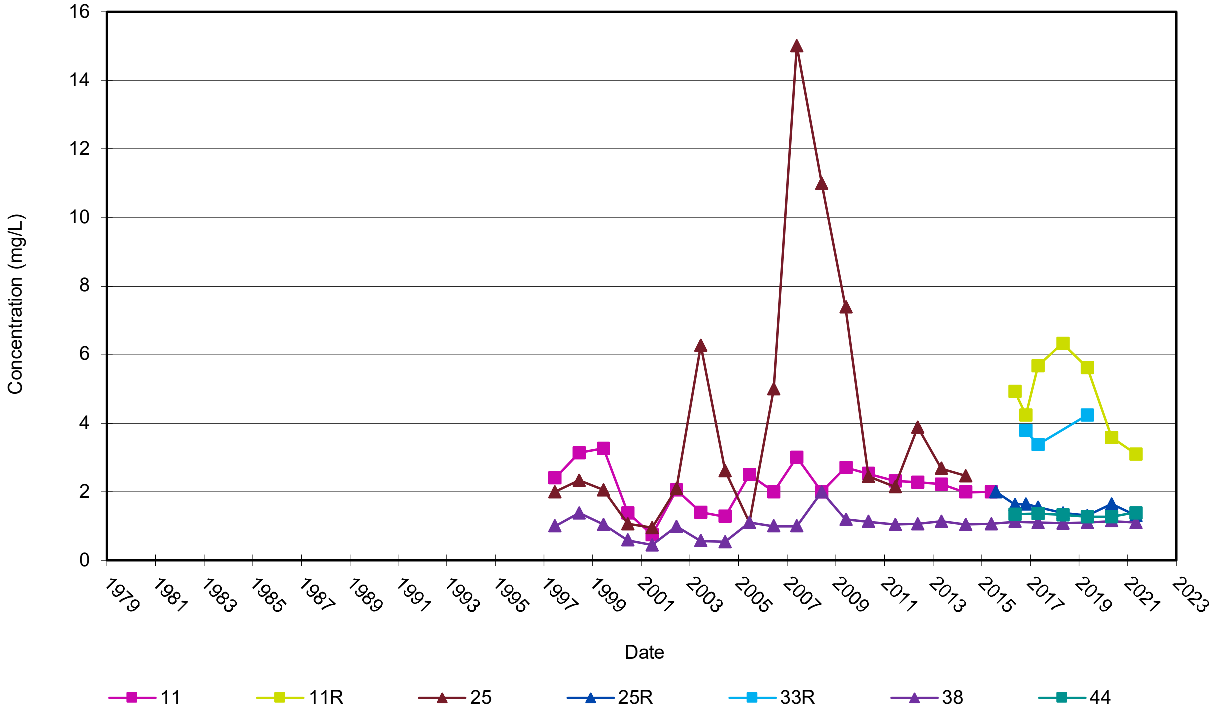
## FIGURE D-16
## TIME-CONCENTRATION GRAPH - POTASSIUM
## HOLBROOK LANDFILL - NORTH SIDE



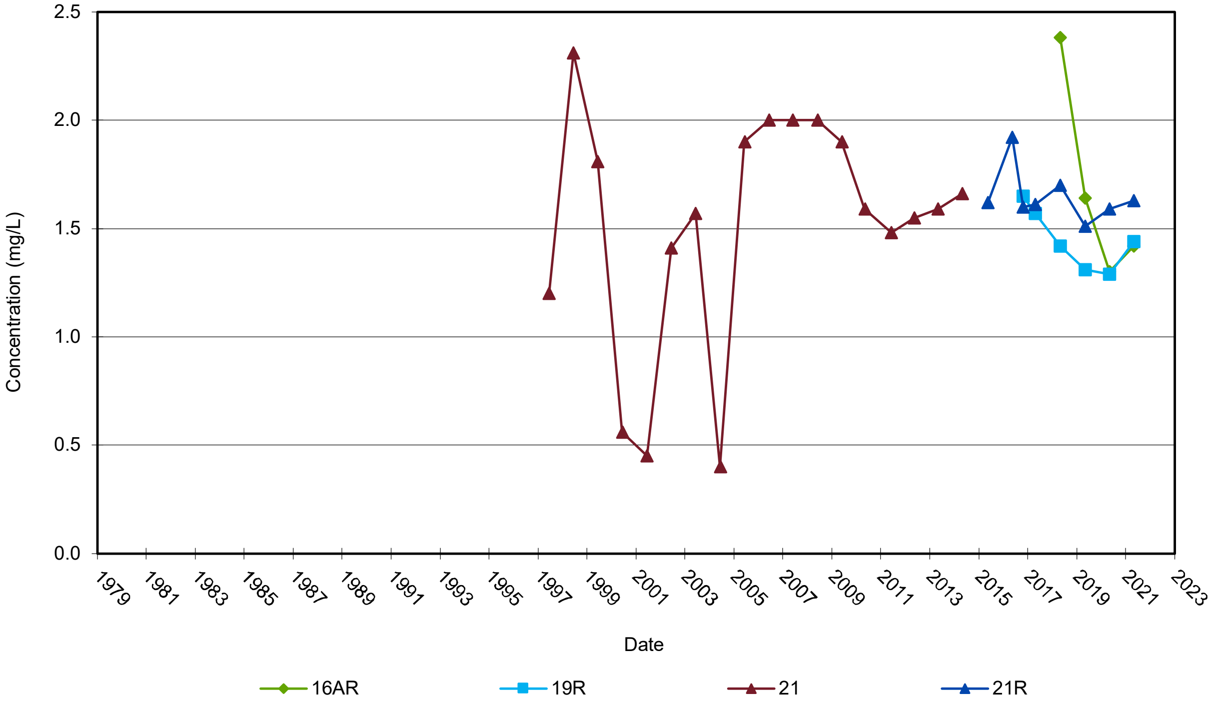
## FIGURE D-17
## TIME-CONCENTRATION GRAPH - POTASSIUM
## HOLBROOK LANDFILL - SOUTH SIDE



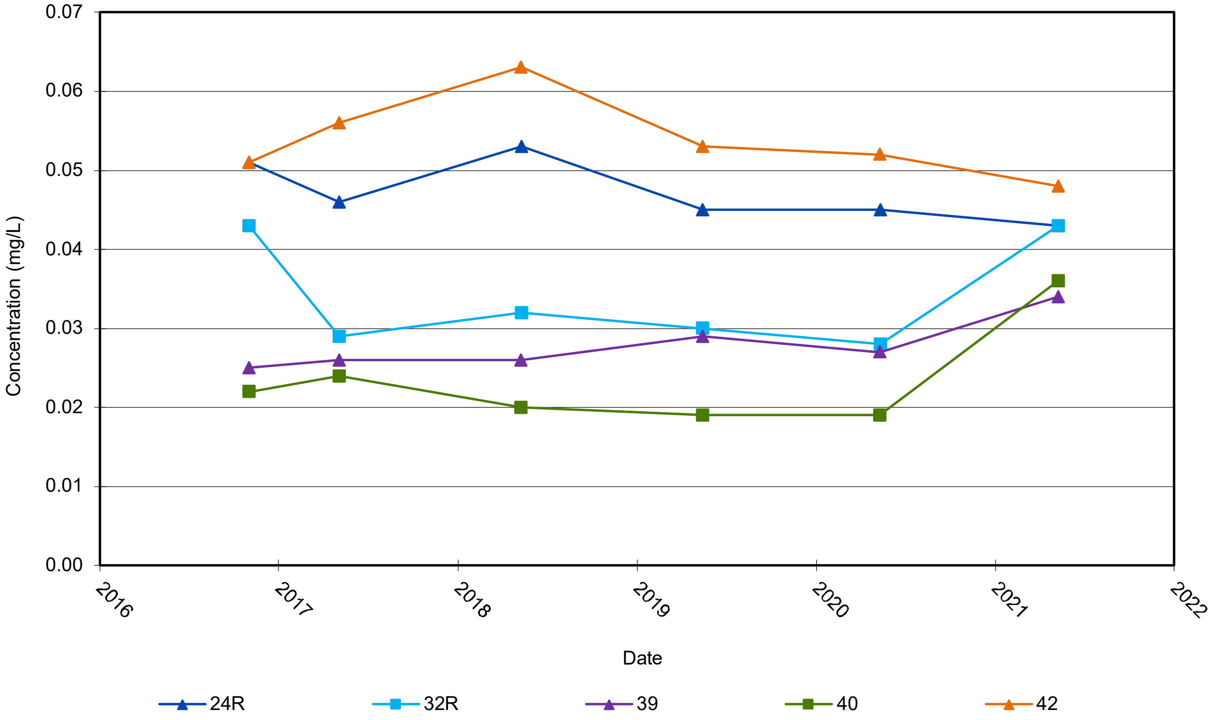
## FIGURE D-18
## TIME-CONCENTRATION GRAPH - POTASSIUM
## HOLBROOK LANDFILL - EAST SIDE



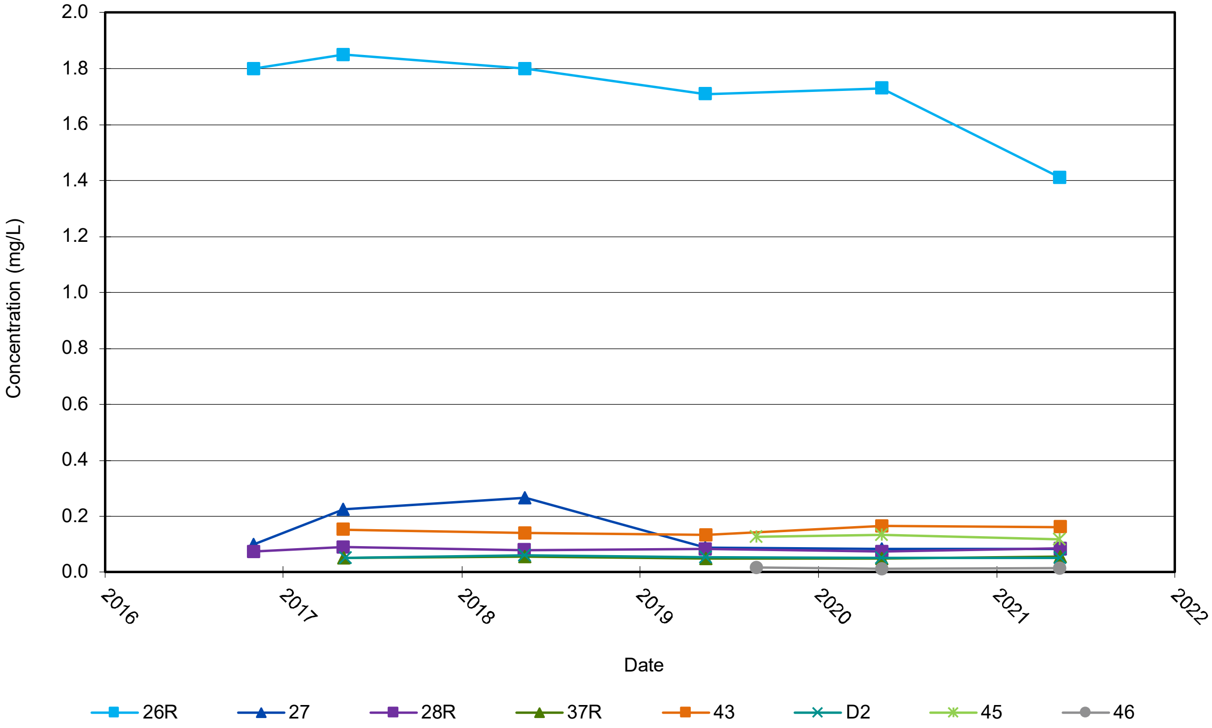
## FIGURE D-19
## TIME-CONCENTRATION GRAPH - POTASSIUM
## HOLBROOK LANDFILL - WEST SIDE



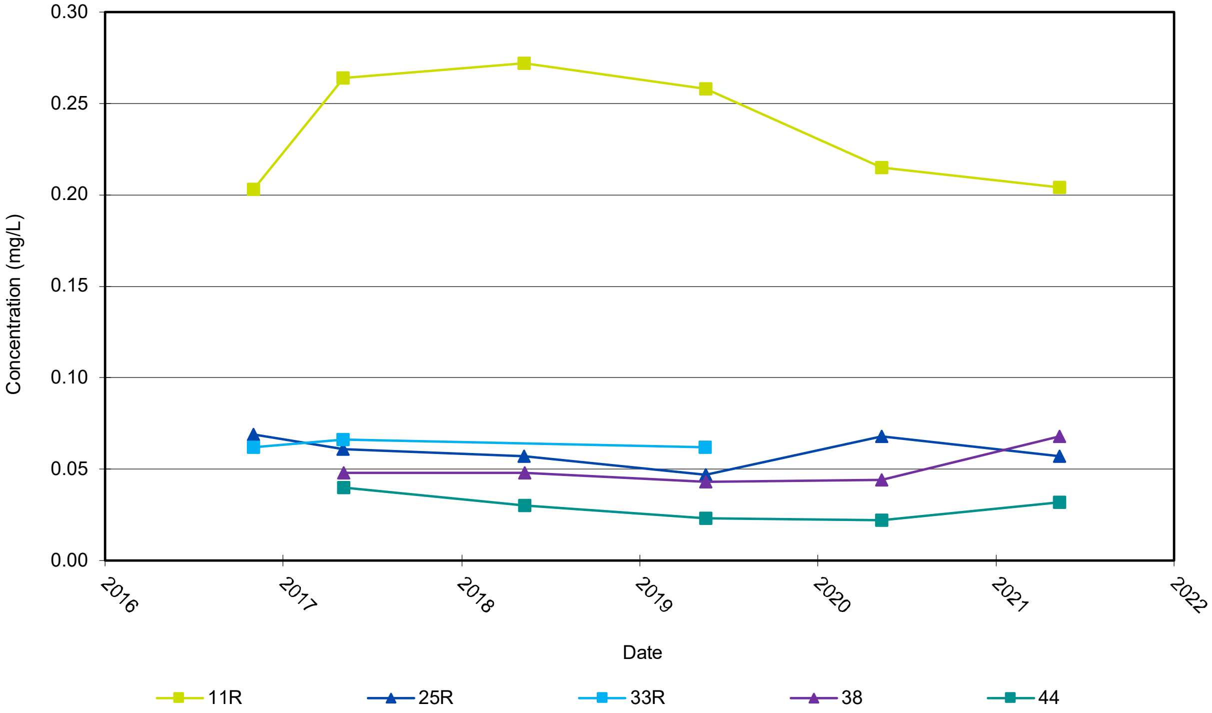
## FIGURE D-20
## TIME-CONCENTRATION GRAPH - BORON
## HOLBROOK LANDFILL - NORTH SIDE



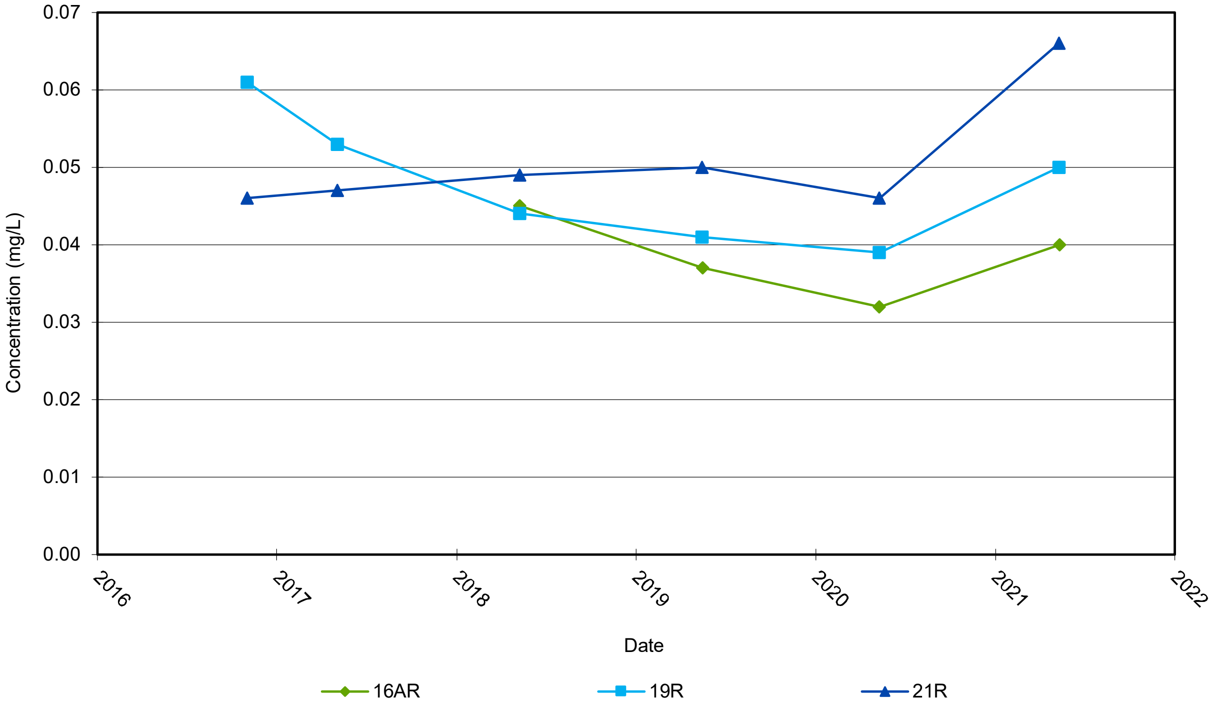
## FIGURE D-21
## TIME-CONCENTRATION GRAPH - BORON
## HOLBROOK LANDFILL - SOUTH SIDE



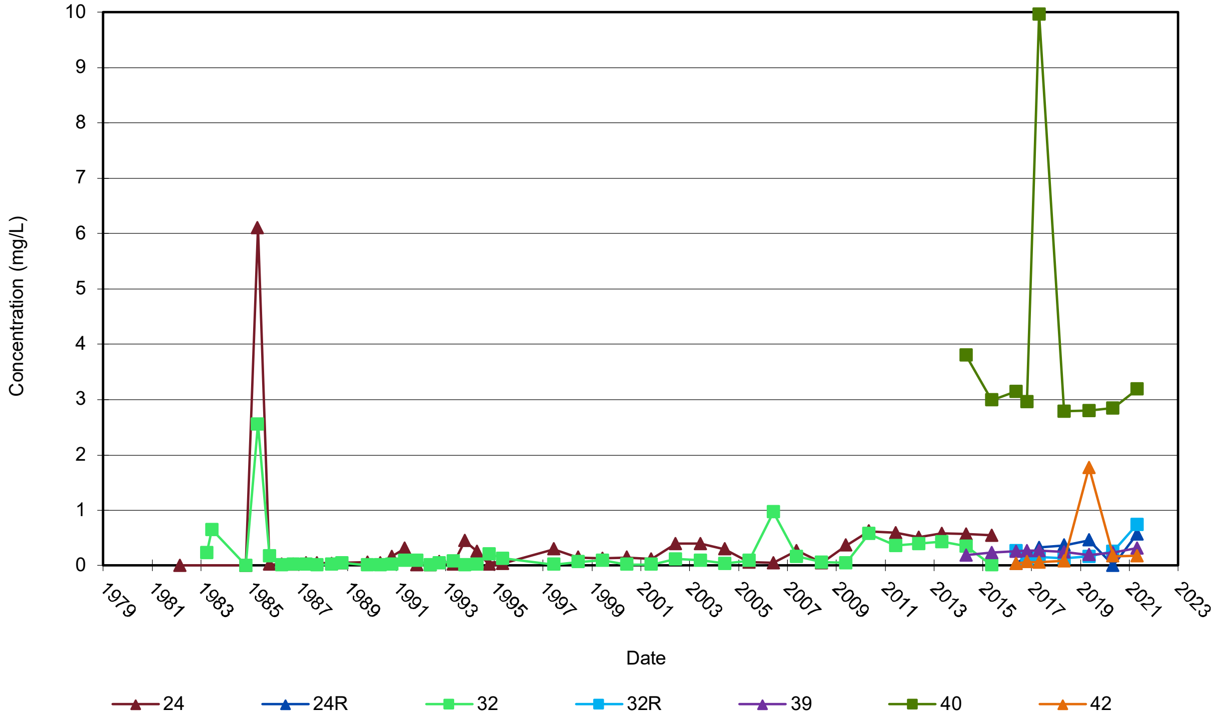
## FIGURE D-22
## TIME-CONCENTRATION GRAPH - BORON
## HOLBROOK LANDFILL - EAST SIDE



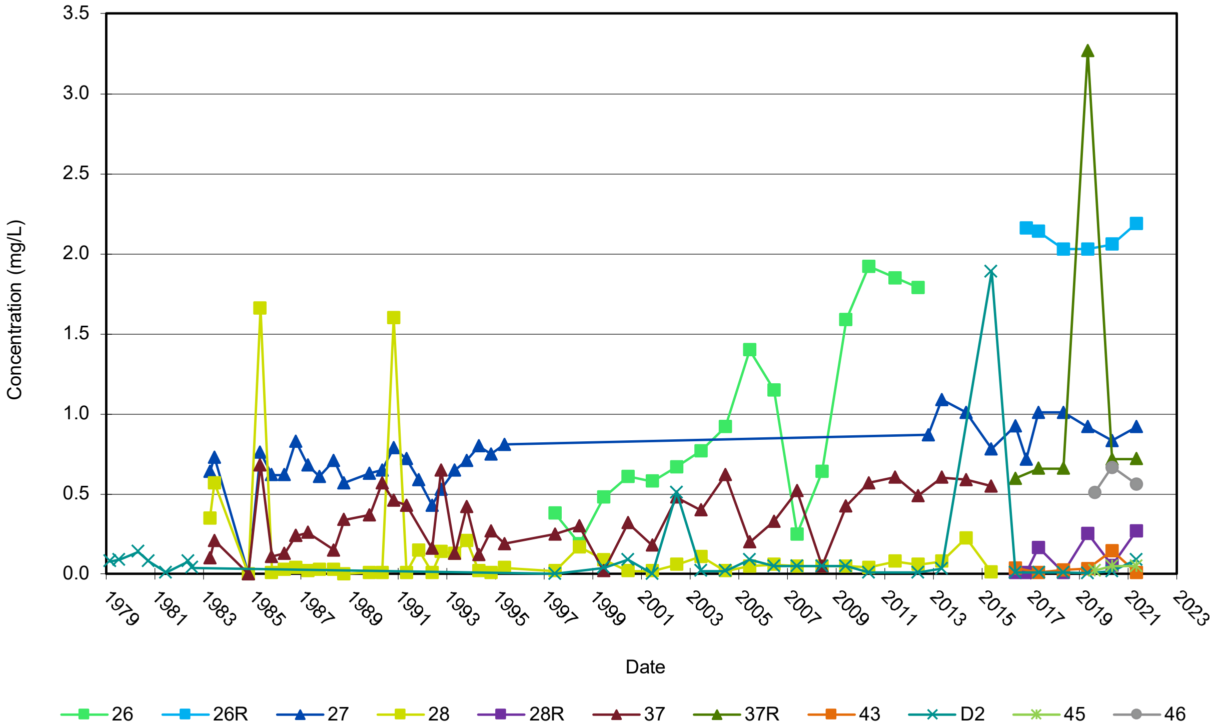
## FIGURE D-23
## TIME-CONCENTRATION GRAPH - BORON
## HOLBROOK LANDFILL - WEST SIDE



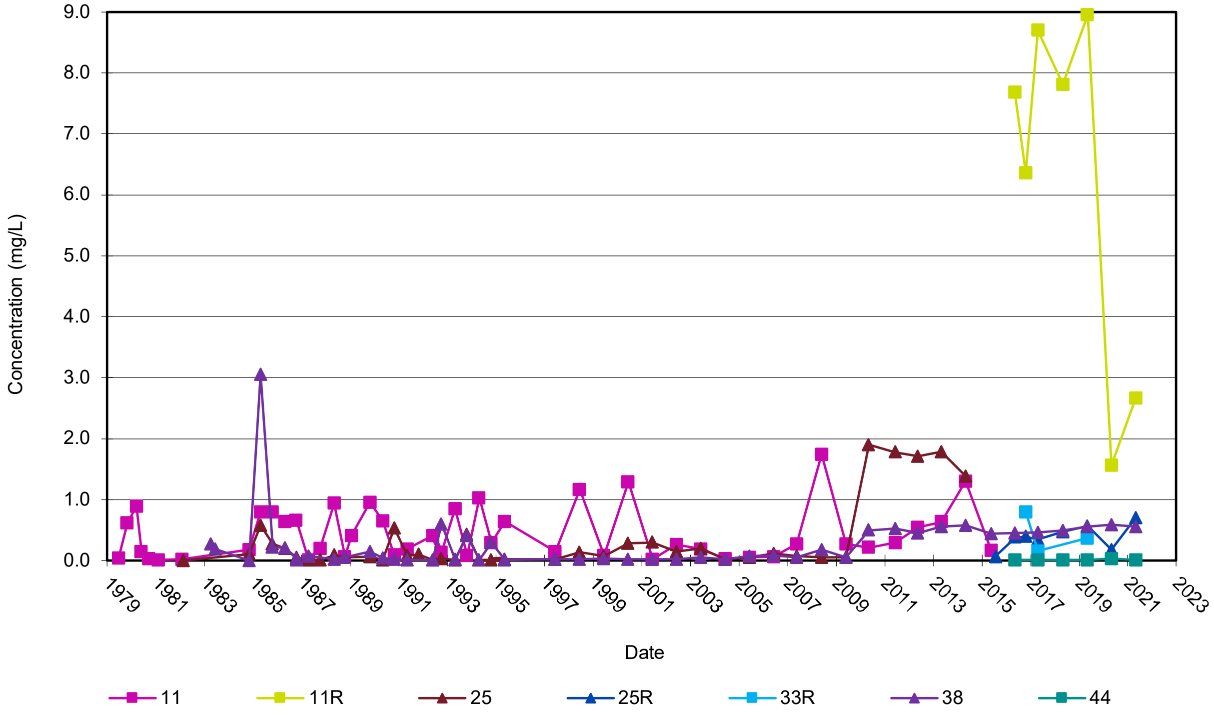
# FIGURE D-24
# TIME-CONCENTRATION GRAPH - IRON
# HOLBROOK LANDFILL - NORTH SIDE



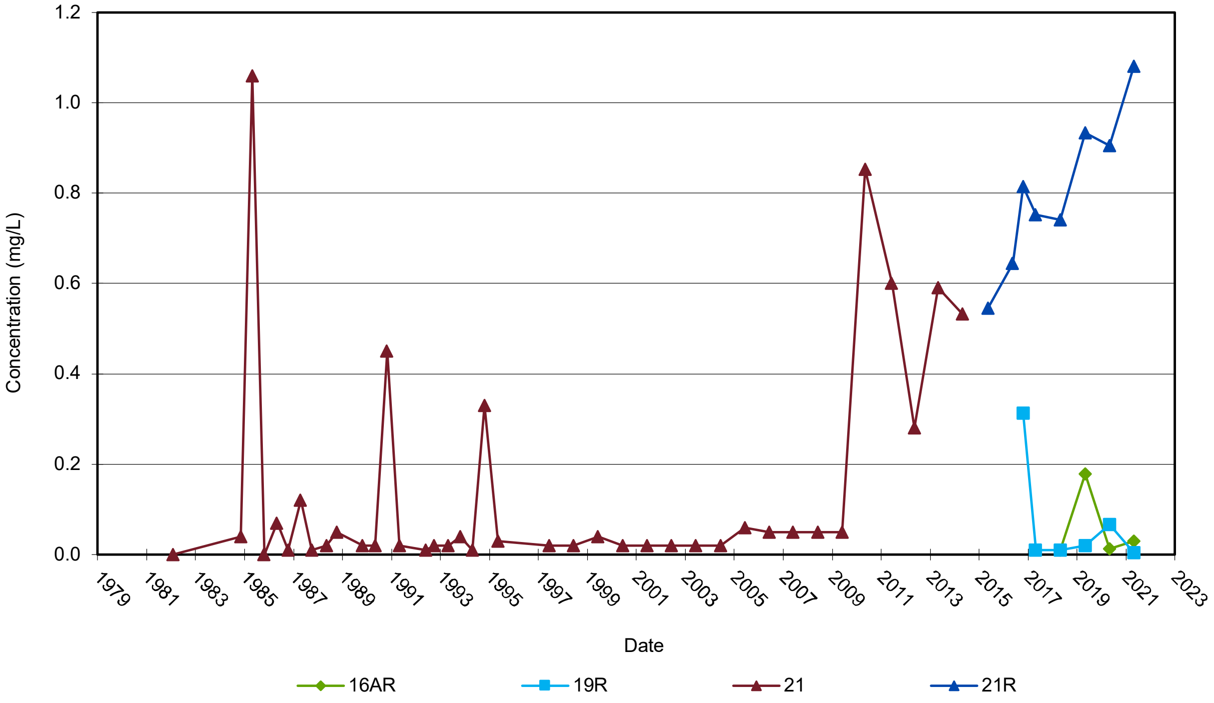
# FIGURE D-25
# TIME-CONCENTRATION GRAPH - IRON
# HOLBROOK LANDFILL - SOUTH SIDE



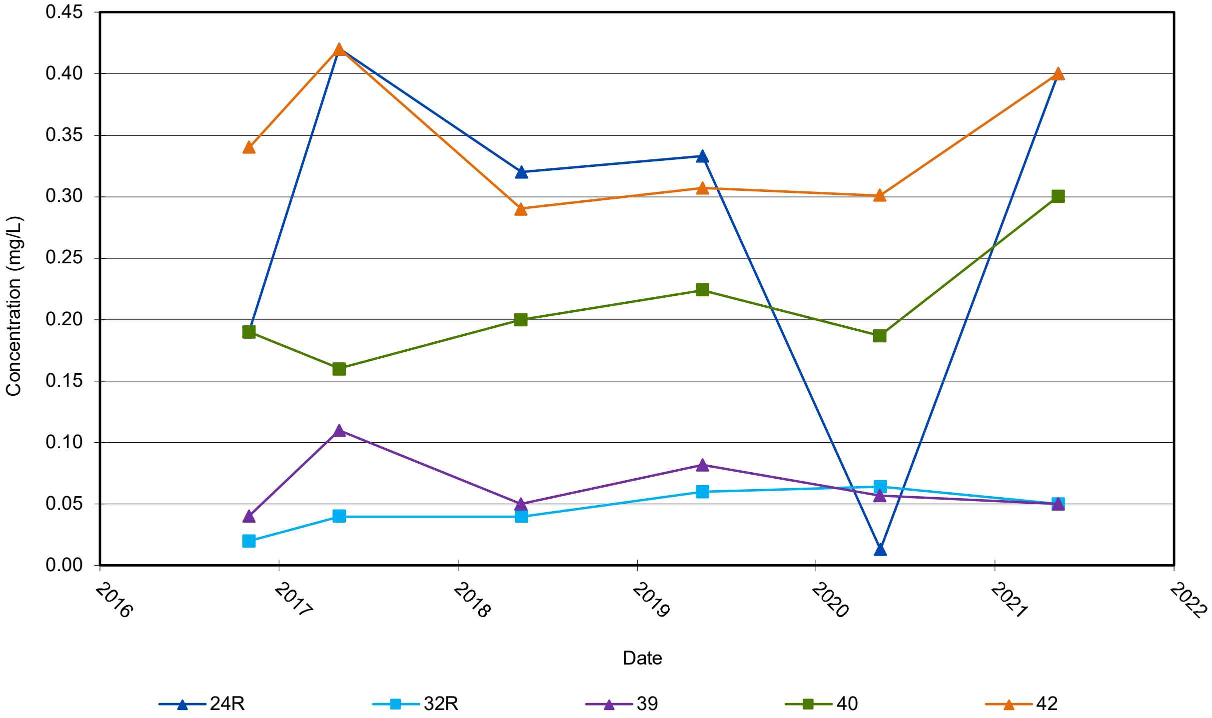
## FIGURE D-26
## TIME-CONCENTRATION GRAPH - IRON
## HOLBROOK LANDFILL - EAST SIDE



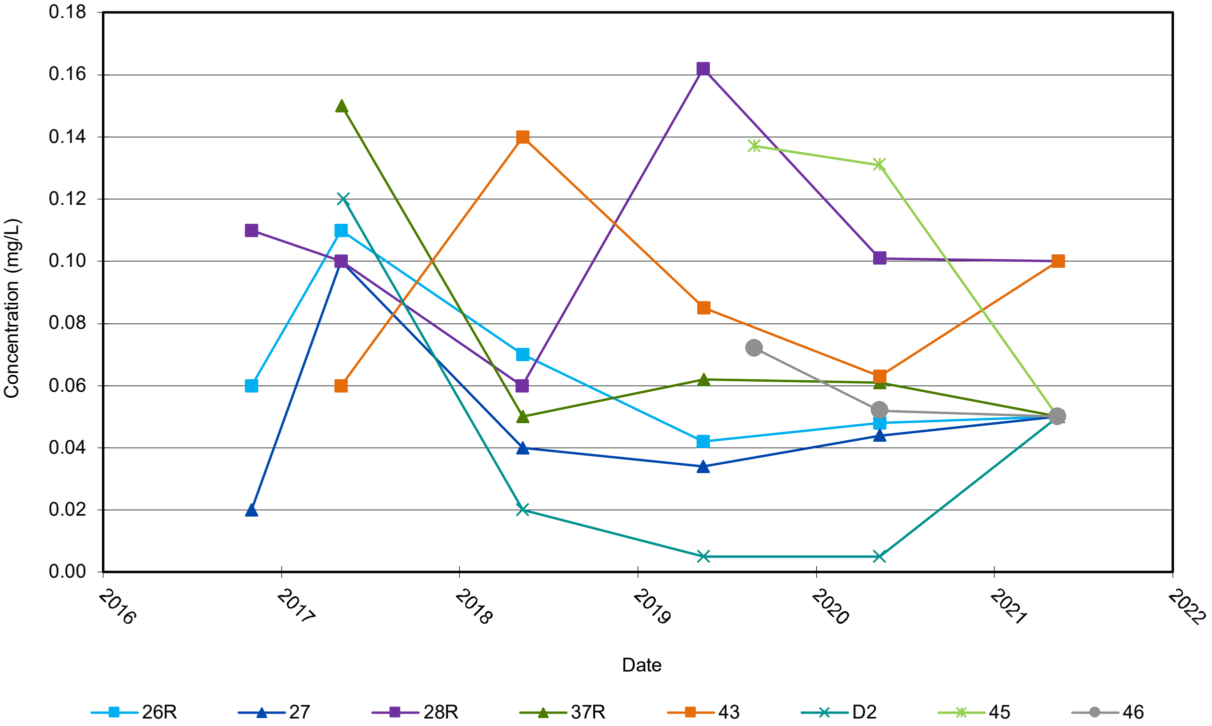
## FIGURE D-27
## TIME-CONCENTRATION GRAPH - IRON
## HOLBROOK LANDFILL - WEST SIDE



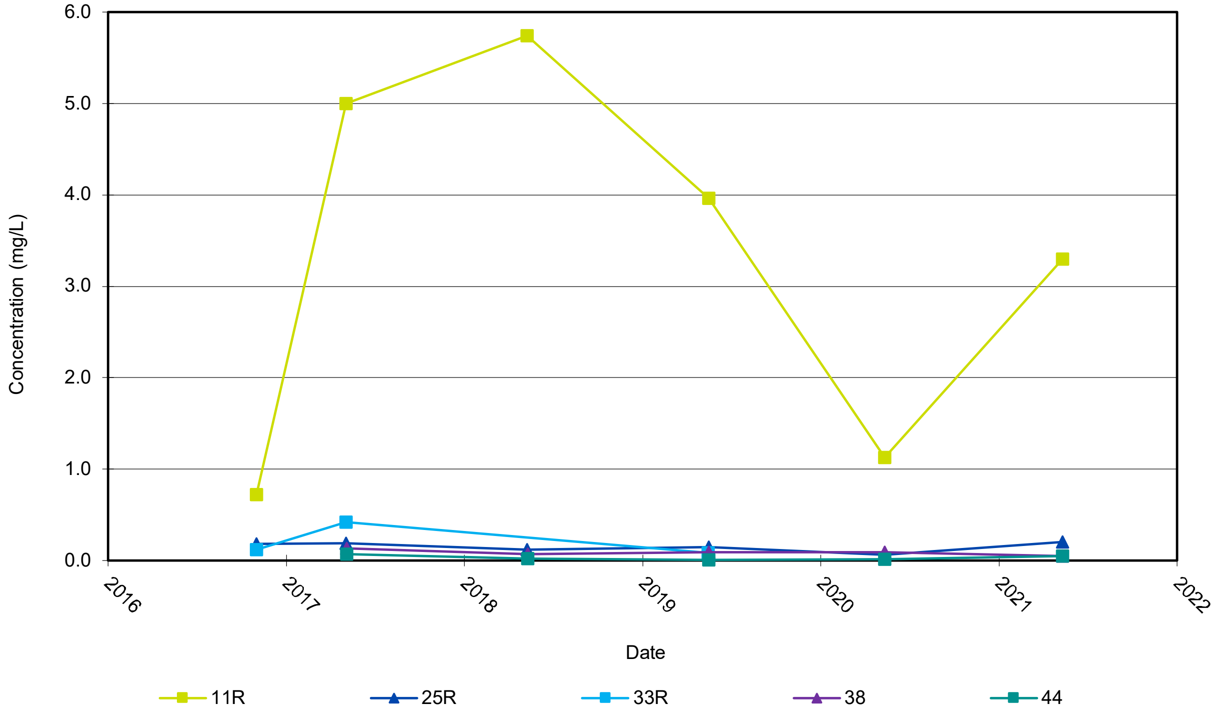
## FIGURE D-28
## TIME-CONCENTRATION GRAPH - AMMONIA
## HOLBROOK LANDFILL - NORTH SIDE



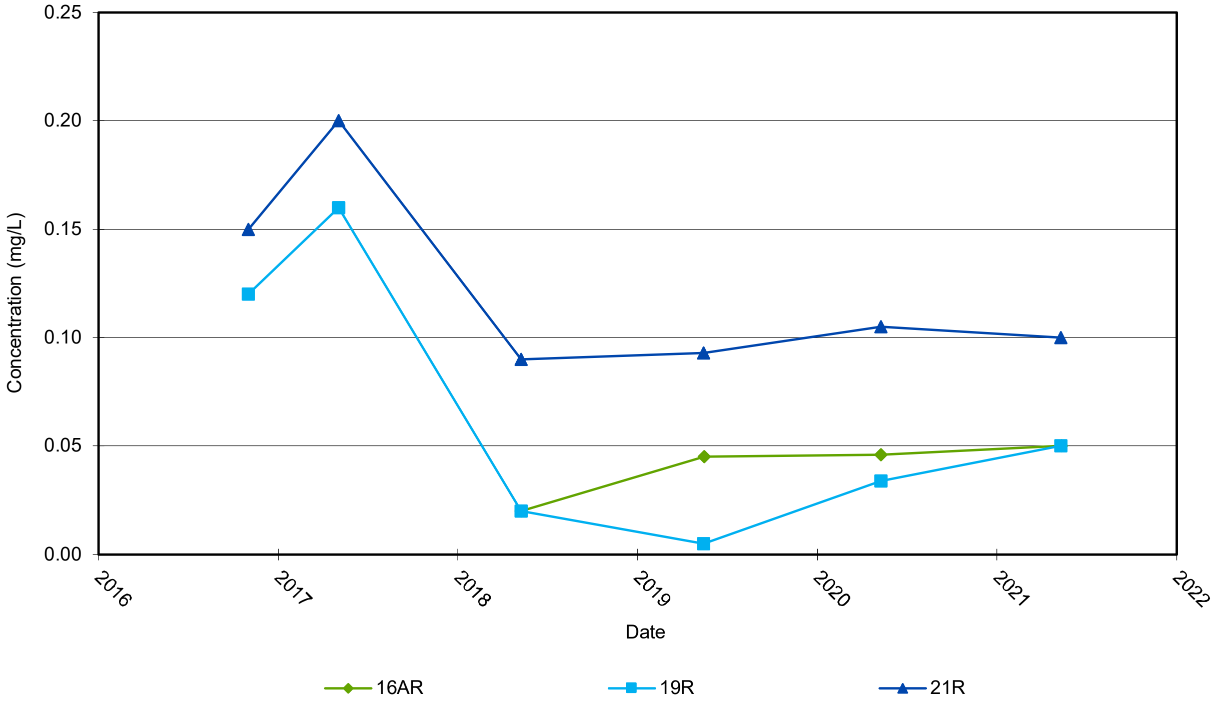
## FIGURE D-29
## TIME-CONCENTRATION GRAPH - AMMONIA
## HOLBROOK LANDFILL - SOUTH SIDE



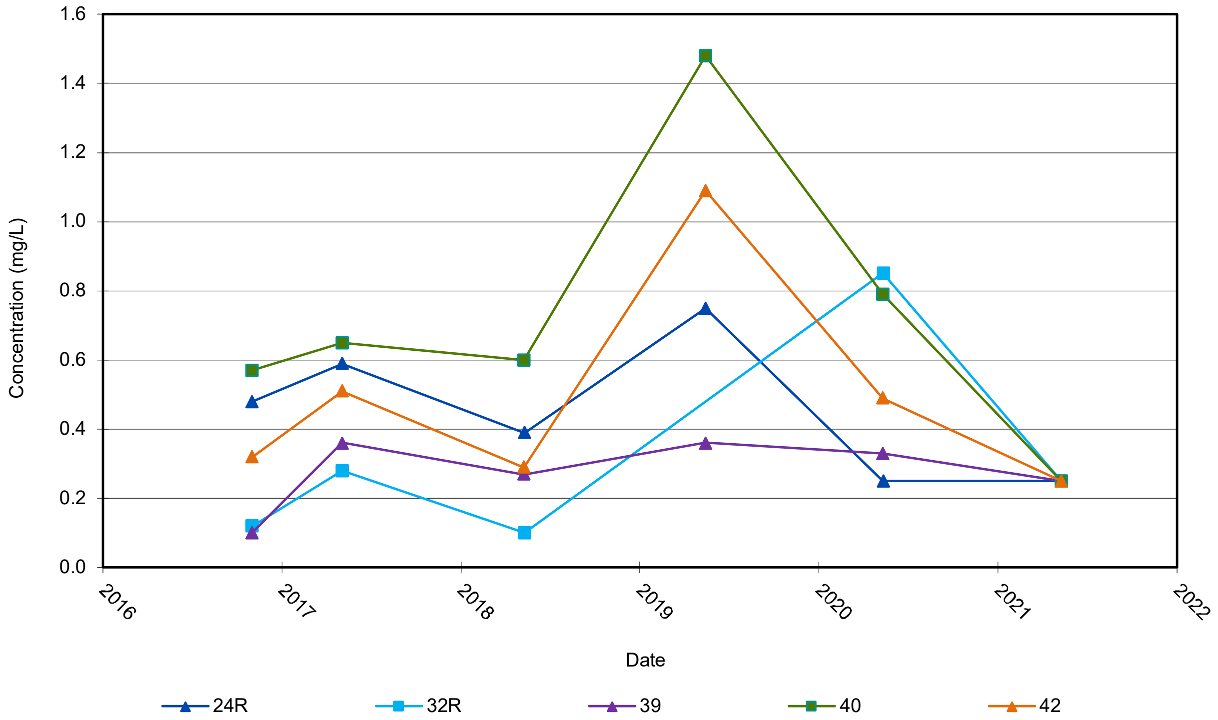
## FIGURE D-30
## TIME-CONCENTRATION GRAPH - AMMONIA
## HOLBROOK LANDFILL - EAST SIDE



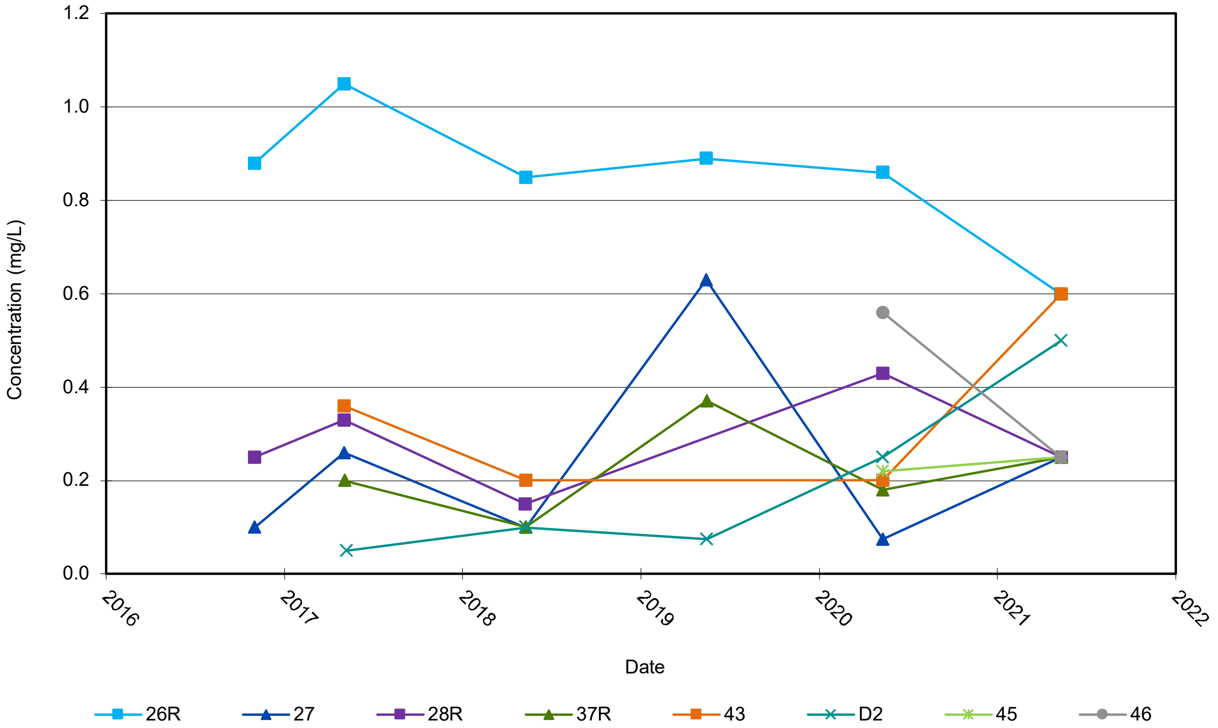
## FIGURE D-31
## TIME-CONCENTRATION GRAPH - AMMONIA
## HOLBROOK LANDFILL - WEST SIDE



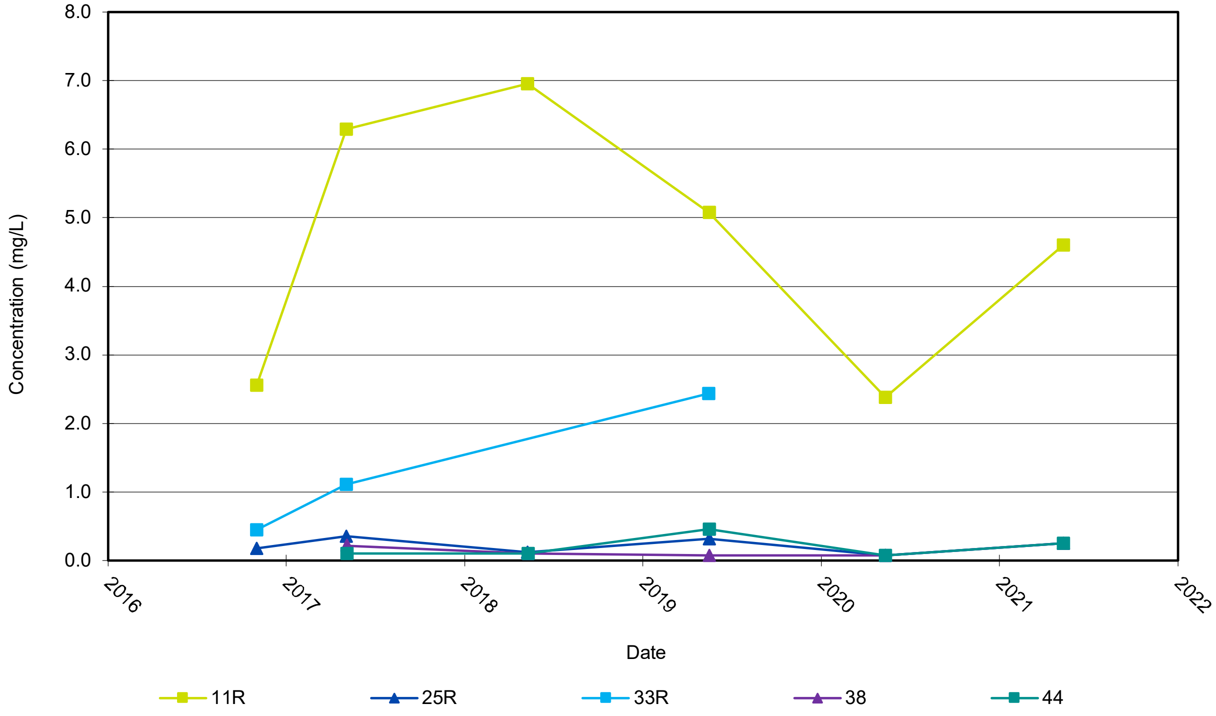
## FIGURE D-32
## TIME-CONCENTRATION GRAPH - TKN
## HOLBROOK LANDFILL - NORTH SIDE



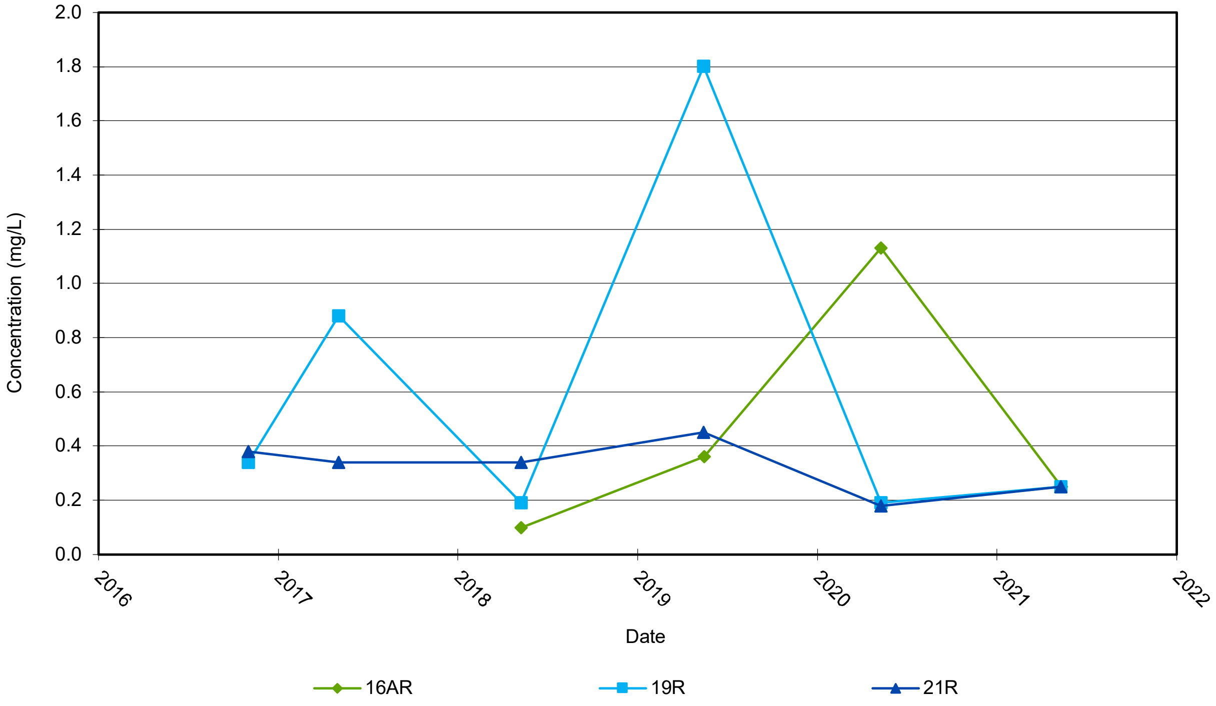
## FIGURE D-33
## TIME-CONCENTRATION GRAPH - TKN
## HOLBROOK LANDFILL - SOUTH SIDE



## FIGURE D-34
## TIME-CONCENTRATION GRAPH - TKN
## HOLBROOK LANDFILL - EAST SIDE



## FIGURE D-35
## TIME-CONCENTRATION GRAPH - TKN
## HOLBROOK LANDFILL - WEST SIDE



# APPENDIX

# E

## SURFACE WATER CHEMISTRY

| *Notation* | *Description* | | |
|---|---|---|---|
| | all units in mg/L unless otherwise noted | EC | Electrical Conductivity |
| mg/L | milligrams per Litre | ºC | degrees Celsius |
| µg/L | micrograms per Litre | µS/cm | microSiemens per centimetre |
| SU | Scientific Units | T | Temperature |
| **PWQO** | Provincial Water Quality Objectives (July 1994) | | |
| *i* | interim PWQO | | |
| *nc* | no PWQO criteria | | |
| *a* | **alkalinity** should not decrease by more than 25% of the natural concentration: | | |
| | calculated on an event specific basis from background station CO6 when sampled | | |
| em | equipment malfunction - field parameter data not available | | |
| DRY | sampling location dry at the time of sampling | | |
| - or blank | parameter not analysed during sampling event | | |
| < value | parameter not detected above associated laboratory reported detection limit | | |
| * | estimated value / result interpreted with caution or considered questionable | | |

# Table E-1:  Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | °C | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 30-Mar-83 | | | | | 7.30 | 380 | 222 | 12.0 | | | | | | | | | | | | | | |
| | 18-Apr-83 | | | | | 7.30 | 380 | 222 | 12.0 | | | | | | | | | | | | | | |
| | 15-Jun-83 | | | | | 7.30 | 620 | 324 | 2.0 | | | | | | | | | | | | | | |
| | 20-Jul-83 | | | | | 7.45 | 670 | 356 | 21.0 | | 328 | 108.0 | 20.8 | | | | | | | | | | |
| | 13-Sep-83 | | | | | 7.20 | 580 | 328 | 26.0 | | | | | | | | | | | | | | |
| | 14-Nov-83 | | | | | 8.24 | 640 | 342 | 21.8 | | 305 | 95.0 | 25.5 | | | | | | | | | 0.39 | |
| | 8-Dec-83 | | | | | 7.30 | 510 | 316 | 19.0 | | | | | | | | | | | | | | |
| | 30-Apr-84 | | | | | 7.30 | 600 | 318 | 18.0 | | | | | | | | | | | | | | |
| | 15-Jun-84 | | | | | 7.94 | 720 | 342 | 22.0 | | 331 | 96.0 | 24.8 | | | | | | | | | 0.42 | |
| | 8-Aug-84 | | | | | 7.92 | 553 | 288 | 17.8 | | 251 | 83.0 | 19.5 | | | | | | | | | 0.22 | |
| | 10-Aug-84 | | | | | 7.48 | 700 | 346 | 23.5 | | 336 | 100.0 | 23.4 | | | | | | | | | 0.65 | |
| | 18-Sep-84 | | | | | 7.65 | 660 | 348 | 21.5 | | 315 | 99.5 | 24.0 | | | | | | | | | 0.32 | |
| | 18-Dec-84 | | | | | 7.88 | 618 | 309 | 22.0 | | 293 | 86.0 | 22.8 | | | | | | | | | 0.20 | |
| | 24-Jun-85 | | | | | 7.77 | 660 | 321 | 22.0 | | 317 | 89.0 | 23.8 | | | | | | | | | 0.30 | |
| | 7-Oct-85 | | | | | 7.57 | 710 | 338 | 18.5 | | 300 | 97.0 | 23.2 | | | | | | | | | 1.45 | |
| | 18-Dec-85 | | | | | 7.51 | 690 | 346 | 22.0 | | 290 | 98.0 | 24.4 | | | | | | | | | 0.80 | |
| | 12-Mar-86 | | | | | 7.46 | 468 | 228 | 18.5 | | 200 | 68.0 | 14.0 | | | | | | | | | 0.84 | |
| | 10-Jun-86 | | | | | 7.81 | 635 | 314 | 20.5 | | 302 | 90.0 | 21.6 | | | | | | | | | 0.44 | |
| | 18-Sep-86 | | | | | 7.60 | 615 | 291 | 23.5 | | 260 | 80.0 | 22.0 | | | | | | | | | 0.24 | |
| | 15-Dec-86 | | | | | 7.56 | 625 | 311 | 21.5 | | 274 | 85.5 | 23.6 | | | | | | | | | 0.74 | |
| | 6-Mar-87 | | | | | 7.81 | 630 | 321 | 20.5 | | 275 | 90.5 | 23.0 | | | | | | | | | 0.20 | |
| | 12-Jun-87 | | | | | 7.61 | 660 | 316 | 25.0 | | 304 | 86.0 | 24.4 | | | | | | | | | 0.65 | |
| | 14-Sep-87 | | | | | 7.52 | 615 | 303 | 28.0 | | | 82.0 | 23.8 | | | | | | | | | 0.60 | |
| | 14-Dec-87 | | | | | 7.60 | 595 | 288 | 22.8 | | 234 | 81.6 | 20.4 | | | | | | | | | 0.26 | |
| | 7-Mar-88 | | | | | 7.36 | 625 | 314 | 19.9 | | 273 | 88.1 | 22.6 | | | | | | | | | 0.54 | |
| | 6-Sep-88 | | | | | 7.49 | 550 | 258 | 24.0 | | 243 | 66.2 | 22.5 | | | | | | | | | 0.38 | |
| | 12-Dec-88 | | | | | 7.31 | 733 | 373 | 26.0 | | 314 | 102.0 | 28.5 | | | | | | | | | 0.25 | |

Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | °C | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 14-Mar-89 | | | | | 7.66 | 610 | 288 | 20.7 | | 260 | 80.3 | 21.2 | | | | | | | | | 0.24 | |
| **cont'd** | 14-Mar-89 | | | | | 7.66 | 610 | 288 | 20.7 | | 260 | 80.3 | 21.2 | | | | | | | | | 0.24 | |
| | 13-Jun-89 | | | | | 7.52 | 498 | 232 | 22.0 | | | 57.9 | 21.1 | | | | | | | | | 0.38 | |
| | 11-Sep-89 | | | | | 7.42 | 559 | 311 | 28.2 | | 256 | 85.0 | 24.0 | | | | | | | | | 2.40 | |
| | 11-Dec-89 | | | | | 7.65 | 667 | 335 | 26.8 | | 280 | 89.3 | 27.2 | | | | | | | | | 0.61 | |
| | 5-Mar-90 | | | | | 7.39 | 598 | 291 | 20.5 | | 272 | 83.3 | 20.1 | | | | | | | | | 0.41 | |
| | 21-Jun-90 | | | | | 7.92 | 508 | 252 | 24.0 | | 231 | 63.1 | 22.9 | | | | | | | | | 0.23 | |
| | 17-Sep-90 | | | | | 7.43 | 531 | 273 | 26.0 | | 237 | 73.3 | 21.9 | | | | | | | | | 0.44 | |
| | 2-Dec-90 | | | | | 8.24 | 568 | 272 | 21.0 | | 246 | 74.2 | 21.1 | | | | | | | | | 0.06 | |
| | 11-Mar-91 | | | | | 7.77 | 619 | 307 | 23.0 | | 271 | 87.3 | 21.6 | | | | | | | | | 0.09 | |
| | 17-Jun-91 | | | | | 7.69 | 493 | 213 | 28.3 | | 201 | 48.6 | 22.3 | | | | | | | | | 0.54 | |
| | 9-Sep-91 | | | | | 7.62 | 494 | 218 | 28.4 | | 183 | 48.0 | 23.8 | | | | | | | | | 0.58 | |
| | 3-Dec-91 | | | | | 7.81 | 515 | 253 | 20.3 | | 221 | 69.3 | 19.4 | | | | | | | | | 0.09 | |
| | 24-Mar-92 | | | | | 7.61 | 618 | 303 | 23.3 | | 273 | 82.1 | 23.8 | | | | | | | | | 0.26 | |
| | 16-Jun-92 | | | | | 7.78 | 486 | 223 | 29.7 | | 166 | 44.2 | 27.4 | | | | | | | | | 0.75 | |
| | 15-Sep-92 | | | | | 7.74 | 511 | 244 | 24.2 | | 212 | 59.3 | 23.3 | | | | | | | | | 0.53 | |
| | 7-Dec-92 | | | | | 7.75 | 632 | 349 | 23.3 | | 285 | 99.3 | 24.4 | | | | | | | | | 0.44 | |
| | 23-Mar-93 | | | | | 7.82 | 629 | 338 | 22.4 | | 272 | 96.5 | 23.6 | | | | | | | | | 0.47 | |
| | 15-Jun-93 | | | | | 7.69 | 446 | 204 | 25.0 | | 198 | 46.3 | 21.3 | | | | | | | | | 0.56 | |
| | 7-Sep-93 | | | | | 7.61 | 533 | 274 | 30.5 | | 227 | 65.4 | 26.9 | | | | | | | | | 0.76 | |
| | 7-Dec-93 | | | | | 8.44 | 621 | 325 | 22.9 | | 243 | 89.1 | 24.7 | | | | | | | | | 0.19 | |
| | 21-Mar-94 | | | | | 7.59 | 667 | 373 | 24.1 | | 296 | 105.0 | 26.6 | | | | | | | | | 0.28 | |
| | 21-Jun-94 | | | | | 7.68 | 522 | 253 | 31.3 | | 248 | 58.0 | 26.3 | | | | | | | | | 0.98 | |
| | 6-Dec-94 | | | | | 7.83 | 618 | 321 | 21.8 | | 268 | 85.8 | 25.9 | | | | | | | | | 0.19 | |
| | 28-Mar-95 | | | | | 7.83 | 613 | 316 | 25.5 | | 252 | 86.7 | 24.2 | | | | | | | | | 0.21 | |
| | 26-Jun-95 | | | | | 7.70 | 529 | 251 | 31.0 | | 208 | 61.5 | 23.6 | | | | | | | | | 0.64 | |
| | 16-May-97 | | | | | 8.42 | 611 | 307 | 27.1 | | 268 | 84.3 | 23.4 | | | | | | | | | 0.22 | 0.030 |

Note: refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | °C | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 16-Oct-97 | | | | | 8.05 | 630 | 383 | 33.0 | | 270 | 112.0 | 25.0 | | | | | | | | | 0.12 | 0.040 |
| **cont'd** | 16-Dec-97 | | | | | 7.71 | 588 | 253 | 32.0 | | 238 | 63.2 | 23.2 | | | | | | | | | 0.66 | 0.130 |
| | 16-May-98 | | | | | 8.40 | 583 | 281 | 33.0 | | 276 | 74.1 | 23.2 | | | | | | | | | 0.37 | 0.100 |
| | 16-Oct-98 | | | | | 8.15 | 869 | 325 | 51.0 | | 236 | 81.2 | 29.7 | | | | | | | | | 0.36 | 0.110 |
| | 16-Dec-98 | | | | | 8.33 | 594 | 273 | 44.0 | | 216 | 65.0 | 27.0 | | | | | | | | | 1.72 | 0.370 |
| | 16-May-99 | | | | | 7.90 | 670 | 344 | 32.0 | | 270 | 97.4 | 24.4 | | | | | | | | | 0.16 | 0.070 |
| | 16-Jul-99 | | | | | 8.04 | 561 | 278 | 40.0 | | 232 | 65.6 | 27.7 | | | | | | | | | 1.19 | 0.370 |
| | 16-Oct-99 | | | | | 7.87 | 888 | 325 | 48.0 | | 220 | 84.3 | 27.8 | | | | | | | | | 1.36 | 0.180 |
| | 16-Dec-99 | | | | | 7.75 | 666 | 396 | 61.9 | | 102 | 113.0 | 27.7 | | | | | | | | | 2.04 | 0.720 |
| | 16-May-00 | | | | | 7.95 | 595 | 329 | 29.0 | | 262 | 94.5 | 22.6 | | | | | | | | | 0.16 | 0.050 |
| | 16-Jul-00 | | | | | 7.57 | 592 | 317 | 30.0 | | 260 | 87.4 | 24.1 | | | | | | | | | 1.08 | 0.530 |
| | 16-Oct-00 | | | | | 7.88 | 637 | 335 | 40.0 | | 261 | 87.2 | 28.4 | | | | | | | | | 0.26 | 0.070 |
| | 16-Dec-00 | | | | | 7.81 | 610 | 352 | 34.0 | | 281 | 100.0 | 24.8 | | | | | | | | | 0.50 | 0.240 |
| | 16-May-01 | | | | | 7.69 | 643 | 341 | 37.0 | | 276 | 96.6 | 24.3 | | | | | | | | | 0.08 | 0.020 |
| | 16-Jul-01 | | | | | 8.24 | 591 | 311 | 45.0 | | 227 | 78.7 | 27.8 | | | | | | | | | 0.32 | 0.090 |
| | 16-Oct-01 | | | | | 8.05 | 624 | 337 | 43.0 | | 265 | 85.8 | 29.7 | | | | | | | | | 0.21 | 0.090 |
| | 16-May-02 | | | | | 7.98 | 717 | 384 | 43.0 | | 303 | 106.0 | 29.0 | | | | | | | | | 0.29 | 0.090 |
| | 16-Jul-02 | | | | | 8.42 | 667 | 297 | 48.0 | | 277 | 75.1 | 26.6 | | | | | | | | | 0.68 | 0.410 |
| | 16-Oct-02 | | | | | 7.97 | 713 | 368 | 57.0 | | 276 | 98.1 | 30.0 | | | | | | | | | 1.68 | 0.410 |
| | 16-May-03 | | | | | 8.06 | 634 | 288 | 46.0 | | 233 | 80.2 | 21.4 | | | | | | | | | 0.27 | 0.130 |
| | 16-Jul-03 | | | | | 7.81 | 628 | 344 | 49.0 | | 254 | 87.7 | 30.4 | | | | | | | | | 2.73 | 0.980 |
| | 16-Dec-03 | | | | | 7.74 | 629 | 316 | 56.0 | | 266 | 84.7 | 25.4 | | | | | | | | | 0.63 | 0.240 |
| | 16-May-04 | | | | | 7.96 | 652 | 327 | 50.0 | | 242 | 87.2 | 29.1 | | | | | | | | | 1.61 | 0.310 |
| | 16-Jul-04 | | | | | 7.68 | 641 | 332 | 49.0 | | 268 | 85.4 | 28.8 | | | | | | | | | 1.01 | 0.360 |
| | 16-Oct-04 | | | | | 8.15 | 657 | 338 | 48.0 | | 262 | 90.0 | 27.6 | | | | | | | | | 0.24 | 0.034 |
| | 16-Dec-04 | | | | | 8.12 | 682 | 310 | 57.0 | | 236 | 73.7 | 30.6 | | | | | | | | | 1.42 | 0.300 |
| | 16-May-05 | | | | | 8.20 | 700 | 321 | 47.4 | | 279 | 88.4 | 24.4 | | | | | | | | | 0.20 | 0.043 |

Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | °C | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 16-Jul-05 | | | | | 8.16 | 646 | 335 | 56.9 | | 245 | 73.8 | 36.5 | | | | | | | | | 2.10 | 0.540 |
| **cont'd** | 16-Oct-05 | | | | | 8.19 | 632 | 330 | 46.0 | | 235 | 94.0 | 24.0 | | | | | | | | | 0.53 | 0.240 |
| | 16-Dec-05 | | | | | 8.05 | 702 | 267 | 55.0 | | 253 | 67.6 | 23.8 | | | | | | | | | 0.46 | 0.099 |
| | 16-May-06 | | | | | 7.83 | 636 | 340 | 45.0 | | 280 | 89.1 | 27.4 | | | | | | | | | 0.48 | 0.650 |
| | 16-Jul-06 | | | | | 7.75 | 619 | 320 | 57.0 | | 250 | 78.6 | 29.6 | | | | | | | | | 1.02 | 0.264 |
| | 16-Oct-06 | | | | | 7.60 | 628 | 330 | 42.0 | | 280 | 99.7 | 19.6 | | | | | | | | | 0.80 | 0.170 |
| | 16-Dec-06 | | | | | 7.60 | 607 | 260 | 60.0 | | 280 | 63.9 | 23.4 | | | | | | | | | 0.70 | 0.170 |
| | 19-Apr-07 | | | | | 7.77 | 750 | 350 | 49.0 | | 310 | 91.7 | 28.8 | | | | | | | | | 0.29 | 0.053 |
| | 28-Jun-07 | | | | | 7.68 | 624 | 320 | 61.0 | | 210 | 64.2 | 37.6 | | | | | | | | | 3.97 | 0.748 |
| | 22-Nov-07 | | | | | 8.09 | 747 | 300 | 79.0 | | 220 | 81.8 | 23.9 | | | | | | | | | 0.29 | 0.042 |
| | 15-Apr-08 | | | | | 8.10 | 687 | 320 | 50.0 | | 270 | 84.0 | 26.0 | | | | | | | | | 0.13 | 0.020 |
| | 28-Jun-08 | | | | | 8.00 | 656 | 280 | 58.0 | | 250 | 65.0 | 29.0 | | | | | | | | | 0.92 | 0.590 |
| | 11-Aug-08 | | | | | 8.00 | 620 | 290 | 45.0 | | 270 | 77.0 | 24.0 | | | | | | | | | 2.80 | 2.320 |
| | 16-Apr-09 | | | | | 8.03 | 722 | 321 | 52.0 | | 289 | 93.8 | 21.1 | | | | | | | | | 0.12 | 0.020 |
| | 1-May-09 | | | | | 8.06 | 554 | 279 | 32.7 | | 240 | 82.9 | 17.5 | | | | | | | | | 0.38 | 0.059 |
| | 1-Oct-09 | | | | | 8.04 | 672 | 381 | 52.0 | | 247 | 97.3 | 33.6 | | | | | | | | | 1.41 | 0.422 |
| | 1-Dec-09 | | | | | 8.14 | 762 | 386 | 49.2 | | 308 | 106.0 | 29.4 | | | | | | | | | 1.60 | 0.336 |
| | 15-Mar-10 | 7.80 | 610 | 2.3 | | 8.11 | 637 | 298 | 40.9 | | 261 | 83.8 | 21.5 | | | | | | | | | 0.20 | 0.092 |
| | 10-May-10 | 7.92 | 670 | 15.2 | | 8.40 | 572 | 312 | 47.3 | | 274 | 82.7 | 25.7 | | | | | | | | | 0.25 | 0.059 |
| | 14-Jul-10 | 7.17 | 540 | 26 | | 7.69 | 650 | 266 | 59.8 | | 252 | 61.5 | 27.4 | | | | | | | | | 1.02 | 0.353 |
| | 4-Oct-10 | 7.65 | 780 | 12.1 | | 8.12 | 666 | 317 | 57.1 | | 286 | 83.9 | 26.0 | | | | | | | | | 0.37 | 0.160 |
| | 11-Apr-11 | 8.03 | 645 | 13.7 | | 8.37 | 731 | 329 | 53.2 | | 288 | 93.0 | 23.4 | | | | | | | | | 0.07 | 0.032 |
| | 15-Jun-11 | 7.49 | 601 | 20.2 | | 8.10 | 642 | 314 | 46.7 | | 294 | 86.1 | 24.1 | | | | | | | | | 0.70 | 0.460 |
| | 6-Aug-11 | 7.32 | 615 | 23.3 | | 8.05 | 589 | 232 | 75.4 | | 208 | 49.3 | 26.5 | | | | | | | | | 0.40 | 0.140 |
| | 24-Oct-11 | 6.77 | 525 | 9.7 | | 7.92 | 543 | 272 | 45.3 | | 242 | 77.1 | 19.3 | | | | | | | | | 0.18 | 0.058 |
| | 8-Mar-12 | 7.61 | 589 | 6.1 | | 8.26 | 715 | 282 | 50.1 | | 279 | 78.5 | 20.9 | | | | | | | | | 0.11 | 0.031 |
| | 23-May-12 | 7.35 | 551 | 23.1 | | 8.05 | 651 | 253 | 66.1 | | 251 | 54.8 | 28.3 | | | | | | | | | 0.47 | 0.094 |

Note: refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

|  |  | Field Parameters |  |  |  | General Parameters |  |  | Major and Minor Ions |  |  |  |  |  |  | Nutrients and Organic Indicators |  |  |  | Metals |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
|  | Units | SU | μS/cm | ºC | NTU | SU | μS/cm |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 13-Aug-12 | 6.98 | 558 | 21.3 |  | 7.94 | 603 | 232 | 69.6 |  | 207 | 44.1 | 29.6 |  |  |  |  |  |  |  |  | 0.67 | 0.236 |
| **cont'd** | 24-Oct-12 | 6.76 | 600 | 11.9 |  | 8.24 | 692 | 303 | 68.5 |  | 283 | 74.4 | 28.4 |  |  |  |  |  |  |  |  | 0.56 | 0.183 |
|  | 9-Apr-13 | 8.32 | 826 | 5.8 |  | 8.03 | 754 | 293 | 45.8 |  | 298 | 82.7 | 20.9 |  |  |  |  |  |  |  |  | 0.20 | 0.069 |
|  | 9-May-13 | 7.94 | 855 | 23.6 |  | 8.39 | 828 | 301 | 58.6 |  | 316 | 74.2 | 28.2 |  |  |  |  |  |  |  |  | 0.44 | 0.149 |
|  | 7-Aug-13 | 8.10 | 707 | 23 |  | 7.48 | 703 | 236 | 66.5 |  | 240 | 52.4 | 25.5 |  |  |  |  |  |  |  |  | 0.17 | 0.063 |
|  | 31-Oct-13 | 8.18 | 647 | 11.2 |  | 8.25 | 595 | 271 | 35.7 |  | 234 | 76.9 | 19.3 |  |  |  |  |  |  |  |  | 0.25 | 0.044 |
|  | 28-Mar-14 | 7.99 | 807 | 2 |  | 8.05 | 641 | 294 | 43.1 |  | 281 | 81.7 | 21.8 |  |  |  |  |  |  |  |  | 0.21 | 0.144 |
|  | 9-May-14 | 7.71 | 724 | 20.1 |  | 8.00 | 693 | 299 | 45.1 |  | 265 | 80.8 | 23.5 |  |  |  |  |  |  |  |  | 0.30 | 0.118 |
|  | 12-Aug-14 | 8.23 | 668 | 21.8 |  | 8.09 | 658 | 244 | 53.4 |  | 249 | 56.8 | 24.9 |  |  |  |  |  |  |  |  | 0.451 | 0.204 |
|  | 20-Oct-14 | 7.90 | 700 | 11.2 |  | 7.96 | 799 | 341 | 51.1 |  | 316 | 91.6 | 27.3 |  |  |  |  |  |  |  |  | 0.22 | 0.061 |
|  | 6-Apr-15 | 6.00 | 610 | 4.4 |  | 7.97 | 731 | 322 | 47.7 |  | 307 | 89.8 | 23.8 |  |  |  |  |  |  |  |  | 0.15 | 0.070 |
|  | 28-May-15 | 7.56 | 494 | 26.3 |  | 8.21 | 740 | 275 | 63.4 |  | 275 | 66.5 | 26.5 |  |  |  |  |  |  |  |  | 0.37 | 0.201 |
|  | 26-Aug-15 | 8.02 | 720 | 19.8 |  | 8.40 | 746 | 268 | 69.5 |  | 262 | 60.0 | 28.8 |  |  |  |  |  |  |  |  | 0.75 | 0.545 |
|  | 29-Oct-15 | 7.76 | 740 | 8.8 |  | 8.17 | 727 | 297 | 60.8 |  | 252 | 79.7 | 23.9 |  |  |  |  |  |  |  |  | 0.15 | 0.047 |
|  | 10-Mar-16 | 7.76 | 550 | 7.6 |  | 7.72 | 695 | 285 | 48.1 |  | 275 | 80.1 | 20.6 |  |  |  |  |  |  |  |  | 0.08 | 0.089 |
|  | 25-May-16 | 7.94 | 556 | 13.9 |  | 8.20 | 773 | 277 | 69.1 |  | 297 | 67.3 | 26.5 |  |  |  |  |  |  |  |  | 0.42 | 0.180 |
|  | 18-Aug-16 | 7.52 | 641 | 21.6 |  | 8.17 | 873 | 316 | 72.8 |  | 251 | 78.1 | 29.3 |  |  |  |  |  |  |  |  | 0.32 | 0.127 |
|  | 17-Oct-16 | 7.28 | 1310 | 17.2 |  | 8.10 | 1290 | 556 | 78.4 |  | 316 | 161 | 37.4 |  |  |  |  |  |  |  |  | 2.66 | 1.92 |
|  | 1-Nov-16 | 7.52 | 1112 | 7.10 |  | 8.03 | 1120 |  | 79.8 | 216 | 308 | 143 | 31.8 | 5.85 | 40.5 | 0.23 | 0.001 | <0.25 | <0.25 | 0.573 | <0.003 | 1.12 | 0.445 |
|  | 7-Mar-17 | 7.72 | 652 | 3.19 |  | 8.19 | 644 | 239 | 43.5 |  | 237 | 66.3 | 17.8 |  |  |  |  |  |  |  |  | 0.092 | 0.012 |
|  | 4-May-17 | 7.94 | 700 | 8.75 |  | 8.31 | 755 | 290 | 44.6 | 17.8 | 294 | 81.5 | 20.9 | 6.16 | 27.4 | 0.21 | 0.003 | 1.59 | <0.10 | 0.292 | <0.003 | <0.010 | 0.023 |
|  | 2-Aug-17 | 7.87 | 633 | 20.93 |  | 8.18 | 761 | 297 | 66.1 |  | 305 | 72.4 | 28.2 |  |  |  |  |  |  |  |  | 0.34 | 0.178 |
|  | 17-Oct-17 | 7.11 | 619 | 12.49 |  | 8.04 | 766 | 309 | 71.8 |  | 304 | 79.9 | 26.6 |  |  |  |  |  |  |  |  | 0.644 | 0.395 |
|  | 2-Apr-18 | 7.96 | 707 | 5.90 | 8.3 | 8.01 | 667 | 289 | 55.2 | 23.5 | 286 | 80.1 | 21.6 | 7.28 | 29.9 | 0.66 | 0.008 | 2.79 | <0.10 | 0.325 | <0.003 | 0.027 | 0.020 |
|  | 18-Oct-18 | 8.05 | 712 | 6.41 | 25.2 | 8.12 | 743 | 320 | 62.1 | 10.9 | 348 | 84.6 | 26.3 | 7.92 | 34.7 | 0.42 | 0.006 | 0.51 | <0.10 | 0.262 | <0.003 | 0.63 | 0.393 |
|  | 15-Apr-19 | 7.78 | 591 | 3.91 | 0.0 | 7.99 | 580 | 256 | 36.0 | 14.0 | 248 | 72.2 | 18.4 | 6.03 | 24.2 | 0.203 | 0.001 | 2.13 | 0.017 | 0.198 | 0.0019 | 0.118 | 0.016 |
|  | 8-Oct-19 | 7.99 | 620 | 12.29 | 8.0 | 7.77 | 715 | 306 | 59.1 | 13.7 | 298 | 72.4 | 30.4 | 8.36 | 38.7 | 0.281 | 0.006 | 0.486 | 0.020 | 0.310 | <0.0050 | 0.34 | 0.189 |

Note: refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| Well | Date | Field Parameters |  |  |  | General Parameters |  |  | Major and Minor Ions |  |  |  |  |  |  | Nutrients and Organic Indicators |  |  |  | Metals |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
|  | Units | SU | µS/cm | ºC | NTU | SU | µS/cm |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO1** | 8-Apr-20 | 7.75 | 614 | 9.52 | 2.0 | 8.23 | 692 | 308 | 48.1 | 14.1 | 297 | 83.5 | 24.1 | 8.00 | 31.2 | 0.142 | 0.001 | 2.12 | 0.03 | 0.307 | <0.00050 | 0.099 | 0.0284 |
| **cont'd** | 15-Oct-20 | 7.96 | 624 | 13.72 | 2.0 | 8.10 | 752 | 334 | 60.7 | 5.99 | 320 | 86.3 | 28.9 | 7.61 | 36.8 | 0.849 | 0.019 | 0.103 | 0.044 | 0.350 | <0.0050 | 1.62 | 0.760 |
|  | 12-Apr-21 | 7.74 | 624 | 14.13 | 1.0 | 8.07 | 677 | 319 | 49 | 15 | 269 | 91.4 | 22.1 | 8.98 | 31.8 | 0.2 | 0.003 | 1.03 | <0.03 | 0.397 | 0.00053 | 0.15 | 0.055 |
|  | 7-Oct-21 | 7.65 | 638 | 17.42 | 2.0 | 7.96 | 728 | 322 | 52 | 12 | 300 | 89.1 | 24.1 | 7.93 | 29.2 | 0.5 | 0.007 | 0.35 | 0.030 | 0.301 | 0.00022 | 0.58 | 0.511 |
| **CO4** | 20-Mar-80 |  |  |  |  | 7.70 | 490 | 253 | 16.0 |  |  | 74.5 | 16.2 |  |  |  |  |  |  |  |  | 1.34 |  |
|  | 27-May-80 |  |  |  |  | 8.00 | 690 | 353 | 25.0 |  |  | 100.0 | 25.0 |  |  |  |  |  |  |  |  | 0.21 |  |
|  | 17-Sep-80 |  |  |  |  | 7.80 | 745 | 376 | 30.5 |  |  | 105.0 | 27.6 |  |  |  |  |  |  |  |  | 0.08 |  |
|  | 25-Sep-81 |  |  |  |  | 7.60 | 625 |  | 26.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2-Oct-81 |  |  |  |  | 7.40 | 595 | 330 | 26.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 3-Oct-81 |  |  |  |  |  | 635 |  | 23.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2-Feb-82 |  |  |  |  | 8.00 | 640 | 388 | 25.0 |  | 305 |  |  |  |  |  |  |  |  |  |  | 0.02 |  |
|  | 4-May-82 |  |  |  |  | 7.90 | 480 | 344 | 20.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2-Sep-82 |  |  |  |  | 8.00 | 780 | 397 | 32.0 |  |  | 112.0 | 28.4 |  |  |  |  |  |  |  |  |  |  |
|  | 3-Sep-82 |  |  |  |  | 8.00 | 780 | 397 | 32.0 |  |  | 112.0 | 28.4 |  |  |  |  |  |  |  |  |  |  |
|  | 30-Mar-83 |  |  |  |  | 7.80 | 460 | 294 | 16.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 18-Apr-83 |  |  |  |  | 7.80 | 460 | 294 | 16.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 15-Jun-83 |  |  |  |  | 7.80 | 700 | 400 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 20-Jul-83 |  |  |  |  | 7.84 | 620 | 329 | 37.0 |  | 302 | 92.0 | 24.0 |  |  |  |  |  |  |  |  |  |  |
|  | 14-Sep-83 |  |  |  |  | 7.70 | 610 | 364 | 20.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 8-Dec-83 |  |  |  |  | 7.70 | 350 | 200 | 16.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 12-Dec-83 |  |  |  |  | 7.70 | 350 | 200 | 16.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 30-Apr-84 |  |  |  |  | 7.70 | 670 | 354 | 20.0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 18-Sep-84 |  |  |  |  | 7.91 | 720 | 212 | 23.0 |  | 356 | 41.0 | 26.6 |  |  |  |  |  |  |  |  | 8.15 |  |
|  | 24-Jun-85 |  |  |  |  | 7.82 | 690 | 329 | 22.5 |  | 310 | 89.5 | 25.6 |  |  |  |  |  |  |  |  | 0.30 |  |
|  | 18-Dec-85 |  |  |  |  | 7.50 | 735 | 374 | 22.5 |  | 308 | 105.0 | 25.2 |  |  |  |  |  |  |  |  | 0.10 |  |
|  | 18-Sep-86 |  |  |  |  | 8.12 | 560 | 256 | 22.5 |  | 212 | 65.5 | 22.4 |  |  |  |  |  |  |  |  | 0.21 |  |

Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | μS/cm | ºC | NTU | SU | μS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO4** | 6-Mar-87 | | | | | 7.84 | 635 | 324 | 19.5 | | 275 | 91.5 | 23.0 | | | | | | | | | 0.26 | |
| **cont'd** | 14-Sep-87 | | | | | 7.53 | 550 | 265 | 27.0 | | | 63.0 | 26.2 | | | | | | | | | 0.84 | |
| | 7-Mar-88 | | | | | 7.66 | 695 | 368 | 21.8 | | 294 | 104.4 | 26.0 | | | | | | | | | 0.19 | |
| | 12-Dec-88 | | | | | 7.07 | 1144 | 748 | 22.7 | | 457 | 233.5 | 40.0 | | | | | | | | | 10.40 | |
| | 5-Mar-90 | | | | | 7.72 | 701 | 347 | 25.6 | | 318 | 99.6 | 23.8 | | | | | | | | | 0.01 | |
| | 21-Jun-90 | | | | | 7.76 | 485 | 234 | 25.0 | | 199 | 54.3 | 23.8 | | | | | | | | | 0.96 | |
| | 2-Dec-90 | | | | | 8.58 | 604 | 280 | 22.1 | | 264 | 74.4 | 22.8 | | | | | | | | | 0.13 | |
| | 11-Mar-91 | | | | | 7.89 | 623 | 303 | 23.7 | | 270 | 87.3 | 20.6 | | | | | | | | | 0.22 | |
| | 9-Sep-91 | | | | | 7.84 | 454 | 198 | 28.6 | | 150 | 39.0 | 24.4 | | | | | | | | | 0.60 | |
| | 24-Mar-92 | | | | | 7.94 | 666 | 328 | 29.0 | | 209 | 87.7 | 26.3 | | | | | | | | | 0.18 | |
| | 16-Jun-92 | | | | | 8.08 | 462 | 213 | 30.7 | | 145 | 38.6 | 28.2 | | | | | | | | | 0.38 | |
| | 7-Dec-92 | | | | | 7.97 | 682 | 343 | 27.5 | | 302 | 96.4 | 24.8 | | | | | | | | | 0.13 | |
| | 23-Mar-93 | | | | | 7.77 | 679 | 370 | 22.0 | | 306 | 104.0 | 26.3 | | | | | | | | | 0.26 | |
| | 7-Sep-93 | | | | | 7.86 | 486 | 234 | 28.4 | | 188 | 51.2 | 25.7 | | | | | | | | | 0.44 | |
| | 21-Mar-94 | | | | | 7.55 | 699 | 381 | 25.0 | | 306 | 108.0 | 26.6 | | | | | | | | | 0.26 | |
| | 21-Jun-94 | | | | | 7.84 | 511 | 240 | 32.6 | | 219 | 51.8 | 26.8 | | | | | | | | | 0.77 | |
| | 6-Dec-94 | | | | | 8.09 | 636 | 304 | 28.6 | | 230 | 77.4 | 26.1 | | | | | | | | | 0.18 | |
| | 28-Mar-95 | | | | | 8.08 | 664 | 306 | 31.7 | | 231 | 86.7 | 26.6 | | | | | | | | | 0.34 | |
| | 15-Jun-97 | | | | | 8.27 | 552 | 324 | 28.0 | | 268 | 86.5 | 26.3 | | | | | | | | | 0.30 | 0.060 |
| | 15-Jun-98 | | | | | 8.05 | 601 | 298 | 33.0 | | 275 | 78.1 | 25.1 | | | | | | | | | 0.41 | 0.230 |
| | 15-Jun-99 | | | | | 8.10 | 677 | 348 | 41.0 | | 300 | 95.2 | 26.8 | | | | | | | | | 0.42 | 0.070 |
| | 15-Jun-00 | | | | | 8.22 | 635 | 371 | 42.0 | | 236 | 102.0 | 28.2 | | | | | | | | | 0.44 | 0.130 |
| | 15-Jun-01 | | | | | 7.76 | 669 | 353 | 42.0 | | 289 | 99.9 | 25.2 | | | | | | | | | 0.40 | 0.080 |
| | 15-Jun-02 | | | | | 8.05 | 749 | 392 | 47.0 | | 317 | 108.0 | 29.6 | | | | | | | | | 0.48 | 0.210 |
| | 15-Jun-03 | | | | | 8.11 | 748 | 370 | 53.0 | | 295 | 94.7 | 32.4 | | | | | | | | | 0.68 | 0.110 |
| | 15-Jun-04 | | | | | 8.12 | 721 | 337 | 52.1 | | 294 | 89.7 | 26.7 | | | | | | | | | 0.70 | 0.102 |
| | 15-Jun-05 | | | | | 8.20 | 738 | 335 | 51.9 | | 298 | 91.7 | 25.8 | | | | | | | | | 0.40 | 0.090 |

Note: refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO4** | 15-Jun-06 | | | | | 7.90 | 693 | 340 | 53.0 | | 290 | 87.9 | 30.1 | | | | | | | | | 1.10 | 0.279 |
| **cont'd** | 19-Apr-07 | | | | | 7.85 | 790 | 380 | 52.0 | | 330 | 101.0 | 30.3 | | | | | | | | | 0.56 | 0.072 |
| | 15-Apr-08 | | | | | 8.10 | 740 | 350 | 49.0 | | 310 | 92.0 | 29.0 | | | | | | | | | 0.47 | 0.040 |
| | 16-Apr-09 | | | | | 8.18 | 747 | 316 | 61.2 | | 306 | 89.1 | 22.8 | | | | | | | | | 0.52 | 0.071 |
| | 10-May-10 | 8.16 | 680 | 14.8 | | 8.17 | 530 | 306 | 54.3 | | 280 | 77.9 | 27.1 | | | | | | | | | 0.40 | 0.058 |
| | 11-Apr-11 | 7.95 | 723 | 14.8 | | 8.32 | 791 | 345 | 55.9 | | 322 | 97.4 | 24.8 | | | | | | | | | 0.35 | 0.060 |
| | 8-Mar-12 | 7.79 | 632 | 7.0 | | 8.34 | 776 | 312 | 50.0 | | 329 | 87.6 | 22.7 | | | | | | | | | 0.31 | 0.041 |
| | 9-Apr-13 | 8.39 | 924 | 8.7 | | 8.13 | 879 | 328 | 56.8 | | 349 | 92.4 | 23.6 | | | | | | | | | 0.47 | 0.110 |
| | 28-Mar-14 | 7.98 | 896 | 2.7 | | 8.15 | 822 | 329 | 48.2 | | 339 | 92.2 | 23.9 | | | | | | | | | 0.20 | 0.209 |
| | 6-Apr-15 | 7.68 | 655 | 8.0 | | 8.15 | 788 | 339 | 52.3 | | 338 | 94.8 | 24.9 | | | | | | | | | 0.42 | 0.116 |
| | 10-Mar-16 | 7.50 | 640 | 9.6 | | 8.20 | 859 | 332 | 63.3 | | 337 | 92.3 | 24.7 | | | | | | | | | 0.08 | 0.042 |
| | 7-Mar-17 | 7.88 | 782 | 5.95 | | 8.24 | 778 | 283 | 48.9 | | 306 | 78.1 | 21.3 | | | | | | | | | 0.422 | 0.166 |
| | 2-Apr-18 | 8.12 | 819 | 8.81 | 10.7 | 8.09 | 765 | 315 | 58.1 | 24.8 | 338 | 85.5 | 24.7 | 9.49 | 35.2 | 5.54 | 0.121 | 0.96 | <0.25 | 0.421 | <0.003 | 0.172 | 0.045 |
| | 15-Apr-19 | 7.97 | 725 | 5.78 | 0.0 | 8.02 | 718 | 304 | 47.9 | 21.7 | 297 | 83.3 | 23.4 | 7.96 | 30.0 | 4.20 | 0.051 | 0.841 | 0.019 | 0.317 | <0.00050 | 0.263 | 0.0577 |
| | 8-Apr-20 | 7.95 | 682 | 11.17 | 10.1 | 8.26 | 768 | 332 | 54.1 | 18.5 | 328 | 88.3 | 27.0 | 9.37 | 35.4 | 4.73 | 0.084 | 0.748 | 0.034 | 0.374 | <0.00050 | 0.309 | 0.0593 |
| | 12-Apr-21 | 7.89 | 683 | 16.33 | 1.0 | 8.11 | 737 | 320 | 52 | 30 | 285 | 86.9 | 25.0 | 9.95 | 33.4 | 5.3 | 0.121 | 0.43 | 0.04 | 0.417 | 0.00045 | 0.34 | 0.103 |
| **CO6** | 20-Jul-83 | | | | | 7.27 | 660 | 294 | 16.0 | | 308 | 87.5 | 18.2 | | | | | | | | | | |
| | 15-Jun-84 | | | | | 7.21 | 340 | 175 | 2.0 | | 158 | 52.0 | 11.0 | | | | | | | | | 3.00 | |
| | 18-Dec-85 | | | | | 7.45 | 705 | 287 | 14.5 | | 308 | 85.5 | 17.8 | | | | | | | | | 33.80 | |
| | 12-Mar-86 | | | | | 7.13 | 432 | 202 | 17.5 | | 175 | 61.5 | 11.6 | | | | | | | | | 7.80 | |
| | 14-Dec-87 | | | | | 7.59 | 650 | 328 | 16.7 | | 79 | 102.8 | 17.2 | | | | | | | | | 0.12 | |
| | 7-Dec-93 | | | | | 4.50 | 586 | 300 | 13.4 | | 111 | 92.5 | 16.8 | | | | | | | | | 0.45 | |
| | 15-Jun-97 | | | | | | | | | | | | | | | | | | | | | | |
| | 15-Jun-98 | | | | | | | | | | | | | | | | | | | | | | |
| | 15-Jun-99 | | | | | 7.69 | 617 | 348 | 15.0 | | 237 | 107.0 | 19.6 | | | | | | | | | 0.71 | 0.120 |
| | 15-Jun-00 | | | | | 7.95 | 488 | 280 | 18.0 | | 200 | 87.3 | 15.0 | | | | | | | | | 0.29 | 0.040 |

Note: refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **CO6** | 15-Jun-01 | | | | | 7.72 | 545 | 297 | 38.0 | | 242 | 92.9 | 15.9 | | | | | | | | | 0.07 | 0.020 |
| **cont'd** | 15-Jun-02 | | | | | 7.93 | 586 | 322 | 39.0 | | 239 | 100.0 | 17.6 | | | | | | | | | 0.26 | 0.060 |
| | 15-Jun-03 | | | | | 7.86 | 622 | 321 | 49.0 | | 220 | 97.6 | 18.7 | | | | | | | | | 0.18 | 0.080 |
| | 15-Jun-04 | | | | | 7.92 | 491 | 257 | 30.7 | | 221 | 87.2 | 15.2 | | | | | | | | | 0.17 | 0.022 |
| | 15-Jun-05 | | | | | 8.15 | 518 | 241 | 29.9 | | 213 | 74.8 | 13.1 | | | | | | | | | <0.1 | <0.005 |
| | 15-Jun-06 | | | | | 7.72 | 482 | 290 | 30.0 | | 230 | 89.8 | 16.6 | | | | | | | | | 0.23 | 0.029 |
| | 19-Apr-07 | | | | | 7.58 | 572 | 290 | 35.0 | | 250 | 86.6 | 16.9 | | | | | | | | | 0.18 | 0.018 |
| | 15-Apr-08 | | | | | 8.00 | 487 | 230 | 38.0 | | 180 | 69.0 | 14.0 | | | | | | | | | 0.10 | |
| | 16-Apr-09 | | | | | 7.87 | 593 | 266 | 54.7 | | 232 | 87.0 | 11.9 | | | | | | | | | 0.12 | 0.007 |
| | 10-May-10 | 7.55 | 590 | 12.4 | | 8.31 | 657 | 338 | 26.7 | | 289 | 105.0 | 18.3 | | | | | | | | | 3.00 | 0.323 |
| | 11-Apr-11 | 7.75 | 511 | 11.5 | | 8.23 | 571 | 255 | 48.1 | | 214 | 80.2 | 13.2 | | | | | | | | | <0.01 | 0.003 |
| | 11-Apr-11 | 7.75 | 511 | 11.5 | | 8.29 | 575 | 247 | 48.4 | | 207 | 78.1 | 12.6 | | | | | | | | | <0.01 | 0.003 |
| | 8-Mar-12 | 7.57 | 414 | 4.7 | | 8.21 | 514 | 214 | 30.2 | | 210 | 66.9 | 11.5 | | | | | | | | | 0.01 | 0.005 |
| | 9-Apr-13 | 8.25 | 541 | 4.9 | | 7.77 | 480 | 196 | 27.1 | | 194 | 61.5 | 10.3 | | | | | | | | | <0.01 | <0.002 |
| | 28-Mar-14 | 7.96 | 605 | 0.4 | | 8.11 | 548 | 238 | 32.7 | | 229 | 72.9 | 13.5 | | | | | | | | | 0.21 | 0.058 |
| | 6-Apr-15 | 8.03 | 412 | 5.0 | | 7.91 | 523 | 253 | 33.2 | | 222 | 78.9 | 13.5 | | | | | | | | | <0.01 | 0.008 |
| | 10-Mar-16 | 7.56 | 355 | 8.0 | | 7.96 | 465 | 233 | 19.6 | | 207 | 72.3 | 12.7 | | | | | | | | | <0.01 | 0.005 |
| | 7-Mar-17 | 7.67 | 556 | 4.89 | | 8.01 | 559 | 204 | 58.1 | | 171 | 63.2 | 11.2 | | | | | | | | | 0.013 | 0.010 |
| | 4-May-17 | 8.15 | 625 | 8.53 | | 8.32 | 657 | 249 | 47.2 | 11.9 | 243 | 77.6 | 13.4 | 1.21 | 24.1 | 0.12 | 0.003 | 0.20 | <0.10 | 0.015 | <0.003 | <0.010 | 0.008 |
| | 2-Apr-18 | 7.43 | 566 | 8.25 | 12.3 | 7.85 | 508 | 234 | 44.6 | 15.9 | 208 | 72.9 | 12.6 | 1.23 | 18.2 | <0.02 | <0.001 | 1.00 | <0.10 | 0.018 | <0.003 | <0.010 | 0.002 |
| | 18-Oct-18 | D | R | Y | | | | | | | | | | | | | | | | | | | |
| | 15-Apr-19 | 7.84 | 521 | 3.92 | 0.0 | 7.80 | 509 | 226 | 45.9 | 8.25 | 201 | 68.4 | 13.3 | 1.49 | 25.1 | 0.049 | <0.001 | 1.12 | 0.015 | 0.011 | <0.00050 | 0.225 | 0.0149 |
| | 8-Oct-19 | D | R | Y | | | | | | | | | | | | | | | | | | | |
| | 8-Apr-20 | 7.97 | 567 | 8.75 | 2.0 | 8.07 | 604 | 274 | 45.4 | 7.52 | 259 | 82.8 | 16.2 | 1.47 | 26.4 | 0.027 | <0.001 | 0.192 | <0.010 | 0.014 | <0.00050 | 0.078 | 0.0114 |
| | 15-Oct-20 | D | R | Y | | | | | | | | | | | | | | | | | | | |
| | 12-Apr-21 | 7.64 | 511 | 13.84 | 0.0 | 8.05 | 549 | 280 | 30 | 14 | 237 | 89.5 | 13.9 | 1.82 | 13.2 | <0.1 | <0.001 | 0.11 | <0.03 | 0.026 | 0.00041 | 0.11 | 0.0334 |
| | 7-Oct-21 | 7.55 | 662 | 10.37 | 22.8 | 8.05 | 754 | 382 | 41 | <2 | 342 | 122 | 18.8 | 2.19 | 22.6 | <0.1 | <0.001 | 0.76 | <0.03 | 0.034 | 0.00072 | 0.60 | 0.243 |

Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **NE1** | 20-Jul-83 | | | | | 7.44 | 330 | 169 | 4.5 | | 156 | 54.0 | 8.2 | | | | | | | | | | |
| | 18-Sep-84 | | | | | 8.00 | 425 | 163 | 24.0 | | 153 | 53.0 | 7.4 | | | | | | | | | <0.04 | |
| | 24-Jun-85 | | | | | 7.64 | 510 | 167 | 31.5 | | 210 | 44.5 | 13.6 | | | | | | | | | 1.10 | |
| | 18-Dec-85 | | | | | 7.57 | 580 | 242 | 22.0 | | 236 | 79.5 | 10.6 | | | | | | | | | 0.60 | |
| | 18-Sep-86 | | | | | 8.30 | 227 | 96 | 5.0 | | 89 | 31.5 | 4.2 | | | | | | | | | 1.85 | |
| | 6-Mar-87 | | | | | 8.03 | 309 | 142 | 7.0 | | 128 | 46.5 | 6.2 | | | | | | | | | 0.44 | |
| | 7-Mar-88 | | | | | 7.65 | 254 | 128 | 4.3 | | 89 | 42.5 | 5.2 | | | | | | | | | 2.30 | |
| | 12-Dec-88 | | | | | 7.28 | 506 | 230 | 13.6 | | 211 | 75.8 | 9.9 | | | | | | | | | 0.50 | |
| | 5-Mar-90 | | | | | 7.05 | 241 | 120 | 2.9 | | 105 | 41.5 | 4.0 | | | | | | | | | 0.09 | |
| | 21-Jun-90 | | | | | 8.12 | 553 | 266 | 15.2 | | 283 | 87.9 | 11.2 | | | | | | | | | 1.14 | |
| | 2-Dec-90 | | | | | 8.20 | 605 | 260 | 22.4 | | 261 | 86.2 | 10.9 | | | | | | | | | 0.05 | |
| | 11-Mar-91 | | | | | 6.68 | 646 | 32 | 0.9 | | 25 | 10.4 | 1.5 | | | | | | | | | 0.06 | |
| | 24-Mar-92 | | | | | 7.39 | 336 | 165 | 9.7 | | 105 | 52.4 | 8.3 | | | | | | | | | 0.02 | |
| | 16-Jun-92 | | | | | 7.75 | 699 | 316 | 20.1 | | 329 | 98.9 | 16.6 | | | | | | | | | 1.14 | |
| | 7-Dec-92 | | | | | 7.30 | 425 | 208 | 9.3 | | 212 | 68.9 | 8.6 | | | | | | | | | 0.40 | |
| | 23-Mar-93 | | | | | 6.80 | 1047 | 507 | 21.8 | | 513 | 170.0 | 19.8 | | | | | | | | | 30.60 | |
| | 21-Mar-94 | | | | | 7.12 | 234 | 117 | 4.9 | | 109 | 40.8 | 3.6 | | | | | | | | | 0.11 | |
| | 21-Jun-94 | | | | | 7.62 | 604 | 287 | 15.1 | | 245 | 93.9 | 12.8 | | | | | | | | | 2.23 | |
| | 28-Mar-95 | | | | | 7.44 | 367 | 181 | 7.4 | | 173 | 60.3 | 7.3 | | | | | | | | | 0.15 | |
| | 15-Jun-97 | | | | | 8.31 | 565 | 314 | 13.0 | | 321 | 103.0 | 13.7 | | | | | | | | | 0.28 | 0.030 |
| | 15-Jun-98 | | | | | 7.60 | 639 | 344 | 18.0 | | 278 | 112.0 | 18.0 | | | | | | | | | 1.41 | 0.440 |
| | 15-Jun-99 | | | | | 8.17 | 798 | 413 | 26.0 | | 346 | 140.0 | 26.0 | | | | | | | | | 0.18 | <0.02 |
| | 15-Jun-00 | | | | | 7.64 | 703 | 428 | 15.0 | | 300 | 144.0 | 15.0 | | | | | | | | | 0.55 | 0.080 |
| | 15-Jun-01 | | | | | 7.21 | 437 | 256 | 7.0 | | 224 | 86.1 | 7.0 | | | | | | | | | 0.22 | 0.030 |
| | 15-Jun-02 | | | | | 7.72 | 795 | 399 | 28.0 | | 385 | 130.0 | 28.0 | | | | | | | | | 0.56 | 0.250 |
| | 15-Jun-03 | | | | | 7.72 | 659 | 361 | 23.0 | | 311 | 118.0 | 23.0 | | | | | | | | | 0.35 | 0.270 |
| | 15-Jun-04 | | | | | 7.97 | 657 | 357 | 21.2 | | 337 | 102.0 | 21.2 | | | | | | | | | 0.92 | 0.034 |
| | 15-Jun-05 | | | | | 8.16 | 730 | 318 | 33.4 | | 334 | 99.3 | 33.4 | | | | | | | | | 0.10 | 0.029 |

Note: refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **NE1** | 15-Jun-06 | | | | | 7.55 | 637 | 370 | 14.0 | | 340 | 121.0 | 14.0 | | | | | | | | | 0.78 | 0.053 |
| **cont'd** | 19-Apr-07 | | | | | 7.25 | 642 | 340 | 13.0 | | 320 | 110.0 | 16.1 | | | | | | | | | 0.34 | 0.023 |
| | 15-Apr-08 | | | | | 7.60 | 380 | 210 | 4.0 | | 180 | 67.0 | 10.0 | | | | | | | | | 0.09 | 0.010 |
| | 16-Apr-09 | | | | | 7.63 | 717 | 341 | 19.0 | | 350 | 115.0 | 13.0 | | | | | | | | | 0.21 | 0.014 |
| | 10-May-10 | 7.69 | 630 | 11.8 | | 8.02 | 599 | 308 | 25.9 | | 314 | 98.0 | 15.4 | | | | | | | | | 0.66 | 0.082 |
| | 11-Apr-11 | 7.78 | 421 | 13.1 | | 8.15 | 491 | 241 | 14.7 | | 221 | 81.2 | 9.35 | | | | | | | | | 0.01 | 0.028 |
| | 8-Mar-12 | 7.84 | 126 | 6.7 | | 7.84 | 258 | 113 | 5.18 | | 123 | 38.1 | 4.22 | | | | | | | | | 0.12 | 0.069 |
| | 9-Apr-13 | 8.29 | 227 | 5.6 | | 7.75 | 240 | 104 | 5.09 | | 112 | 34.2 | 4.40 | | | | | | | | | 0.02 | 0.048 |
| | 28-Mar-14 | 7.97 | 378 | 1.8 | | 7.90 | 306 | 150 | 4.76 | | 153 | 47.9 | 7.30 | | | | | | | | | 0.38 | 0.196 |
| | 6-Apr-15 | 8.30 | 220 | 10 | | 7.69 | 260 | 120 | 8.30 | | 115 | 38.9 | 5.48 | | | | | | | | | <0.01 | 0.048 |
| | 10-Mar-16 | 7.71 | 267 | 8.9 | | 7.77 | 399 | 152 | 21.7 | | 156 | 47.9 | 7.88 | | | | | | | | | <0.01 | 0.035 |
| | 7-Mar-17 | 7.52 | 593 | 5.3 | | 8.05 | 585 | 237 | 14.3 | | 255 | 77.9 | 10.2 | | | | | | | | | <0.010 | 0.088 |
| | 2-Apr-18 | 7.64 | 465 | 9.56 | 8.5 | 7.89 | 429 | 232 | 4.29 | 8.75 | 239 | 77.3 | 9.40 | 2.50 | 2.82 | 0.40 | 0.003 | 0.88 | <0.10 | 0.046 | <0.003 | 0.016 | 0.069 |
| | 15-Apr-19 | 8.16 | 585 | 5.18 | 0.0 | 7.55 | 480 | 244 | 6.75 | 5.33 | 237 | 79.7 | 10.9 | 3.81 | 5.74 | 1.67 | 0.030 | 3.53 | 0.035 | 0.054 | <0.00050 | 0.071 | 0.00734 |
| | 8-Apr-20 | 8.09 | 493 | 9.35 | 2.8 | 7.85 | 618 | 323 | 6.29 | 5.50 | 326 | 106 | 14.0 | 3.60 | 5.35 | 1.91 | 0.041 | 2.50 | 0.069 | 0.060 | <0.00050 | 0.039 | 0.0233 |
| | 12-Apr-21 | 7.67 | 590 | 14.82 | 2.0 | 8.02 | 639 | 318 | 30 | 4 | 296 | 104 | 13.9 | 10.1 | 17.3 | 1.2 | 0.015 | <0.06 | <0.03 | 0.143 | 0.00031 | 0.73 | 0.103 |
| **PO1** | 18-Sep-84 | | | | | 8.30 | 365 | 179 | 9.0 | | 133 | 52.0 | 12.0 | | | | | | | | | <0.04 | |
| | 24-Jun-85 | | | | | 8.21 | 350 | 150 | 14.0 | | 146 | 29.5 | 18.4 | | | | | | | | | 2.00 | |
| | 18-Dec-85 | | | | | 7.47 | 715 | 338 | 27.5 | | 283 | 96.5 | 23.4 | | | | | | | | | 0.46 | |
| | 18-Sep-86 | | | | | 8.26 | 279 | 122 | 7.5 | | 113 | 33.0 | 9.6 | | | | | | | | | 0.18 | |
| | 6-Mar-87 | | | | | 7.87 | 454 | 233 | 7.5 | | 208 | 66.5 | 16.2 | | | | | | | | | 0.78 | |
| | 14-Sep-87 | | | | | 9.00 | 262 | 116 | 3.5 | | | 21.5 | 15.0 | | | | | | | | | 0.46 | |
| | 7-Mar-88 | | | | | 7.71 | 192 | 97 | 4.1 | | 72 | 30.9 | 4.8 | | | | | | | | | 0.80 | |
| | 12-Dec-88 | | | | | 7.77 | 538 | 255 | 10.8 | | 231 | 72.6 | 17.9 | | | | | | | | | 0.37 | |
| | 13-Jun-89 | | | | | 8.20 | 429 | 187 | 23.0 | | | 36.3 | 23.4 | | | | | | | | | 0.14 | |
| | 11-Sep-89 | | | | | 7.78 | 335 | 191 | 10.3 | | 142 | 46.0 | 18.4 | | | | | | | | | 1.75 | |
| | 5-Mar-90 | | | | | 7.66 | 471 | 235 | 10.6 | | 203 | 66.5 | 16.6 | | | | | | | | | 0.38 | |
| | 21-Jun-90 | | | | | 8.32 | 405 | 207 | 8.9 | | 182 | 56.4 | 15.9 | | | | | | | | | 1.05 | |

Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well** | **Date** | **pH** | **EC** | **T** | **Turbidity** | **pH** | **EC** | **Total Hardness** | **Chloride** | **Sulphate** | **Alkalinity** | **Calcium** | **Magnesium** | **Potassium** | **Sodium** | **Ammonia** | **Un-ionized Ammonia** | **Nitrate** | **Nitrite** | **Boron** | **Chromium** | **Iron** | **Manganese** |
| | **Units** | **SU** | **µS/cm** | **ºC** | **NTU** | **SU** | **µS/cm** | | | | | | | | | | | | | | | | |
| | **PQWO** | **6.5-8.5** | **nc** | **nc** | **Narrative** | **6.5-8.5** | **nc** | **nc** | **nc** | **nc** | ***a*** | **nc** | **nc** | **nc** | **nc** | **nc** | **0.02** | **nc** | **nc** | **0.2 *i*** | **0.0089** | **0.3** | **nc** |
| **PO1** | 2-Dec-90 | | | | | 8.56 | 436 | 212 | 11.6 | | 195 | 60.9 | 14.4 | | | | | | | | | 0.24 | |
| **cont'd** | 11-Mar-91 | | | | | 7.58 | 378 | 186 | 6.7 | | 169 | 55.6 | 11.4 | | | | | | | | | 0.63 | |
| | 9-Sep-91 | | | | | 7.64 | 359 | 163 | 7.1 | | 155 | 41.4 | 14.5 | | | | | | | | | 0.73 | |
| | 24-Mar-92 | | | | | 8.18 | 408 | 208 | 7.8 | | 178 | 57.7 | 15.5 | | | | | | | | | 0.22 | |
| | 16-Jun-92 | | | | | 8.78 | 259 | 132 | 6.4 | | 95 | 22.2 | 18.6 | | | | | | | | | 2.35 | |
| | 7-Dec-92 | | | | | 8.20 | 427 | 226 | 4.5 | | 216 | 61.2 | 17.8 | | | | | | | | | 0.35 | |
| | 23-Mar-93 | | | | | 7.33 | 336 | 134 | 11.7 | | 133 | 42.9 | 6.5 | | | | | | | | | 3.46 | |
| | 7-Sep-93 | | | | | 7.73 | 343 | 169 | 7.9 | | 155 | 35.1 | 19.8 | | | | | | | | | 1.87 | |
| | 21-Mar-94 | | | | | 7.36 | 339 | 175 | 6.3 | | 148 | 53.2 | 10.3 | | | | | | | | | 1.94 | |
| | 21-Jun-94 | | | | | 7.50 | 312 | 156 | 2.4 | | 156 | 36.5 | 15.8 | | | | | | | | | <0.01 | |
| | 6-Dec-94 | | | | | 7.98 | 310 | 157 | 4.8 | | 147 | 38.7 | 14.7 | | | | | | | | | 1.36 | |
| | 28-Mar-95 | | | | | 8.69 | 261 | 136 | 2.6 | | 121 | 30.6 | 14.5 | | | | | | | | | 0.62 | |
| | 15-Jun-97 | | | | | 8.45 | 350 | 195 | 8.2 | | 182 | 50.8 | 16.6 | | | | | | | | | 1.01 | 0.170 |
| | 15-Jun-98 | | | | | 8.42 | 323 | 189 | 10.0 | | 168 | 45.1 | 18.6 | | | | | | | | | 1.91 | 0.100 |
| | 15-Jun-99 | | | | | 8.21 | 410 | 217 | 6.0 | | 178 | 81.2 | 15.5 | | | | | | | | | 0.29 | 0.030 |
| | 15-Jun-00 | | | | | 8.28 | 532 | 316 | 18.0 | | 210 | 92.9 | 20.4 | | | | | | | | | 0.11 | 0.040 |
| | 15-Jun-01 | | | | | 7.88 | 524 | 256 | 21.0 | | 246 | 72.4 | 18.2 | | | | | | | | | 0.29 | 0.060 |
| | 15-Jun-02 | | | | | 8.06 | 560 | 284 | 18.0 | | 259 | 79.2 | 21.0 | | | | | | | | | 0.57 | 0.040 |
| | 15-Jun-03 | | | | | 8.05 | 560 | 315 | 21.0 | | 227 | 88.3 | 22.9 | | | | | | | | | 0.07 | 0.020 |
| | 15-Jun-04 | | | | | 8.01 | 432 | 222 | 18.9 | | 181 | 57.0 | 18.7 | | | | | | | | | 0.31 | 0.061 |
| | 15-Jun-05 | | | | | 8.15 | 496 | 231 | 16.2 | | 190 | 63.0 | 17.9 | | | | | | | | | 0.22 | 0.070 |
| | 15-Jun-06 | | | | | 7.97 | 414 | 210 | 24.0 | | 180 | 50.6 | 21.4 | | | | | | | | | 0.58 | 0.056 |
| | 19-Apr-07 | | | | | 8.13 | 378 | 180 | 13.0 | | 170 | 39.4 | 20.1 | | | | | | | | | 0.30 | 0.013 |
| | 15-Apr-08 | | | | | 8.20 | 443 | 200 | 16.0 | | 180 | 51.0 | 18.0 | | | | | | | | | 0.16 | 0.010 |
| | 16-Apr-09 | | | | | 8.16 | 478 | 197 | 26.9 | | 197 | 53.0 | 15.6 | | | | | | | | | 0.10 | 0.009 |
| | 10-May-10 | 8.36 | 390 | 14.7 | | 8.34 | 534 | 208 | 12.7 | | 258 | 51.1 | 19.6 | | | | | | | | | 0.30 | 0.029 |
| | 11-Apr-11 | 8.12 | 450 | 17.7 | | 8.39 | 491 | 226 | 13.0 | | 223 | 65.6 | 15.1 | | | | | | | | | 0.06 | 0.020 |

Note: refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **PO1** | 8-Mar-12 | 7.93 | 416 | 7.1 | | 8.34 | 592 | 234 | 24.8 | | 261 | 66.5 | 16.4 | | | | | | | | | 0.14 | 0.012 |
| **cont'd** | 9-Apr-13 | 8.46 | 471 | 8.4 | | 8.00 | 421 | 192 | 5.72 | | 199 | 53.3 | 14.2 | | | | | | | | | 0.07 | 0.011 |
| | 28-Mar-14 | 8.41 | 215 | 1.9 | | 8.02 | 237 | 115 | 1.26 | | 120 | 37.7 | 5.03 | | | | | | | | | 0.08 | 0.004 |
| | 6-Apr-15 | 6.50 | 420 | 7.4 | | 7.91 | 488 | 268 | 4.21 | | 254 | 83.0 | 14.8 | | | | | | | | | 0.06 | 0.025 |
| | 10-Mar-16 | 7.64 | 540 | 10.1 | | 8.05 | 522 | 238 | 14.9 | | 237 | 70.8 | 14.8 | | | | | | | | | <0.01 | 0.018 |
| | 7-Mar-17 | 7.76 | 457 | 5.2 | | 8.19 | 459 | 208 | 6.35 | | 212 | 63.5 | 12.1 | | | | | | | | | 0.123 | 0.021 |
| | 2-Apr-18 | 8.07 | 495 | 6.33 | 9.9 | 8.08 | 455 | 222 | 14.1 | 9.18 | 232 | 63.8 | 15.3 | 6.92 | 10.5 | 0.21 | 0.003 | 1.87 | <0.10 | 0.118 | <0.003 | 0.104 | 0.010 |
| | 15-Apr-19 | 7.85 | 476 | 6.5 | 5.0 | 7.76 | 422 | 186 | 9.45 | 4.16 | 212 | 56.5 | 10.9 | 3.17 | 3.45 | 0.078 | 0.001 | 1.25 | 0.016 | 0.038 | <0.00050 | 0.208 | 0.0183 |
| | 8-Apr-20 | 8.12 | 421 | 11.55 | 10.4 | 8.22 | 472 | 238 | 11.4 | 6.85 | 235 | 65.6 | 17.9 | 7.57 | 9.71 | 0.061 | 0.002 | 1.78 | 0.036 | 0.135 | <0.00050 | 0.216 | 0.0318 |
| | 12-Apr-21 | 8.12 | 363 | 16.03 | 0.0 | 8.12 | 366 | 326 | 9 | 8 | 175 | 88.5 | 25.6 | 10.5 | 34.3 | <0.1 | <0.004 | 0.72 | <0.03 | 0.45 | 0.00036 | 0.34 | 0.102 |
| **PO2** | 15-Jun-84 | | | | | 7.67 | 780 | 369 | 24.5 | | 331 | 104.0 | 26.4 | | | | | | | | | 0.18 | |
| | 18-Dec-84 | | | | | 7.73 | 670 | 251 | 21.0 | | 271 | 59.0 | 25.0 | | | | | | | | | 0.48 | |
| | 7-Oct-85 | | | | | 8.02 | 605 | 275 | 20.5 | | 218 | 70.5 | 24.0 | | | | | | | | | 0.10 | |
| | 12-Mar-86 | | | | | 8.12 | 120 | 39 | 6.0 | | 40 | 12.5 | 1.8 | | | | | | | | | 2.52 | |
| | 10-Jun-86 | | | | | 7.97 | 670 | 328 | 23.0 | | 282 | 89.0 | 25.6 | | | | | | | | | 0.19 | |
| | 15-Dec-86 | | | | | 7.37 | 640 | 302 | 20.5 | | 285 | 83.0 | 23.0 | | | | | | | | | 0.17 | |
| | 12-Jun-87 | | | | | 7.91 | 615 | 284 | 26.0 | | 252 | 69.0 | 27.0 | | | | | | | | | 0.45 | |
| | 14-Dec-87 | | | | | 8.04 | 645 | 319 | 22.4 | | 263 | 89.6 | 23.1 | | | | | | | | | 0.25 | |
| | 6-Sep-88 | | | | | 7.94 | 505 | 234 | 24.0 | | 198 | 54.9 | 23.6 | | | | | | | | | 0.18 | |
| | 14-Mar-89 | | | | | 7.54 | 680 | 321 | 23.3 | | 290 | 89.1 | 23.9 | | | | | | | | | 0.23 | |
| | 11-Dec-89 | | | | | 7.86 | 689 | 349 | 24.8 | | 297 | 95.3 | 27.0 | | | | | | | | | 0.07 | |
| | 11-Jun-90 | | | | | 8.52 | 453 | 216 | 25.2 | | 173 | 46.3 | 24.3 | | | | | | | | | 0.21 | |
| | 17-Sep-90 | | | | | 7.98 | 474 | 213 | 25.7 | | 183 | 47.9 | 22.6 | | | | | | | | | 0.13 | |
| | 17-Jun-91 | | | | | 8.20 | 440 | 181 | 27.6 | | 160 | 34.7 | 22.9 | | | | | | | | | 0.16 | |
| | 3-Dec-91 | | | | | 8.17 | 571 | 279 | 26.1 | | 229 | 71.2 | 24.6 | | | | | | | | | 0.16 | |
| | 15-Sep-92 | | | | | 8.16 | 487 | 228 | 26.7 | | 188 | 52.3 | 23.6 | | | | | | | | | 0.20 | |

Note:  refer to notation page for surface water notation details

# Table E-1:  Surface Water Chemical Results

| | | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Date | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | °C | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **PO2** | 15-Jun-93 | | | | | 8.27 | 390 | 173 | 25.6 | | 152 | 32.7 | 22.1 | | | | | | | | | 0.20 | |
| **cont'd** | 7-Dec-93 | | | | | 8.09 | 605 | 338 | 26.0 | | 222 | 91.2 | 26.8 | | | | | | | | | 0.20 | |
| | 26-Jun-95 | | | | | 8.27 | 468 | 209 | 32.0 | | 170 | 41.9 | 25.2 | | | | | | | | | 0.20 | |
| | 15-Jun-97 | | | | | 8.34 | 567 | 327 | 29.2 | | 269 | 87.8 | 26.2 | | | | | | | | | 0.41 | 0.110 |
| | 15-Jun-98 | | | | | 8.28 | 599 | 300 | 34.0 | | 256 | 79.3 | 24.8 | | | | | | | | | 0.42 | 0.210 |
| | 15-Jun-99 | | | | | 8.03 | 712 | 364 | 40.0 | | 313 | 99.9 | 27.7 | | | | | | | | | 0.38 | 0.100 |
| | 15-Jun-00 | | | | | 8.61 | 377 | 203 | 10.0 | | 174 | 48.9 | 19.6 | | | | | | | | | 0.54 | 0.040 |
| | 15-Jun-01 | | | | | 7.67 | 678 | 376 | 44.0 | | 292 | 107.0 | 26.5 | | | | | | | | | 0.42 | 0.090 |
| | 15-Jun-02 | | | | | 8.01 | 770 | 387 | 48.0 | | 321 | 107.0 | 29.0 | | | | | | | | | 0.45 | 0.200 |
| | 15-Jun-03 | | | | | 8.13 | 731 | 389 | 50.0 | | 286 | 103.0 | 31.9 | | | | | | | | | 0.90 | 0.090 |
| | 15-Jun-04 | | | | | 7.89 | 521 | 321 | 27.2 | | 289 | 94.7 | 18.7 | | | | | | | | | 0.51 | 0.100 |
| | 15-Jun-05 | | | | | 8.10 | 745 | 333 | 49.9 | | 301 | 91.4 | 25.5 | | | | | | | | | 0.40 | 0.090 |
| | 15-Jun-06 | | | | | 7.59 | 481 | 310 | 22.0 | | 240 | 97.0 | 17.5 | | | | | | | | | 0.59 | 0.115 |
| | 19-Apr-07 | | | | | 7.84 | 777 | 380 | 52.0 | | 330 | 102.0 | 31.3 | | | | | | | | | 0.55 | 0.061 |
| | 15-Apr-08 | | | | | 8.10 | 741 | 360 | 49.0 | | 310 | 95.0 | 30.0 | | | | | | | | | 0.42 | 0.050 |
| | 16-Apr-09 | | | | | 8.20 | 763 | 305 | 57.4 | | 296 | 85.8 | 22.1 | | | | | | | | | 0.34 | 0.014 |
| | 10-May-10 | 7.88 | 760 | 18.1 | | 8.25 | 374 | 327 | 51.6 | | 195 | 87.4 | 26.5 | | | | | | | | | 0.29 | 0.067 |
| | 11-Apr-11 | 7.70 | 780 | 14.4 | | 8.27 | 863 | 363 | 64.1 | | 343 | 102 | 26.4 | | | | | | | | | 0.22 | 0.055 |
| | 8-Mar-12 | 7.58 | 8.28 | 8 | | 8.37 | 861 | 325 | 65.3 | | 348 | 89.1 | 25.0 | | | | | | | | | 0.44 | 0.050 |
| | 9-Apr-13 | 8.42 | 928 | 8.9 | | 8.05 | 885 | 333 | 58.3 | | 349 | 93.7 | 24.0 | | | | | | | | | 0.54 | 0.149 |
| | 28-Mar-14 | 7.63 | 948 | 2.6 | | 8.10 | 876 | 342 | 55.8 | | 365 | 94.9 | 25.4 | | | | | | | | | 0.32 | 0.233 |
| | 28-Mar-14 | 7.63 | 948 | 2.6 | | 8.15 | 882 | 341 | 54.6 | | 366 | 95.0 | 25.2 | | | | | | | | | 0.37 | 0.219 |
| | 6-Apr-15 | 7.30 | 720 | 9.1 | | 7.93 | 898 | 372 | 65.4 | | 372 | 102 | 28.4 | | | | | | | | | 0.91 | 0.127 |
| | 10-Mar-16 | 7.52 | 519 | 10.4 | | 8.12 | 691 | 321 | 35.8 | | 308 | 97.5 | 18.8 | | | | | | | | | <0.01 | 0.084 |
| | 7-Mar-17 | 7.84 | 844 | 6.98 | | 8.21 | 819 | 282 | 56.4 | | 322 | 75.7 | 22.5 | | | | | | | | | 0.170 | 0.023 |
| | 2-Apr-18 | 8.13 | 784 | 7.88 | 26.2 | 8.06 | 795 | 323 | 60.2 | 23.8 | 357 | 86.5 | 25.9 | 10.5 | 37.4 | 8.47 | 0.176 | 0.29 | <0.25 | 0.453 | <0.003 | 0.210 | 0.023 |
| | 15-Apr-19 | 7.60 | 807 | 6.40 | 0.0 | 7.90 | 774 | 319 | 57.0 | 18.8 | 335 | 84.6 | 26.1 | 9.56 | 36.9 | 6.93 | 0.038 | 0.414 | 0.017 | 0.386 | 0.00150 | 0.375 | 0.0556 |

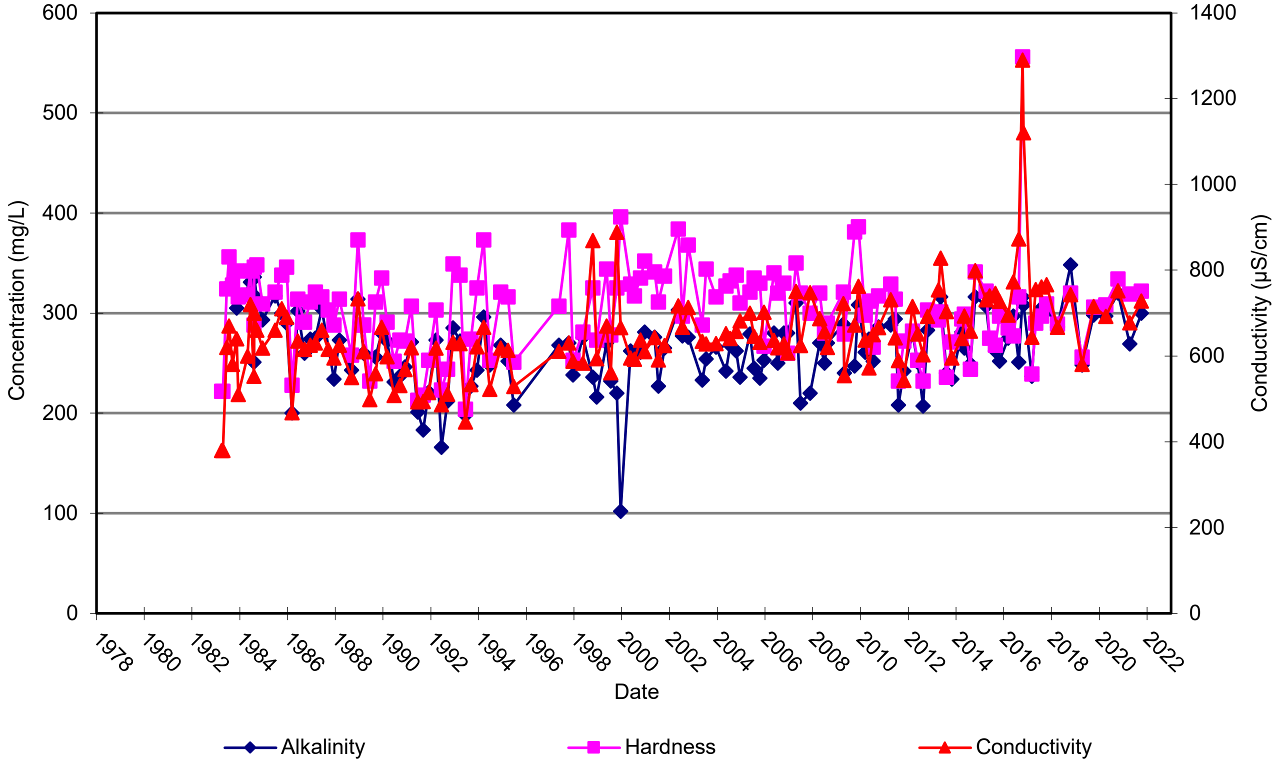
Note:  refer to notation page for surface water notation details

# Table E-1: Surface Water Chemical Results

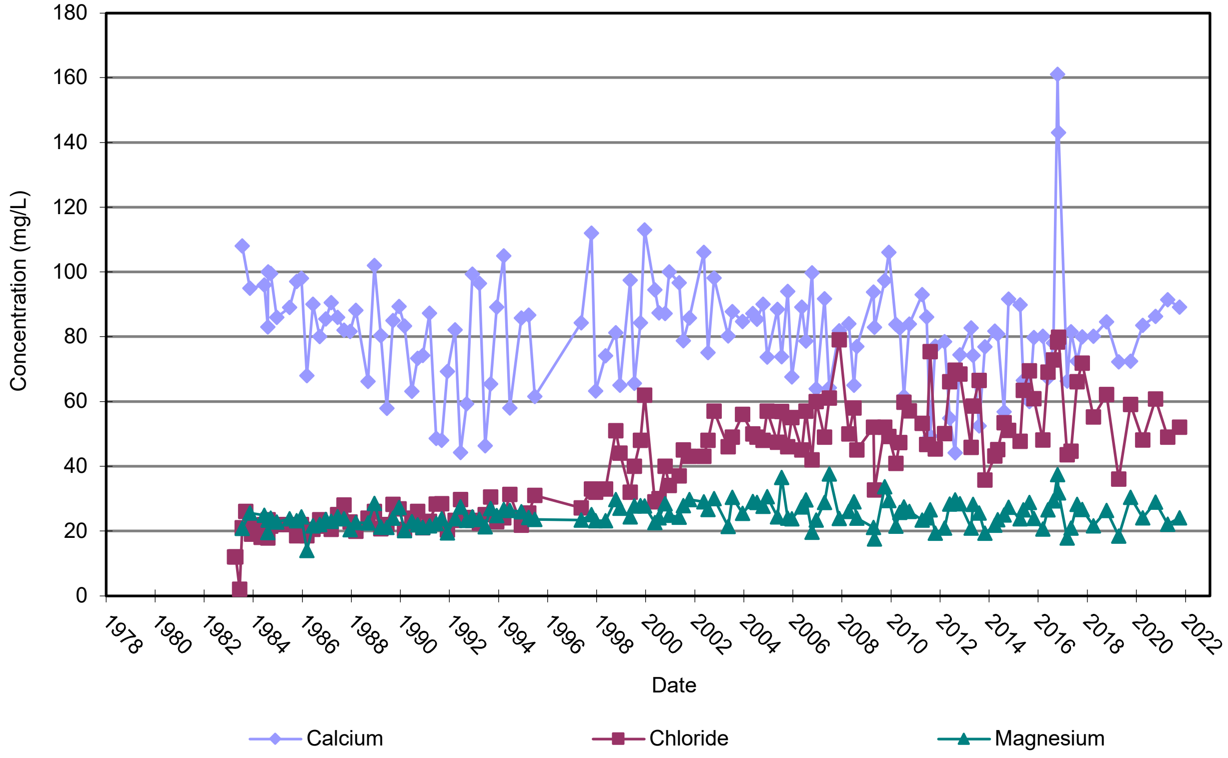
| Well | Date | Field Parameters | | | | General Parameters | | | Major and Minor Ions | | | | | | | Nutrients and Organic Indicators | | | | Metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | EC | T | Turbidity | pH | EC | Total Hardness | Chloride | Sulphate | Alkalinity | Calcium | Magnesium | Potassium | Sodium | Ammonia | Un-ionized Ammonia | Nitrate | Nitrite | Boron | Chromium | Iron | Manganese |
| | Units | SU | µS/cm | ºC | NTU | SU | µS/cm | | | | | | | | | | | | | | | | |
| | PQWO | 6.5-8.5 | nc | nc | Narrative | 6.5-8.5 | nc | nc | nc | nc | *a* | nc | nc | nc | nc | nc | 0.02 | nc | nc | 0.2 *i* | 0.0089 | 0.3 | nc |
| **PO2** | 8-Apr-20 | 7.92 | 715 | 11.81 | 2.0 | 8.18 | 795 | 334 | 57.2 | 17.2 | 341 | 87.1 | 28.2 | 10.3 | 37.5 | 6.56 | 0.115 | 0.256 | 0.014 | 0.383 | <0.00050 | 0.472 | 0.0844 |
| **cont'd** | 12-Apr-21 | 7.77 | 736 | 17.66 | 2.0 | 8.13 | 799 | 316 | 63 | 20 | 306 | 83.0 | 26.3 | 11.8 | 37.9 | 7.5 | 0.144 | 0.27 | <0.03 | 0.435 | 0.00035 | 0.36 | 0.104 |
| **PO3** | 15-Jun-84 | | | | | 7.57 | 495 | 209 | 21.5 | | 198 | 63.0 | 12.6 | | | | | | | | | 1.30 | |
| | 18-Dec-84 | | | | | 7.64 | 730 | 297 | 55.0 | | 181 | 87.0 | 19.2 | | | | | | | | | 0.35 | |
| | 12-Mar-86 | | | | | 7.54 | 423 | 132 | 30.0 | | 122 | 41.0 | 7.2 | | | | | | | | | 4.70 | |
| | 15-Dec-86 | | | | | 7.52 | 273 | 136 | 12.0 | | 106 | 45.0 | 5.6 | | | | | | | | | 0.68 | |
| | 14-Dec-87 | | | | | 8.01 | 328 | 150 | 12.6 | | 101 | 49.9 | 6.1 | | | | | | | | | 1.18 | |
| | 6-Sep-88 | | | | | 7.78 | 680 | 162 | 8.3 | | 87 | 52.6 | 7.3 | | | | | | | | | 22.8 | |
| | 14-Mar-89 | | | | | 7.60 | 208 | 94 | 5.8 | | 65 | 30.5 | 4.2 | | | | | | | | | 1.02 | |
| | 3-Dec-91 | | | | | 7.64 | 468 | 204 | 24.7 | | 175 | 63.5 | 11.0 | | | | | | | | | 0.63 | |
| | 15-Sep-92 | | | | | 7.68 | 412 | 197 | 6.1 | | 199 | 63.9 | 9.1 | | | | | | | | | 1.60 | |
| | 7-Dec-92 | | | | | 8.02 | 631 | 307 | 24.3 | | 246 | 96.9 | 15.8 | | | | | | | | | 0.20 | |
| | 15-Jun-00 | | | | | 8.23 | 635 | 358 | 43.0 | | 234 | 98.4 | 27.3 | | | | | | | | | 0.37 | 0.110 |
| | 15-Jun-04 | | | | | 7.91 | 531 | 331 | 7.2 | | 302 | 106.0 | 18.7 | | | | | | | | | 0.27 | 0.062 |
| | 15-Jun-05 | | | | | 8.21 | 597 | 330 | 6.8 | | 307 | 102.0 | 18.4 | | | | | | | | | <0.1 | 0.042 |
| | 15-Jun-06 | | | | | 7.84 | 512 | 350 | 10.0 | | 300 | 103.0 | 21.4 | | | | | | | | | 0.31 | 0.086 |
| | 19-Apr-07 | | | | | 7.72 | 548 | 300 | 7.0 | | 300 | 87.4 | 19.2 | | | | | | | | | 0.26 | 0.018 |
| | 15-Apr-08 | | | | | 8.10 | 493 | 250 | 10.0 | | 240 | 76.0 | 15.0 | | | | | | | | | 0.15 | 0.020 |
| | 16-Apr-09 | | | | | 8.12 | 637 | 327 | 19.0 | | 315 | 101.0 | 18.1 | | | | | | | | | 0.068 | 0.023 |
| | 11-Apr-11 | 7.86 | 397 | 14.9 | | 8.31 | 448 | 207 | 11.1 | | 208 | 64.6 | 11.1 | | | | | | | | | <0.01 | 0.006 |
| | 8-Mar-12 | 8.16 | 97 | 2.5 | | 8.10 | 264 | 95 | 10.9 | | 110 | 28.9 | 5.6 | | | | | | | | | 0.016 | 0.004 |
| | 7-Mar-17 | 8.04 | 525 | 4.68 | | 8.14 | 543 | 200 | 17.4 | | 233 | 62.3 | 10.8 | | | | | | | | | 0.053 | 0.003 |
| | 2-Apr-18 | 7.90 | 686 | 8.97 | 13.4 | 8.00 | 575 | 244 | 27.8 | 6.56 | 274 | 75.7 | 13.3 | 13.4 | 21.3 | 1.92 | 0.026 | 3.50 | <0.10 | 0.417 | <0.003 | <0.010 | 0.002 |
| | 15-Apr-19 | 7.99 | 558 | 2.87 | 0.0 | 7.85 | 531 | 233 | 19.3 | 3.12 | 258 | 70.9 | 13.7 | 14.0 | 18.5 | 2.95 | 0.030 | 2.71 | 0.017 | 0.368 | <0.00050 | 0.053 | 0.00629 |
| | 8-Apr-20 | 8.13 | 583 | 9.54 | 2.4 | 8.11 | 657 | 337 | 14.8 | 17.6 | 329 | 102 | 20.2 | 12.4 | 14.9 | 0.176 | 0.004 | 1.98 | 0.032 | 0.525 | <0.00050 | 0.113 | 0.0242 |
| | 12-Apr-21 | D | R | Y | | | | | | | | | | | | | | | | | | | |

Note: refer to notation page for surface water notation details

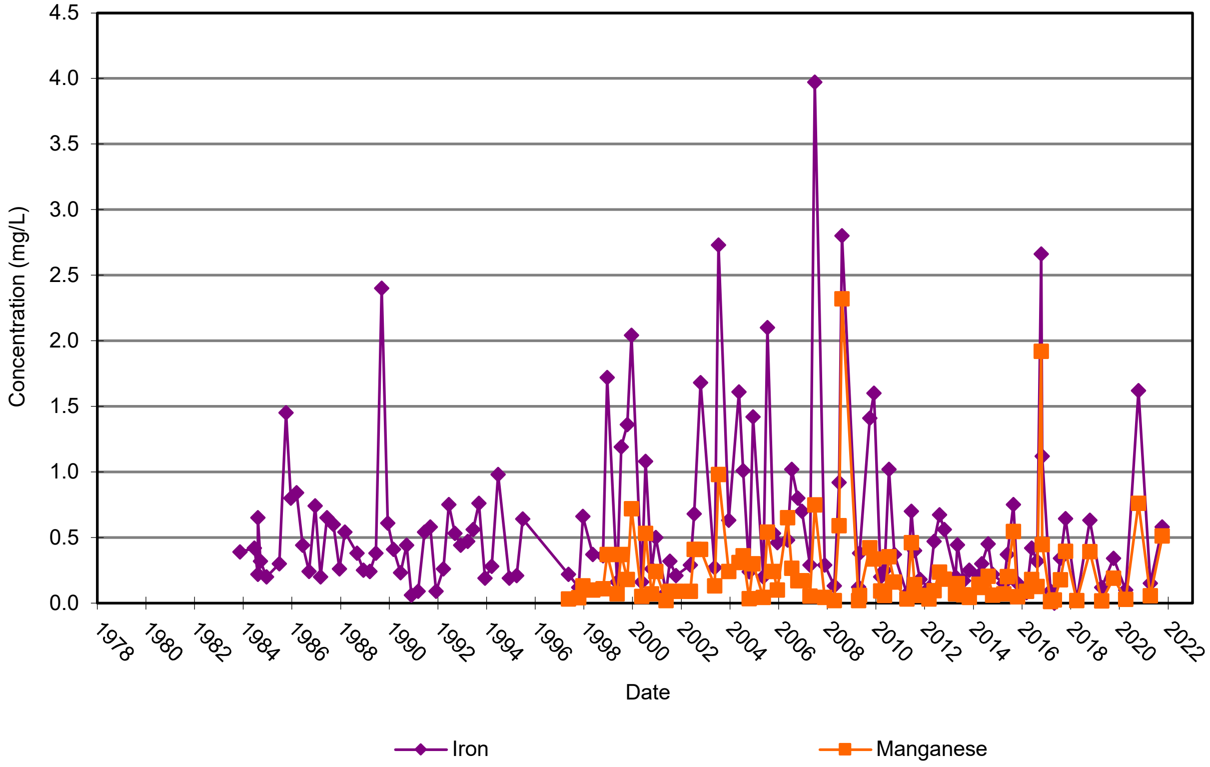
## Figure E-1
## Concentration Versus Time - Surface Water Station CO1
## Holbrook Landfill Site - Surface Water



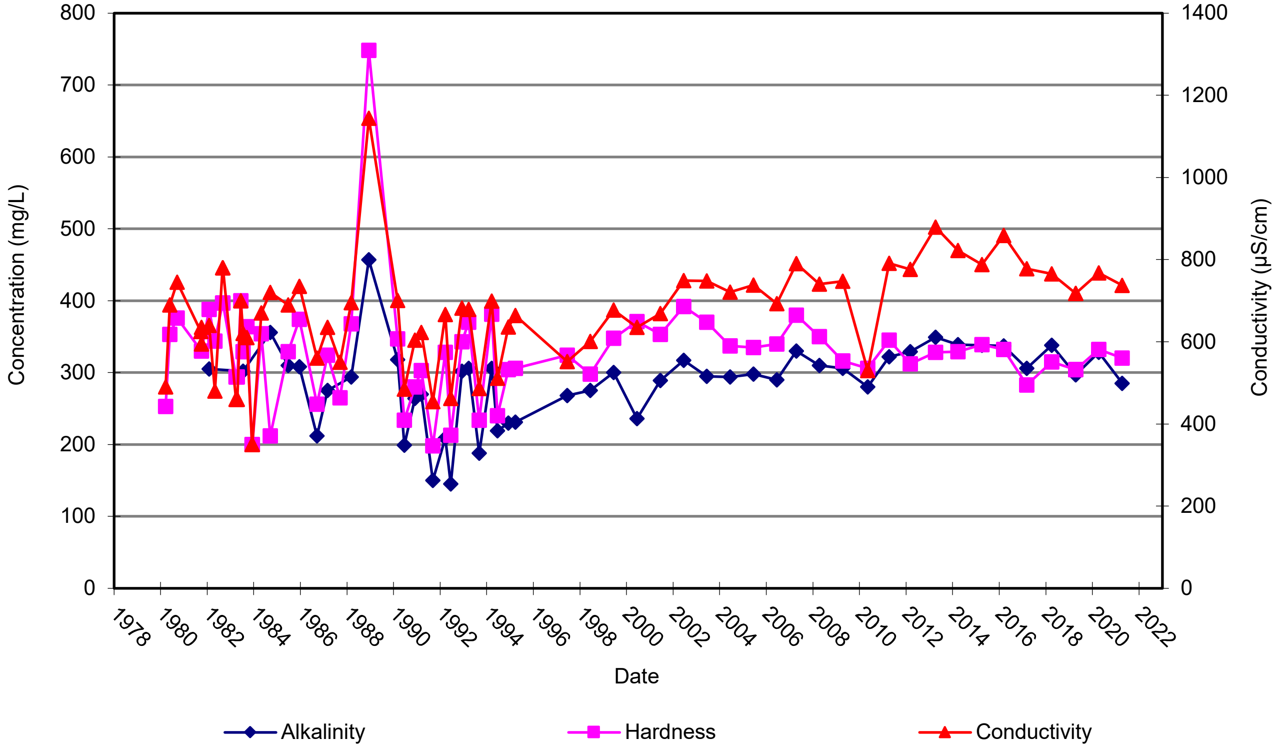
## Figure E-2
## Concentration Versus Time - Surface Water Station CO1
## Holbrook Landfill Site - Surface Water



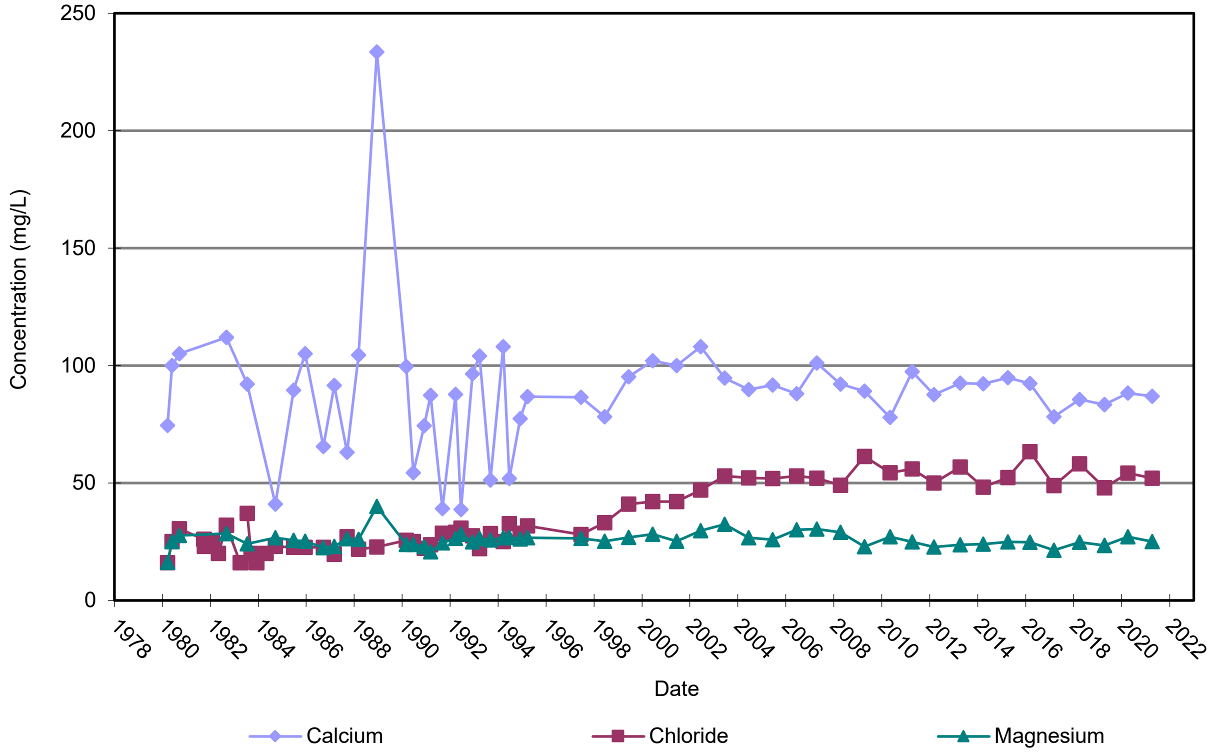
## Figure E-3
## Concentration Versus Time - Surface Water Station CO1
## Holbrook Landfill Site - Surface Water



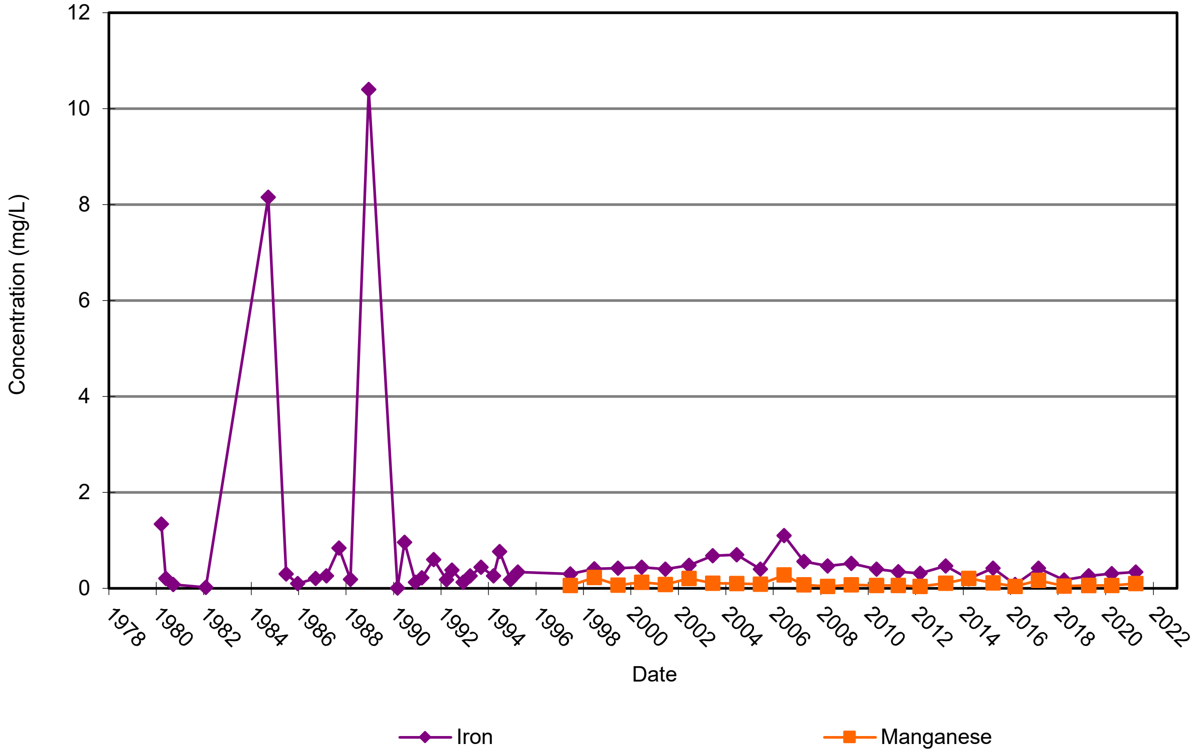
## Figure E-4
## Concentration Versus Time - Surface Water Station CO4
## Holbrook Landfill Site - Surface Water



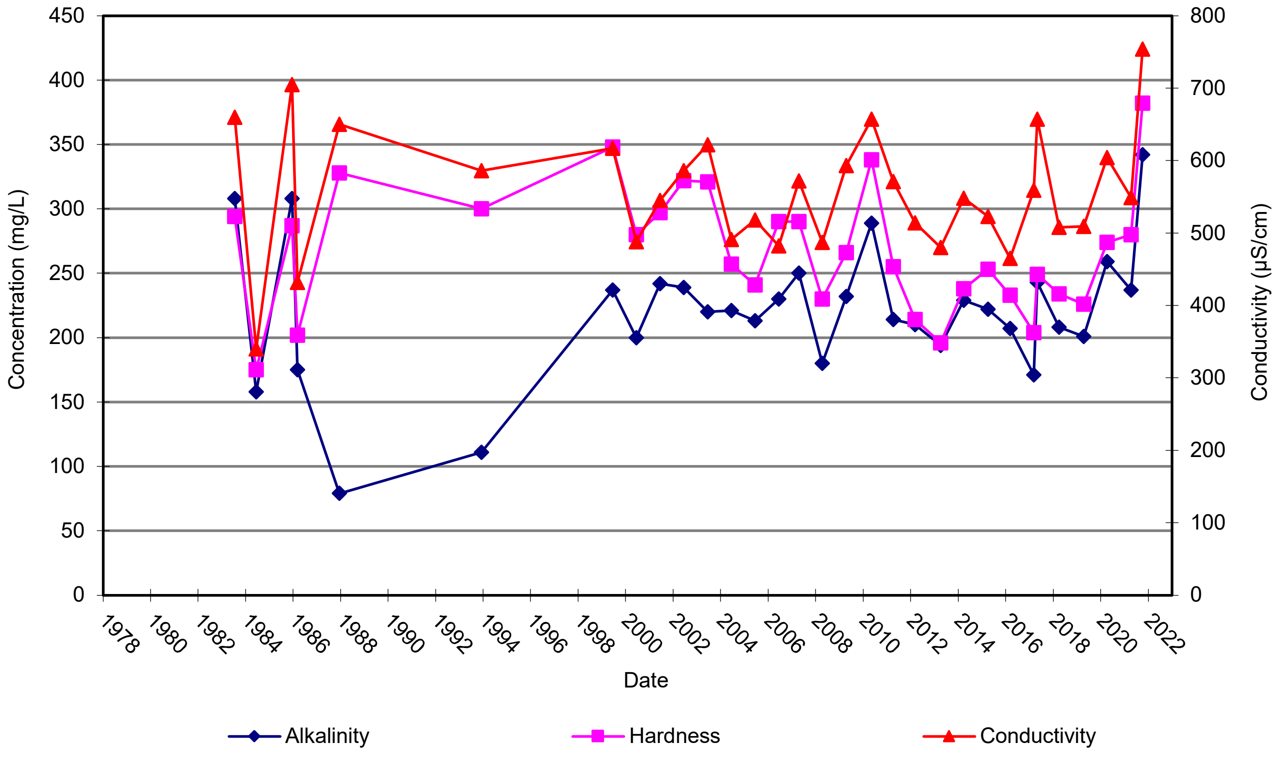
## Figure E-5
## Concentration Versus Time - Surface Water Station CO4
## Holbrook Landfill Site - Surface Water



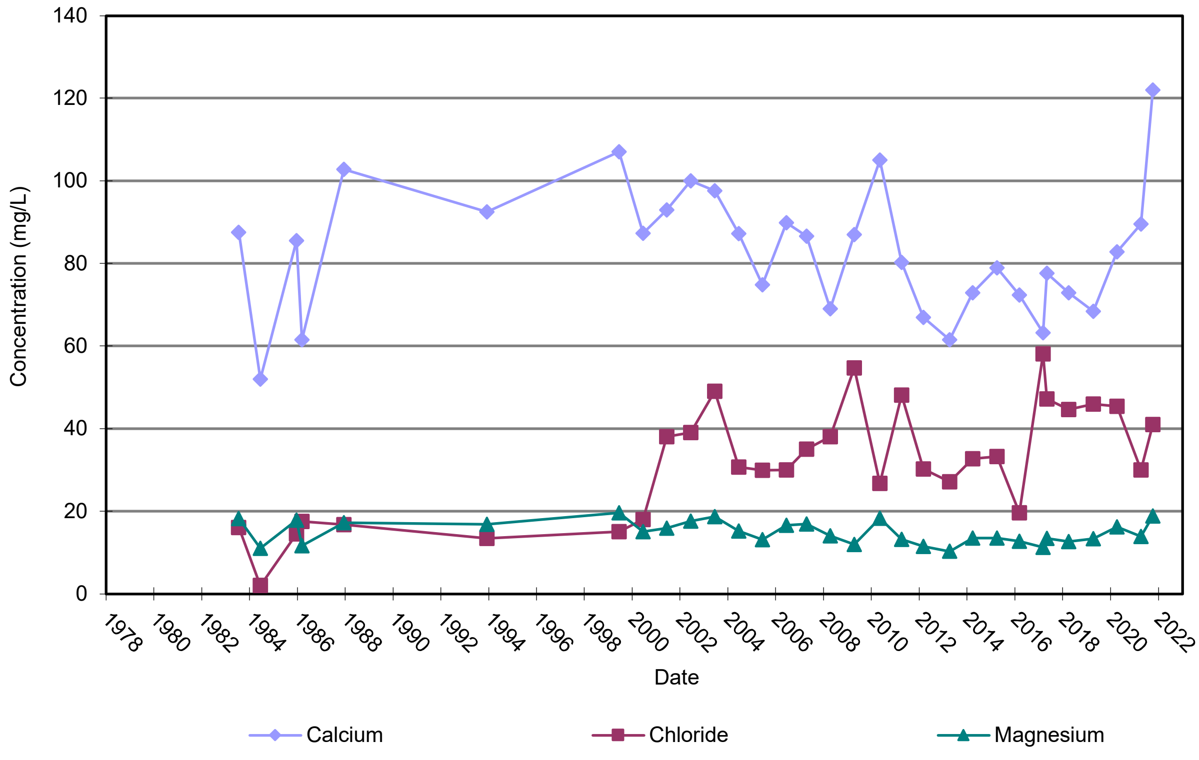
## Figure E-6
## Concentration Versus Time - Surface Water Station CO4
## Holbrook Landfill Site - Surface Water



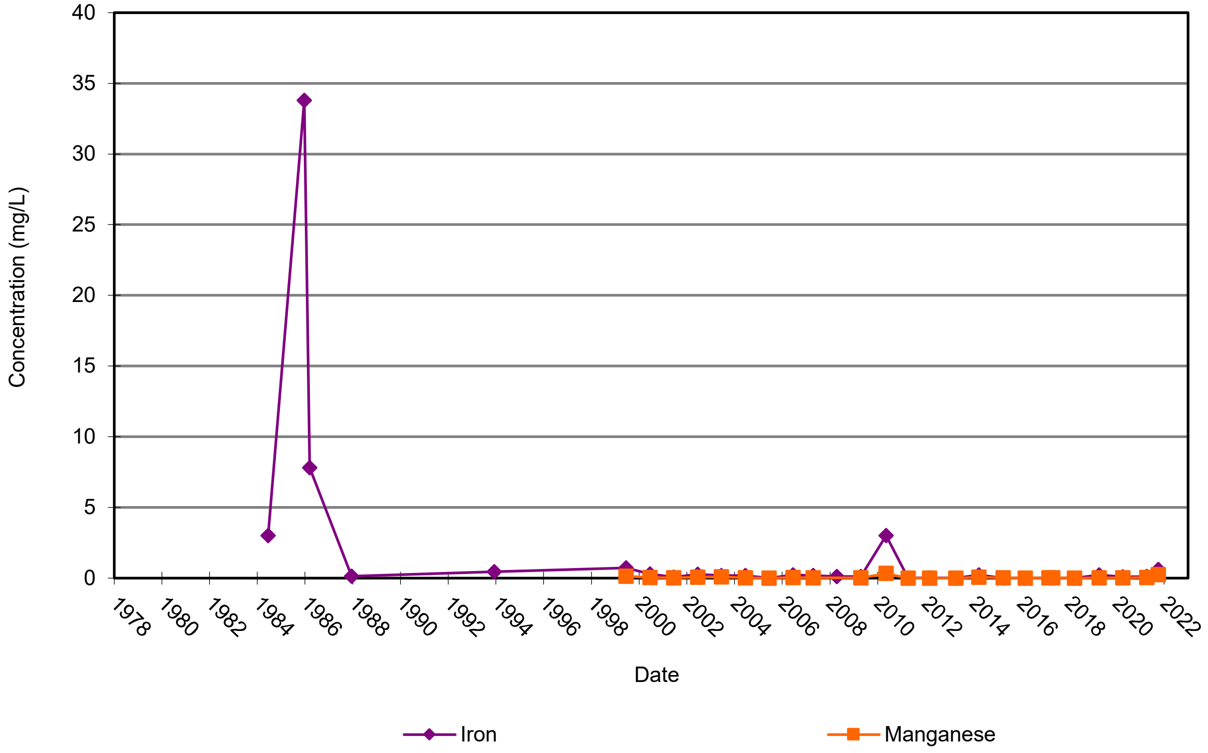
## Figure E-7
## Concentration Versus Time - Surface Water Station CO6
## Holbrook Landfill Site - Surface Water



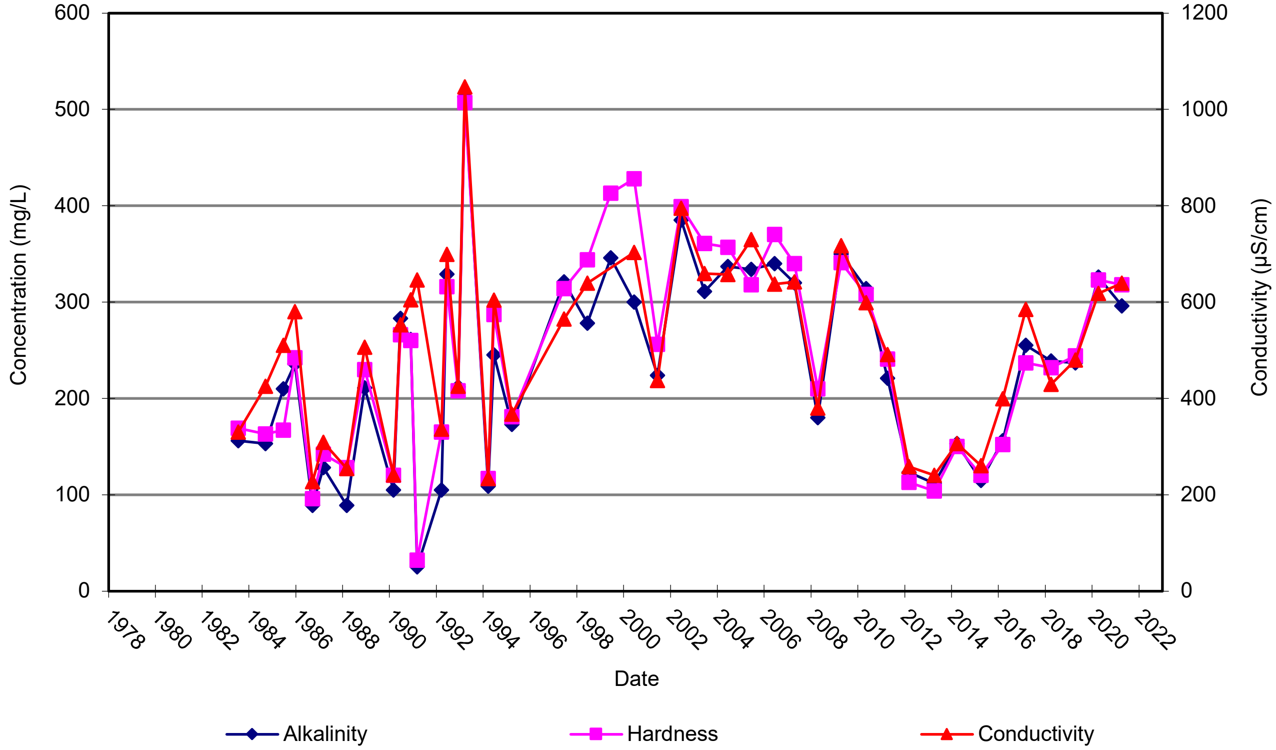
## Figure E-8
## Concentration Versus Time - Surface Water Station CO6
## Holbrook Landfill Site - Surface Water



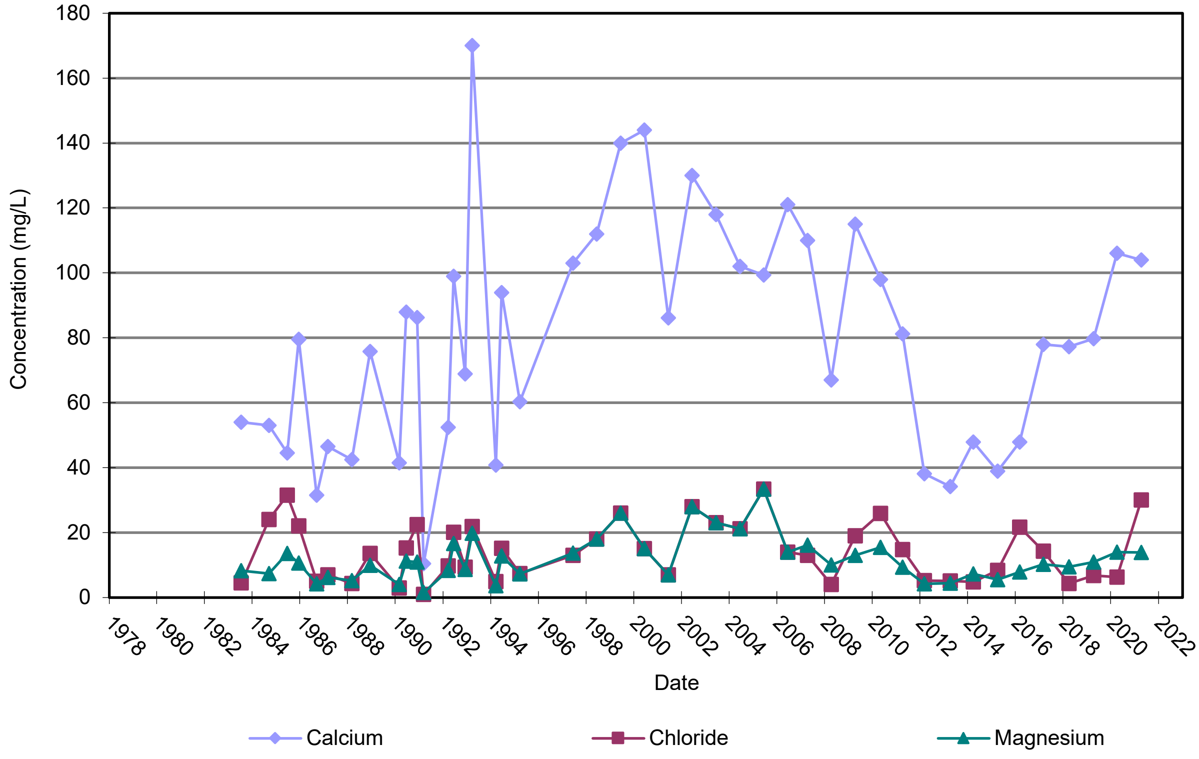
## Figure E-9
## Concentration Versus Time - Surface Water Station CO6
## Holbrook Landfill Site - Surface Water



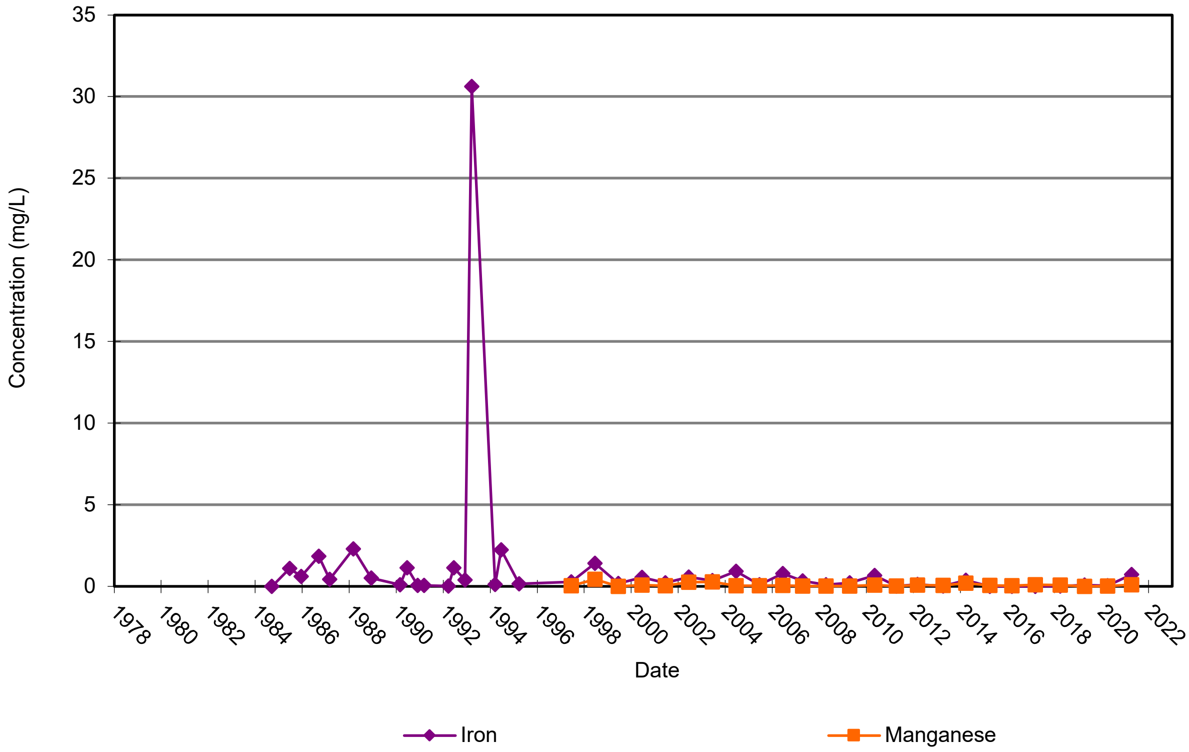
## Figure E-10
## Concentration Versus Time - Surface Water Station NE1
## Holbrook Landfill Site - Surface Water



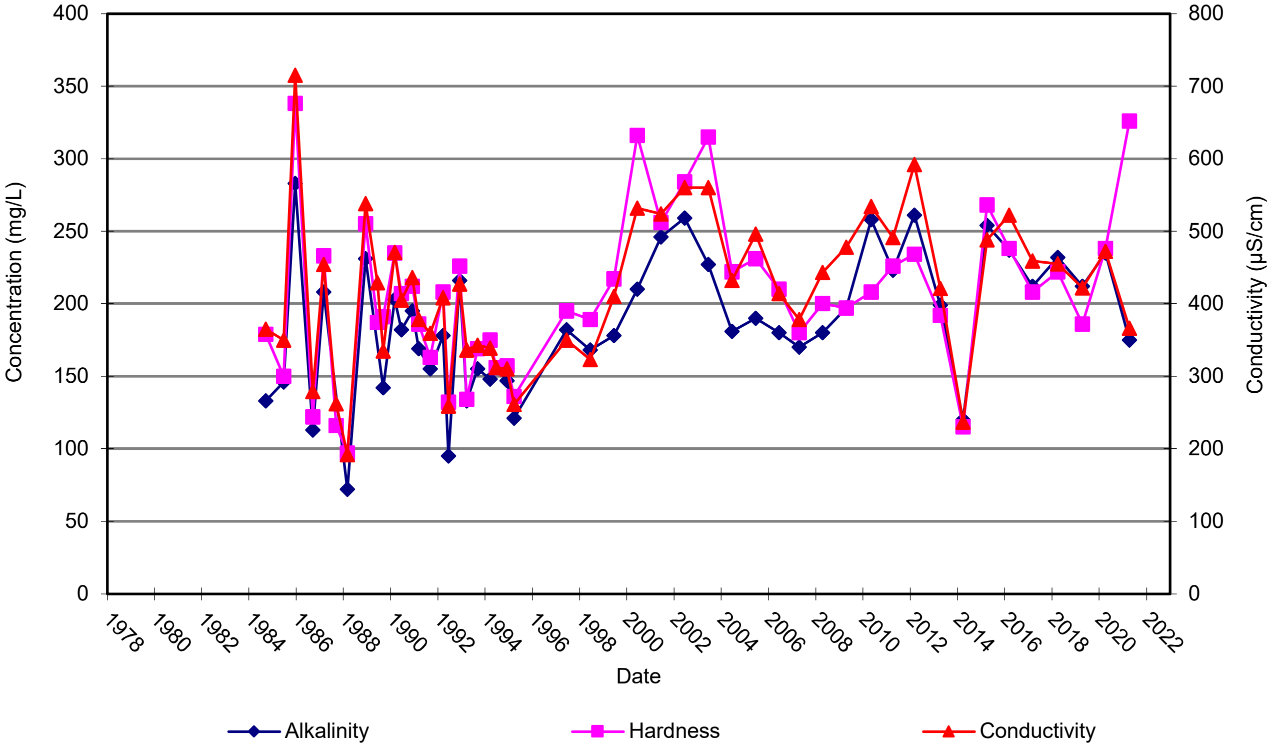
## Figure E-11
## Concentration Versus Time - Surface Water Station NE1
## Holbrook Landfill Site - Surface Water



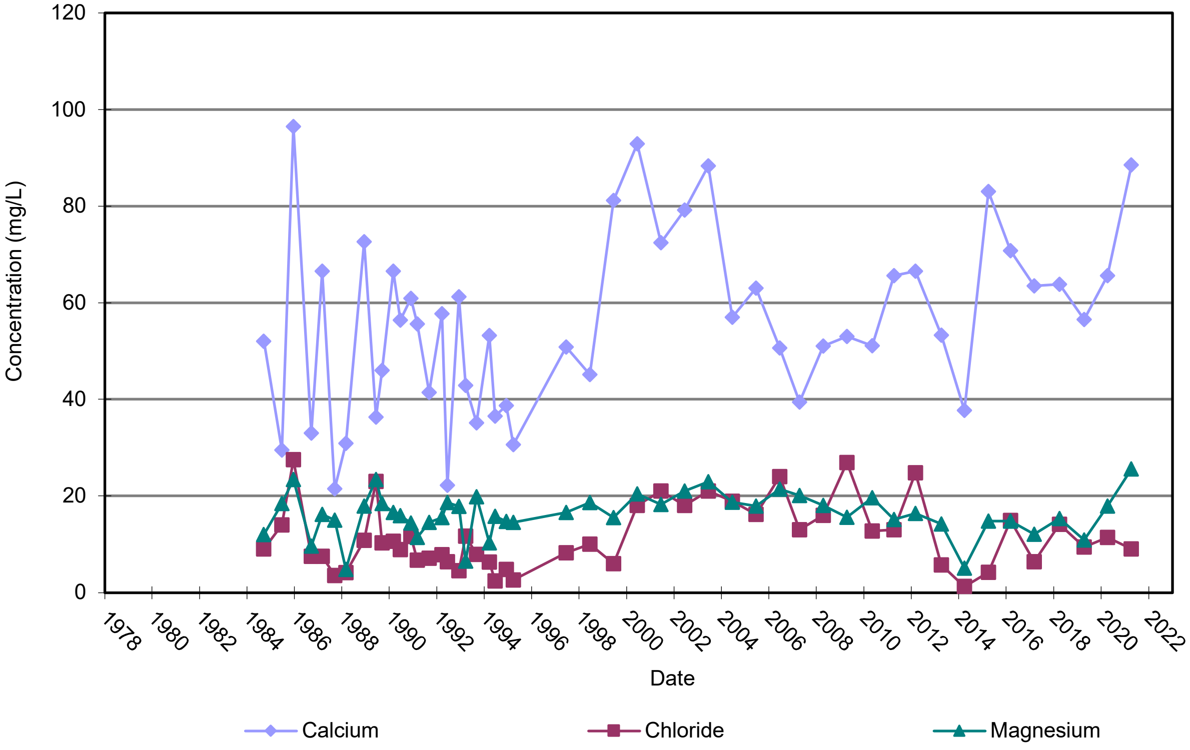
## Figure E-12
## Concentration Versus Time - Surface Water Station NE1
## Holbrook Landfill Site - Surface Water



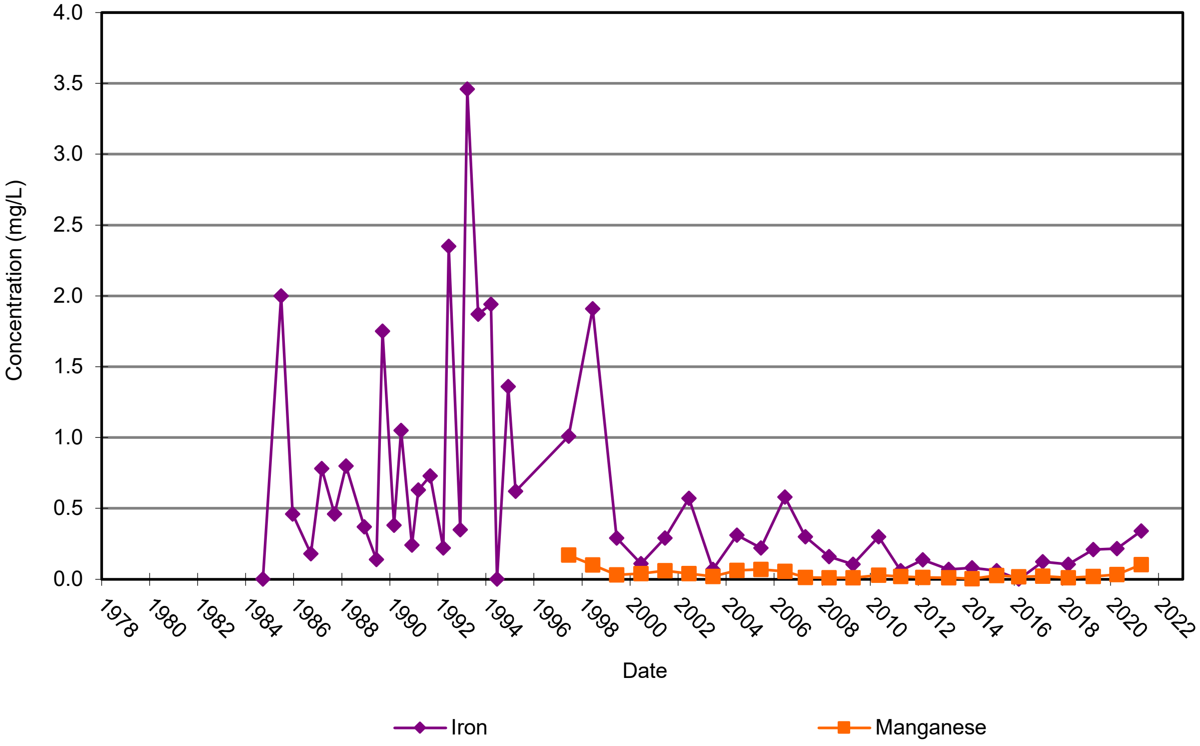
## Figure E-13
## Concentration Versus Time - Surface Water Station PO1
## Holbrook Landfill Site - Surface Water



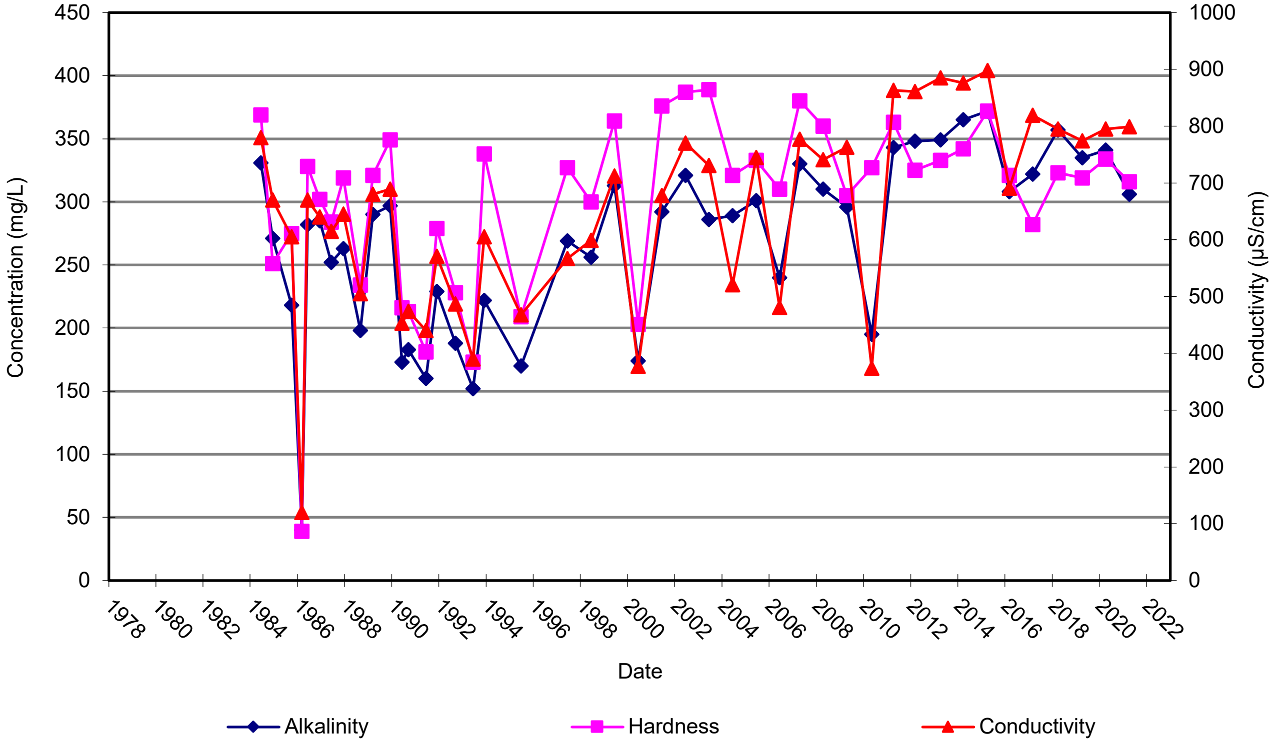
## Figure E-14
## Concentration Versus Time - Surface Water Station PO1
## Holbrook Landfill Site - Surface Water



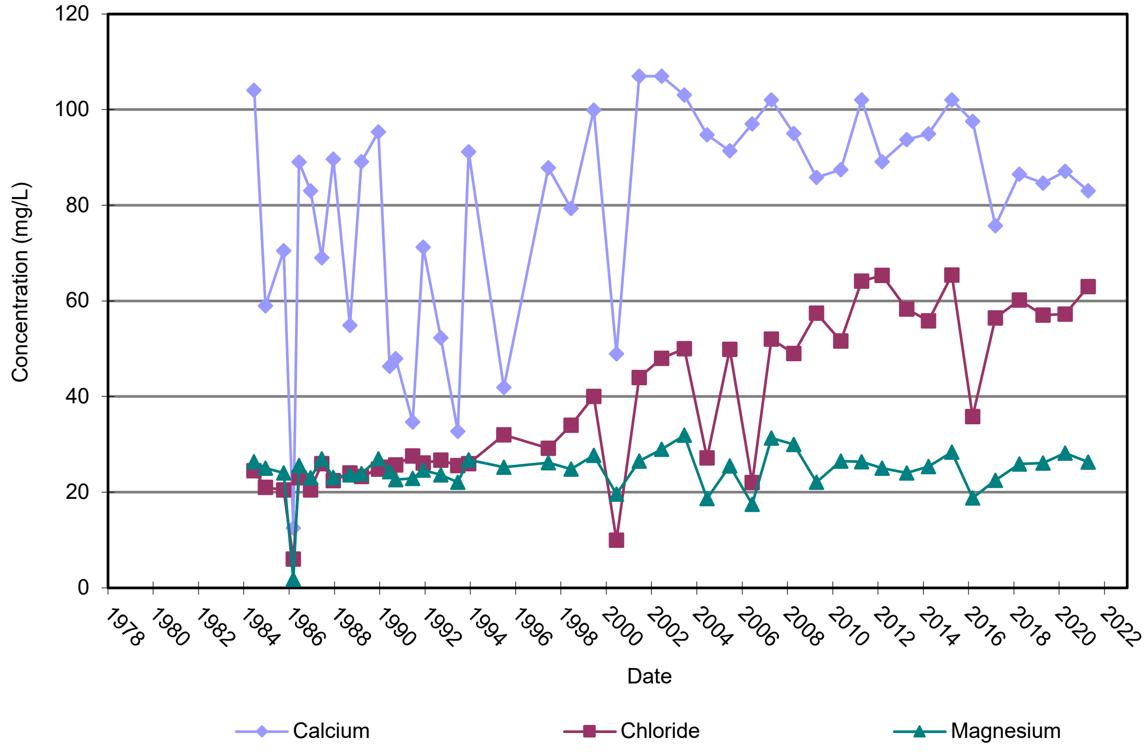
## Figure E-15
## Concentration Versus Time - Surface Water Station PO1
## Holbrook Landfill Site - Surface Water



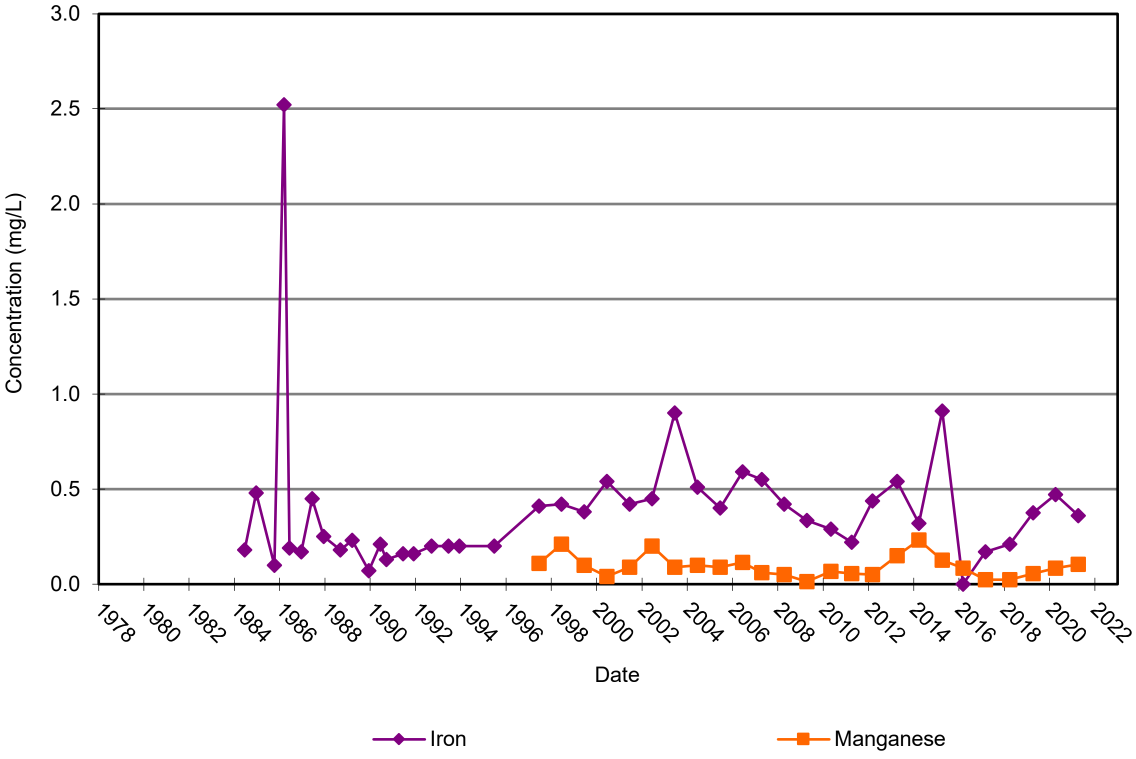
## Figure E-16
## Concentration Versus Time - Surface Water Station PO2
## Holbrook Landfill Site - Surface Water



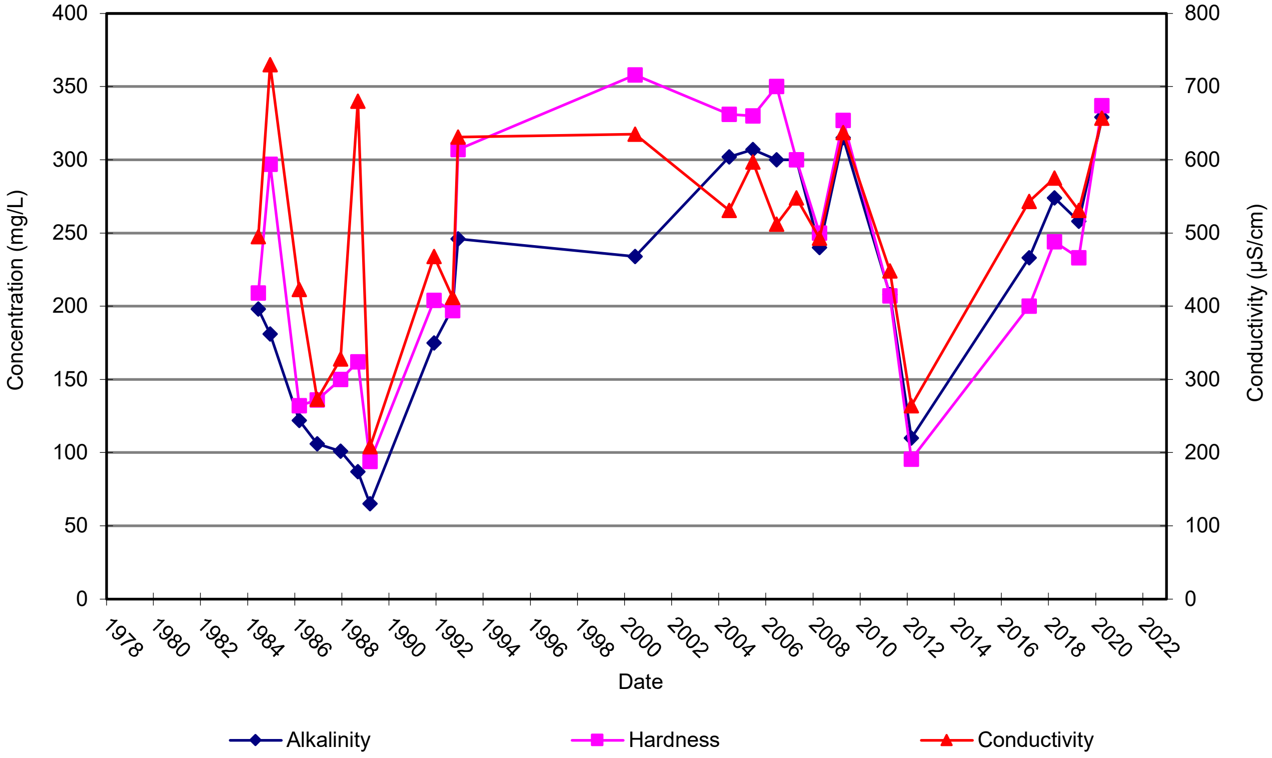
## Figure E-17
## Concentration Versus Time - Surface Water Station PO2
## Holbrook Landfill Site - Surface Water



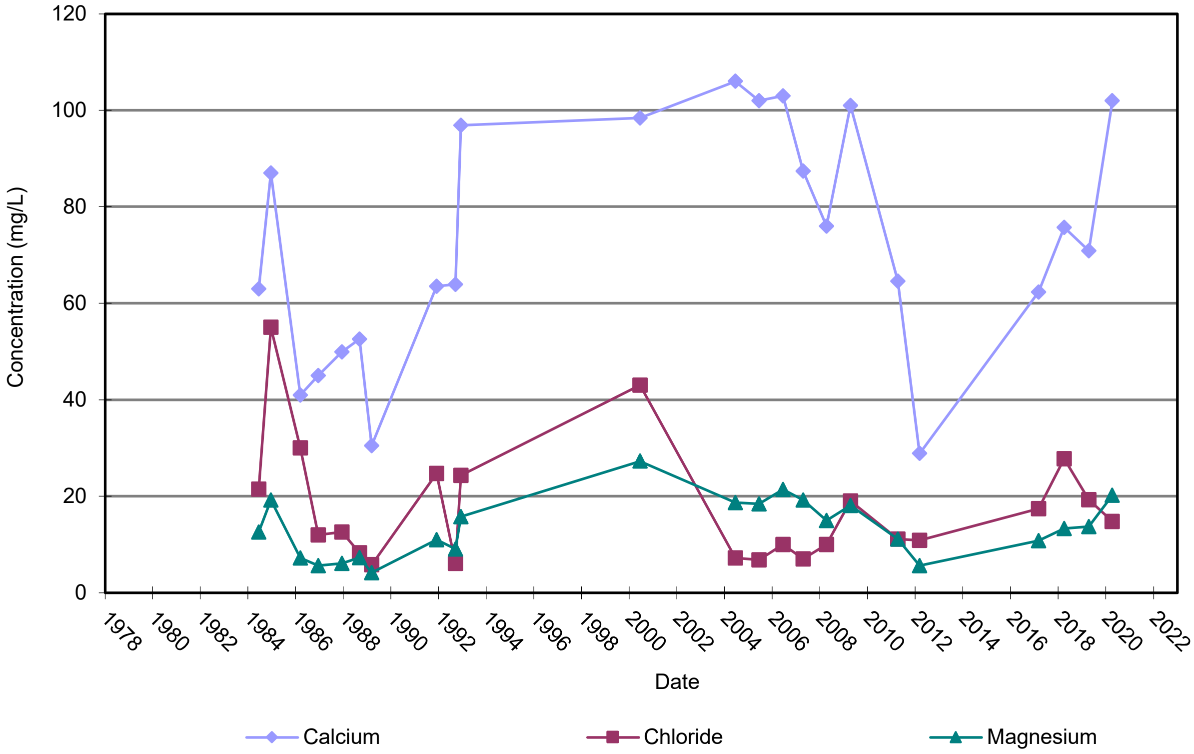
## Figure E-18
## Concentration Versus Time - Surface Water Station PO2
## Holbrook Landfill Site - Surface Water



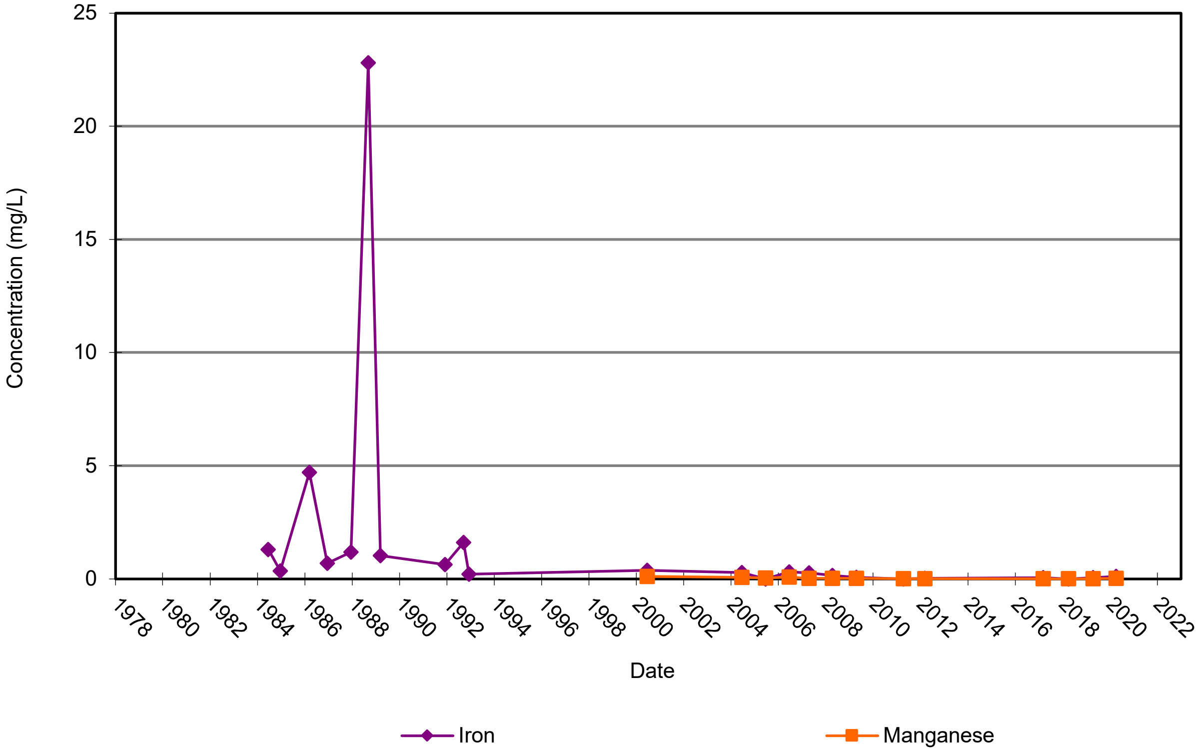
## Figure E-19
## Concentration Versus Time - Surface Water Station PO3
## Holbrook Landfill Site - Surface Water



## Figure E-20
## Concentration Versus Time - Surface Water Station PO3
## Holbrook Landfill Site - Surface Water



# Figure E-21
# Concentration Versus Time - Surface Water Station PO3
# Holbrook Landfill Site - Surface Water



# APPENDIX

# F

## LABORATORY CERTIFICATES OF ANALYSIS

**SGS Canada Inc.**
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

**Project :** 111-53037-05, Oxford County Landfill - Holbrook SW

21-April-2021

**WSP Canada Inc.**
Attn : Albert Siertsema

1821 Provincial Road, Unit 10, Windsor
Canada, N8W 5V7
Phone: 905-687-1771 x 240, Fax:

**Date Rec. :** 13 April 2021
**LR Report:** **CA14346-APR21**
**Reference:** 111-53037-05, Albert Siertsema

**Copy:** 2

# CERTIFICATE OF ANALYSIS
## Final Report - Revised

| Analysis | 1: Analysis Start Date | 2: Analysis Start Time | 3: Analysis Completed Date | 4: Analysis Completed Time | 5: RL | 6: NE1 | 7: CO6 |
|---|---|---|---|---|---|---|---|
| Sample Date & Time | | | | | | 12-Apr-21 | 12-Apr-21 |
| Temp Upon Receipt [°C] | --- | --- | --- | --- | --- | 9.0 | 9.0 |
| pH [No unit] | 13-Apr-21 | 10:26 | 13-Apr-21 | 15:47 | 0.05 | 8.02 | 8.05 |
| Conductivity [uS/cm] | 13-Apr-21 | 10:26 | 13-Apr-21 | 15:47 | 2 | 639 | 549 |
| Hardness [mg/L as CaCO3] | 15-Apr-21 | 14:02 | 20-Apr-21 | 16:45 | 0.05 | 318 | 280 |
| Alkalinity [mg/L as CaCO3] | 13-Apr-21 | 10:26 | 13-Apr-21 | 15:47 | 2 | 296 | 237 |
| Cl [mg/L] | 14-Apr-21 | 14:57 | 19-Apr-21 | 10:16 | 1 | 30 | 30 |
| SO4 [mg/L] | 14-Apr-21 | 14:52 | 19-Apr-21 | 10:16 | 2 | 4 | 14 |
| NO2 [as N mg/L] | 14-Apr-21 | 14:58 | 16-Apr-21 | 10:43 | 0.03 | < 0.03 | < 0.03 |
| NO3 [as N mg/L] | 14-Apr-21 | 14:58 | 16-Apr-21 | 10:43 | 0.06 | < 0.06 | 0.11 |
| NO2+NO3 [as N mg/L] | 14-Apr-21 | 14:58 | 16-Apr-21 | 10:43 | 0.06 | < 0.06 | 0.11 |
| NH3+NH4 [as N mg/L] | 13-Apr-21 | 19:10 | 15-Apr-21 | 13:43 | 0.1 | 1.2 | < 0.1 |
| B (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.002 | 0.143 | 0.026 |
| Ca (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.003 | 104 | 89.5 |
| Cr (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 8e-005 | 0.00031 | 0.00041 |
| Fe (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.01 | 0.73 | 0.11 |
| Mn (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 1e-005 | 0.103 | 0.0334 |
| Mg (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.001 | 13.9 | 13.9 |
| K (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.009 | 10.1 | 1.82 |
| Na (tot) [mg/L] | 15-Apr-21 | 14:02 | 19-Apr-21 | 12:04 | 0.01 | 17.3 | 13.2 |

| Analysis | 8: PO2 | 9: CO4 | 10: PO1 | 11: CO1 | 12: SW DUP |
|---|---|---|---|---|---|
| Sample Date & Time | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 |
| Temp Upon Receipt [°C] | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |

OnLine LIMS

0002469517

| **Analysis** | **8:<br>PO2** | **9:<br>CO4** | **10:<br>PO1** | **11:<br>CO1** | **12:<br>SW DUP** |
|---|---|---|---|---|---|
| pH [No unit] | 8.13 | 8.11 | 8.12 | 8.07 | 8.11 |
| Conductivity [uS/cm] | 799 | 737 | 366 | 677 | 679 |
| Hardness [mg/L as CaCO3] | 316 | 320 | 326 | 319 | 305 |
| Alkalinity [mg/L as CaCO3] | 306 | 285 | 175 | 269 | 268 |
| Cl [mg/L] | 63 | 52 | 9 | 49 | 50 |
| SO4 [mg/L] | 20 | 30 | 8 | 15 | 16 |
| NO2 [as N mg/L] | < 0.03 | 0.04 | < 0.03 | < 0.03 | < 0.03 |
| NO3 [as N mg/L] | 0.27 | 0.43 | 0.72 | 1.03 | 1.03 |
| NO2+NO3 [as N mg/L] | 0.27 | 0.47 | 0.72 | 1.03 | 1.03 |
| NH3+NH4 [as N mg/L] | 7.5 | 5.3 | < 0.1 | 0.2 | 0.2 |
| B (tot) [mg/L] | 0.435 | 0.417 | 0.450 | 0.397 | 0.344 |
| Ca (tot) [mg/L] | 83.0 | 86.9 | 88.5 | 91.4 | 85.8 |
| Cr (tot) [mg/L] | 0.00035 | 0.00045 | 0.00036 | 0.00053 | 0.00022 |
| Fe (tot) [mg/L] | 0.36 | 0.34 | 0.34 | 0.15 | 0.15 |
| Mn (tot) [mg/L] | 0.104 | 0.103 | 0.102 | 0.0550 | 0.0532 |
| Mg (tot) [mg/L] | 26.3 | 25.0 | 25.6 | 22.1 | 21.9 |
| K (tot) [mg/L] | 11.8 | 9.95 | 10.5 | 8.98 | 8.60 |
| Na (tot) [mg/L] | 37.9 | 33.4 | 34.3 | 31.8 | 31.2 |

PWQO - Provincial Water Quality Objectives
Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999
a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.
b PWQO limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQO = 1100 ug/L)
c PWQO limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQO = 0.5 ug/L)
d PWQO limit based on Cr VI (PWQO limit for Cr III = 8.9 ug/L)
e PWQO limit based on Hardness 0-20 (For Hardness >20 mg/L PWQO = 5 ug/L)
f PWQO limit based on Hardness <30 (For Hardness 30-80 PWQO = 3 ug/L, & >80 PWQO=5)

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:NA

## Method Descriptions

| Parameter | Description | SGS Method Code |
|---|---|---|
| Alkalinity | Alkalinity by Titration | ME-CA-[ENV]EWL-LAK-AN-006 |
| Ammonia+Ammonium (N) | NH3+NH4 by Skalar - solution | ME-CA-[ENV]SFA-LAK-AN-007 |
| Boron (total) | B by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Calcium (total) | Ca by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Chloride | Chloride by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Chromium (total) | Cr by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Conductivity | Conductivity by Conductivity Meter | ME-CA-[ENV]EWL-LAK-AN-006 |
| Hardness | Hardness (CaCO3) by ICP | ME-CA-[ENV]SPE-LAK-AN-003 |
| Iron (total) | Fe by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |

OnLine LIMS

0002469517

| Parameter | Description | SGS Method Code |
|---|---|---|
| Magnesium (total) | Mg by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Manganese (total) | Mn by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Nitrate (as N) | Nitrate by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| Nitrate + Nitrite (as N) | Total Nitrate/Nitrite by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| Nitrite (as N) | Nitrite by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| pH | pH - solution | ME-CA-[ENV]EWL-LAK-AN-006 |
| Potassium (total) | K by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sodium (total) | Na by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sulphate | Sulphate by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |

*Brad Moore Hon. B.Sc*
*Project Specialist,*
*Environment, Health & Safety*

# Quality Control Report

| Inorganic Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Alkalinity - QCBatchID: EWL0203-APR21* | | | | | | | | | | | | | |
| Alkalinity | 2 | mg/L as Ca | < 2 | | | 2 | 20 | 102 | 80 | 120 | NA | | |
| *Ammonia by SFA - QCBatchID: SKA0120-APR21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | 5 | 10 | 96 | 90 | 110 | 100 | 75 | 125 |
| *Ammonia by SFA - QCBatchID: SKA0132-APR21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | ND | 10 | 95 | 90 | 110 | 103 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO0282-APR21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | 0 | 20 | 103 | 80 | 120 | 104 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 1 | 20 | 101 | 80 | 120 | 107 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO5031-APR21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | 0 | 20 | 105 | 80 | 120 | 100 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 5 | 20 | 108 | 80 | 120 | 115 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0202-APR21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | 0 | 20 | 103 | 80 | 120 | 86 | 75 | 125 |
| Nitrate + Nitrite (as N) | 0.06 | mg/L | <0.06 | | | NA | | NA | | | NA | | |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | 5 | 20 | 96 | 80 | 120 | 96 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0205-APR21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | ND | 20 | 102 | 80 | 120 | 102 | 75 | 125 |
| Nitrate + Nitrite (as N) | 0.06 | mg/L | <0.06 | | | NA | | NA | | | NA | | |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | ND | 20 | 97 | 80 | 120 | 101 | 75 | 125 |
| *Conductivity - QCBatchID: EWL0203-APR21* | | | | | | | | | | | | | |
| Conductivity | 2 | uS/cm | < 2 | | | 1 | 20 | 98 | 90 | 110 | NA | | |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0054-APR21* | | | | | | | | | | | | | |
| Boron (total) | 0.002 | mg/L | <0.002 | | | 7 | 20 | 102 | 90 | 110 | 102 | 70 | 130 |
| Calcium (total) | 0.01 | mg/L | <0.01 | | | 8 | 20 | 109 | 90 | 110 | 106 | 70 | 130 |
| Chromium (total) | 0.00008 | mg/L | <0.00008 | | | 3 | 20 | 104 | 90 | 110 | 105 | 70 | 130 |
| Iron (total) | 0.01 | mg/L | <0.007 | | | 0 | 20 | 104 | 90 | 110 | 125 | 70 | 130 |
| Magnesium (total) | 0.001 | mg/L | <0.001 | | | 0 | 20 | 110 | 90 | 110 | 102 | 70 | 130 |
| Manganese (total) | 0.00001 | mg/L | <0.00001 | | | 4 | 20 | 103 | 90 | 110 | 102 | 70 | 130 |
| Potassium (total) | 0.009 | mg/L | <0.009 | | | 7 | 20 | 105 | 90 | 110 | 93 | 70 | 130 |
| Sodium (total) | 0.01 | mg/L | <0.01 | | | 6 | 20 | 102 | 90 | 110 | 91 | 70 | 130 |
| *pH - QCBatchID: EWL0203-APR21* | | | | | | | | | | | | | |
| pH | 0.05 | No unit | NA | | | 0 | | 100 | | | NA | | |

**SGS Canada Inc.**
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

**Project :** 111-53037-05.100, Holbrook GW

**WSP Canada Inc.**
Attn : Albert Siertsema

1821 Provincial Road, Unit 10, Windsor
Canada, N8W 5V7
Phone: 905-687-1771 x 240, Fax:

25-May-2021

**Date Rec. :** 12 May 2021
**LR Report:** **CA14269-MAY21**
**Reference:** 111-53037-05.100, Albert Siertsema

**Copy:** 1

# CERTIFICATE OF ANALYSIS

## Final Report

| **Analysis** | **1: Analysis Start Date** | **2: Analysis Start Time** | **3: Analysis Completed Date** | **4: Analysis Completed Time** | **5: RL** | **6: 40** | **7: 39** | **8: 42** |
|---|---|---|---|---|---|---|---|---|
| Sample Date & Time | | | | | | 11-May-21 11:45 | 11-May-21 12:00 | 11-May-21 12:30 |
| Temp Upon Receipt [@ London Lab °C] | *** | *** | *** | *** | *** | *** | *** | *** |
| Temp Upon Receipt [@ Lakefield Lab °C] | *** | *** | *** | *** | *** | *** | *** | *** |
| pH [No unit] | 15-May-21 | 11:41 | 18-May-21 | 08:46 | 0.05 | 8.15 | 8.16 | 8.22 |
| Conductivity [uS/cm] | 15-May-21 | 11:41 | 18-May-21 | 08:46 | 2 | 722 | 684 | 386 |
| Alkalinity [mg/L as CaCO3] | 15-May-21 | 11:41 | 18-May-21 | 08:46 | 2 | 337 | 275 | 213 |
| DOC [mg/L] | 13-May-21 | 15:14 | 18-May-21 | 07:57 | 1.0 | 6.8 | 2.0 | 1.5 |
| Cl [mg/L] | 18-May-21 | 14:20 | 25-May-21 | 16:26 | 1 | 20 | 38 | < 1 |
| SO4 [mg/L] | 18-May-21 | 14:15 | 25-May-21 | 16:26 | 2 | 45 | 50 | 2 |
| NO2 [as N mg/L] | 15-May-21 | 06:37 | 19-May-21 | 15:38 | 0.03 | < 0.03 | 0.04 | < 0.03 |
| NO3 [as N mg/L] | 15-May-21 | 06:37 | 19-May-21 | 15:38 | 0.06 | < 0.06 | 0.39 | < 0.06 |
| TKN [as N mg/L] | 15-May-21 | 14:28 | 17-May-21 | 12:03 | 0.5 | < 0.5 | < 0.5 | < 0.5 |
| NH3+NH4 [as N mg/L] | 14-May-21 | 10:39 | 17-May-21 | 08:13 | 0.1 | 0.3 | < 0.1 | 0.4 |
| Ca (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:54 | 0.01 | 142 | 107 | 42.3 |
| Mg (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:54 | 0.001 | 23.2 | 25.7 | 22.5 |
| Na (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:54 | 0.01 | 10.4 | 21.7 | 19.2 |

| **Analysis** | **1: Analysis Start Date** | **2: Analysis Start Time** | **3: Analysis Completed Date** | **4: Analysis Completed Time** | **5: RL** | **6: 40** | **7: 39** | **8: 42** |
|---|---|---|---|---|---|---|---|---|
| K (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:54 | 0.009 | 1.02 | 1.82 | 1.21 |
| Hardness [mg/L as CaCO3] | 14-May-21 | 19:57 | 17-May-21 | 13:54 | 0.05 | 450 | 374 | 198 |
| B (diss) [mg/L] | 14-May-21 | 19:57 | 18-May-21 | 17:00 | 0.002 | 0.036 | 0.034 | 0.048 |
| Cr (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:55 | 8e-005 | 0.00029 | 0.00008 | 0.00017 |
| Fe (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:55 | 0.007 | 3.19 | 0.316 | 0.177 |
| Mn (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:55 | 1e-005 | 0.242 | 0.165 | 0.0111 |
| P (diss) [mg/L] | 14-May-21 | 19:57 | 17-May-21 | 13:55 | 0.003 | 0.028 | < 0.003 | 0.027 |
| Vinyl Chloride [µg/L] | 13-May-21 | 13:56 | 17-May-21 | 15:58 | | < 0.2 | < 0.2 | < 0.2 |
| Benzene [ug/L] | 13-May-21 | 13:56 | 17-May-21 | 15:58 | | < 0.5 | < 0.5 | < 0.5 |
| 1,4-Dichlorobenzene [µg/L] | 13-May-21 | 13:56 | 17-May-21 | 15:58 | | < 0.5 | < 0.5 | < 0.5 |

| **Analysis** | **9: 24R** | **10: 32R** | **11: 21R** | **12: 19R** | **13: 45** | **14: 46** |
|---|---|---|---|---|---|---|
| Sample Date & Time | 11-May-21 13:30 | 11-May-21 14:00 | 11-May-21 14:45 | 11-May-21 15:15 | 11-May-21 15:45 | 11-May-21 16:00 |
| Temp Upon Receipt [@ London Lab °C] | *** | *** | *** | *** | *** | *** |
| Temp Upon Receipt [@ Lakefield Lab °C] | *** | *** | *** | *** | *** | *** |
| pH [No unit] | 8.29 | 8.14 | 8.22 | 8.27 | 8.24 | 8.20 |
| Conductivity [uS/cm] | 410 | 519 | 609 | 432 | 328 | 391 |
| Alkalinity [mg/L as CaCO3] | 208 | 245 | 266 | 205 | 153 | 198 |
| DOC [mg/L] | 3.7 | 2.7 | 1.7 | 3.6 | 1.8 | 3.1 |
| Cl [mg/L] | 2 | 14 | 36 | 2 | < 1 | 2 |
| SO4 [mg/L] | 12 | 39 | 14 | 30 | 25 | 33 |
| NO2 [as N mg/L] | < 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 |
| NO3 [as N mg/L] | 2.48 | 0.08 | < 0.06 | 0.23 | 0.11 | < 0.06 |
| TKN [as N mg/L] | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| NH3+NH4 [as N mg/L] | 0.4 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Ca (diss) [mg/L] | 59.5 | 95.4 | 83.6 | 61.0 | 50.1 | 71.4 |

| **Analysis** | **9:<br>24R** | **10:<br>32R** | **11:<br>21R** | **12:<br>19R** | **13:<br>45** | **14:<br>46** |
|---|---|---|---|---|---|---|
| Mg (diss) [mg/L] | 21.8 | 27.5 | 25.2 | 22.6 | 14.3 | 20.3 |
| Na (diss) [mg/L] | 11.5 | 8.47 | 15.0 | 14.4 | 24.6 | 2.36 |
| K (diss) [mg/L] | 1.18 | 0.920 | 1.63 | 1.44 | 1.05 | 1.02 |
| Hardness [mg/L as CaCO3] | 238 | 351 | 312 | 245 | 184 | 262 |
| B (diss) [mg/L] | 0.043 | 0.043 | 0.066 | 0.050 | 0.118 | 0.015 |
| Cr (diss) [mg/L] | < 0.00008 | 0.00010 | 0.00008 | 0.00017 | 0.00015 | 0.00014 |
| Fe (diss) [mg/L] | 0.567 | 0.747 | 1.08 | < 0.007 | 0.049 | 0.562 |
| Mn (diss) [mg/L] | 0.0168 | 0.0389 | 0.0449 | 0.0002 | 0.0193 | 0.0177 |
| P (diss) [mg/L] | 0.017 | < 0.003 | 0.008 | 0.009 | 0.009 | < 0.003 |
| Vinyl Chloride [µg/L] | --- | < 0.2 | --- | --- | < 0.2 | < 0.4 |
| Benzene [ug/L] | --- | < 0.5 | --- | --- | < 0.5 | < 1 |
| 1,4-Dichlorobenzene [µg/L] | --- | < 0.5 | --- | --- | < 0.5 | < 1 |

| **Analysis** | **15:<br>26R** | **16:<br>GWDUP1** | **17:<br>Trip Blank** |
|---|---|---|---|
| Sample Date & Time | 11-May-21 16:30 | 11-May-21 | 11-May-21 |
| Temp Upon Receipt [@ London Lab °C] | *** | *** | *** |
| Temp Upon Receipt [@ Lakefield Lab °C] | *** | *** | *** |
| pH [No unit] | 8.08 | 8.20 | --- |
| Conductivity [uS/cm] | 1790 | 583 | --- |
| Alkalinity [mg/L as CaCO3] | 601 | 261 | --- |
| DOC [mg/L] | 9.8 | 1.7 | --- |
| Cl [mg/L] | 260 | 36 | --- |
| SO4 [mg/L] | 21 | 14 | --- |
| NO2 [as N mg/L] | < 0.03 | < 0.03 | --- |
| NO3 [as N mg/L] | < 0.06 | < 0.06 | --- |
| TKN [as N mg/L] | 0.6 | < 0.5 | --- |

| **Analysis** | **15:<br>26R** | **16:<br>GWDUP1** | **17:<br>Trip Blank** |
|---|---|---|---|
| NH3+NH4 [as N mg/L] | < 0.1 | 0.1 | --- |
| Ca (diss) [mg/L] | 172 | 85.1 | --- |
| Mg (diss) [mg/L] | 55.4 | 25.2 | --- |
| Na (diss) [mg/L] | 183 | 15.3 | --- |
| K (diss) [mg/L] | 2.95 | 1.64 | --- |
| Hardness [mg/L as CaCO3] | 657 | 316 | --- |
| B (diss) [mg/L] | 1.41 | 0.054 | --- |
| Cr (diss) [mg/L] | 0.00053 | < 0.00008 | --- |
| Fe (diss) [mg/L] | 2.19 | 1.07 | --- |
| Mn (diss) [mg/L] | 0.0450 | 0.0451 | --- |
| P (diss) [mg/L] | 0.024 | 0.008 | --- |
| Vinyl Chloride [µg/L] | < 0.2 | --- | < 0.2 |
| Benzene [ug/L] | < 0.5 | --- | < 0.5 |
| 1,4-Dichlorobenzene [µg/L] | < 0.5 | --- | < 0.5 |

```
Temperature of Sample upon Receipt: 10 degrees C
Cooling Agent Present:Yes
Custody Seal  Present:Yes
```

## Method Descriptions

| Parameter | Description | SGS Method Code |
|---|---|---|
| 1,4-Dichlorobenzene | VOC wtr | ME-CA-[ENV]GC-LAK-AN-004 |
| Alkalinity | Alkalinity by Titration | ME-CA-[ENV]EWL-LAK-AN-006 |
| Ammonia+Ammonium (N) | NH3+NH4 by Skalar - solution | ME-CA-[ENV]SFA-LAK-AN-007 |
| Benzene | VOC wtr - BTEX | ME-CA-[ENV]GC-LAK-AN-004 |
| Boron (dissolved) | B by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Calcium (dissolved) | Ca by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Chloride | Chloride by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Chromium (dissolved) | Cr by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Conductivity | Conductivity by Conductivity Meter | ME-CA-[ENV]EWL-LAK-AN-006 |

| Parameter | Description | SGS Method Code |
|---|---|---|
| Dissolved Organic Carbon | DOC by Combustion/Oxidation | ME-CA-[ENV]EWL-LAK-AN-023 |
| Hardness (dissolved) | Hardness (CaCO3) by ICP-MS dissolved | ME-CA-[ENV]SPE-LAK-AN-003 |
| Iron (dissolved) | Fe by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Magnesium (dissolved) | Mg by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Manganese (dissolved) | Mn by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Nitrate (as N) | Nitrate by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| Nitrite (as N) | Nitrite by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| pH | pH - solution | ME-CA-[ENV]EWL-LAK-AN-006 |
| Phosphorus (dissolved) | P by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Potassium (dissolved) | K by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sodium (dissolved) | Na by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sulphate | Sulphate by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Total Kjeldahl Nitrogen | Tot. kjeldahl Nitrogen by Skalar | ME-CA-[ENV]SFA-LAK-AN-002 |
| Vinyl Chloride | VOC wtr | ME-CA-[ENV]GC-LAK-AN-004 |

Jill Campbell

*Jill Campbell, B.Sc.,GISAS*
*Project Specialist,*
*Environment, Health & Safety*

# Quality Control Report

| **Organic Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Volatile Organics - QCBatchID: GCM0231-MAY21* | | | | | | | | | | | | | |
| 1,4-Dichlorobenzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 110 | 60 | 130 | 107 | 50 | 140 |
| Benzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 107 | 60 | 130 | 112 | 50 | 140 |
| Vinyl Chloride | 0.2 | ug/L | <0.2 | | | ND | 30 | 93 | 60 | 130 | 103 | 50 | 140 |
| *Volatile Organics - QCBatchID: GCM0250-MAY21* | | | | | | | | | | | | | |
| 1,4-Dichlorobenzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 104 | 60 | 130 | 101 | 50 | 140 |
| Benzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 106 | 60 | 130 | 101 | 50 | 140 |
| Vinyl Chloride | 0.2 | ug/L | <0.2 | | | ND | 30 | 105 | 60 | 130 | 101 | 50 | 140 |
| **Inorganic Analysis** | | | | | | | | | | | | | |
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Alkalinity - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| Alkalinity | 2 | mg/L as Ca | 2 | | | 2 | 20 | 100 | 80 | 120 | NA | | |
| *Ammonia by SFA - QCBatchID: SKA0146-MAY21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | ND | 10 | 103 | 90 | 110 | 88 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO5059-MAY21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | 0 | 20 | 96 | 80 | 120 | 89 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 3 | 20 | 93 | 80 | 120 | 87 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO5070-MAY21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | ND | 20 | 98 | 80 | 120 | 100 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 2 | 20 | 106 | 80 | 120 | 94 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0257-MAY21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | ND | 20 | 102 | 80 | 120 | 104 | 75 | 125 |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | ND | 20 | 97 | 80 | 120 | 101 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0262-MAY21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | ND | 20 | 100 | 80 | 120 | 101 | 75 | 125 |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | ND | 20 | 95 | 80 | 120 | 96 | 75 | 125 |
| *Carbon by Combustion/Oxidation - QCBatchID: EWL0254-MAY21* | | | | | | | | | | | | | |
| Dissolved Organic Carbon | 1.0 | mg/L | <1.0 | | | ND | 20 | 101 | 90 | 110 | 104 | 75 | 125 |
| *Carbon by Combustion/Oxidation - QCBatchID: EWL0282-MAY21* | | | | | | | | | | | | | |
| Dissolved Organic Carbon | 1.0 | mg/L | <1.0 | | | 0 | 20 | 99 | 90 | 110 | 100 | 75 | 125 |
| *Conductivity - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| Conductivity | 2 | uS/cm | 2 | | | 1 | 20 | 99 | 90 | 110 | NA | | |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0067-MAY21* | | | | | | | | | | | | | |

**Inorganic Analysis**

| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| Boron (dissolved) | 0.002 | mg/L | <0.002 | | | 0 | 20 | 107 | 90 | 110 | 107 | 70 | 130 |
| Calcium (dissolved) | 0.01 | mg/L | <0.01 | | | 0 | 20 | 101 | 90 | 110 | 102 | 70 | 130 |
| Chromium (dissolved) | 0.00008 | mg/L | <0.00008 | | | 6 | 20 | 105 | 90 | 110 | 106 | 70 | 130 |
| Iron (dissolved) | 0.007 | mg/L | <0.007 | | | 1 | 20 | 99 | 90 | 110 | 100 | 70 | 130 |
| Magnesium (dissolved) | 0.001 | mg/L | <0.001 | | | 1 | 20 | 99 | 90 | 110 | 97 | 70 | 130 |
| Manganese (dissolved) | 0.00001 | mg/L | <0.00001 | | | 3 | 20 | 102 | 90 | 110 | 98 | 70 | 130 |
| Phosphorus (dissolved) | 0.003 | mg/L | <0.003 | | | ND | 20 | 100 | 90 | 110 | NV | 70 | 130 |
| Potassium (dissolved) | 0.009 | mg/L | <0.009 | | | 2 | 20 | 101 | 90 | 110 | 99 | 70 | 130 |
| Sodium (dissolved) | 0.01 | mg/L | <0.01 | | | 0 | 20 | 108 | 90 | 110 | 98 | 70 | 130 |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0068-MAY21* | | | | | | | | | | | | | |
| Boron (dissolved) | 0.002 | mg/L | <0.002 | | | 10 | 20 | 97 | 90 | 110 | 95 | 70 | 130 |
| *pH - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| pH | 0.05 | No unit | NA | | | 0 | | 100 | | | NA | | |
| *Total Nitrogen - QCBatchID: SKA0157-MAY21* | | | | | | | | | | | | | |
| Total Kjeldahl Nitrogen | 0.5 | as N mg/L | <0.5 | | | ND | 10 | 99 | 90 | 110 | 92 | 75 | 125 |

**SGS Canada Inc.**
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**Project :** 111-53037-05, Holbrook GW

28-May-2021

**WSP Canada Inc.**
Attn : Albert Siertsema

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St. Catharines, ON
L2R 3H5, Canada

Phone: 905-687-1771 x 240
Fax:

**Date Rec. :** 13 May 2021
**LR Report:** **CA14891-MAY21**
**Reference:** 111-53037-05-Holbrook Landfill, Albert Siertsema

**Copy:** 1

# CERTIFICATE OF ANALYSIS

## Final Report

| **Analysis** | **1: Analysis Start Date** | **2: Analysis Start Time** | **3: Analysis Completed Date** | **4: Analysis Completed Time** | **5: RL** | **6: 16AR** | **7: 28R** | **8: 25R** | **9: 11R** |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date & Time | | | | | | 12-May-21 10:00 | 12-May-21 11:00 | 12-May-21 13:00 | 12-May-21 12:30 |
| Temp Upon Receipt [@ London Lab °C] | --- | --- | --- | --- | --- | 7.3 | 7.3 | 7.3 | 7.3 |
| Temp Upon Receipt [@ Lakefield Lab °C] | --- | --- | --- | --- | --- | 7.0 | 7.0 | 7.0 | 7.0 |
| pH [No unit] | 15-May-21 | 11:41 | 19-May-21 | 08:34 | 0.05 | 8.15 | 8.00 | 8.32 | 7.98 |
| Conductivity [uS/cm] | 15-May-21 | 11:41 | 19-May-21 | 08:34 | 2 | 619 | 480 | 427 | 1550 |
| Alkalinity [mg/L as CaCO3] | 15-May-21 | 11:41 | 19-May-21 | 08:34 | 2 | 244 | 239 | 206 | 715 |
| DOC [mg/L] | 17-May-21 | 15:41 | 19-May-21 | 07:55 | 1.0 | 1.1 | 2.0 | 2.3 | 16.9 |
| Cl [mg/L] | 27-May-21 | 08:04 | 27-May-21 | 15:40 | 1 | 27 | 3 | 13 | 120 |
| SO4 [mg/L] | 27-May-21 | 08:02 | 27-May-21 | 15:40 | 2 | 86 | 67 | 9 | 4 |
| NO2 [as N mg/L] | 17-May-21 | 21:56 | 20-May-21 | 14:39 | 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 |
| NO3 [as N mg/L] | 17-May-21 | 21:56 | 20-May-21 | 14:39 | 0.06 | 0.09 | < 0.06 | 0.22 | 0.12 |
| NH3+NH4 [as N mg/L] | 14-May-21 | 18:00 | 19-May-21 | 14:57 | 0.1 | < 0.1 | 0.1 | 0.2 | 3.3 |
| TKN [as N mg/L] | 15-May-21 | 14:28 | 19-May-21 | 11:01 | 0.5 | < 0.5 | < 0.5 | < 0.5 | 4.6 |
| Hardness [mg/L as CaCO3] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | | 319 | 232 | 206 | 761 |
| Ca (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | 0.01 | 72.9 | 51.4 | 53.8 | 194 |
| Mg (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | 0.001 | 33.3 | 25.1 | 17.4 | 66.8 |
| Na (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | 0.01 | 24.4 | 22.3 | 13.1 | 54.7 |
| K (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | 0.009 | 1.42 | 1.47 | 1.30 | 3.09 |
| B (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | --- | 0.040 | 0.085 | 0.057 | 0.204 |
| Cr (tot) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | 8e-005 | 0.00013 | 0.00018 | 0.00013 | 0.00042 |

| **Analysis** | **1: Analysis Start Date** | **2: Analysis Start Time** | **3: Analysis Completed Date** | **4: Analysis Completed Time** | **5: RL** | **6: 16AR** | **7: 28R** | **8: 25R** | **9: 11R** |
|---|---|---|---|---|---|---|---|---|---|
| Fe (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | --- | 0.03 | 0.27 | 0.70 | 2.67 |
| Mn (diss) [mg/L] | 17-May-21 | 17:53 | 19-May-21 | 11:47 | --- | 0.024 | 0.019 | 0.026 | 0.059 |
| Vinyl Chloride [µg/L] | 18-May-21 | 09:03 | 20-May-21 | 14:29 | | --- | --- | --- | --- |
| Benzene [ug/L] | 18-May-21 | 09:03 | 20-May-21 | 14:29 | | --- | --- | --- | --- |
| 1,4-Dichlorobenzene [µg/L] | 18-May-21 | 09:03 | 20-May-21 | 14:29 | | --- | --- | --- | --- |

| **Analysis** | **10: 43** | **11: 37R** | **12: 38** | **13: 44** | **14: D-2** | **15: 27** | **16: 41** | **17: GWDUP2** |
|---|---|---|---|---|---|---|---|---|
| Sample Date & Time | 12-May-21 13:30 | 12-May-21 14:30 | 12-May-21 15:00 | 12-May-21 15:20 | 12-May-21 16:00 | 12-May-21 11:30 | 12-May-21 10:30 | 12-May-21 |
| Temp Upon Receipt [@ London Lab °C] | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| Temp Upon Receipt [@ Lakefield Lab °C] | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| pH [No unit] | 8.24 | 8.05 | 8.08 | 7.98 | 8.19 | 8.07 | 7.63 | 8.07 |
| Conductivity [uS/cm] | 394 | 596 | 553 | 667 | 689 | 686 | 2160 | 596 |
| Alkalinity [mg/L as CaCO3] | 172 | 238 | 237 | 229 | 278 | 284 | 1030 | 237 |
| DOC [mg/L] | 1.6 | < 1.0 | 1.3 | 1.2 | 1.2 | 1.2 | 146 | 1.1 |
| Cl [mg/L] | 16 | 35 | 27 | 16 | 37 | 41 | 80 | 35 |
| SO4 [mg/L] | 59 | 41 | 24 | 61 | 35 | 34 | 22 | 41 |
| NO2 [as N mg/L] | 0.08 | < 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 | < 0.03 |
| NO3 [as N mg/L] | 0.20 | < 0.06 | < 0.06 | 15.4 | < 0.06 | < 0.06 | < 0.06 | < 0.06 |
| NH3+NH4 [as N mg/L] | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 99.1 | < 0.1 |
| TKN [as N mg/L] | 0.6 | < 0.5 | < 0.5 | < 0.5 | 0.5 | < 0.5 | 95.8 | < 0.5 |
| Hardness [mg/L as CaCO3] | 110 | 316 | 260 | 342 | 2.2 | 361 | 685 | 324 |
| Ca (diss) [mg/L] | 23.5 | 87.1 | 71.2 | 86.8 | 0.50 | 104 | 199 | 89.3 |
| Mg (diss) [mg/L] | 12.5 | 24.0 | 19.9 | 30.5 | 0.236 | 24.4 | 45.9 | 24.6 |
| Na (diss) [mg/L] | 49.4 | 12.0 | 14.5 | 7.22 | 160 | 15.1 | 63.3 | 12.3 |
| K (diss) [mg/L] | 1.20 | 1.29 | 1.10 | 1.39 | 0.824 | 1.42 | 66.5 | 1.34 |
| B (diss) [mg/L] | 0.162 | 0.056 | 0.068 | 0.032 | 0.051 | 0.084 | 1.90 | 0.050 |
| Cr (tot) [mg/L] | 0.00012 | 0.00009 | < 0.00008 | 0.00040 | 0.00033 | 0.00012 | 0.00306 | 0.00012 |
| Fe (diss) [mg/L] | 0.01 | 0.72 | 0.56 | 0.01 | 0.09 | 0.92 | 60.6 | 0.77 |
| Mn (diss) [mg/L] | < 0.002 | 0.041 | 0.047 | < 0.002 | < 0.002 | 0.062 | 0.391 | 0.042 |
| Vinyl Chloride [µg/L] | < 0.2 | < 0.2 | < 0.2 | < 0.2 | --- | < 0.2 | 0.5 | --- |
| Benzene [ug/L] | < 0.5 | < 0.5 | < 0.5 | < 0.5 | --- | < 0.5 | 18.8 | --- |
| 1,4-Dichlorobenzene [µg/L] | < 0.5 | < 0.5 | < 0.5 | < 0.5 | --- | < 0.5 | 17.9 | --- |

| **Analysis** | **18:<br>Trip Blank** |
|---|---|
| Sample Date & Time | 12-May-21 |
| Temp Upon Receipt [@ London Lab °C] | 7.3 |
| Temp Upon Receipt [@ Lakefield Lab °C] | 7.0 |
| pH [No unit] | --- |
| Conductivity [uS/cm] | --- |
| Alkalinity [mg/L as CaCO3] | --- |
| DOC [mg/L] | --- |
| Cl [mg/L] | --- |
| SO4 [mg/L] | --- |
| NO2 [as N mg/L] | --- |
| NO3 [as N mg/L] | --- |
| NH3+NH4 [as N mg/L] | --- |
| TKN [as N mg/L] | --- |
| Hardness [mg/L as CaCO3] | --- |
| Ca (diss) [mg/L] | --- |
| Mg (diss) [mg/L] | --- |
| Na (diss) [mg/L] | --- |
| K (diss) [mg/L] | --- |
| B (diss) [mg/L] | --- |
| Cr (tot) [mg/L] | --- |
| Fe (diss) [mg/L] | --- |
| Mn (diss) [mg/L] | --- |
| Vinyl Chloride [µg/L] | < 0.2 |
| Benzene [ug/L] | < 0.5 |
| 1,4-Dichlorobenzene [µg/L] | < 0.5 |

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal  Present:Yes

## Method Descriptions

| Parameter | Description | SGS Method Code |
|---|---|---|
| 1,4-Dichlorobenzene | VOC wtr | ME-CA-[ENV]GC-LAK-AN-004 |
| Alkalinity | Alkalinity by Titration | ME-CA-[ENV]EWL-LAK-AN-006 |
| Ammonia+Ammonium (N) | NH3+NH4 by Skalar - solution | ME-CA-[ENV]SFA-LAK-AN-007 |

| Parameter | Description | SGS Method Code |
|---|---|---|
| Benzene | VOC wtr - BTEX | ME-CA-[ENV]GC-LAK-AN-004 |
| Boron (dissolved) | B by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Calcium (dissolved) | Ca by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Chloride | Chloride by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Chromium (total) | Cr by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Conductivity | Conductivity by Conductivity Meter | ME-CA-[ENV]EWL-LAK-AN-006 |
| Dissolved Organic Carbon | DOC by Combustion/Oxidation | ME-CA-[ENV]EWL-LAK-AN-023 |
| Hardness (dissolved) | Hardness (CaCO3) by ICP-MS dissolved | ME-CA-[ENV]SPE-LAK-AN-003 |
| Iron (dissolved) | Fe by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Magnesium (dissolved) | Mg by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Manganese (dissolved) | Mn by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Nitrate (as N) | Nitrate by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| Nitrite (as N) | Nitrite by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| pH | pH - solution | ME-CA-[ENV]EWL-LAK-AN-006 |
| Potassium (dissolved) | K by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sodium (dissolved) | Na by ICP-MS solution (dissolved) | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sulphate | Sulphate by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Total Kjeldahl Nitrogen | Tot. kjeldahl Nitrogen by Skalar | ME-CA-[ENV]SFA-LAK-AN-002 |
| Vinyl Chloride | VOC wtr | ME-CA-[ENV]GC-LAK-AN-004 |

*Brad Moore Hon. B.Sc*
*Project Specialist,*
*Environment, Health & Safety*

# Quality Control Report

| **Organic Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Volatile Organics - QCBatchID: GCM0299-MAY21* | | | | | | | | | | | | | |
| 1,4-Dichlorobenzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 99 | 60 | 130 | 136 | 50 | 140 |
| Benzene | 0.5 | ug/L | <0.5 | | | ND | 30 | 86 | 60 | 130 | 131 | 50 | 140 |
| Vinyl Chloride | 0.2 | ug/L | <0.2 | | | ND | 30 | 64 | 60 | 130 | 119 | 50 | 140 |
| **Inorganic Analysis** | | | | | | | | | | | | | |
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Alkalinity - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| Alkalinity | 2 | mg/L as Ca | 2 | | | 2 | 20 | 100 | 80 | 120 | NA | | |
| *Alkalinity - QCBatchID: EWL0315-MAY21* | | | | | | | | | | | | | |
| Alkalinity | 2 | mg/L as Ca | < 2 | | | 0 | 20 | 104 | 80 | 120 | NA | | |
| *Ammonia by SFA - QCBatchID: SKA0154-MAY21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | ND | 10 | 101 | 90 | 110 | NV | 75 | 125 |
| *Ammonia by SFA - QCBatchID: SKA0183-MAY21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | 1 | 10 | 95 | 90 | 110 | 88 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO5078-MAY21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | 0 | 20 | 101 | 80 | 120 | 83 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 5 | 20 | 104 | 80 | 120 | 94 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0306-MAY21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | ND | 20 | 101 | 80 | 120 | 102 | 75 | 125 |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | ND | 20 | 99 | 80 | 120 | 102 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0307-MAY21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | 3 | 20 | 101 | 80 | 120 | 102 | 75 | 125 |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | ND | 20 | 99 | 80 | 120 | 102 | 75 | 125 |
| *Carbon by Combustion/Oxidation - QCBatchID: EWL0316-MAY21* | | | | | | | | | | | | | |
| Dissolved Organic Carbon | 1.0 | mg/L | <1.0 | | | 0 | 20 | 100 | 90 | 110 | 100 | 75 | 125 |
| *Conductivity - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| Conductivity | 2 | uS/cm | 2 | | | 1 | 20 | 99 | 90 | 110 | NA | | |
| *Conductivity - QCBatchID: EWL0315-MAY21* | | | | | | | | | | | | | |
| Conductivity | 2 | uS/cm | < 2 | | | 0 | 20 | 99 | 90 | 110 | NA | | |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0074-MAY21* | | | | | | | | | | | | | |
| Boron (dissolved) | 0.002 | mg/L | <0.002 | | | 4 | 20 | 97 | 90 | 110 | 95 | 70 | 130 |
| Calcium (dissolved) | 0.01 | mg/L | <0.01 | | | 3 | 20 | 98 | 90 | 110 | 100 | 70 | 130 |
| Chromium (total) | 0.00008 | mg/L | <0.00008 | | | 7 | 20 | 97 | 90 | 110 | 87 | 70 | 130 |

OnLine LIMS

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**Inorganic Analysis**

| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| Iron (dissolved) | 0.01 | mg/L | <0.007 | | | 3 | 20 | 96 | 90 | 110 | 125 | 70 | 130 |
| Magnesium (dissolved) | 0.001 | mg/L | <0.001 | | | 3 | 20 | 95 | 90 | 110 | 95 | 70 | 130 |
| Manganese (dissolved) | 0.002 | mg/L | <0.00001 | | | 2 | 20 | 105 | 90 | 110 | 97 | 70 | 130 |
| Potassium (dissolved) | 0.009 | mg/L | <0.009 | | | 2 | 20 | 97 | 90 | 110 | 85 | 70 | 130 |
| Sodium (dissolved) | 0.01 | mg/L | <0.01 | | | 3 | 20 | 101 | 90 | 110 | 90 | 70 | 130 |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0087-MAY21* | | | | | | | | | | | | | |
| Boron (dissolved) | 0.002 | mg/L | <0.002 | | | 11 | 20 | 99 | 90 | 110 | 105 | 70 | 130 |
| *pH - QCBatchID: EWL0299-MAY21* | | | | | | | | | | | | | |
| pH | 0.05 | No unit | NA | | | 0 | | 100 | | | NA | | |
| *pH - QCBatchID: EWL0315-MAY21* | | | | | | | | | | | | | |
| pH | 0.05 | No unit | NA | | | 2 | | 101 | | | NA | | |
| *Total Nitrogen - QCBatchID: SKA0157-MAY21* | | | | | | | | | | | | | |
| Total Kjeldahl Nitrogen | 0.5 | as N mg/L | <0.5 | | | ND | 10 | 99 | 90 | 110 | 92 | 75 | 125 |
| *Total Nitrogen - QCBatchID: SKA0178-MAY21* | | | | | | | | | | | | | |
| Total Kjeldahl Nitrogen | 0.5 | as N mg/L | <0.5 | | | ND | 10 | 103 | 90 | 110 | 121 | 75 | 125 |
| *Total Nitrogen - QCBatchID: SKA1000-MAY21* | | | | | | | | | | | | | |
| Total Kjeldahl Nitrogen | 0.5 | as N mg/L | <0.5 | | | 8 | 10 | 98 | 90 | 110 | 108 | 75 | 125 |

OnLine LIMS

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Test method information available upon request. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.
SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

**SGS Canada Inc.**
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Phone: 705-652-2000 FAX: 705-652-6365

**Project :** 111-53037-05, SW

15-October-2021

**WSP Canada Inc.**
Attn : Albert Siertsema

55 King Street, Suite 700
St. Catharines, ON
L2R 3H5, Canada

Phone: 905-687-1771 x 240
Fax:

**Date Rec. :** 08 October 2021
**LR Report:** **CA40084-OCT21**
**Reference:** 111-53037-05, Albert Siertsema

**Copy:** 1

# CERTIFICATE OF ANALYSIS

## Final Report

| **Analysis** | **1: Analysis Start Date** | **2: Analysis Start Time** | **3: Analysis Completed Date** | **4: Analysis Completed Time** | **5: Client Reporting Limits** | **6: RL** | **7: PWQO Limits** |
|---|---|---|---|---|---|---|---|
| Sample Date & Time | | | | | | | |
| Temp Upon Receipt [°C] | --- | --- | --- | --- | --- | --- | --- |
| pH [No unit] | 14-Oct-21 | 12:45 | 15-Oct-21 | 14:10 | | 0.05 | 6.5-8.5 |
| Conductivity [uS/cm] | 14-Oct-21 | 12:45 | 15-Oct-21 | 14:10 | | 2 | |
| Alkalinity [mg/L as CaCO3] | 14-Oct-21 | 12:45 | 15-Oct-21 | 14:10 | | 2 | |
| Cl [mg/L] | 13-Oct-21 | 15:54 | 15-Oct-21 | 06:24 | | 1 | |
| SO4 [mg/L] | 13-Oct-21 | 16:28 | 15-Oct-21 | 06:24 | | 2 | |
| NO3 [as N mg/L] | 12-Oct-21 | 16:01 | 14-Oct-21 | 07:19 | | 0.06 | |
| NO2 [as N mg/L] | 12-Oct-21 | 16:01 | 14-Oct-21 | 07:19 | | 0.03 | |
| NH3+NH4 [as N mg/L] | 13-Oct-21 | 07:26 | 14-Oct-21 | 09:43 | | 0.1 | |
| Ca (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | --- | |
| Mg (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | --- | |
| Na (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | --- | |
| K (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | --- | |
| Hardness [mg/L as CaCO3] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | --- | |
| B (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:37 | | 0.002 | |
| Cr (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:38 | | 0.00008 | |
| Fe (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:38 | | --- | 0.3 |
| Mn (tot) [mg/L] | 14-Oct-21 | 14:41 | 15-Oct-21 | 13:38 | | 0.00001 | |

| **Analysis** | **8: C01** | **9: C06** | **10: SWDUP** |
|---|---|---|---|
| Sample Date & Time | 07-Oct-21 11:00 | 07-Oct-21 10:00 | 07-Oct-21 |
| Temp Upon Receipt [°C] | 5.0 | 5.0 | 5.0 |

| **Analysis** | **8:<br>C01** | **9:<br>C06** | **10:<br>SWDUP** |
|---|---|---|---|
| pH [No unit] | 7.96 | 8.05 | 8.16 |
| Conductivity [uS/cm] | 728 | 754 | 716 |
| Alkalinity [mg/L as CaCO3] | 300 | 342 | 299 |
| Cl [mg/L] | 52 | 41 | 52 |
| SO4 [mg/L] | 12 | < 2 | 11 |
| NO3 [as N mg/L] | 0.35 | 0.76 | 0.35 |
| NO2 [as N mg/L] | 0.03 | < 0.03 | 0.04 |
| NH3+NH4 [as N mg/L] | 0.5 | < 0.1 | 0.5 |
| Ca (tot) [mg/L] | 89.1 | 122 | 91.3 |
| Mg (tot) [mg/L] | 24.1 | 18.8 | 24.9 |
| Na (tot) [mg/L] | 29.2 | 22.6 | 29.9 |
| K (tot) [mg/L] | 7.93 | 2.19 | 7.98 |
| Hardness [mg/L as CaCO3] | 322 | 382 | 330 |
| B (tot) [mg/L] | 0.301 | 0.034 | 0.316 |
| Cr (tot) [mg/L] | 0.00022 | 0.00072 | 0.00022 |
| Fe (tot) [mg/L] | 0.58 | 0.60 | 0.57 |
| Mn (tot) [mg/L] | 0.511 | 0.243 | 0.494 |

PWQO - Provincial Water Quality Objectives
Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999
a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.
b PWQO limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQO = 1100 ug/L)
c PWQO limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQO = 0.5 ug/L)
d PWQO limit based on Cr VI (PWQO limit for Cr III = 8.9 ug/L)
e PWQO limit based on Hardness 0-20 (For Hardness >20 mg/L PWQO = 5 ug/L)
f PWQO limit based on Hardness <30 (For Hardness 30-80 PWQO = 3 ug/L, & >80 PWQO=5)

Temperature of Sample upon Receipt: 5 degrees C
Cooling Agent Present:Yes
Custody Seal Present:yes

Chain of Custody Number:NA

## Method Descriptions

| **Parameter** | **Description** | **SGS Method Code** |
|---|---|---|
| Alkalinity | Alkalinity by Titration | ME-CA-[ENV]EWL-LAK-AN-006 |
| Ammonia+Ammonium (N) | NH3+NH4 by Skalar - solution | ME-CA-[ENV]SFA-LAK-AN-007 |
| Boron (total) | B by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Calcium (total) | Ca by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Chloride | Chloride by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |
| Chromium (total) | Cr by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Conductivity | Conductivity by Conductivity Meter | ME-CA-[ENV]EWL-LAK-AN-006 |
| Hardness | Hardness (CaCO3) by ICP | ME-CA-[ENV]SPE-LAK-AN-003 |
| Iron (total) | Fe by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Magnesium (total) | Mg by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |

| Parameter | Description | SGS Method Code |
|---|---|---|
| Manganese (total) | Mn by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Nitrate (as N) | Nitrate by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| Nitrite (as N) | Nitrite by Ion Chromatography | ME-CA-[ENV]IC-LAK-AN-001 |
| pH | pH - solution | ME-CA-[ENV]EWL-LAK-AN-006 |
| Potassium (total) | K by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sodium (total) | Na by ICP-MS solution | ME-CA-[ENV]SPE-LAK-AN-006 |
| Sulphate | Sulphate by discrete colourmetric analysis | ME-CA-[ENV]EWL-LAK-AN-026 |

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*Project Specialist,*
*Environment, Health & Safety*

# Quality Control Report

| **Inorganic Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Reporting Limit | Unit | Method Blank | Duplicate | | | | LCS / Spike Blank | | | Matrix Spike / Reference Material | | |
| | | | | Result 1 | Result 2 | RPD | Acceptance Criteria | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | % | | Low | High | | Low | High |
| *Alkalinity - QCBatchID: EWL0294-OCT21* | | | | | | | | | | | | | |
| Alkalinity | 2 | mg/L as Ca | < 2 | | | 3 | 20 | 100 | 80 | 120 | NA | | |
| *Ammonia by SFA - QCBatchID: SKA0136-OCT21* | | | | | | | | | | | | | |
| Ammonia+Ammonium (N) | 0.1 | as N mg/L | <0.1 | | | ND | 10 | 97 | 90 | 110 | 100 | 75 | 125 |
| *Anions by discrete analyzer - QCBatchID: DIO5039-OCT21* | | | | | | | | | | | | | |
| Chloride | 1 | mg/L | <1 | | | ND | 20 | 101 | 80 | 120 | 109 | 75 | 125 |
| Sulphate | 2 | mg/L | <2 | | | 7 | 20 | 99 | 80 | 120 | 93 | 75 | 125 |
| *Anions by IC - QCBatchID: DIO0217-OCT21* | | | | | | | | | | | | | |
| Nitrate (as N) | 0.06 | mg/L | <0.06 | | | 1 | 20 | 102 | 90 | 110 | 100 | 75 | 125 |
| Nitrite (as N) | 0.03 | mg/L | <0.03 | | | 8 | 20 | 100 | 90 | 110 | 99 | 75 | 125 |
| *Conductivity - QCBatchID: EWL0294-OCT21* | | | | | | | | | | | | | |
| Conductivity | 2 | uS/cm | < 2 | | | 1 | 20 | 99 | 90 | 110 | NA | | |
| *Metals in aqueous samples - ICP-MS - QCBatchID: EMS0080-OCT21* | | | | | | | | | | | | | |
| Boron (total) | 0.002 | mg/L | <0.002 | | | 5 | 20 | 100 | 90 | 110 | 103 | 70 | 130 |
| Calcium (total) | 0.01 | mg/L | <0.01 | | | 4 | 20 | 99 | 90 | 110 | 102 | 70 | 130 |
| Chromium (total) | 0.00008 | mg/L | <0.00008 | | | 9 | 20 | 95 | 90 | 110 | 109 | 70 | 130 |
| Iron (total) | 0.01 | mg/L | <0.007 | | | 5 | 20 | 99 | 90 | 110 | NV | 70 | 130 |
| Magnesium (total) | 0.001 | mg/L | <0.001 | | | 2 | 20 | 99 | 90 | 110 | 99 | 70 | 130 |
| Manganese (total) | 0.00001 | mg/L | <0.00001 | | | 3 | 20 | 98 | 90 | 110 | 108 | 70 | 130 |
| Potassium (total) | 0.009 | mg/L | <0.009 | | | 4 | 20 | 103 | 90 | 110 | 105 | 70 | 130 |
| Sodium (total) | 0.01 | mg/L | <0.01 | | | 3 | 20 | 95 | 90 | 110 | 100 | 70 | 130 |
| *pH - QCBatchID: EWL0294-OCT21* | | | | | | | | | | | | | |
| pH | 0.05 | No unit | NA | | | 0 | | 100 | | | NA | | |

# APPENDIX

# G

## MONITORING AND SCREENING CHECKLIST

# Appendix D-Monitoring and Screening Checklist
# General Information and Instructions

**General Information: The checklist is to be completed, and submitted with the Monitoring Report.**
**Instructions:** A complete checklist consists of:
(a) a completed and signed checklist, including any additional pages of information which can be attached as needed to provide further details where indicated.
(b) completed contact information for the Competent Environmental Practitioner (CEP)
(c) self-declaration that CEP(s) meet(s) the qualifications as set out below and in Section 1.2 of the Technical Guidance Document.

**Definition of Groundwater CEP:**
For groundwater, the CEP must have expertise in hydrogeology and meet one of the following:
(a) the person holds a licence, limited licence or temporary licence under the *Professional Engineers Act*; or
(b) the person holds a certificate of registration under the *Professional Geoscientists Act, 2000* and is a practicing member, temporary, member or limited member of the Association of Professional Geoscientists of Ontario. O. Reg. 66/08, s. 2..
**Definition of Surface water CEP:**
A CEP for surface water assessments is a scientist, professional engineer or professional geoscientist as described in (a) and (b) above with demonstrated experience and post-secondary education, either a diploma or degree, in hydrology, aquatic ecology, limnology, aquatic biology, physical geography with specialization in surface water, and/or water resource management.

The type of scientific work that a CEP performs must be consistent with that person's education and experience. If an individual has appropriate training and credentials in both groundwater and surface water and is responsible for both areas of expertise, the CEP may then complete and validate both sections of the checklist.

## Monitoring Report and Site Information

| | |
|---|---|
| **Waste Disposal Site (WDS) Name** | Holbrook Landfill Site |
| **Location (e.g. street address, lot, concession)** | Part of Lots 20 and 21, Concession III, Township of Norwich |
| **GPS Location (taken within the property boundary at front gate/ front entry)** | NAD 83, Zone 17, N 4759736 E 525949 |
| **Municipality** | Township of Norwich |
| **Client and/or Site Owner** | County of Oxford |
| **Monitoring Period (Year)** | 2021 |
| This Monitoring Report is being submitted under the following: | |
| **Environmental Compliance Approval (ECA) Number (formerly "Certificate of Approval" (C of A)) :** | Amended ECA No. A070702 - dated September 8, 2016<br>Notice No. 1 - dated March 6, 2018 |
| **Director's Order No.:** | |
| **Provincial Officer's Order No.:** | |

| | | | |
|---|---|---|---|
| **Other:** | | | |
| **Report Submission Frequency** | ● **Annual**<br>○ **Other** | | |
| **The site is:**<br>**(Operation Status)** | ○ **Open**<br>○ **Inactive**<br>● **Closed** | | |
| **Is there an active waste transfer station at the site?** | ○ **Yes**<br>● **No** | | |
| **Does this WDS have a Closure Plan?** | ○ **Not yet submitted**<br>○ **Submitted and under review**<br>● **Submitted and approved** | | |
| **Total Approved Capacity** | | *Units* | Tonnes |
| **Maximum Approved Fill Rate** | | *Units* | |
| **Total Waste Received within Monitoring Period (Year)** | | *Units* | Tonnes |
| **Total Waste Received within Monitoring Period (Year)** *Describe the methodology used to determine this quantity* | | | |
| **Estimated Remaining Capacity** | | *Units* | Cubic Metres |
| **Estimated Remaining Capacity** *Describe the methodology used to determine this quantity* | | | |
| **Estimated Remaining Capacity** *Date Last Determined* | | | |
| **Non-Hazardous Approved Waste Types** | ☐ Domestic<br>☐ Industrial, Commercial & Institutional (IC&I)<br>☐ Source Separated Organics (Green Bin)<br>☐ Tires | ☐ Contaminated Soil<br>☐ Wood Waste<br>☐ Blue Box Material<br>☐ Processed Organics<br>☐ Leaf and Yard Waste | ☐ Food Processing/Preparation Operations Waste<br>☐ Hauled Sewage<br>Other: |
| **Subject Waste Approved Waste Classes: Hazardous & Liquid Industrial** *(separate waste classes by comma)* | | | |

| | | | |
|---|---|---|---|
| **Year Site Opened**<br>*(enter the Calendar Year only)* | 1970 | **Current**<br>**ECA Issue Date** | 9/8/2016 |

| | |
|---|---|
| **Is your Site required to submit Financial Assurance?** | ○ **Yes**<br>● **No** |
| **Describe how your WDS is designed.** | ● Natural Attenuation only ○ Fully engineered Facility<br>○ Partially engineered Facility |
| **Does your Site have an approved Contaminant Attenuation Zone?** | ● **Yes**<br>○ **No** |
| **If closed, specify ECA, control or authorizing document closure date:** | Select Date |
| **Has the nature of the operations at the site changed during this monitoring period?** | ○ **Yes**<br>● **No** |
| **If yes, provide details:** | |

|  |  |
|---|---|
| **Have any measurements been taken since the last reporting period that indicate landfill gas volumes have exceeded the MOE limits for subsurface or adjacent buildings? (i.e. exceeded the LEL for methane)** | ○ Yes<br>● No |

## Groundwater WDS Verification:

**Based on all available information about the site and site knowledge, it is my opinion that:**

## Sampling and Monitoring Program Status:

|  |  |  |
|---|---|---|
| **1) The monitoring program continues to effectively characterize site conditions and any groundwater discharges from the site. All monitoring wells are confirmed to be in good condition and are secure:** | ● **Yes**<br>○ **No** |  |
| **2) All groundwater, leachate and landfill gas sampling and monitoring for the monitoring period being reported on was successfully completed as required by ECA or other relevant authorizing/ control document(s):** | ● **Yes**<br>○ **No**<br>○ **Not Applicable** | If no, list exceptions below or attach information. |

| **Groundwater Sampling Location** | **Description/Explanation for change (change in name or location, additions, deletions)** | **Date** |
|---|---|---|
| All groundwater sampling and monitoring was successfully completed as required. |  |  |
|  |  |  |

| | | |
|---|---|---|
| | | |
| | | |

| | |
|---|---|
| **3) a) Some or all groundwater, leachate and landfill gas sampling and monitoring requirements have been established or defined outside of a ministry ECA, authorizing, or control document.** | ○ **Yes**<br>● **No**<br>○ **Not Applicable** |

| | | |
|---|---|---|
| **b) If yes, the sampling and monitoring identified under 3(a) for the monitoring period being reported on was successfully completed in accordance with established protocols, frequencies, locations, and parameters developed as per the Technical Guidance Document:** | ○ **Yes**<br>○ **No**<br>● **Not Applicable** | If no, list exceptions below or attach additional information. |

| **Groundwater Sampling Location** | **Description/Explanation for change (change in name or location, additions, deletions)** | **Date** |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| | | |
|---|---|---|
| **4) All field work for groundwater investigations was done in accordance with Standard Operating Procedures (SOP) as established/outlined per the Technical Guidance Document (including internal/external QA/QC requirements) (Note: A SOP can be from a published source, developed internally by the site owner's consultant, or adopted by the consultant from another organization):** | ● **Yes**<br>○ **No** | Field work for groundwater monitoring was completed in accordance with standard operating procedures. The field QA/QC program included blind duplicate field duplicates; however, travel spiked blanks were not part of the field QA/QC program.<br>The laboratory QA/QC control program was extensive and included method blanks, duplicates, spiked blanks, matrix spikes, and surrogate recovery. |
| **Sampling and Monitoring Program Results/WDS Conditions and Assessment:** | | |
| **5) The site has an adequate buffer, Contaminant Attenuation Zone (CAZ) and/or contingency plan in place. Design and operational measures, including the size and configuration of any CAZ, are adequate to prevent potential human health impacts and impairment of the environment.** | ● **Yes**<br>○ **No** | |
| **6) The site meets compliance and assessment criteria.** | ○ **Yes**<br>● **No** | Please see Sections 4.2.4, 4.2.5, and 4.2.6 of the 2021 Water Monitoring Report. |
| **7) The site continues to perform as anticipated. There have been no unusual trends/changes in measured leachate and groundwater levels or concentrations.** | ● **Yes**<br>○ **No** | |

|  |  |  |  |
|---|---|---|---|
| **1) Is one or more of the following risk reduction practices in place at the site:**<br>**(a) There is minimal reliance on natural attenuation of leachate due to the presence of an effective waste liner and active leachate collection/ treatment; or**<br>**(b) There is a predictive monitoring program in-place (modeled indicator concentrations projected over time for key locations); or**<br>**(c) The site meets the following two conditions (typically achieved after 15 years or longer of site operation):**<br>***i.*The site has developed stable leachate mound(s) and stable leachate plume geometry/ concentrations; and**<br>***ii.*Seasonal and annual water levels and water quality fluctuations are well understood.** | ● **Yes**<br>○ **No** | **Note which practice(s):** | ☐ **(a)**<br>☐ **(b)**<br>☒ **(c)** |
| **9) Have trigger values for contingency plans or site remedial actions been exceeded (where they exist):** | ● **Yes**<br>○ **No**<br>○ **Not Applicable** | Please see Section 4.2.6 of the 2021 Water Monitoring Report. |  |

## Groundwater CEP Declaration:

**I am a licensed professional Engineer or a registered professional geoscientist in Ontario with expertise in hydrogeology, as defined in Appendix D under Instructions. Where additional expertise was needed to evaluate the site monitoring data, I have relied on individuals who I believe to be experts in the relevant discipline, who have co-signed the compliance monitoring report or monitoring program status report, and who have provided evidence to me of their credentials.**

**I have examined the applicable Environmental Compliance Approval and any other environmental authorizing or control documents that apply to the site. I have read and followed the Monitoring and Reporting for Waste Disposal Sites Groundwater and Surface Water Technical Guidance Document (MOE, 2010, or as amended), and associated monitoring and sampling guidance documents, as amended from time to time. I have reviewed all of the data collected for the above-referenced site for the monitoring period(s) identified in this checklist. Except as otherwise agreed with the ministry for certain parameters, all of the analytical work has been undertaken by a laboratory which is accredited for the parameters analysed to *ISO/IEC 17025:2005 (E)- General requirements for the competence of testing and calibration laboratories,* or as amended from time to time by the ministry.**

**If any exceptions or potential concerns have been noted in the questions in the checklist attached to this declaration, it is my opinion that these exceptions and concerns are minor in nature and will be rectified for the next monitoring/reporting period. Where this is not the case, the circumstances concerning the exception or potential concern and my client's proposed action have been documented in writing to the Ministry of the Environment District Manager in a letter from me dated:**

## Recommendations:

**Based on my technical review of the monitoring results for the waste disposal site:**

| | |
|---|---|
| ● **No changes to the monitoring program are recommended**<br>○ **The following change(s) to the monitoring program is/are recommended:** | |
| ● **No Changes to site design and operation are recommended**<br>○ **The following change(s) to the site design and operation is/are recommended:** | |
| **Name:** | Albert Siertsema |
| **Seal:** | Add Image<br>LICENSED PROFESSIONAL ENGINEER<br>Feb 3, 2022<br>A. M. SIERTSEMA<br>100168317<br>PROVINCE OF ONTARIO |

| | | | |
|---|---|---|---|
| **Signature:** | | **Date:** | 3-Feb-2022 |
| **CEP Contact Information:** | Albert Siertsema | | |
| **Company:** | WSP Canada Inc. | | |
| **Address:** | 1821 Provincial Rd, Suite 100, Windsor, ON  N8W 5V7 | | |
| **Telephone No.:** | 519-383-0366 | Fax No. : | |
| **E-mail Address:** | albert.siertsema@wsp.com | | |
| **Co-signers for additional expertise provided:** | | | |
| **Signature:** | | **Date:** | |
| **Signature:** | | **Date:** | |

## Surface Water WDS Verification:

**Provide the name of surface water body/bodies potentially receiving the WDS effluent and the approximate distance to the waterbody (including the nearest surface water body/bodies to the site):**

| | |
|---|---|
| **Name (s)** | Branch Creek |

| | |
|---|---|
| **Distance(s)** | Crosses Site, +/- 150 m from the fill area |

**Based on all available information and site knowledge, it is my opinion that:**

## Sampling and Monitoring Program Status:

| | | |
|---|---|---|
| **1) The current surface water monitoring program continues to effectively characterize the surface water conditions, and includes data that relates upstream/background and downstream receiving water conditions:** | ● **Yes**<br>○ **No** | If no, identify issues (Type Here): |
| **2) All surface water sampling for the monitoring period being reported was successfully completed in accordance with the ECA or relevant authorizing/control document(s) (if applicable):** | ● **Yes**<br>○ **No**<br>○ **Not applicable** | If no, specify below or provide details in an attachment. |

| **Surface Water Sampling Location** | **Description/Explanation for change (change in name or location, additions, deletions)** | **Date** |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| | | |
|---|---|---|
| **3) a) Some or all surface water sampling and monitoring program requirements for the monitoring period have been established outside of a ministry ECA or authorizing/control document.** | ○ **Yes**<br>● **No**<br>○ **Not Applicable** | |
| **b) If yes, all surface water sampling and monitoring identified under 3 (a) was successfully completed in accordance with the established program from the site, including sampling protocols, frequencies, locations and parameters) as developed per the Technical Guidance Document:** | ○ **Yes**<br>○ **No**<br>● **Not Applicable** | If no, specify below or provide details in an attachment. |

| Surface Water Sampling Location | Description/Explanation for change (change in name or location, additions, deletions) | Date |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| | | |
|---|---|---|
| **4) All field work for surface water investigations was done in accordance with SOP, including internal/external QA/QC requirements, as established/outlined as per the Technical Guidance Document, MOE 2010, or as amended. (Note: A SOP can be from a published source, developed internally by the site owner's consultant, or adopted by the consultant from another organization):** | ● **Yes**<br>○ **No** | Field work for groundwater monitoring was completed in accordance with standard operating procedures. The field QA/QC program included blind duplicate field duplicates; however, travel spiked blanks were not part of the field QA/QC program.<br>The laboratory QA/QC control program was extensive and included method blanks, duplicates, spiked blanks, matrix spikes, and surrogate recovery. |

## Sampling and Monitoring Program Results/WDS Conditions and Assessment:

| | |
|---|---|
| **5) The receiving water body meets surface water-related compliance criteria and assessment criteria: i.e., there are no exceedances of criteria, based on MOE legislation, regulations, Water Management Policies, Guidelines and Provincial Water Quality Objectives and other assessment criteria (e.g., CWQGs, APVs), as noted in Table A or Table B in the Technical Guidance Document (Section 4.6):** | ○ **Yes**<br>● **No** |

**If no, list parameters that exceed criteria outlined above and the amount/percentage of the exceedance as per the table on the following page or provide details in an attachment:**

| Parameter | Compliance or Assessment Criteria or Background | Amount by which Compliance or Assessment Criteria or Background Exceeded |
|---|---|---|
| e.g. Nickel | e.g. ECA limit, PWQO, background | e.g. X% above PWQO |
| Please refer to Section 5.0 of the 2021 Water Monitoring Report | | |
| | | |
| | | |
| | | |
| **6) In my opinion, any exceedances listed in Question 5 are the result of non-WDS related influences (such as background, road salting, sampling site conditions)?** | ○ **Yes**<br>● **No** | Weak landfill influences are likely observed in the surface water quality in retention pond P02, and in the on-site stream at intermediate station C04. The retention pond and the on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. At station C01, which monitors surface water quality leaving the site, landfill influences from upstream portions of the on-site stream, shallow groundwater discharge, and possibly road salting practices have likely affected the surface water quality at the station. |

| | | |
|---|---|---|
| **7) All monitoring program surface water parameter concentrations fall within a stable or decreasing trend. The site is not characterized by historical ranges of concentrations above assessment and compliance criteria.** | ● **Yes**<br>○ **No** | |
| **8) For the monitoring program parameters, does the water quality in the groundwater zones adjacent to surface water receivers exceed assessment or compliance criteria (e.g. , PWQOs, CWQGs, or toxicity values for aquatic biota (APVs)):** | ● Yes<br>○ No<br>○ Not Known<br>○ Not Applicable | The retention pond and on-site stream are inferred to receive shallow groundwater flow from beneath the landfill. As such, weak leachate impacts are observed in the on-site stream. |
| **9) Have trigger values for contingency plans or site remedial actions been exceeded (where they exist):** | ○ **Yes**<br>● **No**<br>○ **Not Applicable** | |

## Surface Water CEP Declaration:

**I, the undersigned hereby declare that I am a Competent Environmental Practitioner as defined in Appendix D under Instructions, holding the necessary level of experience and education to design surface water monitoring and sampling programs, conduct appropriate surface water investigations and interpret the related data as it pertains to the site for this monitoring period.**

**I have examined the applicable Environmental Compliance Approval and any other environmental authorizing or control documents that apply to the site. I have read and followed the Monitoring and Reporting for Waste Disposal Sites Groundwater and Surface Water Technical Guidance Document (MOE, 2010, or as amended) and associated monitoring and sampling guidance documents, as amended from time to time. I have reviewed all of the data collected for the above-referenced site for the monitoring period(s) identified in this checklist. Except as otherwise agreed with the ministry for certain parameters, all of the analytical work has been undertaken by a laboratory which is accredited for the parameters analysed to *ISO/IEC 17025:2005 (E)- General requirements for the competence of testing and calibration laboratories,* or as amended from time to time by the ministry.**

**If any exceptions or potential concerns have been noted in the questions in the checklist attached to this declaration, it is my opinion that these exceptions and concerns are minor in nature or will be rectified for future monitoring events. Where this is not the case, the circumstances concerning the exception or potential concern and my client's proposed action have been documented in writing to the Ministry of the Environment District Manager in a letter from me dated:**

## Recommendations:

**Based on my technical review of the monitoring results for the waste disposal site:**

| | |
|---|---|
| ● **No Changes to the monitoring program are recommended**<br>○ **The following change(s) to the monitoring program is/are recommended:** | |
| ● **No changes to the site design and operation are recommended**<br>○ **The following change(s) to the site design and operation is/are recommended:** | |

| | | |
|---|---|---|
| **CEP Signature** | | |
| **Relevant Discipline** | Geological Engineer | |
| **Date:** | 3-Feb-2022 | |
| **CEP Contact Information:** | Albert Siertsema | |
| **Company:** | WSP Canada Inc. | |
| **Address:** | 1821 Provincial Rd, Suite 100, Windsor, ON  N8W 5V7 | |
| **Telephone No.:** | 519-383-0366 | |
| **Fax No. :** | | |
| **E-mail Address:** | albert.siertsema@wsp.com | |
| **Save As** | | **Print Form** |