Golder Associates Ltd.

32 Steacie Drive
Kanata, Ontario, Canada K2K 2A9
Telephone 613-592-9600
Fax 613-592-9601

REPORT ON

2005 HYDROGEOLOGICAL INVESTIGATION AND GROUNDWATER AND SURFACE WATER MONITORING PROGRAM ST. ALBERT LANDFILL NATION MUNCIPALITY ONTARIO

Submitted to:

Corporation of the Nation Municipality
958 Road 500 West
R.R. 3
Casselman, Ontario
K0A 1M0

Attention: Mrs. Mary McCuaig, A.M.C.T.

DISTRIBUTION:

7 copies - Corporation of the Nation Municipality
2 copies - Golder Associates Ltd.

March 2006

05-1120-760

EXECUTIVE SUMMARY

The St. Albert Waste Disposal Site is located on part of Lot 21, Concession 8 of the former Township of Cambridge, approximately 2.3 kilometres northwest of the Village of St. Albert. The site is licensed under Provisional Certificate of Approval (C of A) A471103 with an approved waste footprint of 2.2 ha within a total site area of 4 ha. Waste disposal activities ceased at the site in 1999 because the site had reached capacity. Closure related works were conducted by Nation Municipality in 2000 during which the wastes were re-shaped and covered with a final soil cover and the ground surface re-vegetated.

Field investigation activities included borehole drilling, monitoring well installation, hydraulic conductivity rising head tests, water level measurements, sampling of groundwater monitors and sampling of surface water locations.

Horizontal hydraulic conductivities range from 3.7×10^{-5} centimetres per second (cm/s) in the weathered crust to 9.4×10^{-7} cm/s in a groundwater monitor which is partially screened in the weathered crust and silty clay. These values are considered a representative range of what would be expected for the overburden sand deposit in the area of the site.

Groundwater flow at the site is east to south-east (towards Whissel Creek). As such, landfill leachate related impacts are also migrating at a slow rate within the shallow subsurface and towards Whissel Creek. There are no groundwater users between the landfill site and Whissel Creek and thus there is no potential for leachate related impacts to affect local water supply wells. Therefore, it is concluded that the site is in compliance with Guideline B-9.

Based on the available surface water quality analytical results, it is concluded that the site is in compliance and that the landfill site is not adversely impacting off-site surface water quality.

The Executive Summary highlights only key points from this report. For complete information and findings, as well as the limitations provided in Section 11.0, it is necessary for the reader to examine the complete report.

TABLE OF CONTENTS

In Order Following Page 22

LIST OF TABLES

LISTOF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the results of the 2005 hydrogeological investigation conducted by Golder Associates Ltd. (Golder Associates) at the closed St. Albert waste disposal site (site), Nation Municipality, Ontario (see Figure 1).

The St. Albert waste disposal site is located on part of Lot 21, Concession 8 of the former Township of Cambridge, approximately 2.3 kilometres northwest of the Village of St. Albert. The site is licensed under Provisional Certificate of Approval (C of A) A471103 with an approved waste footprint of 2.2 ha within a total site area of 4 ha. Waste disposal activities ceased at the site in 1999. Closure related works were conducted by Nation Municipality in 2000 during which the wastes were re-shaped and covered with a final soil cover and the ground surface re-vegetated.

A Draft Closure Plan (Stantec, 1999) for the site was prepared by Stantec Consulting Ltd. (Stantec) in April 1999. However, this Draft Closure Plan did not receive final approval by the Ministry of the Environment (MOE), mainly because it did not include a post-closure groundwater and surface water monitoring program.

In February 2005, the MOE completed a Closed Waste Disposal Site Inspection Report (MOE, 2005) for the site. In Section 5.0 of their report, MOE noted that "there [was] an immediate need to assess possible groundwater and surface water impacts to vicinity off property receptors". Also, it was observed that most surface water run off from the St. Albert landfill flowed towards a tributary (Whissel Creek) to the Nation River located approximately 30 metres southeast of the waste disposal area. As such, it was suggested that there may be impacts to surface water quality in the creek related to landfill leachate, and the initiation of a surface water monitoring program was recommended to verify the presence of such impacts. MOE concluded that the assessment of site compliance for off-site impacts derived from the findings of the groundwater and surface water monitoring program to be conducted at the site could be incorporated into a final closure plan for review and incorporation into an amended C of A for the site.

2.0 PROJECT OBJECTIVES

Prior to applying for an amended C of A, it is necessary to ensure the site is in compliance with the relevant Provincial regulations, guidelines and policies. As such, Golder Associates designed a hydrogeological investigation program to accomplish these requirements. The objectives of the 2005 hydrogeological investigation are summarized as follows:

- Installation of nine monitoring wells at six borehole locations;
- Measurement of groundwater levels at all monitoring wells in July and October 2005;
- Rising head tests for physical hydrogeology characterization in July 2005;
- Collection of groundwater samples from all monitoring wells in July and October 2005 as well on January 2006;
- Collection of surface water samples in July and October 2005; and,
- Preparation of a hydrogeological investigation and monitoring report based on the field and laboratory results.

3.0 INVESTIGATION AND MONITORING PROCEDURES

The hydrogeological and monitoring activities undertaken in 2005 are discussed in this section in chronological order.

The locations of the groundwater monitoring wells in the vicinity of the site are shown on Figure 2. The base plan was provided by Stantec Consulting Ltd. (Stantec). Borehole locations were surveyed by Stantec in July 2005. Borehole locations have been plotted on the base plan as surveyed in order to keep their relative positions accurate. However, it is noted borehole 05-1 is located on the north-west corner of the site, inside the fence.

Field investigation activities included borehole drilling, monitoring well installation, hydraulic conductivity rising head tests, water level measurements, sampling of groundwater monitors and sampling of surface water locations.

3.1 Health and Safety

Prior to initiating the fieldwork, Golder developed and implemented site-specific protocols to protect the health and safety of its employees and subcontractors through the preparation of a site-specific Health and Safety Plan.

3.2 Borehole Drilling and Monitoring Well Installation Program

The borehole drilling and monitoring well installation program was conducted on June 21, 22, and 23, 2005 for the purpose of characterizing the physical hydrogeology, geological conditions, and degree of on-site leachate impacts on groundwater in the overburden.

During the 2005 borehole drilling and monitoring well installation program, six boreholes were advanced on-site. The borehole locations were placed around the site to allow an interpretation of groundwater flow directions, and leachate impacts at the site boundaries. Borehole locations are shown on Figure 2.

The boreholes were drilled using a CME55 track mounted 200 millimetre outside diameter hollow stem auger/rotary drill rig supplied and operated by Marathon Drilling Co. Ltd. of Ottawa, Ontario. All drilling activities were monitored in the field by a member of Golder Associates field technical staff.

Boreholes were advanced to depths of 4.3 to 7.2 metres below ground surface (mbgs) and were completed in the overburden. Soil samples were collected at 0.76 metre intervals using a 50 millimetre diameter split spoon sampler in conjunction with performing the standard penetration test. The overburden stratigraphy was logged by the Golder Associates technician at the drill rig

during the field program. The soil samples recovered from the boreholes during the drilling program were visually described in the field and returned to the Golder Associates Ottawa Laboratory for further examination and classification.

After the completion of drilling, three boreholes had single monitoring wells installed, and three boreholes had multi-level (shallow and deep) monitoring wells installed. The position of monitoring wells was selected based on results of the drilling program. Monitoring wells are termed MW 05-1 to MW 05-6. The convention adopted in this report is that the deeper monitoring well at each borehole location is designated as monitoring well "A" and the shallower well at the same borehole location is referred to as monitoring well "B" (i.e., MW 05-1A and MW 05-1B).

The monitoring wells were installed in the boreholes to allow subsequent measurement of groundwater levels and groundwater sampling. The monitoring wells at each borehole location consist of a schedule 40, 32-millimetre diameter, flush threaded, PVC riser pipe with a 1.5 metre length of #10 slot PVC screen. Filter sand is present below, around and above the screened intervals in the monitoring wells. Bentonite seals were placed at various locations in the boreholes to provide seals to prevent vertical migration of groundwater along the well bore and/or surface water intrusion.

All of the monitoring wells constructed during the borehole drilling and monitoring well installation program were provided with dedicated sampling devices consisting of a length of flexible low density polyethylene (LDPE) tubing and a model D-25 foot valve manufactured by Waterra Pumps Ltd. of Toronto, Ontario.

Appendix C contains the Record of Borehole Sheets for the 2005. The ground surface and top of pipe elevations at the 2005 borehole locations were surveyed by Stantec relative to a Ministry of Natural Resources geodetic benchmark. A summary of the elevation data for all of the existing monitoring wells is presented in the following table.

Borehole and Monitoring Well Survey Information

Monitoring Well	Ground Surface Elevation (metres)	Top of Pipe Elevation (metres)	Easting (metres)	Northing (metres)
MW 05-1A (deep)	63.47	64.204	488627.32	5012812.26
MW 05-1B (shallow)		64.259		
MW 05-2	63.31	64.144	488703.56	5012621.16
MW 05-3	61.18	61.898	488788.57	5012518.66
MW 05-4A (deep)	62.59	63.379	488822.19	5012585.11
MW 05-4B (shallow)		63.469		
MW 05-5	62.70	63.505	488796.21	5012644.73
MW 05-6A (deep)		63.743	488758.45	5012734.86
MW 05-6B (shallow)	62.95	63.810		

Notes: Elevations are geodetic.
Ground surface elevations represent elevations at the time of drilling.
Ground surface and top of pipe elevations surveyed in 2005 by Stantec.

3.3 July Monitoring Session

The July monitoring session was carried out from July 5 to 12, 2005. The following sections describe the various activities which took place.

3.3.1 Rising Head Tests

During the monitoring session, rising head tests were conducted in monitoring wells MW 05-1B, MW 05-1A, MW 05-2, MW 05-3, MW 05-4B, MW 05-5, and MW 05-6B. The data from rising head tests were analyzed using the Hvorslev method (Hvorslev, 1951) and results are given in Appendix D. Section 5.4 discusses the results.

3.3.2 Groundwater Component

During the monitoring session, groundwater levels were measured, and samples collected in all existing monitoring wells. Groundwater levels are shown in Table 1.

Prior to collecting samples, monitoring wells were developed through the removal of at least three standing volumes of water using the installed dedicated samplers.

One sample blank was prepared during the groundwater monitoring session as part of the project Quality Control/Quality Assurance (QA/QC) program. The temperature, pH and conductivity of the groundwater samples were measured in the field at the time of sample collection. The field conductivity measurements were obtained using a Myron L Conductivity Meter Model EP that was calibrated in the field before use. All samples were placed in coolers with ice packs until they were delivered in person to the private analytical laboratory. Groundwater samples were collected, prepared and preserved in the field as follows:

- one 125 millilitre plastic bottle, field filtered to 0.45 microns and preserved to pH<2 with nitric acid for the following analyses: silver, aluminium, boron, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, silicon, sodium, strontium, thallium, titanium, vanadium, and zinc;

- one 1000 millilitre plastic bottle, unfiltered and unpreserved for alkalinity, bromide, chloride, total dissolved solids (TDS), nitrate, nitrite, and sulphate analyses;

- one 1000 millilitre plastic bottle, unfiltered and preserved to pH<2 with sulphuric acid for analysis of ammonia, total kjeldahl nitrogen (TKN), chemical oxygen demand (COD), dissolved reactive phosphorous, and dissolved organic carbon; and,

- one 250 millilitre amber glass bottle with foil lined cap, unfiltered and preserved with phosphoric acid (to pH<4) for analysis of phenols.

All laboratory chemical and physical analyses on groundwater samples were performed by Accutest Laboratories Ltd. in Ottawa, Ontario (Accutest). The Reports of Analyses from Accutest are provided in Appendix A.

3.3.3 Surface Water Component

The approximate locations of the three surface water sampling stations SW1, SW2, and SW3 are shown on Figure 1.

The temperature, pH, DO (dissolved oxygen) and conductivity of the surface water sample were measured in the field at the time of sample collection. All samples were entered on a Chain of Custody Form and placed in coolers with ice packs until they were delivered in person to the private analytical laboratory. The surface water samples were collected, prepared and preserved in the field as follows:

- one 125 millilitre plastic bottle, unfiltered and preserved to pH<2 with nitric acid for the following analyses (i.e., total concentration in an unfiltered surface water sample): silver, aluminium, boron, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, silicon, sodium, strontium, thallium, titanium, vanadium, and zinc;

- one 1000 millilitre plastic bottle, unfiltered and unpreserved for alkalinity, bromide, chloride, total dissolved solids (TDS), nitrate, nitrite, and sulphate analyses;

- one 1000 millilitre plastic bottle, unfiltered and preserved to pH<2 with sulphuric acid for analysis of ammonia; and,

- one 250 millilitre amber glass bottle with foil lined cap, unfiltered and preserved with phosphoric acid (to pH<4) for analysis of phenols.

All laboratory chemical and physical analyses on groundwater samples were performed by Accutest Laboratories Ltd. in Ottawa, Ontario (Accutest). The Reports of Analyses from Accutest are provided in Appendix A.

Photographs of the surface water monitoring station during each sampling event are provided in Appendix D.

3.4 October Monitoring Session

The October monitoring session was carried out on October 24, 2005. The following sections describe the various components which took place.

3.4.1 Groundwater Component

During the monitoring session, groundwater levels were measured, and samples collected in all existing monitoring wells. Groundwater samples were collected as described in Section 3.3.2, however metals were not field filtered. As such, an additional round of sampling was conducted in January 2006 during which time filtered metals samples were collected. Groundwater levels are shown in Table 1.

3.4.2 Surface Water Component

Surface water samples were collected as described in Section 3.3.3.

4.0 GEOLOGICAL CONDITIONS

Six boreholes were drilled during the 2005 hydrogeological by Golder at the site. The borehole logs detailing the geological conditions encountered in each are provided on the Record of Borehole Sheets in Appendix C.

It must be noted that the boundaries between strata on the Record of Borehole Sheets have been inferred from observations during drilling and non-continuous sampling and, as such, their positions should be considered as transitional in nature rather than an exact plane of geological change. Natural variations other than those encountered in the boreholes should also be expected to exist.

In general, the geological conditions encountered in the borehole drilled during 2005 are consistent across the site.

4.1 Fill Materials

Fill materials consisting of grey brown and red silty clay, trace organics and topsoil exist in boreholes BH 05-3 to BH 05-6. The fill ranged in thickness from 0.2 metres at BH 05-5 to 1.7 metres at BH 05-3.

4.2 Native Overburden Deposits

Native overburden deposits occur at all boreholes across the site. Organic topsoil with an average thickness of 0.20 metres was encountered at all boreholes except BH 05-3. Topsoil was underlain by a thin layer of brown sandy silt with an average thickness of 0.24 metres at boreholes BH 05-1, BH 05-2, BH 05-5 and BH 05-6.

In all boreholes, a grey brown to red brown silty clay layer (weathered crust) overlies a silty clay layer. The weathered crust varies in thickness from 0.9 metres at BH 05-3 to 3.1 metres at BH 05-4 (average thickness 2.4 metres). A thin 0.1 metre thick brown sandy silt layer was encountered at depth in boreholes BH 05-3, BH 05-4 and BH 05-6.

Based on available literature, the bedrock underlying the site is indicated to be limestone of the Lindsay Formation, and possibly shale of the Verulam Formation near the southwest corner of the site. MOE well records in the nearby area indicate that bedrock is likely at depths ranging from 16 metres to more than 30 metres below ground surface.

5.0 PHYSICAL HYDROGEOLOGY

5.1 Water Level Data

Groundwater elevation data collected in July 2005 and October 2005 is presented in Table 1.

5.2 Hydraulic Gradients

5.2.1 Horizontal Component

The horizontal hydraulic gradients for the sand deposit groundwater flow system at the site were estimated from the 2005 groundwater elevation data. The horizontal hydraulic gradient in the overburden groundwater flow system between monitoring wells MW 05-2 and MW 05-6B (flowing predominantly east, ultimately towards Whissel Creek) is estimated to be 0.002 metres per metre (m/m). The horizontal hydraulic gradient in the overburden groundwater flow system between monitoring wells MW 05-2 and MW 05-4B (flowing predominantly south-east towards Whissel Creek) is estimated to be significantly larger at 0.02 metres per metre (m/m).

5.2.2 Vertical Component

Based on the 2005 groundwater elevation data from the monitoring wells in boreholes BH 05-1, BH 05-4, and BH 05-6, the vertical hydraulic gradient at the site can be estimated.

In general, downward vertical gradients were observed in the overburden silty clay deposit at groundwater monitor BH 05-1, however on July 12, 2005 an upward gradient was noted. (see Table 1 for groundwater elevations). Downward vertical gradients were observed in the overburden silty clay deposit at groundwater monitor BH 05-6. At groundwater monitor BH 05-4, stronger downward gradients were noted. These stronger gradients are likely due to the fact that this monitoring is in close proximity to the low lying Whissel Creek, and that the creek is likely the discharge point of the groundwater.

5.3 Groundwater Flow Direction

The direction of the groundwater flow within the shallow weathered crust at the site was interpreted from the 2005 groundwater elevation data (see Figure 3).

Based on the groundwater elevations measured in the overburden monitoring wells, the interpreted direction of groundwater flow at the site is east to south-east (towards Whissel Creek).

5.4 Horizontal Hydraulic Conductivity

Estimates of the horizontal hydraulic conductivities (K) of the overburden geological units in the vicinity of the monitoring well intake screens were calculated, where possible, from rising head tests performed on the monitoring wells during the 2005 hydrogeological investigation. The data from rising head tests were analyzed using the Hvorslev method (Hvorslev, 1951) and test results for the rising head tests conducted in 2005 are given in Appendix D.

Horizontal hydraulic conductivities range from 3.7×10^{-5} centimetres per second (cm/s) in the weathered crust to 9.4×10^{-7} cm/s in a groundwater monitor which is partially screened in the weathered crust and silty clay. These values are considered a representative range of what would be expected for the overburden deposits in the area of the site.

5.5 Groundwater Flux

Groundwater flux or specific discharge, q, is the discharge of groundwater per unit area per unit time and is calculated from Darcy's equation. Because the groundwater flux has the dimensions of a velocity, it is sometimes known as the Darcy velocity or Darcy flux (Hubbert, 1940; Freeze and Cherry, 1979). The Darcy flux is calculated from the equation:

$$v_s = Ki$$

where v_s = groundwater flux (units of length per time)
K = horizontal hydraulic conductivity (units of length per time)
i = horizontal hydraulic gradient in direction of v_s (dimensionless)

Using a horizontal hydraulic gradient of 0.002 between groundwater monitors MW05-2 and MW05-6B and a horizontal hydraulic conductivity for the overburden ranging from 3.7×10^{-5} cm/s to 9.4×10^{-7} cm/s, the corresponding Darcy flux within the overburden is calculated to be 1.9×10^{-9} cm/s to 7.4×10^{-8} cm/s (towards the east).

Using a horizontal hydraulic gradient of 0.02 between groundwater monitors MW05-2 and MW05-4B and a horizontal hydraulic conductivity for the overburden ranging from 3.7×10^{-5} cm/s to 9.4×10^{-7} cm/s, the corresponding Darcy flux within the overburden is calculated to be 1.9×10^{-8} cm/s to 7.4×10^{-7} cm/s (towards Whissel Creek).

5.6 Average Linear Groundwater Velocity

The average linear groundwater velocity (seepage velocity), $\bar{v}$, is directly proportional to the groundwater flux and inversely proportional to formation porosity. The average linear groundwater velocity is calculated using the equation:

$$\bar{v} = \frac{Ki}{n}$$

where $\bar{v}$ = average linear groundwater velocity (units of length per time)
n = formation porosity (dimensionless)
K = horizontal hydraulic conductivity (units of length per time)
i = horizontal hydraulic gradient in direction of $\bar{v}$ (dimensionless)

For unconsolidated deposits such as silts and clays, typical porosity values can range from 35 to 70 percent (Freeze and Cherry, 1979). An average porosity of 53 percent for the overburden deposit is assumed for the determination of average linear groundwater velocities in the vicinity of the waste disposal site.

The average linear groundwater velocity within the overburden between groundwater monitors MW05-2 and MW05-6B (towards the east) is estimated to be less than 1 metres per year (towards the east). The average linear groundwater velocity within the overburden between groundwater monitors MW05-2 and MW05-4B is also estimated to be less than 1 metres per year (towards Whissel Creek).

6.0 INTERPRETATION OF GROUNDWATER QUALITY DATA

6.1 Background Groundwater Quality

Monitoring well 05-3 is used to monitor background groundwater quality in 2005. This monitor is screened within the weathered crust silty clay layer and silty clay layer and is not interpreted to be impacted by leachate originating from the landfill site based on a review of the groundwater quality data. Groundwater quality data at the site is limited and only exists for 2005. In 2005, the background groundwater quality is characterized by low concentrations of boron, chloride and sulphate.

The results of the field and laboratory chemical and physical analyses conducted during the 2005 monitoring session, along with the relevant Ontario Drinking Water Quality Standards (MOE, 2003), are presented in Appendix B-I.

6.2 Leachate Indicator Parameters

In order to aid interpretation of groundwater quality at the site, parameters which indicate leachate impact are identified and termed *Leachate Indicator Parameters*. Based on 2005 groundwater quality data, and parameters which are typically elevated in leachate impacted groundwater at other municipal landfills, *Leachate Indicator Parameters* have been selected for the site. The *Leachate Indicator Parameters,* relevant water quality criteria, and the range in the concentrations of the parameters at the background groundwater location are summarized in the following table:

Leachate Indicator Parameter	Water Quality Criteria		Concentration Range at Background Location[2]
	ODWQS	Status[1]	
Chloride	250	AO	19 - 23
Sulphate	500	AO	43 - 63
Hardness	-	-	341 - 379
Potassium	-	-	3 - 4
Barium	1	MAC	<0.01
Boron	5	IMAC	0.03
Manganese	0.05	AO	0.12 - 0.16
Strontium	-	-	0.277 - 0.295
TDS	500	AO	460 - 472
Iron	0.3	AO	<0.03 - 0.05
Ammonia	-	-	0.06 - 0.31

Notes: All concentrations are reported in milligrams per Litre
ODWS - Ontario Drinking Water Quality Standards (MOE, 2003)
[1]considers Aesthetic Objectives (AO), Maximum Acceptable Concentrations (MAC) and Interim Maximum Acceptable Concentrations (IMAC)
[2]Background groundwater quality represented by groundwater quality data available at monitor MW 05-3

Chloride is often the most useful indicator parameter for municipal landfill leachate because it is a common constituent of municipal landfill leachate and is relatively mobile in the groundwater flow system. Chloride ions do not significantly enter into oxidation or reduction reactions, form no important solute complexes with other ions unless the chloride concentration is very high, do not form salts of low solubility, are not significantly adsorbed on mineral surfaces, and play few vital biochemical roles (Hem, 1989). As such, the mobility of the chloride ions in the subsurface is not appreciably retarded with respect to the rate of groundwater flow. Therefore, in areas characterized by naturally low groundwater concentrations of chloride, this parameter becomes a useful indicator with respect to the extent of landfill leachate impact on groundwater. At the St. Albert Waste disposal site, all deep monitoring wells have low chloride concentrations; however road salt impacts are likely at the shallow wells in close proximity to the road. At the background monitoring location (05-3) which is slightly set back from the road, chloride concentrations are significantly less. As such, chloride is considered a useful parameter to observe leachate impacts at the site.

Based on the 2005 groundwater monitoring data, elevated sulphate concentrations are noted in at monitoring locations immediately downgradient of the waste, but not upgradient or in the background monitoring well. Sulphate concentrations are not associated with road salting operations, and thus sulphate is considered a useful parameter to observe leachate impacts at the site.

Chloride and sulphate are considered to be the most useful indicator parameters for this site in 2005 and are used to assess the potential extent of landfill leachate impact on groundwater and surface water quality.

6.3 Impact Evaluation Monitoring Wells

The groundwater quality in the vicinity of the site was assessed by collecting samples from all groundwater monitors and submitting them for chemical and physical analyses. The results of the field and laboratory chemical and physical analyses conducted through 2005, along with the relevant Ontario Drinking Water Quality Standards (MOE, 2003), are presented in Appendix B-I.

This section discusses groundwater quality in the area of the site based on the results of the laboratory analyses for the 2005 *Leachate Indicator Parameters*.

As discussed in Section 6.1, background groundwater quality within the overburden in the vicinity of the landfill site is considered to be represented by the groundwater quality at monitoring well MW 05-3, which is screened within the weather crust silty clay layer and silty clay layer.

The geological unit(s) contributing groundwater to the monitors; trend(s) in groundwater quality; a comparison of the groundwater quality to background conditions; and, an interpretation of the groundwater quality data along with relevant comments are summarized in Table 2 for each of the monitors sampled during the 2005 monitoring session.

The factors which were considered in assessing the interpreted extent of leachate impact on groundwater are as follows:

- emphasis on chloride as an indicator of landfill leachate because the groundwater is characterized by relatively low chloride concentrations in the background groundwater monitor (19 to 23 mg/L), it is present at elevated levels in landfill leachate, and, chloride is relatively mobile in the groundwater flow system (although recognizing the road salt impact to groundwater primarily along the road);

- emphasis on sulphate as an indicator of landfill leachate because the groundwater is characterized by relatively low sulphate concentrations in the background groundwater monitor (23 to 43 mg/L), and it is not present at significantly elevated levels in monitors adjacent to the road which have elevated chloride concentrations due to road salt impacts; and,

- the physical hydrogeological setting of the site which governs the location, direction and speed of the leachate plume migration to the east to south-east of the landfill in the direction of the hydrogeological gradient.

Based on an interpretation of the 2005 groundwater quality data, the following conclusions are provided:

- the groundwater quality in monitoring well MW 05-1A is interpreted not to be impacted by landfill leachate based on low concentrations of the *Leachate Indicator Parameters;*

- the groundwater quality in monitoring well MW 05-1B appears to be impacted by road salt operations, and possibly impacted by landfill leachate based on elevated concentrations of chloride (road salt), and elevated concentrations of strontium and sulphate;

- the groundwater quality in monitoring well MW 05-2 appears to be impacted by road salt operations based on elevated concentrations of chloride, but low concentrations of sulphate;

- the groundwater quality in monitoring well MW 05-4A is interpreted not to be impacted by landfill leachate based on low concentrations of chloride;

- the groundwater quality in monitoring well MW 05-4B is interpreted to be possibility impacted by landfill leachate based elevated concentrations of sulphate, conductivity, and TDS concentrations, but chloride concentrations are within the background range;

- the groundwater quality in monitoring well MW 05-5 is interpreted to be impacted by landfill leachate based primarily on elevated concentrations of chloride, sulphate, hardness, and TDS;

- the groundwater quality in monitoring well MW 05-6A is interpreted not to be impacted by landfill leachate based primarily on low concentrations of chloride; and,

- the groundwater quality in monitoring well 05-6B is interpreted to be impacted by landfill leachate based primarily on elevated concentrations of chloride, sulphate, hardness, and TDS.

Groundwater monitors MW 05-1A, MW 05-4A, and MW 05-6A are completed, entirely within the unweathered silty clay deposit. At each of these monitors, chloride concentrations are less than the background range (2 - 8 mg/L compared to background of 19-23 mg/L), which is screened in the weathered crust silty clay unit (2.13-3.66 mbgs). The low chloride concentrations in the deeper unweathered silty clay deposit suggest that leachate impacts are present in the weathered crust silty clay and have not migrated into the unweathered silty clay (i.e., the landfill leachate-impacted groundwater plume is present in the shallow subsurface).

7.0 GROUNDWATER COMPLIANCE ASSESSMENT

The MOE guideline relevant to closed waste disposal sites is the Resolution of Groundwater Quality Interference Problems, Guideline B-9. Examples of applicable contaminant sources are provided in Guideline B-9 and include: *"discharges of contaminants from facilities that have been used for the disposal of wastes but are now closed"*. The St. Albert Waste Disposal Site has been closed to disposal since 1999. As such, the requirements of Guideline B-9 were considered when assessing groundwater compliance at the site.

In accordance with Guideline B-9, the MOE assumes responsibility for ensuring that action is taken to cleanup and restore the environment in such a manner that the threat to human health, environmental damage, and inconvenience to the public are minimized. This includes action for restoring affected water supplies or providing alternative supplies, where the problem has been caused by a third party. The guideline establishes the timing of the MOE response and a procedure for determining the extent or degree of cleanup that the MOE will require. These requirements are based upon consideration of the value of the resource and cleanup costs and are therefore determined on a case-by-case basis.

Groundwater flow at the site is east to south-east (towards Whissel Creek). As such, landfill leachate related impacts are also migrating at a slow rate within the shallow subsurface and towards Whissel Creek. There are no groundwater users between the landfill site and Whissel Creek and thus there is no potential for leachate related impacts to affect local water supply wells. Therefore, it is concluded that the site is in compliance with Guideline B-9.

8.0 INTERPRETATION OF SURFACE WATER QUALITY DATA

The surface water quality in the vicinity of the site was accessed by collecting and analyzing three surface water samples (including one background sample) from the Whissel Creek. The results of field and laboratory chemical and physical analyses conducted during the 2005 surface water monitoring session along with the relevant Provincial Water Quality Objectives, PWQO (MOE, 1994a), are provided in Appendix B-II. The October 2005 aluminum data are not considered because the sample was not field filtered.

This section discusses surface water quality in the area of the site based primarily on the results of the laboratory analyses for the 2005 *Leachate Indicator Parameters*.

Background surface water quality in the vicinity of the site is considered to be represented by the surface water quality data for the samples collected (in July and October 2005) from station SW1 (located upstream of the site). Surface water station SW2 is located directly downstream to the site and SW3 is located downstream of SW2. The approximate surface water station locations are shown on Figure 1. The parameters with reported levels exceeding their respective PWQO; trends in surface water quality; a comparison of the surface water quality to background conditions; and, an interpretation of the surface water physical and chemical data are summarized in Table 3.

Based on the results of the analytical results, the following conclusions on surface water quality in Whissel Creek are provided:

- Surface water quality at SW2 is interpreted to be possibly impacted by landfill leachate based on slightly elevated concentrations of several of the *Leachate Indicator Parameters* during the July and October 2005 sampling event; and,

- Surface water quality at SW3 is interpreted to be possibly impacted by landfill leachate based on slightly elevated concentrations of several of the *Leachate Indicator Parameters* during the October 2005 sampling event.

- Surface water quality at SW1, SW2 and SW3 are likely impacted by local agriculture activities based on the available nitrate data.

9.0 SURFACE WATER COMPLIANCE ASSESSMENT

This section provides an assessment of the impact of the landfill site on surface water quality in the vicinity of the site based on the results of the 2005 monitoring program.

Based on the available surface water quality data at station SW1, it is interpreted that the surface water at this location represents background surface water quality in the area of the landfill site. The parameters that exceeded the PWQO at the background surface water quality monitoring location are total phosphorus, iron (in October 2005 only) and Vanadium (in October 2005 only). As SW1 is located upstream of the site these exceedances are considered to be naturally occurring. Therefore, it is assumed, for the purpose of this assessment, that the background surface water quality in the vicinity of the landfill site does not naturally meet the PWQO for all parameters. For this surface water quality compliance assessment, it is considered that Policy 2 (MOE, 1994a) would apply to surface water quality in the vicinity of the landfill site. Policy 2 indicates that "water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives".

Surface water sampling stations SW2 and SW3 were sampled in July and October 2005. With respect to compliance, only total phosphorus exceeds the PWQO. Total phosphorus concentrations also exceed the PWQO at the SW1 (background) and these concentrations are considered natural. The total phosphorus concentrations at SW2 and SW3 during each monitoring session are similar to the corresponding total phosphorus levels at SW1.

Based on the available surface water quality analytical results, it is concluded that the site is in compliance and that the landfill site is not adversely impacting off-site surface water quality.

10.0 PROPOSED 2006 GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

The proposed groundwater and surface water monitoring programs for 2006 are summarized in Tables 4 and 5, respectively. The monitoring programs are similar to those conducted during 2005 and include early summer and fall monitoring sessions.

11.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of the Corporation of the Nation Municipality. The report, which specifically includes all tables, figures and appendices, is based on data and information collected by Golder Associates and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder Associates as described in this report. Each of these reports must be read and understood collectively, and can only be relied upon in their totality.

Golder Associates has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the reports as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The assessment of environmental conditions and possible hazards at this site has been made using the results of physical measurements and chemical analyses of liquids from a number of locations. The site conditions between sampling locations have been inferred based on conditions observed at borehole and monitoring well locations. Subsurface conditions may vary from these sampled locations.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

GOLDER ASSOCIATES LTD.
Environmental Division

Paul Hurst

P.A. Hurst, M.Sc. (Eng.)
E.I.T

K.A. Marentette, M.Sc., P.Geo
Senior Hydrogeologist/Associate

PH:KAM:em
n:\active\2005\1120\environmental\05-1120-760 st.albert 2005 invest. act\landfill monitoring\2005 report\rpt 001 24jan06 - 2005 monitoring report.doc

REFERENCES

Freeze and Cherry, 1979. Freeze, R.A. and Cherry, J.A. *Groundwater.* New Jersey. Prentice-Hall Inc., 604 p. 1979.

Hem, J.D., 1989. Study and Interpretation of the Chemical Characteristics of Natural Water, Third Edition: United States Geological Survey, Water-Supply Paper 2254, 263 p.

Hubbert, 1940. Hubbert, M.K., 1940. *The Theory of Groundwater Motion.* Journal of Geology, No. 48, p. 785-944.

Hvorslev, 1951. Hvorslev, M.J., 1951. *Time Lag and Soil Permeability in Groundwater Observations*: U.S. Army Corps Engrs., Waterways Exp. Sta. Bull. 36, Vicksburg, Mississippi.

MOE 1994a. Water Management Polices and Guidelines, Provincial Water Quality Objectives of the Ontario Ministry of the Environment and Energy, April 1994.

MOE 1994b. Guideline B-9: The Resolution of Groundwater Quality Interference Problems (formerly Policy 15-10): MOEE Program Development Branch: Ontario Ministry of the Environment and Energy, April 1994.

MOE, 2003. Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, Ontario Ministry of the Environment and Energy, June 2003.

MOE, 2005. Closed Waste Disposal Site Inspection Report, Ontario Ministry of the Environment and Energy, February 2005.

Stantec, 1999. Nation Municipality, St. Albert Landfill Closure Report, Stantec Consulting Limited, April 1999

TABLE 1

2005 GROUNDWATER LEVEL DATA
ST. ALBERT WASTE DISPOAL SITE
NATION MUNICIPALITY

	July 12, 2005		October 24, 2005	
Monitoring Well	**Depth to Groundwater (metres below top of pipe)**	**Groundwater Elevation (metres)**	**Depth to Groundwater (metres below top of pipe)**	**Groundwater Elevation (metres)**
MW 05-1A	1.145	63.06	1.88	62.32
MW 05-1B	1.98	62.28	1.62	62.64
MW 05-2	1.83	62.31	1.54	62.60
MW 05-3	1.63	60.27	0.98	60.92
MW 05-4A	7.16	56.22	3.75	59.63
MW 05-4B	3.355	60.11	2.71	60.76
MW 05-5	1.545	61.96	0.96	62.55
MW 05-6A	1.9	61.84	1.96	61.78
MW 05-6B	1.565	62.25	1.52	62.29

Notes: - All elevations surveyed geodetic. Top of pipe elevations surveyed by Stantec in July 2005.

TABLE 2

INTERPRETATION OF 2005 GROUNDWATER QUALITY DATA
ST. ALBERT WASTE DISPOSAL SITE
NATION MUNICIPALITY

Borehole	Monitoring Well [a]	Parameters Exceeding ODWQS (mg/L)	Trends	Parameters Elevated Compared to Background Conditions (mg/L) [b]	Vertical Variation in Groundwater Quality at Borehole Location	Comments
BH 05-1	MW 05-1A *(silty clay)*	• manganese	• groundwater generally consistent over time	• TKN (July/October) • sodium (January) • ammonia (October)	• TKN and ammonia concentrations higher in 1A • hardness, chloride, strontium, sulphate, conductivity and TDS concentrations higher in 1B	• borehole 05-1 is located at the north-west corner on-site, hydraulically upgradient based on interpreted groundwater flow directions • monitoring well MW 05-1A is interpreted not to be impacted by landfill leachate based on low chloride and sulphate concentrations • monitoring well MW 05-1B is interpreted to be possibly impacted by landfill leachate based on elevated concentrations of strontium, and sulphate compared to background • monitoring well MW 05-1B is interpreted to be impacted by winter road salting operations based on high chloride concentrations and proximity to road.
	MW 05-1B *(silty clay weathered crust)*	• manganese • TDS	• Groundwater generally consistent over time	• chloride • conductivity • strontium • sulphate • TDS • hardness		

Borehole	Monitoring Well [a]	Parameters Exceeding ODWQS (mg/L)	Trends	Parameters Elevated Compared to Background Conditions (mg/L) [b]	Vertical Variation in Groundwater Quality at Borehole Location	Comments
BH 05-2	MW 05-2 *(silty clay / silty clay weathered crust)*	• manganese • TDS • iron (January)	• most parameters generally consistent over time • possibly increasing chloride and TDS concentrations	• hardness • chloride • TDS • strontium	• NA	• borehole 05-2 is located at the west boundary on-site, hydraulically upgradient based on interpreted groundwater flow directions • monitoring well 2 is interpreted to be impacted by winter road salting operations based on elevated chloride concentrations and proximity to road
BH 05-4	MW 05-4A *(silty clay*	• DOC (January) • iron (January) • manganese (July) • TDS	• Groundwater generally consistent over time	• ammonia • boron • COD • conductivity • DOC • manganese • molybdenum • potassium • sodium • sulphate • TDS • TKN (July)	• ammonia, TKN, boron, COD, DOC, sodium concentrations higher in MW 05-1A • chloride concentrations higher in MW 05-4B	• borehole 05-4 is located at the south-east corner on-site, hydraulically downgradient based on interpreted groundwater flow directions, approximately 60 metres from Whissel Creek • monitoring well MW 05-4A is interpreted not to be impacted by landfill leachate based on low chloride concentrations • monitoring well MW 05-4B is interpreted to be possibly impacted by landfill leachate based on elevated sulphate, boron, conductivity, and TDS concentrations
	MW 05-4B *(silty clay weathered crust)*	• manganese • TDS (October/ January)	• most parameters generally consistent over time • possibly increasing sulphate and TDS concentrations	• conductivity • sulphate • TDS • hardness (January)		
BH 05-5	MW 05-5 *(silty clay / silty clay weathered crust)*	• DOC • TDS • Manganese • iron	• Groundwater generally consistent over time	• chloride • boron • COD • conductivity • DOC • iron (January) • manganese • sodium	• NA	• borehole 05-5 is located at the east boundary on-site, hydraulically downgradient based on interpreted groundwater flow directions • groundwater monitor MW 05-5 is interpreted to be **impacted by landfill leachate** based on

Borehole	Monitoring Well [a]	Parameters Exceeding ODWQS (mg/L)	Trends	Parameters Elevated Compared to Background Conditions (mg/L) [b]	Vertical Variation in Groundwater Quality at Borehole Location	Comments
				• strontium • sulphate • TDS • hardness • TKN (July)		elevated chloride, boron, strontium, sulphate, and hardness concentrations compared to background
BH 05-6	MW 05-6A *(silty clay)*	• DOC (October) • manganese (July)	• Groundwater generally consistent over time	• ammonia (October/January) • boron (July/January) • potassium • TKN	• ammonia and TKN concentrations higher in MW 05-6A • chloride, chromium, COD, conductivity, DOC, sulphate concentrations higher in MW 05-6B	• borehole 05-6 is located at the east boundary on-site, hydraulically downgradient based on interpreted groundwater flow directions • groundwater monitorMW 05-6A is interpreted not to be impacted by landfill leachate based on low chloride concentrations • groundwater monitor MW 05-6B is interpreted to be **impacted by landfill leachate** based on elevated chloride, sulphate, hardness and TDS concentrations
	MW 05-6B *(silty clay / silty clay weathered crust*	• DOC • manganese • TDS	• Groundwater generally consistent over time	• alkalinity • boron • chloride • COD • conductivity • DOC • DRP (October) • sulphate • TDS • hardness • manganese • sodium • strontium		

Notes:ODQWS - Ontario Drinking Water Standards (MOE, 2003)
(a) overburden geological unit contributing groundwater to piezometer/monitoring well screened interval
(b) defined based on groundwater quality data available for background monitoring well MW05-3

TABLE 3

INTERPRETATION OF 2003 SURFACE WATER QUALITY DATA
ST. ALBERT WASTE DISPOSAL SITE
NATION MUNICIPALITY

Surface Water Sampling Station	Parameters Exceeding or Outside PWQO in 2005	Trend(s)	Parameters Elevated Compared to Background Conditions (mg/L) [a]	Interpretation
SW-1 Background	• total phosphorus • iron (October) • Vanadium (October)	• surface water quality generally variable • nitrate higher in October and strontium higher is July	• not applicable	• SW-1 is located upstream at the culvert crossing Montee Oument Road • Elevated nitrate levels are likely associated with local agricultural impacts since nitrate is not present at elevated concentration in the on-site monitoring wells
SW-2	• total phosphorus	• surface water quality generally variable • nitrate, and hardness higher in October and strontium higher is July	• chloride • COD (July) • strontium (July) • sulphate (July) • TKN (July) • Hardness (October) • nitrate (October)	• SW-2 is located approximately 60 metres south-east of borehole 05-4 (the closest monitoring point at the site) • Surface water quality at SW-2 is interpreted to be possibly impacted by landfill leachate based on slightly elevated chloride, strontium, TDS and conductivity levels • Elevated nitrate levels are likely associated with local agricultural impacts since nitrate is not present at elevated concentration in the on-site monitoring wells
SW-3	• total phosphorus	• surface water quality generally variable • nitrate, and hardness higher in October and strontium higher is July	• chloride (October) • conductivity (October) • nitrate (October) • TDS (October) • Hardness (October)	• SW-3 is the furthest downstream surface water sampling station • Surface water quality at SW-3 is interpreted to be possibly impacted based on slightly elevated chloride, TDS, and conductivity levels • Elevated nitrate levels are likely associated with local agricultural impacts since nitrate is not present at elevated concentration in the on-site monitoring wells

Notes: PWQO - Provincial Water Quality Objectives (MOE, 1994a)
(a) defined based on surface water quality data available for background station SW-1

TABLE 4

PROPOSED 2006 GROUNDWATER MONITORING PROGRAM
ST. ALBERT WASTE DISPOSAL SITE
NATION MUNICIPALITY, ONTARIO

1.0 MONITORING SESSIONS

1.1 Water Level and Quality Monitoring

Summer (June/July), Fall (Oct/Nov)

2.0 GROUNDWATER SAMPLING LOCATIONS

3.1 Surveillance Groundwater Monitors

Summer (June/July)
05-1A, 05-1B, 05-2, 05-3, 05-4A, 05-4B, 05-5, 05-6A, 05-6B

Fall (Oct/Nov)
05-1A, 05-1B, 05-2, 05-3, 05-4A, 05-4B, 05-5, 05-6A, 05-6B

3.2 Field Blank

4.0 FIELD MEASURED PARAMETERS

Groundwater levels in all monitors
temperature, conductivity, pH

5.0 LABORATORY MEASURED PARAMETERS

5.1 Surveillance Groundwater Monitors

calcium, magnesium, sodium, potassium, aluminium, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, dissolved reactive phosphorus, silicon, silver, strontium, thallium, titanium, vanadium, zinc
alkalinity, ammonia, COD, TDS, bromide, chloride, fluoride, sulphate, nitrate, nitrite, phenols, TKN, DOC
hardness (calculated from laboratory calcium and magnesium analyses)

5.2 Special Note for Parameters with Established Provincial Water Quality Criteria

All laboratory analyses on groundwater samples should be performed by a private analytical laboratory and the method detection limits (MDLs) for the specific analyses should be commensurate with the standards established in the Provincial Water Quality Objectives (MOE, 1994a) or the Ontario Drinking Water Standards (MOE, 2003), whichever is lower.

TABLE 5

PROPOSED 2006 SURFACE WATER MONITORING PROGRAM
ST. ALBERT WASTE DISPOSAL SITE
NATION MUNICIPALITY, ONTARIO

1.0 MONITORING SESSIONS

1.1 Water Quality Monitoring

Summer (June/July), Fall (Oct/Nov)

2.0 SURFACE WATER SAMPLING LOCATIONS

SW-1, SW-2, SW-3

Photos of each surface water station.

2.1 Surveillance Groundwater Monitors

Summer (June/July)
SW-1, SW-2, SW-3

Fall (Oct/Nov)
SW-1, SW-2, SW-3

2.2 Field Blank

3.0 FIELD MEASURED PARAMETERS

Temperature, conductivity, pH, dissolved oxygen

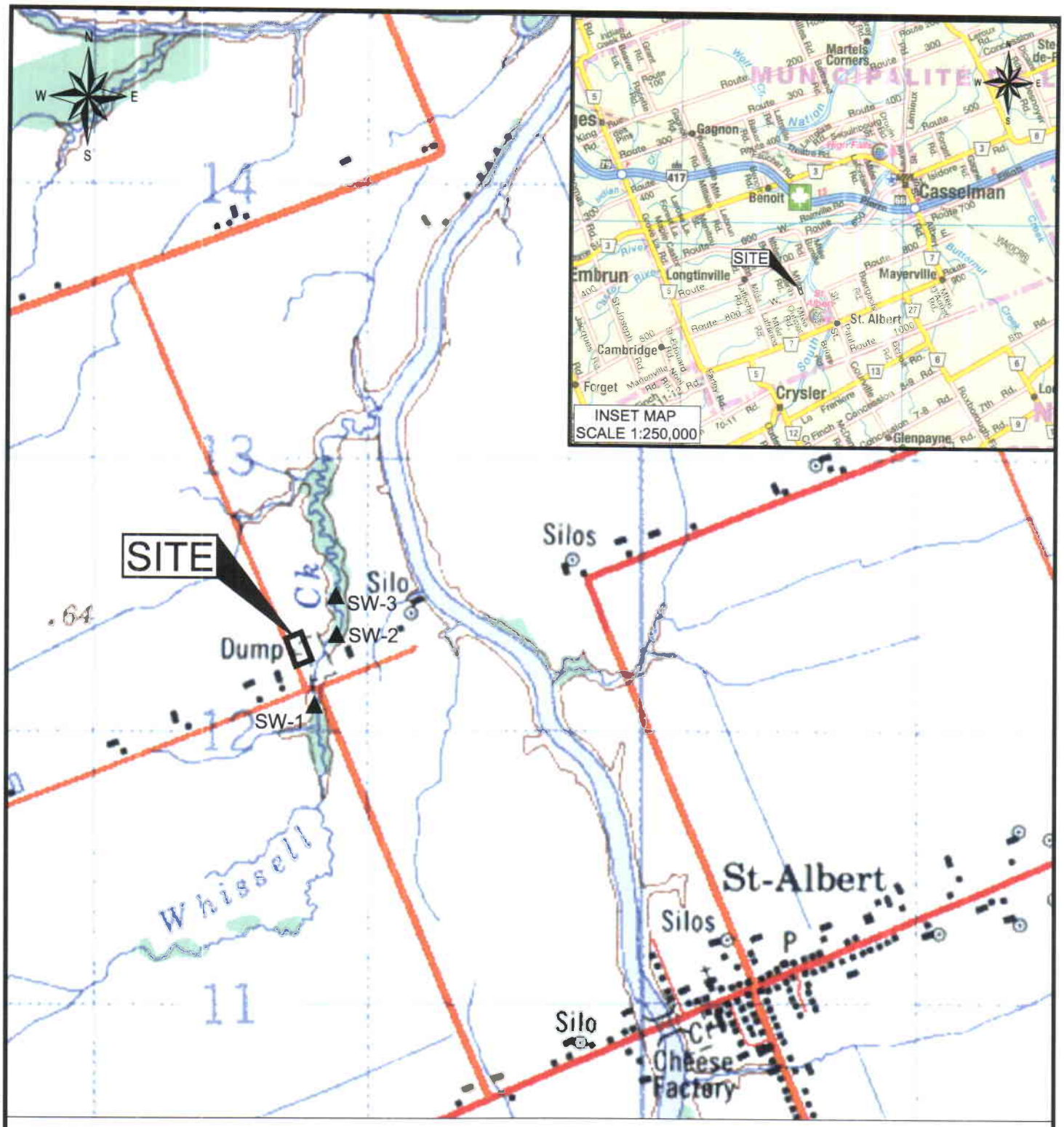
4.0 LABORATORY MEASURED PARAMETERS

4.1 Surveillance Surface Water Monitors

calcium, magnesium, sodium, potassium, aluminium, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, total phosphorus, silicon, silver, strontium, thallium, titanium, vanadium, zinc
alkalinity, ammonia, COD, TDS, bromide, chloride, fluoride, sulphate, nitrate, nitrite, phenols, TKN, DOC
hardness (calculated from laboratory calcium and magnesium analyses)
unionized ammonia (calculated from laboratory ammonia analyses and field pH and temperature measurements)

4.2 Special Note for Parameters with Established Provincial Water Quality Criteria

All laboratory analyses on groundwater samples should be performed by a private analytical laboratory and the method detection limits (MDLs) for the specific analyses should be commensurate with the standards established in the Provincial Water Quality Objectives (MOE, 1994b) or the Ontario Drinking Water Standards (MOE, 2003), whichever is lower.



LEGEND

SW-1 ▲ SURFACE WATER MONITORING STATION

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

Golder Associates
Ottawa, Ontario

SCALE	1:20,000
DATE	MAR. 2006
DESIGN	
CADD	S.L.
CHECK	P.A.H.
REVIEW	K.A.M.

FILE No. 05-1120-760-4000-01.dwg
PROJECT No. 05-1120-760 REV.

TITLE

KEY PLAN

ST. ALBERT LANDFILL

FIGURE 1

Drawing file: 05-1120-760-4000-01.dwg Mar 14, 2006 - 5:25pm

APPENDIX A

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSES
2005 MONITORING SESSIONS

JULY 2005 MONITORING SESSION
LAB REPORTS NO. 2513350, 2513351

NOTES

July 2005 Monitoring Session Lab Reports No. 2513350, 2513351		October 2005 Monitoring Session Lab Reports No. 2521517, 2521518		December 2005 Monitoring Session Lab Reports No. 2600306	
Lab ID	Monitor	Lab ID	Monitor	Lab ID	Monitor
S-7	= 05-1A	W-1	= 05-1A	GW-9	= 05-1A
S-6	= 05-1B	W-8	= 05-1B	GW-8	= 05-1B
S-9	= 05-2	W-9	= 05-2	GW-1	= 05-2
S-8	= 05-3	W-2	= 05-3	GW-2	= 05-3
S-3	= 05-4A	W-4	= 05-4A	GW-4	= 05-4A
S-2	= 05-4B	W-3	= 05-4B	GW-3	= 05-4B
S-1	= 05-5	W-5	= 05-5	GW-5	= 05-5
S-5	= 05-6A	W-6	= 05-6A	GW-7	= 05-6A
S-4	= 05-6B	W-7	= 05-6B	GW-6	= 05-6B
W-3	= SW-1	W-10	= Blank	GW-10	= GW BLANK
W-2	= SW-2	S-1	= SW-1		
W-1	= SW-3	S-2	= SW-2		
S-10	= GW BLANK	S-3	= SW-3		
		S-4	= SW BLANK		

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: **29155**

	LAB ID:	397358	397359	397360	397361	397362	GUIDELINE		
	Sample Date:	2005-07-08	2005-07-08	2005-07-08	2005-07-08	2005-07-08			
	Sample ID:	S-1	S-2	S-3	S-4	S-5			
PARAMETER	**UNITS**	**MDL**					**TYPE**	**LIMIT**	**UNITS**
Alkalinity as CaCO3	mg/L	5	332	287	222	667	327			
Bromide	mg/L	0.05	<0.05	<0.05	<0.05	0.31	<0.05			
Chemical Oxygen Demand	mg/L	5	20	9	24	25	<5			
Chloride	mg/L	1	117	17	6	42	2			
Conductivity	uS/cm	5	1530	731	888	1450	586			
Dissolved Organic Carbon	mg/L	0.5	7.4	3.3	12.7	7.8	3.2			
Dissolved Reactive Phosphorus	mg/L	0.01	0.03	0.02	0.02	0.05	0.05			
Fluoride	mg/L	0.10	<0.10	0.25	0.18	0.18	0.28			
N-NH3 (Ammonia)	mg/L	0.02	0.14	0.16	0.72	0.04	0.22			
N-NO2 (Nitrite)	mg/L	0.10	0.13	<0.10	<0.10	<0.10	<0.10			
N-NO3 (Nitrate)	mg/L	0.10	0.53	0.10	<0.10	<0.10	<0.10			
Phenols	mg/L	0.001	<0.001	<0.001	0.001	<0.001	<0.001			
Sulphate	mg/L	1	389	90	244	100	21			
TDS (COND - CALC)	mg/L	5	1070	475	577	943	381			
Total Kjeldahl Nitrogen	mg/L	0.05	1.96	0.67	12.2	1.36	1.57			
Calcium	mg/L	1	198	88	43	179	54			
Magnesium	mg/L	1	78	33	29	81	33			
Potassium	mg/L	1	3	3	8	4	6			
Sodium	mg/L	2	40	27	96	36	32			
Aluminum	mg/L	0.01	<0.01	0.01	0.01	0.01	0.02			
Barium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	0.05	0.03	0.22	0.11	0.11			
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Chromium	mg/L	0.001	0.004	0.010	<0.001	0.005	0.001			
Cobalt	mg/L	0.0002	0.0026	0.0006	0.0039	0.0021	0.0012			
Copper	mg/L	0.001	0.023	0.001	0.376	0.003	0.015			
Iron	mg/L	0.03	<0.03	<0.03	0.05	<0.03	<0.03			
Lead	mg/L	0.001	<0.001	<0.001	0.002	<0.001	<0.001			
Manganese	mg/L	0.01	0.29	0.06	0.49	0.31	0.12			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08
Project: 051120760
P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: **29155**

			397358	397359	397360	397361	397362	GUIDELINE		
			2005-07-08	2005-07-08	2005-07-08	2005-07-08	2005-07-08			
			S-1	S-2	S-3	S-4	S-5			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Molybdenum	mg/L	0.005	0.024	0.012	0.030	0.014	0.015			
Nickel	mg/L	0.005	0.011	<0.005	0.011	0.012	0.005			
Silicon	mg/L	0.1	8.0	7.8	4.7	12.0	9.8			
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	0.491	0.212	0.191	0.545	0.266			
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Titanium	mg/L	0.01	0.15	0.08	0.05	0.14	0.04			
Vanadium	mg/L	0.001	0.005	0.003	0.003	0.011	0.005			
Zinc	mg/L	0.01	<0.01	<0.01	0.03	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

Client: Golder Associates Ltd.
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: Mr. Paul Hurst

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08
Project: 051120760
P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 29155

			LAB ID:	397363	397364	397365	397366		GUIDELINE		
			Sample Date:	2005-07-08	2005-07-08	2005-07-08	2005-07-08				
			Sample ID:	S-6	S-7	S-8	S-9				
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		232	292	315	398				
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	0.48				
Chemical Oxygen Demand	mg/L	5		5	8	5	<5				
Chloride	mg/L	1		191	8	19	75				
Conductivity	uS/cm	5		1120	588	726	972				
Dissolved Organic Carbon	mg/L	0.5		3.2	3.2	3.2	3.5				
Dissolved Reactive Phosphorus	mg/L	0.01		0.03	0.05	0.06	0.06				
Fluoride	mg/L	0.10		0.21	0.29	0.19	0.20				
N-NH3 (Ammonia)	mg/L	0.02		0.03	0.13	0.06	<0.02				
N-NO2 (Nitrite)	mg/L	0.10		<0.10	<0.10	<0.10	<0.10				
N-NO3 (Nitrate)	mg/L	0.10		<0.10	<0.10	<0.10	<0.10				
Phenols	mg/L	0.001		<0.001	0.001	<0.001	<0.001				
Sulphate	mg/L	1		84	29	63	36				
TDS (COND - CALC)	mg/L	5		728	382	472	632				
Total Kjeldahl Nitrogen	mg/L	0.05		1.12	1.67	0.65	0.62				
Calcium	mg/L	1		131	63	94	117				
Magnesium	mg/L	1		52	27	35	51				
Potassium	mg/L	1		3	4	3	3				
Sodium	mg/L	2		23	20	22	24				
Aluminum	mg/L	0.01		<0.01	<0.01	<0.01	<0.01				
Barium	mg/L	0.01		<0.01	0.01	<0.01	<0.01				
Beryllium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001				
Boron	mg/L	0.01		0.01	0.03	0.03	0.02				
Cadmium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Chromium	mg/L	0.001		0.003	0.001	0.002	0.003				
Cobalt	mg/L	0.0002		0.0012	0.0011	0.0013	0.0009				
Copper	mg/L	0.001		0.002	0.002	0.002	0.001				
Iron	mg/L	0.03		<0.03	<0.03	<0.03	<0.03				
Lead	mg/L	0.001		<0.001	<0.001	<0.001	<0.001				
Manganese	mg/L	0.01		0.17	0.14	0.16	0.14				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 29155

			LAB ID:	397363	397364	397365	397366		GUIDELINE		
			Sample Date:	2005-07-08	2005-07-08	2005-07-08	2005-07-08				
			Sample ID:	S-6	S-7	S-8	S-9				
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005		0.015	0.011	0.013	0.011				
Nickel	mg/L	0.005		0.007	<0.005	0.006	0.005				
Silicon	mg/L	0.1		5.8	9.0	7.0	9.0				
Silver	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Strontium	mg/L	0.001		0.343	0.212	0.277	0.346				
Thallium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Titanium	mg/L	0.01		0.09	0.05	0.07	0.10				
Vanadium	mg/L	0.001		0.002	0.003	0.004	0.004				
Zinc	mg/L	0.01		<0.01	<0.01	<0.01	<0.01				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

[redacted] 8-116 Colonnade Road, Ott[redacted] ON, K2E [redacted] 608 [redacted] Court, [redacted]n, ON, [redacted]R9 [redacted] [redacted] 4 of [redacted] [redacted] Res[redacted]te onl[redacted] param[redacted]sted d[redacted]ample[redacted]tted fo[redacted]is. [redacted]

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 29155

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		<5	100	95-105	2005-07-12			
Bromide	mg/L	0.05		<0.05	100	70-130	2005-07-11			
Chemical Oxygen Demand	mg/L	5		<5	101	80-120	2005-07-12			
Chloride	mg/L	1		<1	97	90-110	2005-07-13			
Conductivity	uS/cm	5		<5	100	95-105	2005-07-12			
Dissolved Organic Carbon	mg/L	0.5		<0.5	102	89-111	2005-07-12			
Dissolved Reactive Phosphorus	mg/L	0.01		<0.01	101	85-115	2005-07-15			
Fluoride	mg/L	0.10		<0.10	96	85-115	2005-07-11			
N-NH3 (Ammonia)	mg/L	0.02		<0.02	115	85-115	2005-07-11			
N-NO2 (Nitrite)	mg/L	0.10		<0.10	99	90-110	2005-07-13			
N-NO3 (Nitrate)	mg/L	0.10		<0.10	99	90-110	2005-07-11			
Phenols	mg/L	0.001		<0.001	99	70-130	2005-07-12			
Sulphate	mg/L	1		<1	100	90-110	2005-07-11			
TDS (COND - CALC)	mg/L	5		<5			2005-07-13			
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	99	77-123	2005-07-13			
Calcium	mg/L	1		<1	97	88-112	2005-07-09			
Magnesium	mg/L	1		<1	95	88-112	2005-07-09			
Potassium	mg/L	1		<1	96	88-112	2005-07-09			
Sodium	mg/L	2		<2	99	82-118	2005-07-09			
Aluminum	mg/L	0.01		<0.01	88	87-113	2005-07-12			
Barium	mg/L	0.01		<0.01	100	90-110	2005-07-12			
Beryllium	mg/L	0.001		<0.001	92	83-117	2005-07-12			
Boron	mg/L	0.01		<0.01	89	70-130	2005-07-12			
Cadmium	mg/L	0.0001		<0.0001	101	87-113	2005-07-12			
Chromium	mg/L	0.001		<0.001	100	80-120	2005-07-12			
Cobalt	mg/L	0.0002		<0.0002	98	85-115	2005-07-12			
Copper	mg/L	0.001		<0.001	100	82-118	2005-07-12			
Iron	mg/L	0.03		<0.03	106	90-110	2005-07-12			
Lead	mg/L	0.001		<0.001	100	84-116	2005-07-12			
Manganese	mg/L	0.01		<0.01	100	90-110	2005-07-12			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513350
Date: 2005-07-15
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 29155

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005		<0.005	99	84-116	2005-07-12			
Nickel	mg/L	0.005		<0.005	100	87-113	2005-07-12			
Silicon	mg/L	0.1		<0.1	110	71-129	2005-07-12			
Silver	mg/L	0.0001		<0.0001	84	71-129	2005-07-12			
Strontium	mg/L	0.001		<0.001	102	90-110	2005-07-12			
Thallium	mg/L	0.0001		<0.0001	103	85-115	2005-07-12			
Titanium	mg/L	0.01		<0.01	100	85-115	2005-07-12			
Vanadium	mg/L	0.001		<0.001	100	85-115	2005-07-12			
Zinc	mg/L	0.01		<0.01	100	89-111	2005-07-12			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

[redacted] [redacted]Colonn[redacted]ad, Ot[redacted]N, K2[redacted] 60[redacted] Cour[redacted]on, On[redacted]2R9 [redacted] [redacted] 6 of[redacted] [redacted] R[redacted]plate o[redacted]e para[redacted]tested[redacted]sampl[redacted]mitted [redacted]ysis. [redacted]

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513351
Date: 2005-07-19
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: **29154**

			LAB ID:	397367	397368	397369			GUIDELINE		
			Sample Date:	2005-07-08	2005-07-08	2005-07-08					
			Sample ID:	W-1	W-2	W-3					
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		231	231	219					
Bromide	mg/L	0.05		<0.05	<0.05	<0.05					
Chemical Oxygen Demand	mg/L	5		9	12	9					
Chloride	mg/L	1		25	31	25					
Conductivity	uS/cm	5		628	628	613					
Dissolved Organic Carbon	mg/L	0.5		3.9	3.8	3.6					
Fluoride	mg/L	0.10		0.23	0.19	0.23					
N-NH3 (Ammonia)	mg/L	0.02		<0.02	0.04	0.03					
N-NO2 (Nitrite)	mg/L	0.10		<0.10	<0.10	<0.10					
N-NO3 (Nitrate)	mg/L	0.10		0.45	0.54	0.40					
Phenols	mg/L	0.001		<0.001	<0.001	<0.001					
Sulphate	mg/L	1		77	80	78					
TDS (COND - CALC)	mg/L	5		408	408	398					
Total Kjeldahl Nitrogen	mg/L	0.05		0.52	0.65	0.46					
Total Phosphorus	mg/L	0.01		0.12	0.14	0.12					
Calcium	mg/L	1		88	90	89					
Magnesium	mg/L	1		19	19	19					
Potassium	mg/L	1		4	4	4					
Sodium	mg/L	2		19	20	19					
Aluminum	mg/L	0.01		<0.01	<0.01	<0.01					
Barium	mg/L	0.01		0.06	0.06	0.06					
Beryllium	mg/L	0.001		<0.001	<0.001	<0.001					
Boron	mg/L	0.01		0.06	0.06	0.06					
Cadmium	mg/L	0.0001		<0.0001	<0.0001	0.0002					
Chromium	mg/L	0.001		0.002	0.002	0.002					
Cobalt	mg/L	0.0002		0.0005	0.0004	0.0004					
Copper	mg/L	0.001		0.002	0.002	0.002					
Iron	mg/L	0.03		0.32	0.30	0.27					
Lead	mg/L	0.001		<0.001	<0.001	<0.001					
Manganese	mg/L	0.01		0.03	0.02	0.02					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Peter Haulena
Analytical Services Manager

Client: ***Golder Associates Ltd.***
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513351
Date: 2005-07-19
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: **29154**

			397367	397368	397369			GUIDELINE		
			2005-07-08	2005-07-08	2005-07-08					
			W-1	W-2	W-3					
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Molybdenum	mg/L	0.005	<0.005	<0.005	<0.005					
Nickel	mg/L	0.005	<0.005	<0.005	<0.005					
Silicon	mg/L	0.1	4.8	4.5	4.9					
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001					
Strontium	mg/L	0.001	2.21	2.32	2.22					
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001					
Titanium	mg/L	0.01	0.09	0.10	0.10					
Vanadium	mg/L	0.001	0.007	0.006	0.006					
Zinc	mg/L	0.01	<0.01	0.02	<0.01					

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Peter Haulena
Analytical Services Manager

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513351
Date: 2005-07-19
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: **29154**

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		<5	99	95-105	2005-07-13			
Bromide	mg/L	0.05		<0.05	100	70-130	2005-07-11			
Chemical Oxygen Demand	mg/L	5		<5	101	80-120	2005-07-12			
Chloride	mg/L	1		<1	100	90-110	2005-07-11			
Conductivity	uS/cm	5		<5	100	95-105	2005-07-13			
Dissolved Organic Carbon	mg/L	0.5		<0.5	102	89-111	2005-07-12			
Fluoride	mg/L	0.10		<0.10	96	85-115	2005-07-11			
N-NH3 (Ammonia)	mg/L	0.02		<0.02	86	85-115	2005-07-11			
N-NO2 (Nitrite)	mg/L	0.10		<0.10	98	90-110	2005-07-11			
N-NO3 (Nitrate)	mg/L	0.10		<0.10	99	90-110	2005-07-11			
Phenols	mg/L	0.001		<0.001	104	70-130	2005-07-12			
Sulphate	mg/L	1		<1	100	90-110	2005-07-11			
TDS (COND - CALC)	mg/L	5		<5			2005-07-18			
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	97	77-123	2005-07-14			
Total Phosphorus	mg/L	0.01		<0.01	102	88-112	2005-07-14			
Calcium	mg/L	1		<1	97	88-112	2005-07-09			
Magnesium	mg/L	1		<1	95	88-112	2005-07-09			
Potassium	mg/L	1		<1	96	88-112	2005-07-09			
Sodium	mg/L	2		<2	99	82-118	2005-07-09			
Aluminum	mg/L	0.01		<0.01	94	87-113	2005-07-13			
Barium	mg/L	0.01		<0.01	100	90-110	2005-07-12			
Beryllium	mg/L	0.001		<0.001	92	83-117	2005-07-12			
Boron	mg/L	0.01		<0.01	89	70-130	2005-07-12			
Cadmium	mg/L	0.0001		<0.0001	92	87-113	2005-07-12			
Chromium	mg/L	0.001		<0.001	100	80-120	2005-07-12			
Cobalt	mg/L	0.0002		<0.0002	92	85-115	2005-07-12			
Copper	mg/L	0.001		<0.001	92	82-118	2005-07-12			
Iron	mg/L	0.03		<0.03	103	90-110	2005-07-12			
Lead	mg/L	0.001		<0.001	93	84-116	2005-07-12			
Manganese	mg/L	0.01		<0.01	100	90-110	2005-07-12			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Peter Haulena
Analytical Services Manager

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2513351
Date: 2005-07-19
Date Submitted: 2005-07-08

Project: 051120760

P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: 29154

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	<0.005	100	84-116	2005-07-12				
Nickel	mg/L	0.005	<0.005	97	87-113	2005-07-12				
Silicon	mg/L	0.1	<0.1	110	71-129	2005-07-12				
Silver	mg/L	0.0001	<0.0001	78	71-129	2005-07-12				
Strontium	mg/L	0.001	<0.001	98	90-110	2005-07-13				
Thallium	mg/L	0.0001	<0.0001	97	85-115	2005-07-12				
Titanium	mg/L	0.01	<0.01	100	85-115	2005-07-12				
Vanadium	mg/L	0.001	<0.001	91	85-115	2005-07-12				
Zinc	mg/L	0.01	<0.01	95	89-111	2005-07-12				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Peter Haulena
Analytical Services Manager

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521517
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

Chain of Custody Number: 33133

P.O. Number: 250398
Matrix: Surfacewater

			LAB ID:	420183	420184	420185	420186		GUIDELINE		
			Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24				
			Sample ID:	S-1	S-2	S-3	S-4				
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		296	291	292	<5				
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05				
Chemical Oxygen Demand	mg/L	5		9	7	7	<5				
Chloride	mg/L	1		24	31	32	<1				
Conductivity	uS/cm	5		657	743	740	<5				
Dissolved Organic Carbon	mg/L	0.5		3.2	3.2	3.1	<0.5				
Fluoride	mg/L	0.10		0.26	0.22	0.22	<0.10				
N-NH3 (Ammonia)	mg/L	0.02		0.07	0.02	0.04	<0.02				
N-NO2 (Nitrite)	mg/L	0.10		<0.10	<0.10	<0.10	<0.10				
N-NO3 (Nitrate)	mg/L	0.10		4.50	7.38	7.17	<0.10				
Phenols	mg/L	0.001		<0.001	<0.001	<0.001	<0.001				
Sulphate	mg/L	1		21	51	48	<1				
TDS (COND - CALC)	mg/L	5		427	483	481	<5				
Total Kjeldahl Nitrogen	mg/L	0.05		0.59	0.51	0.51	<0.05				
Total Phosphorus	mg/L	0.01		0.13	0.14	0.10	<0.01				
Calcium	mg/L	1		89	115	116	<1				
Magnesium	mg/L	1		26	18	18	<1				
Potassium	mg/L	1		3	5	5	<1				
Sodium	mg/L	2		18	20	20	<2				
Aluminum	mg/L	0.01		0.69	0.27	0.30	<0.01				
Barium	mg/L	0.01		0.04	0.07	0.07	<0.01				
Beryllium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001				
Boron	mg/L	0.01		0.03	0.06	0.06	<0.01				
Cadmium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Chromium	mg/L	0.001		0.003	0.003	0.003	<0.001				
Cobalt	mg/L	0.0002		0.0004	0.0004	0.0004	<0.0002				
Copper	mg/L	0.001		0.002	0.002	0.002	<0.001				
Iron	mg/L	0.03		0.39	0.21	0.22	<0.03				
Lead	mg/L	0.001		<0.001	<0.001	<0.001	<0.001				
Manganese	mg/L	0.01		<0.01	0.01	0.02	<0.01				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: Mr. Paul Hurst

Report Number: 2521517
Date: 2005-11-08
Date Submitted: 2005-10-24
Project: 05-1120-760
P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: 33133

			LAB ID:	420183	420184	420185	420186		GUIDELINE		
			Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24				
			Sample ID:	S-1	S-2	S-3	S-4				
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005		<0.005	<0.005	<0.005	<0.005				
Nickel	mg/L	0.005		<0.005	<0.005	<0.005	<0.005				
Silicon	mg/L	0.1		10.5	8.2	8.4	<0.1				
Silver	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Strontium	mg/L	0.001		0.540	1.49	1.48	<0.001				
Thallium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001				
Titanium	mg/L	0.01		0.03	0.01	0.01	<0.01				
Vanadium	mg/L	0.001		0.007	0.006	0.007	<0.001				
Zinc	mg/L	0.01		<0.01	<0.01	<0.01	<0.01				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521517
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: 33133

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		<5	100	95-105	2005-10-26			
Bromide	mg/L	0.05		<0.05	95	70-130	2005-10-26			
Chemical Oxygen Demand	mg/L	5		<5	102	80-120	2005-10-25			
Chloride	mg/L	1		<1	100	90-110	2005-10-26			
Conductivity	uS/cm	5		<5	101	95-105	2005-10-26			
Dissolved Organic Carbon	mg/L	0.5		<0.5	100	89-111	2005-10-26			
Fluoride	mg/L	0.10		<0.10	113	80-120	2005-10-26			
N-NH3 (Ammonia)	mg/L	0.02		<0.02	106	85-115	2005-10-25			
N-NO2 (Nitrite)	mg/L	0.10		<0.10	97	90-110	2005-10-26			
N-NO3 (Nitrate)	mg/L	0.10		<0.10	93	90-110	2005-10-26			
Phenols	mg/L	0.001		<0.001	103	70-130	2005-10-26			
Sulphate	mg/L	1		<1	95	90-110	2005-10-26			
TDS (COND - CALC)	mg/L	5		<5			2005-10-28			
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	96	77-123	2005-10-26			
Total Phosphorus	mg/L	0.01		<0.01	98	88-112	2005-10-28			
Calcium	mg/L	1		<1	101	88-112	2005-10-27			
Magnesium	mg/L	1		<1	96	88-112	2005-10-27			
Potassium	mg/L	1		<1	101	88-112	2005-10-27			
Sodium	mg/L	2		<2	96	82-118	2005-10-27			
Aluminum	mg/L	0.01		<0.01	94	87-113	2005-10-26			
Barium	mg/L	0.01		<0.01	100	90-110	2005-10-26			
Beryllium	mg/L	0.001		<0.001	100	83-117	2005-10-26			
Boron	mg/L	0.01		<0.01	89	70-130	2005-10-26			
Cadmium	mg/L	0.0001		<0.0001	98	87-113	2005-10-26			
Chromium	mg/L	0.001		<0.001	100	80-120	2005-10-26			
Cobalt	mg/L	0.0002		<0.0002	100	85-115	2005-10-26			
Copper	mg/L	0.001		<0.001	100	82-118	2005-10-26			
Iron	mg/L	0.03		<0.03	94	90-110	2005-10-26			
Lead	mg/L	0.001		<0.001	100	84-116	2005-10-26			
Manganese	mg/L	0.01		<0.01	100	90-110	2005-10-26			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: Mr. Paul Hurst

Report Number: 2521517
Date: 2005-11-08
Date Submitted: 2005-10-24
Project: 05-1120-760
P.O. Number: 250398
Matrix: Surfacewater

Chain of Custody Number: 33133

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	<0.005	99	91-109	2005-10-26				
Nickel	mg/L	0.005	<0.005	97	87-113	2005-10-26				
Silicon	mg/L	0.1	<0.1	100	92-108	2005-10-26				
Silver	mg/L	0.0001	<0.0001	90	80-120	2005-10-26				
Strontium	mg/L	0.001	<0.001	98	90-110	2005-10-26				
Thallium	mg/L	0.0001	<0.0001	100	85-115	2005-10-26				
Titanium	mg/L	0.01	<0.01	93	73-127	2005-10-26				
Vanadium	mg/L	0.001	<0.001	100	85-115	2005-10-26				
Zinc	mg/L	0.01	<0.01	97	89-111	2005-10-26				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

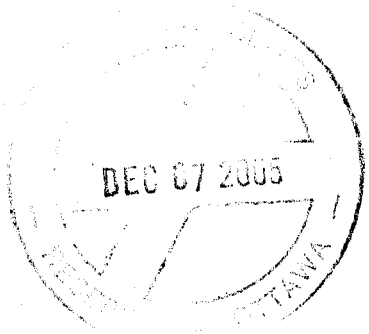
Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

	LAB ID:	420187	420188	420189	420190	420191	GUIDELINE		
	Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24	2005-10-24			
	Sample ID:	W-1	W-2	W-3	W-4	W-5			
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	295	326	295	307	347			
Bromide	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	0.36			
Chemical Oxygen Demand	mg/L	5	14	12	11	29	21			
Chloride	mg/L	1	7	23	16	4	94			
Conductivity	uS/cm	5	573	708	810	851	1270			
Dissolved Organic Carbon	mg/L	0.5	4.0	3.8	3.1	9.6	6.6			
Dissolved Reactive Phosphorus	mg/L	0.01	0.07	0.08	0.09	0.07	0.05			
Fluoride	mg/L	0.10	0.31	0.20	0.24	0.23	0.21			
N-NH3 (Ammonia)	mg/L	0.02	0.48	0.31	0.07	1.48	0.27			
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	0.11	<0.10	<0.10			
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Sulphate	mg/L	1	32	55	153	160	255			
TDS (COND - CALC)	mg/L	5	372	460	527	553	825			
Total Kjeldahl Nitrogen	mg/L	0.05	0.79	0.56	0.23	4.30	0.58			
Calcium	mg/L	1	61	87	112	43	157			
Magnesium	mg/L	1	28	33	40	31	67			
Potassium	mg/L	1	5	5	3	9	5			
Sodium	mg/L	2	29	21	24	98	36			
Aluminum	mg/L	0.01	1.89	0.90	0.92	1.97	0.29			
Barium	mg/L	0.01	0.02	<0.01	0.02	<0.01	<0.01			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	0.03	0.03	0.02	0.17	0.04			
Cadmium	mg/L	0.0001	0.0003	0.0001	<0.0001	<0.0001	<0.0001			
Chromium	mg/L	0.001	0.007	0.005	0.005	0.008	0.005			
Cobalt	mg/L	0.0002	0.0048	0.0022	0.0010	0.0033	0.0010			
Copper	mg/L	0.001	0.002	0.005	0.003	0.005	0.002			
Iron	mg/L	0.03	5.18	6.33	1.84	8.95	4.62			
Lead	mg/L	0.001	0.002	0.001	<0.001	0.002	<0.001			
Manganese	mg/L	0.01	0.68	0.19	0.04	0.21	0.23			



MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24
Project: 05-1120-760
P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

	LAB ID:	420187	420188	420189	420190	420191	GUIDELINE		
	Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24	2005-10-24			
	Sample ID:	W-1	W-2	W-3	W-4	W-5			
PARAMETER	**UNITS**	**MDL**					**TYPE**	**LIMIT**	**UNITS**
Molybdenum	mg/L	0.005	0.015	0.013	<0.005	0.038	0.013			
Nickel	mg/L	0.005	0.014	0.008	0.006	0.012	0.008			
Silicon	mg/L	0.1	9.7	8.8	9.5	6.9	9.4			
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	0.340	0.234	0.194	0.215	0.371			
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Titanium	mg/L	0.01	0.02	0.01	0.02	0.02	<0.01			
Vanadium	mg/L	0.001	0.015	0.007	0.007	0.009	0.006			
Zinc	mg/L	0.01	0.01	<0.01	<0.01	0.02	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

[redacted] 8-146 Colonnade Road, Otta[redacted], K2E [redacted] 608 [redacted] Court, [redacted]h, ON, [redacted]R9 [redacted] [redacted] 2 of 6 [redacted] [redacted] Res[redacted]ate only to the parameters tested on the samples submitted for analysis. [redacted]

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

	LAB ID:	420192	420193	420194	420195	420196	GUIDELINE		
	Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24	2005-10-24			
	Sample ID:	W-6	W-7	W-8	W-9	W-10			
PARAMETER	**UNITS**	**MDL**					**TYPE**	**LIMIT**	**UNITS**
Alkalinity as CaCO3	mg/L	5	328	652	248	451	7			
Bromide	mg/L	0.05	<0.05	0.23	<0.05	0.51	<0.05			
Chemical Oxygen Demand	mg/L	5	18	23	9	9	<5			
Chloride	mg/L	1	3	61	174	98	<1			
Conductivity	uS/cm	5	600	1270	1040	1060	<5			
Dissolved Organic Carbon	mg/L	0.5	5.7	6.5	2.4	3.2	<0.5			
Dissolved Reactive Phosphorus	mg/L	0.01	0.06	0.12	0.11	0.10	<0.01			
Fluoride	mg/L	0.10	0.20	0.20	0.25	0.21	<0.10			
N-NH3 (Ammonia)	mg/L	0.02	0.90	0.24	0.20	0.12	0.02			
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Sulphate	mg/L	1	27	66	73	28	<1			
TDS (COND - CALC)	mg/L	5	390	825	676	689	<5			
Total Kjeldahl Nitrogen	mg/L	0.05	1.44	0.65	0.37	0.24	<0.05			
Calcium	mg/L	1	53	161	127	142	<1			
Magnesium	mg/L	1	34	77	51	53	<1			
Potassium	mg/L	1	7	5	3	4	<1			
Sodium	mg/L	2	33	31	22	22	<2			
Aluminum	mg/L	0.01	1.70	0.48	0.80	0.82	<0.01			
Barium	mg/L	0.01	0.03	<0.01	<0.01	0.02	<0.01			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	0.09	0.07	0.02	0.03	<0.01			
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001			
Chromium	mg/L	0.001	0.006	0.008	0.006	0.007	<0.001			
Cobalt	mg/L	0.0002	0.0023	0.0011	0.0012	0.0010	<0.0002			
Copper	mg/L	0.001	<0.001	0.001	0.002	0.004	<0.001			
Iron	mg/L	0.03	6.49	5.14	4.15	4.81	<0.03			
Lead	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001			
Manganese	mg/L	0.01	0.56	0.34	0.21	0.21	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24
Project: 05-1120-760
P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

	LAB ID:	420192	420193	420194	420195	420196	GUIDELINE		
	Sample Date:	2005-10-24	2005-10-24	2005-10-24	2005-10-24	2005-10-24			
	Sample ID:	W-6	W-7	W-8	W-9	W-10			
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	0.018	<0.005	0.005	<0.005	<0.005			
Nickel	mg/L	0.005	0.010	0.009	0.008	0.007	<0.005			
Silicon	mg/L	0.1	9.2	12.6	9.2	12.1	<0.1			
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	0.282	0.438	0.263	0.304	<0.001			
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Titanium	mg/L	0.01	0.03	0.01	0.02	0.01	<0.01			
Vanadium	mg/L	0.001	0.013	0.017	0.005	0.013	<0.001			
Zinc	mg/L	0.01	0.01	<0.01	<0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

[redacted] 8[redacted]lonna[redacted]d, Otta[redacted], K2E [redacted] 608 [redacted]Court, [redacted]n, ON, [redacted]9 [redacted] [redacted] 4 of 6[redacted] [redacted] Res[redacted]te onl[redacted]param[redacted]sted d[redacted]ample[redacted]tted fo[redacted]is. [redacted]

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	<5	100	95-105	2005-10-27				
Bromide	mg/L	0.05	<0.05	95	70-130	2005-10-26				
Chemical Oxygen Demand	mg/L	5	<5	102	80-120	2005-10-25				
Chloride	mg/L	1	<1	100	90-110	2005-10-26				
Conductivity	uS/cm	5	<5	100	95-105	2005-10-27				
Dissolved Organic Carbon	mg/L	0.5	<0.5	100	89-111	2005-10-26				
Dissolved Reactive Phosphorus	mg/L	0.01	<0.01	101	85-115	2005-10-31				
Fluoride	mg/L	0.10	<0.10	113	80-120	2005-10-26				
N-NH3 (Ammonia)	mg/L	0.02	<0.02	106	85-115	2005-10-25				
N-NO2 (Nitrite)	mg/L	0.10	<0.10	97	90-110	2005-10-26				
N-NO3 (Nitrate)	mg/L	0.10	<0.10	93	90-110	2005-10-26				
Phenols	mg/L	0.001	<0.001	103	70-130	2005-10-26				
Sulphate	mg/L	1	<1	95	90-110	2005-10-26				
TDS (COND - CALC)	mg/L	5	<5			2005-11-07				
Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	96	77-123	2005-10-26				
Calcium	mg/L	1	<1	101	88-112	2005-10-27				
Magnesium	mg/L	1	<1	96	88-112	2005-10-27				
Potassium	mg/L	1	<1	101	88-112	2005-10-27				
Sodium	mg/L	2	<2	96	82-118	2005-10-27				
Aluminum	mg/L	0.01	<0.01	94	87-113	2005-10-26				
Barium	mg/L	0.01	<0.01	100	90-110	2005-10-26				
Beryllium	mg/L	0.001	<0.001	92	83-117	2005-10-26				
Boron	mg/L	0.01	<0.01	89	70-130	2005-10-26				
Cadmium	mg/L	0.0001	<0.0001	98	87-113	2005-10-26				
Chromium	mg/L	0.001	<0.001	100	80-120	2005-10-26				
Cobalt	mg/L	0.0002	<0.0002	99	85-115	2005-10-26				
Copper	mg/L	0.001	<0.001	100	82-118	2005-10-26				
Iron	mg/L	0.03	<0.03	106	90-110	2005-10-26				
Lead	mg/L	0.001	<0.001	93	84-116	2005-10-26				
Manganese	mg/L	0.01	<0.01	100	90-110	2005-10-26				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2521518
Date: 2005-11-08
Date Submitted: 2005-10-24

Project: 05-1120-760

P.O. Number: 250397
Matrix: Groundwater

Chain of Custody Number: 33130

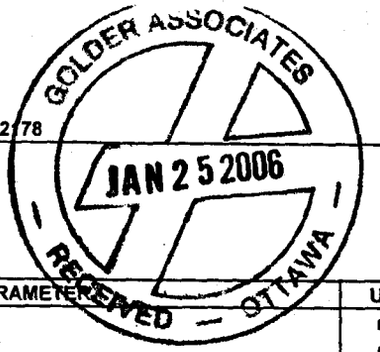
			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	<0.005	101	91-109	2005-10-26				
Nickel	mg/L	0.005	<0.005	99	87-113	2005-10-26				
Silicon	mg/L	0.1	<0.1	99	92-108	2005-10-26				
Silver	mg/L	0.0001	<0.0001	90	80-120	2005-10-26				
Strontium	mg/L	0.001	<0.001	102	90-110	2005-10-26				
Thallium	mg/L	0.0001	<0.0001	100	85-115	2005-10-26				
Titanium	mg/L	0.01	<0.01	93	73-127	2005-10-26				
Vanadium	mg/L	0.001	<0.001	91	85-115	2005-10-26				
Zinc	mg/L	0.01	<0.01	97	89-111	2005-10-26				

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**



Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06

Project: 05-1120-760 Task 9000

P.O. Number: 250635
Matrix: Groundwater

Chain of Custody Number: 42178

	LAB ID:	435535	435536	435537	435538	435539	GUIDELINE		
	Sample Date:	2006-01-06	2006-01-06	2006-01-06	2006-01-06	2006-01-06			
	Sample ID:	GW-1	GW-2	GW-3	GW-4	GW-5			
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	526	342	294	354	372			
Bromide	mg/L	0.05	0.74	<0.05	<0.05	<0.05	0.52			
Chemical Oxygen Demand	mg/L	5	8	7	11	27	16			
Chloride	mg/L	1	122	20	16	4	99			
Conductivity	uS/cm	5	1310	729	847	856	1430			
Dissolved Organic Carbon	mg/L	0.5	2.9	2.5	3.7	10.0	5.8			
Dissolved Reactive Phosphorus	mg/L	0.01	0.07	0.05	0.06	0.06	0.04			
Fluoride	mg/L	0.10	0.20	0.22	0.25	0.24	0.12			
N-NH3 (Ammonia)	mg/L	0.02	0.09	0.14	0.04	0.98	0.14			
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	0.14			
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	0.007	<0.001			
Sulphate	mg/L	1	31	43	173	126	279			
TDS (COND - CALC)	mg/L	5	852	474	551	556	930			
Total Kjeldahl Nitrogen	mg/L	0.05	0.19	0.21	0.27	2.17	0.50			
Calcium	mg/L	1	160	84	107	42	169			
Magnesium	mg/L	1	58	32	38	31	71			
Potassium	mg/L	1	3	4	3	8	4			
Sodium	mg/L	2	22	20	23	94	33			
Aluminum	mg/L	0.01	<0.01	<0.01	<0.01	0.02	<0.01			
Barium	mg/L	0.01	0.02	<0.01	0.01	<0.01	<0.01			
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01	0.03	0.03	0.02	0.21	0.06			
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Chromium	mg/L	0.001	0.004	0.002	0.002	0.001	0.003			
Cobalt	mg/L	0.0002	0.0004	0.0006	0.0002	0.0003	0.0008			
Copper	mg/L	0.001	0.001	0.001	0.001	<0.001	0.002			
Iron	mg/L	0.03	0.31	0.05	<0.03	1.86	1.04			
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
Manganese	mg/L	0.01	0.22	0.12	0.02	0.07	0.19			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: Mr. Paul Hurst

Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06
Project: 05-1120-760 Task 9000
P.O. Number: 250635
Matrix: Groundwater

Chain of Custody Number: 42178

	LAB ID:	435535	435536	435537	435538	435539	GUIDELINE		
	Sample Date:	2006-01-06	2006-01-06	2006-01-06	2006-01-06	2006-01-06			
	Sample ID:	GW-1	GW-2	GW-3	GW-4	GW-5			
PARAMETER	UNITS	MDL					TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	<0.005	0.006	<0.005	0.037	0.007			
Nickel	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	0.005			
Silicon	mg/L	0.1	13.6	9.9	10.5	7.7	11.6			
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	0.518	0.295	0.252	0.244	0.483			
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Titanium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Vanadium	mg/L	0.001	0.009	0.006	0.005	0.006	0.006			
Zinc	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

[redacted]

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06

Project: 05-1120-760 Task 9000

Chain of Custody Number: **42178**

P.O. Number: 250635
Matrix: Groundwater

			LAB ID:	435540	435541	435542	435543	435544	GUIDELINE		
			Sample Date:	2006-01-06	2006-01-06	2006-01-06	2006-01-06	2006-01-06			
			Sample ID:	GW-6	GW-7	GW-8	GW-9	GW-10			
PARAMETER	UNITS	MDL							TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		714	343	257	315	<5			
Bromide	mg/L	0.05		0.21	<0.05	<0.05	<0.05	<0.05			
Chemical Oxygen Demand	mg/L	5		23	<5	6	5	<5			
Chloride	mg/L	1		63	2	186	8	<1			
Conductivity	uS/cm	5		1490	613	1180	621	<5			
Dissolved Organic Carbon	mg/L	0.5		7.1	2.6	2.3	2.9	0.8			
Dissolved Reactive Phosphorus	mg/L	0.01		0.08	0.09	0.06	0.04	<0.01			
Fluoride	mg/L	0.10		0.22	0.31	0.43	0.30	<0.10			
N-NH3 (Ammonia)	mg/L	0.02		0.12	0.49	0.07	0.36	<0.02			
N-NO2 (Nitrite)	mg/L	0.10		<0.10	<0.10	<0.10	<0.10	<0.10			
N-NO3 (Nitrate)	mg/L	0.10		<0.10	<0.10	<0.10	<0.10	<0.10			
Phenols	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001			
Sulphate	mg/L	1		83	12	74	28	<1			
TDS (COND - CALC)	mg/L	5		968	398	767	404	<5			
Total Kjeldahl Nitrogen	mg/L	0.05		0.52	0.64	0.18	0.48	0.07			
Calcium	mg/L	1		173	50	127	61	<1			
Magnesium	mg/L	1		79	32	50	27	<1			
Potassium	mg/L	1		4	6	3	5	<1			
Sodium	mg/L	2		31	28	22	29	<2			
Aluminum	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01			
Barium	mg/L	0.01		0.02	<0.01	<0.01	<0.01	<0.01			
Beryllium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001			
Boron	mg/L	0.01		0.08	0.09	0.01	0.03	<0.01			
Cadmium	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Chromium	mg/L	0.001		0.005	0.001	0.004	0.002	<0.001			
Cobalt	mg/L	0.0002		0.0005	0.0002	0.0004	0.0003	<0.0002			
Copper	mg/L	0.001		<0.001	<0.001	0.001	0.006	<0.001			
Iron	mg/L	0.03		1.00	0.12	0.18	<0.03	<0.03			
Lead	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001			
Manganese	mg/L	0.01		0.26	0.04	0.11	0.08	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: Golder Associates Ltd.
32 Steacie Drive
Ottawa, ON
K2K 2A9

Attention: Mr. Paul Hurst

Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06

Project: 05-1120-760 Task 9000

P.O. Number: 250635
Matrix: Groundwater

Chain of Custody Number: 42178

		LAB ID:	435540	435541	435542	435543	435544	GUIDELINE		
		Sample Date:	2006-01-06	2006-01-06	2006-01-06	2006-01-06	2006-01-06			
		Sample ID:	GW-6	GW-7	GW-8	GW-9	GW-10			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Molybdenum	mg/L	0.005	<0.005	<0.005	0.005	0.016	<0.005			
Nickel	mg/L	0.005	0.006	<0.005	<0.005	<0.005	<0.005			
Silicon	mg/L	0.1	15.3	13.6	11.5	12.7	<0.1			
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Strontium	mg/L	0.001	0.566	0.242	0.348	0.213	<0.001			
Thallium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Titanium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Vanadium	mg/L	0.001	0.016	0.006	0.005	0.005	<0.001			
Zinc	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

Re[redacted]ate on[redacted] param[redacted]tested [redacted] sampl[redacted]mitted for analysis.

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06

Project: 05-1120-760 Task 9000

P.O. Number: 250635
Matrix: Groundwater

Chain of Custody Number: 42178

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	UNITS	MDL						TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5		<5	101	95-105	2006-01-10			
Bromide	mg/L	0.05		<0.05	100	90-110	2006-01-06			
Chemical Oxygen Demand	mg/L	5		<5	102	80-120	2006-01-09			
Chloride	mg/L	1		<1	96	90-110	2006-01-09			
Conductivity	uS/cm	5		<5	100	95-105	2006-01-10			
Dissolved Organic Carbon	mg/L	0.5		<0.5	103	89-111	2006-01-06			
Dissolved Reactive Phosphorus	mg/L	0.01		<0.01	99	89-111	2006-01-10			
Fluoride	mg/L	0.10		<0.10	109	90-110	2006-01-06			
N-NH3 (Ammonia)	mg/L	0.02		<0.02	99	85-115	2006-01-09			
N-NO2 (Nitrite)	mg/L	0.10		<0.10	97	90-110	2006-01-06			
N-NO3 (Nitrate)	mg/L	0.10		<0.10	102	90-110	2006-01-06			
Phenols	mg/L	0.001		<0.001	96	70-130	2006-01-10			
Sulphate	mg/L	1		<1	105	90-110	2006-01-06			
TDS (COND - CALC)	mg/L	5		<5		-	2006-01-10			
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	97	77-123	2006-01-10			
Calcium	mg/L	1		<1	95	80-120	2006-01-07			
Magnesium	mg/L	1		<1	95	80-120	2006-01-07			
Potassium	mg/L	1		<1	100	80-120	2006-01-07			
Sodium	mg/L	2		<2	96	80-120	2006-01-07			
Aluminum	mg/L	0.01		<0.01	88	87-113	2006-01-06			
Barium	mg/L	0.01		<0.01	100	90-110	2006-01-06			
Beryllium	mg/L	0.001		<0.001	92	83-117	2006-01-06			
Boron	mg/L	0.01		<0.01	78	70-130	2006-01-06			
Cadmium	mg/L	0.0001		<0.0001	100	87-113	2006-01-06			
Chromium	mg/L	0.001		<0.001	114	80-120	2006-01-06			
Cobalt	mg/L	0.0002		<0.0002	100	85-115	2006-01-06			
Copper	mg/L	0.001		<0.001	100	82-118	2006-01-06			
Iron	mg/L	0.03		<0.03	94	90-110	2006-01-06			
Lead	mg/L	0.001		<0.001	100	84-116	2006-01-06			
Manganese	mg/L	0.01		<0.01	98	90-110	2006-01-06			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

Client: **Golder Associates Ltd.**
32 Steacie Drive
Ottawa, ON
K2K 2A9
Attention: **Mr. Paul Hurst**

Report Number: 2600306
Date: 2006-01-16
Date Submitted: 2006-01-06

Project: 05-1120-760 Task 9000

P.O. Number: 250635
Matrix: Groundwater

Chain of Custody Number: 42178

			LAB ID:					GUIDELINE		
			Sample Date:							
			Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Molybdenum	mg/L	0.005		<0.005	103	90-110	2006-01-06			
Nickel	mg/L	0.005		<0.005	96	89-111	2006-01-06			
Silicon	mg/L	0.1		<0.1	100	70-130	2006-01-06			
Silver	mg/L	0.0001		<0.0001	100	80-120	2006-01-06			
Strontium	mg/L	0.001		<0.001	98	90-110	2006-01-06			
Thallium	mg/L	0.0001		<0.0001	97	85-115	2006-01-06			
Titanium	mg/L	0.01		<0.01	100	75-125	2006-01-06			
Vanadium	mg/L	0.001		<0.001	100	85-115	2006-01-06			
Zinc	mg/L	0.01		<0.01	95	89-111	2006-01-06			

MDL = Method Detection Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration
Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

[redacted] 6 of [redacted] Res[redacted]te on[redacted] para[redacted] tested on the sample[redacted] submitted for analysis. [redacted]

APPENDIX B

RESULTS OF FIELD AND LABORATORY CHEMICAL AND PHYSICAL ANALYSES

APPENDIX B-I - GROUNDWATER MONITORS
APPENDIX B-II - SURFACE WATER MONITORING STATIONS

NOTES

NS	location not sampled during monitoring session
IS	insufficient water to permit sample collection
DRY	surface water station dry at time of monitoring session
NM	field parameter not measured due to instrument malfunction

LIST OF ABBREVIATIONS

The abbreviations commonly employed on the "Chemical and Physical Analyses Data Sheets", on the figures, in the tables and in the text of the report as related to the water quality monitoring programs are as follows:

ODWO/S	Ontario Drinking Water Standards (Ministry of the Environment, 2003)
PWQO	Provincial Water Quality Objective (Ministry of the Environment, 1994b) (Includes Interim PWQO also)
N	nitrogen
P	phosphorus
$CaCO_3$	calcium carbonate
C	degrees Celsius
uS/cm	microsiemens per centimetre
NTU	Nephelometric Turbidity Unit
TCU	True Colour Unit
mL	millilitre
mg/L	milligrams per litre
ppm	parts per million
COND.	conductivity
DIS. OXYGEN	dissolved oxygen
TKN	total kjeldahl nitrogen
BOD	biochemical oxygen demand
COD	chemical oxygen demand
DOC	dissolved organic carbon
EC	*Escherichia coli*
TOC	total organic carbon
TS	total solids
TSS	total suspended solids
TDS	total dissolved solids
TC	total coliform
FC	faecal coliform
FS	faecal streptococcus
Bkgd	background
f(Alkalinity)	PWQO related to alkalinity of surface water
f (Hardness)	PWQO related to hardness of surface water
f (Temp)	PWQO related to temperature of surface water
f (pH,Temp)	PWQO related to pH and temperature of surface water
f (pH)	PWQO related to pH of surface water
*	See Ministry of Environment (2003) for narrative guideline

APPENDIX B-I

GROUNDWATER MONITORS

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-1A**

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	292	295	315
Aluminum	0.1	<0.010		<0.010
Ammonia (as N)		0.13	0.48	0.36
Barium	1	0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.030		0.030
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		63.0		61.0
Chloride	250	8.0	7.0	8.0
Chromium	0.05	0.0010		0.0020
Cobalt		0.0011		0.0003
COD		8	14	5
Conductivity (uS/cm)		588	573	621
Copper	1	0.0020		0.0060
DOC	5	3.2	4.0	2.9
Fluoride	1.5	0.29	0.31	0.30
Hardness (CaCO3)	80-100	268		263
Iron	0.3	<0.03		<0.03
Lead	0.01	<0.0010		<0.0010
Magnesium		27.00		27.00
Manganese	0.05	0.140		0.080
Molybdenum		0.011		0.016
Nickel		<0.005		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.3	7.1	7.4
Phenols		0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.050	0.070	0.040
Potassium		4.0		5.0
Silicon		9.00		12.70
Silver		<0.00010		<0.00010
Sodium	200	20.0		29.0
Strontium		0.212		0.213
Sulphate	500	29.0	32.0	28.0
TDS	500	382	372	404
Temperature (C)	15	14.5	9.1	6.8
Thallium		<0.00010		<0.00010
Titanium		0.050		<0.010
TKN		1.67	0.79	0.48
Vanadium		0.0030		0.0050
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-1B**

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	232	248	257
Aluminum	0.1	<0.010		<0.010
Ammonia (as N)		0.03	0.20	0.07
Barium	1	<0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.010		0.010
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		131.0		127.0
Chloride	250	191.0	174.0	186.0
Chromium	0.05	0.0030		0.0040
Cobalt		0.0012		0.0004
COD		5	9	6
Conductivity (uS/cm)		1120	1040	1180
Copper	1	0.0020		0.0010
DOC	5	3.2	2.4	2.3
Fluoride	1.5	0.21	0.25	0.43
Hardness (CaCO3)	80-100	541		523
Iron	0.3	<0.03		0.18
Lead	0.01	<0.0010		<0.0010
Magnesium		52.00		50.00
Manganese	0.05	0.170		0.110
Molybdenum		0.015		0.005
Nickel		0.007		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.3	7.1	7.4
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.030	0.110	0.060
Potassium		3.0		3.0
Silicon		5.80		11.50
Silver		<0.00010		<0.00010
Sodium	200	23.0		22.0
Strontium		0.343		0.348
Sulphate	500	84.0	73.0	74.0
TDS	500	728	676	767
Temperature (C)	15	13.0	9.1	6.0
Thallium		<0.00010		<0.00010
Titanium		0.090		<0.010
TKN		1.12	0.37	0.18
Vanadium		0.0020		0.0050
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-2**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	398	451	526
Aluminum	0.1	<0.010		<0.010
Ammonia (as N)		<0.02	0.12	0.09
Barium	1	<0.010		0.020
Beryllium		<0.001		<0.001
Boron	5	0.020		0.030
Bromide		0.48	0.51	0.74
Cadmium	0.005	<0.0001		<0.0001
Calcium		117.0		160.0
Chloride	250	75.0	98.0	122.0
Chromium	0.05	0.0030		0.0040
Cobalt		0.0009		0.0004
COD		<5	9	8
Conductivity (uS/cm)		972	1060	1310
Copper	1	0.0010		0.0010
DOC	5	3.5	3.2	2.9
Fluoride	1.5	0.20	0.21	0.20
Hardness (CaCO3)	80-100	502		638
Iron	0.3	<0.03		0.31
Lead	0.01	<0.0010		<0.0010
Magnesium		51.00		58.00
Manganese	0.05	0.140		0.220
Molybdenum		0.011		<0.005
Nickel		0.005		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.2	7.1	7.3
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.060	0.100	0.070
Potassium		3.0		3.0
Silicon		9.00		13.60
Silver		<0.00010		<0.00010
Sodium	200	24.0		22.0
Strontium		0.346		0.518
Sulphate	500	36.0	28.0	31.0
TDS	500	632	689	852
Temperature (C)	15	14.0	9.2	4.8
Thallium		<0.00010		<0.00010
Titanium		0.100		<0.010
TKN		0.62	0.24	0.19
Vanadium		0.0040		0.0090
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

[redacted]

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-3**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	315	326	342
Aluminum	0.1	<0.010		<0.010
Ammonia (as N)		0.06	0.31	0.14
Barium	1	<0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.030		0.030
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		94.0		84.0
Chloride	250	19.0	23.0	20.0
Chromium	0.05	0.0020		0.0020
Cobalt		0.0013		0.0006
COD		5	12	7
Conductivity (uS/cm)		726	708	729
Copper	1	0.0020		0.0010
DOC	5	3.2	3.8	2.5
Fluoride	1.5	0.19	0.20	0.22
Hardness (CaCO3)	80-100	379		341
Iron	0.3	<0.03		0.05
Lead	0.01	<0.0010		<0.0010
Magnesium		35.00		32.00
Manganese	0.05	0.160		0.120
Molybdenum		0.013		0.006
Nickel		0.006		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.2	7.1	7.5
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.060	0.080	0.050
Potassium		3.0		4.0
Silicon		7.00		9.90
Silver		<0.00010		<0.00010
Sodium	200	22.0		20.0
Strontium		0.277		0.295
Sulphate	500	63.0	55.0	43.0
TDS	500	472	460	474
Temperature (C)	15	14.0	10.3	6.0
Thallium		<0.00010		<0.00010
Titanium		0.070		<0.010
TKN		0.65	0.56	0.21
Vanadium		0.0040		0.0060
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-4A**

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	222	307	354
Aluminum	0.1	0.010		0.020
Ammonia (as N)		0.72	1.48	0.98
Barium	1	<0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.220		0.210
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		43.0		42.0
Chloride	250	6.0	4.0	4.0
Chromium	0.05	<0.0010		0.0010
Cobalt		0.0039		0.0003
COD		24	29	27
Conductivity (uS/cm)		888	851	856
Copper	1	0.3760		<0.0010
DOC	5	12.7	9.6	10.0
Fluoride	1.5	0.18	0.23	0.24
Hardness (CaCO3)	80-100	226		232
Iron	0.3	0.05		1.86
Lead	0.01	0.0020		<0.0010
Magnesium		29.00		31.00
Manganese	0.05	0.490		0.070
Molybdenum		0.030		0.037
Nickel		0.011		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.1	7.3	7.4
Phenols		0.001	<0.001	0.007
Phosphorus (dissolved reactive)		0.020	0.070	0.060
Potassium		8.0		8.0
Silicon		4.70		7.70
Silver		<0.00010		<0.00010
Sodium	200	96.0		94.0
Strontium		0.191		0.244
Sulphate	500	244.0	160.0	126.0
TDS	500	577	553	556
Temperature (C)	15	13.0	7.3	6.2
Thallium		<0.00010		<0.00010
Titanium		0.050		<0.010
TKN		12.20	4.30	2.17
Vanadium		0.0030		0.0060
Zinc	5	0.030		<0.010

All values reported in mg/L unless otherwise noted.

[redacted]

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-4B**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	287	295	294
Aluminum	0.1	0.010		<0.010
Ammonia (as N)		0.16	0.07	0.04
Barium	1	<0.010		0.010
Beryllium		<0.001		<0.001
Boron	5	0.030		0.020
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		88.0		107.0
Chloride	250	17.0	16.0	16.0
Chromium	0.05	0.0100		0.0020
Cobalt		0.0006		0.0002
COD		9	11	11
Conductivity (uS/cm)		731	810	847
Copper	1	0.0010		0.0010
DOC	5	3.3	3.1	3.7
Fluoride	1.5	0.25	0.24	0.25
Hardness (CaCO3)	80-100	355		423
Iron	0.3	<0.03		<0.03
Lead	0.01	<0.0010		<0.0010
Magnesium		33.00		38.00
Manganese	0.05	0.060		0.020
Molybdenum		0.012		<0.005
Nickel		<0.005		<0.005
Nitrate (as N)	10	0.10	0.11	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.3	7.1	7.4
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.020	0.090	0.060
Potassium		3.0		3.0
Silicon		7.80		10.50
Silver		<0.00010		<0.00010
Sodium	200	27.0		23.0
Strontium		0.212		0.252
Sulphate	500	90.0	153.0	173.0
TDS	500	475	527	551
Temperature (C)	15	600.0	9.3	4.7
Thallium		<0.00010		<0.00010
Titanium		0.080		<0.010
TKN		0.67	0.23	0.27
Vanadium		0.0030		0.0050
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-5**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	332	347	372
Aluminum	0.1	<0.010		<0.010
Ammonia (as N)		0.14	0.27	0.14
Barium	1	<0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.050		0.060
Bromide		<0.05	0.36	0.52
Cadmium	0.005	<0.0001		<0.0001
Calcium		198.0		169.0
Chloride	250	117.0	94.0	99.0
Chromium	0.05	0.0040		0.0030
Cobalt		0.0026		0.0008
COD		20	21	16
Conductivity (uS/cm)		1530	1270	1430
Copper	1	0.0230		0.0020
DOC	5	7.4	6.6	5.8
Fluoride	1.5	<0.10	0.21	0.12
Hardness (CaCO3)	80-100	815		714
Iron	0.3	<0.03		1.04
Lead	0.01	<0.0010		<0.0010
Magnesium		78.00		71.00
Manganese	0.05	0.290		0.190
Molybdenum		0.024		0.007
Nickel		0.011		0.005
Nitrate (as N)	10	0.53	<0.10	0.14
Nitrite (as N)	1	0.13	<0.10	<0.10
pH (pH units)	6.5-8.5	7.0	7.1	7.2
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.030	0.050	0.040
Potassium		3.0		4.0
Silicon		8.00		11.60
Silver		<0.00010		<0.00010
Sodium	200	40.0		33.0
Strontium		0.491		0.483
Sulphate	500	389.0	255.0	279.0
TDS	500	1070	825	930
Temperature (C)	15	15.0	9.9	5.2
Thallium		<0.00010		<0.00010
Titanium		0.150		<0.010
TKN		1.96	0.58	0.50
Vanadium		0.0050		0.0060
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-6A**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	327	328	343
Aluminum	0.1	0.020		<0.010
Ammonia (as N)		0.22	0.90	0.49
Barium	1	<0.010		<0.010
Beryllium		<0.001		<0.001
Boron	5	0.110		0.090
Bromide		<0.05	<0.05	<0.05
Cadmium	0.005	<0.0001		<0.0001
Calcium		54.0		50.0
Chloride	250	2.0	3.0	2.0
Chromium	0.05	0.0010		0.0010
Cobalt		0.0012		0.0002
COD		<5	18	<5
Conductivity (uS/cm)		586	600	613
Copper	1	0.0150		<0.0010
DOC	5	3.2	5.7	2.6
Fluoride	1.5	0.28	0.20	0.31
Hardness (CaCO3)	80-100	270		256
Iron	0.3	<0.03		0.12
Lead	0.01	<0.0010		<0.0010
Magnesium		33.00		32.00
Manganese	0.05	0.120		0.040
Molybdenum		0.015		<0.005
Nickel		0.005		<0.005
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	7.4	8.4	7.3
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.050	0.060	0.090
Potassium		6.0		6.0
Silicon		9.80		13.60
Silver		<0.00010		<0.00010
Sodium	200	32.0		28.0
Strontium		0.266		0.242
Sulphate	500	21.0	27.0	12.0
TDS	500	381	390	398
Temperature (C)	15	15.0	7.1	6.8
Thallium		<0.00010		<0.00010
Titanium		0.040		<0.010
TKN		1.57	1.44	0.64
Vanadium		0.0050		0.0060
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **MW 05-6B**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005	06-Jan-2006
Parameter	ODWQS			
Alkalinity (CaCO3)	30-500	667	652	714
Aluminum	0.1	0.010		<0.010
Ammonia (as N)		0.04	0.24	0.12
Barium	1	<0.010		0.020
Beryllium		<0.001		<0.001
Boron	5	0.110		0.080
Bromide		0.31	0.23	0.21
Cadmium	0.005	<0.0001		<0.0001
Calcium		179.0		173.0
Chloride	250	42.0	61.0	63.0
Chromium	0.05	0.0050		0.0050
Cobalt		0.0021		0.0005
COD		25	23	23
Conductivity (uS/cm)		1450	1270	1490
Copper	1	0.0030		<0.0010
DOC	5	7.8	6.5	7.1
Fluoride	1.5	0.18	0.20	0.22
Hardness (CaCO3)	80-100	780		756
Iron	0.3	<0.03		1.00
Lead	0.01	<0.0010		<0.0010
Magnesium		81.00		79.00
Manganese	0.05	0.310		0.260
Molybdenum		0.014		<0.005
Nickel		0.012		0.006
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10	<0.10
pH (pH units)	6.5-8.5	6.8	7.1	7.1
Phenols		<0.001	<0.001	<0.001
Phosphorus (dissolved reactive)		0.050	0.120	0.080
Potassium		4.0		4.0
Silicon		12.00		15.30
Silver		<0.00010		<0.00010
Sodium	200	36.0		31.0
Strontium		0.545		0.566
Sulphate	500	100.0	66.0	83.0
TDS	500	943	825	968
Temperature (C)	15	14.0	9.3	5.1
Thallium		<0.00010		<0.00010
Titanium		0.140		<0.010
TKN		1.36	0.65	0.52
Vanadium		0.0110		0.0160
Zinc	5	<0.010		<0.010

All values reported in mg/L unless otherwise noted.

APPENDIX B-II

SURFACE WATER MONITORING STATIONS

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **SW-1**

Parameter	PWQO	Date Sampled: 08-Jul-2005	24-Oct-2005
Alkalinity (CaCO3)	75% Bkgd	219	296
Aluminum	f (pH)	<0.010	0.690
Ammonia (as N)		0.03	0.07
Barium		0.060	0.040
Beryllium	f (Hardness)	<0.001	<0.001
Boron	0.2	0.060	0.030
Bromide		<0.05	<0.05
Cadmium	0.0002	0.0002	<0.0001
Calcium		89.0	89.0
Chloride		25.0	24.0
Chromium		0.0020	0.0030
Cobalt	0.0009	0.0004	0.0004
COD		9	9
Conductivity (uS/cm)		613	657
Copper	0.005	0.0020	0.0020
Dissolved Oxygen	f (Temp)	10.1	9.8
DOC		3.6	3.2
Fluoride		0.23	0.26
Hardness (CaCO3)		300	329
Iron	0.3	0.27	0.39
Lead	f (Alk)	<0.0010	<0.0010
Magnesium		19.00	26.00
Manganese		0.020	<0.010
Molybdenum	0.04	<0.005	<0.005
Nickel	0.025	<0.005	<0.005
Nitrate (as N)		0.40	4.50
Nitrite (as N)		<0.10	<0.10
pH (pH units)	6.5-8.5	8.3	8.1
Phenols	0.001	<0.001	<0.001
Phosphorus (total)	0.03	0.120	0.130
Potassium		4.0	3.0
Silicon		4.90	10.50
Silver	0.0001	<0.00010	<0.00010
Sodium		19.0	18.0
Strontium		2.220	0.540
Sulphate		78.0	21.0
TDS		398	427
Temperature (C)		22.0	11.1
Thallium	0.0003	<0.00010	<0.00010
Titanium		0.100	0.030
TKN		0.46	0.59
Unionized Ammonia	0.02	<0.020	<0.020
Vanadium	0.006	0.0060	0.0070
Zinc	0.03	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **SW-2**

Sheet: 1

Date Sampled:		08-Jul-2005	24-Oct-2005
Parameter	PWQO		
Alkalinity (CaCO3)	75% Bkgd	231	291
Aluminum	f (pH)	<0.010	0.270
Ammonia (as N)		0.04	0.02
Barium		0.060	0.070
Beryllium	f (Hardness)	<0.001	<0.001
Boron	0.2	0.060	0.060
Bromide		<0.05	<0.05
Cadmium	0.0002	<0.0001	<0.0001
Calcium		90.0	115.0
Chloride		31.0	31.0
Chromium		0.0020	0.0030
Cobalt	0.0009	0.0004	0.0004
COD		12	7
Conductivity (uS/cm)		628	743
Copper	0.005	0.0020	0.0020
Dissolved Oxygen	f (Temp)	9.1	9.9
DOC		3.8	3.2
Fluoride		0.19	0.22
Hardness (CaCO3)		303	361
Iron	0.3	0.30	0.21
Lead	f (Alk)	<0.0010	<0.0010
Magnesium		19.00	18.00
Manganese		0.020	0.010
Molybdenum	0.04	<0.005	<0.005
Nickel	0.025	<0.005	<0.005
Nitrate (as N)		0.54	7.38
Nitrite (as N)		<0.10	<0.10
pH (pH units)	6.5-8.5	8.1	7.1
Phenols	0.001	<0.001	<0.001
Phosphorus (total)	0.03	0.140	0.140
Potassium		4.0	5.0
Silicon		4.50	8.20
Silver	0.0001	<0.00010	<0.00010
Sodium		20.0	20.0
Strontium		2.320	1.490
Sulphate		80.0	51.0
TDS		408	483
Temperature (C)		20.0	9.5
Thallium	0.0003	<0.00010	<0.00010
Titanium		0.100	0.010
TKN		0.65	0.51
Unionized Ammonia	0.02	<0.020	<0.020
Vanadium	0.006	0.0060	0.0060
Zinc	0.03	0.020	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

ST. ALBERT LANDFILL - NATION MUNICIPALITY - REPORT OF MONITORING RESULTS

Sample Source: **SW-3**

Sheet: 1

Parameter	PWQO	Date Sampled: 08-Jul-2005	24-Oct-2005
Alkalinity (CaCO3)	75% Bkgd	231	292
Aluminum	f (pH)	<0.010	0.300
Ammonia (as N)		<0.02	0.04
Barium		0.060	0.070
Beryllium	f (Hardness)	<0.001	<0.001
Boron	0.2	0.060	0.060
Bromide		<0.05	<0.05
Cadmium	0.0002	<0.0001	<0.0001
Calcium		88.0	116.0
Chloride		25.0	32.0
Chromium		0.0020	0.0030
Cobalt	0.0009	0.0005	0.0004
COD		9	7
Conductivity (uS/cm)		628	740
Copper	0.005	0.0020	0.0020
Dissolved Oxygen	f (Temp)	9.4	9.4
DOC		3.9	3.1
Fluoride		0.23	0.22
Hardness (CaCO3)		298	364
Iron	0.3	0.32	0.22
Lead	f (Alk)	<0.0010	<0.0010
Magnesium		19.00	18.00
Manganese		0.030	0.020
Molybdenum	0.04	<0.005	<0.005
Nickel	0.025	<0.005	<0.005
Nitrate (as N)		0.45	7.17
Nitrite (as N)		<0.10	<0.10
pH (pH units)	6.5-8.5	8.2	7.1
Phenols	0.001	<0.001	<0.001
Phosphorus (total)	0.03	0.120	0.100
Potassium		4.0	5.0
Silicon		4.80	8.40
Silver	0.0001	<0.00010	<0.00010
Sodium		19.0	20.0
Strontium		2.210	1.480
Sulphate		77.0	48.0
TDS		408	481
Temperature (C)		22.0	9.3
Thallium	0.0003	<0.00010	<0.00010
Titanium		0.090	0.010
TKN		0.52	0.51
Unionized Ammonia	0.02	<0.020	<0.020
Vanadium	0.006	0.0070	0.0070
Zinc	0.03	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

APPENDIX C

RECORD OF BOREHOLES

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open Sampler for a distance of 300 mm (12 in.)

Dynamic Penetration Resistance; N_d:
The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive Uncased a 50 mm (2 in.) diameter, 60^0 cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Peizo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60^0 conical tip and a projected end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded Electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	**N** Blows/300 mm Or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	$C_{u2}S_u$ Kpa	Psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	Over 200	Over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limited
w_l	liquid limit
C	consolidaiton (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	modified Proctor compaction test
SPC	standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:
1. Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	= 3.1416
ln x,	natural logarithm of x
$\log_{10}$ x or log x,	logarithm of x to base 10
g	Acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma'$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma''-u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1\sigma_2\sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma'=\gamma-\gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R= p_s/p_w$) formerly (G_s)
e	void ratio
n	porosity
S	degree of saturation
*	Density symbol is p. Unit weight symbol is γ where $\gamma=\rho g$(i.e. mass density x acceleration due to gravity)

(a) Index Properties (cont'd.)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity Index=(w_l-w_p)
w_s	shrinkage limit
I_L	liquidity index=($w-w_p$)/I_p
I_c	consistency index=(w_l-w)/I_p
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index-(e_{max}-e)/(e_{max}-e_{min}) (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (overconsolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	Overconsolidation ratio=σ'_p/σ'_{vo}

(d) Shear Strength

$\tau_p\tau_r$	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction=tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength (ϕ=0 analysis)
p	mean total stress $(\sigma_1+\sigma_3)/2$
p'	mean effective stress $(\sigma'_1+\sigma'_3)/2$
q	$(\sigma_1-\sigma_3)/2$ or $(\sigma'_1-\sigma_3)/2$
q_u	compressive strength ($\sigma_1-\sigma_3$)
S_t	sensitivity

Notes: 1. $\tau=c'\sigma'\tan\phi'$
2. Shear strength=(Compressive strength)/2

PROJECT: 05-1120-760

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 05-1

BORING DATE: June 21, 2005

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		63.47							
		Dark brown silty TOPSOIL		0.00							
		Dark brown SANDY SILT		63.23 / 0.24							
		Grey brown and red brown SILTY CLAY, occasional very thin silt seam (Weathered Crust)		62.80 / 0.67	1	50 DO	5				Bentonite Seal
1											Native Backfill
					2	50 DO	4				Bentonite Seal
2											Silica Sand
					3	50 DO	3				
3	Power Auger 200mm Diam. (Hollow Stem)										32mm Diam. PVC #10 Slot Screen B
		Grey SILTY CLAY, occasional red brown layer, scattered black organic matter		60.03 / 3.44	4	50 DO	WH				
4											Silica Sand
					5	50 DO	WH				Bentonite Seal
											Silica Sand
5					6	50 DO	WH				
											32mm Diam. PVC #10 Slot Screen A
6					7	50 DO	WH				
											Silica Sand
					8	50 DO	WH				
		End of Borehole		56.76 / 6.71							
7											Water level in screen A at elev. 62.32 m on Oct. 24, 2005
8											Water level in screen B at elev. 62.64 m on Oct. 24, 2005
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

PROJECT: 05-1120-760

RECORD OF BOREHOLE: 05-2

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 21, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - O) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl, 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		63.31							
0	Power Auger 200mm Diam. (Hollow Stem)	Dark brown silty TOPSOIL		0.00							
				63.07							
		Brown SANDY SILT		0.24							
				62.85							
		Grey brown and red brown SILTY CLAY, occasional thin silt seam (Weathered Crust)		0.46							Bentonite Seal
1					1	50 DO	6				Native Backfill
2					2	50 DO	4				Bentonite Seal
											Silica Sand
3					3	50 DO	1				
				60.05							
		Grey SILTY CLAY, occasional red brown layer		3.28	4	50 DO	1				32mm Diam. PVC #10 Slot Screen
4					5	50 DO	WH				Silica Sand
				58.74							
		End of Borehole		4.57							
5											Water level in screen at elev. 62.60 m on Oct. 24, 2005
6											
7											
8											
9											
10											

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

PROJECT: 05-1120-760

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 05-3

BORING DATE: June 22, 2005

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		61.18							
	Power Auger 200mm Diam. (Hollow Stem)	Grey brown and red brown silty clay, trace roots and topsoil (FILL)		0.00	1	50 DO	1				Bentonite Seal
1											Native Backfill
		Grey brown and red brown SILTY CLAY (Weathered Crust)		59.50 1.68	2	50 DO	1				Bentonite Seal
2											Silica Sand
		Grey SANDY SILT		58.74 2.44	3	50 DO	1				
		Grey SILTY CLAY, occasional red brown layer		2.53							32mm Diam. PVC #10 Slot Screen
3					4	50 DO	WH				
					5	50 DO	WH				Silica Sand
4		End of Borehole		58.91 4.27							
5											Water level in screen at elev. 60.92 m on Oct. 24, 2005
6											
7											
8											
9											
10											

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

RECORD OF BOREHOLE: 05-4

PROJECT: 05-1120-760

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: June 22, 2005

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		62.59							
0	Power Auger 200mm Diam. (Hollow Stem)	Topsoil (FILL)		0.00 / 62.41							
		Grey brown silty clay, trace sand and plastic (FILL)		0.18 / 61.86							Bentonite Seal
		Grey brown and red brown SILTY CLAY (Weathered Crust)		0.73	1	50 DO	9				
1					2	50 DO	7				Native Backfill ▽
2					3	50 DO	5				Bentonite Seal
											Silica Sand ▽
3					4	50 DO	3				
				58.78							32mm Diam. PVC #10 Slot Screen B
4		Grey SILTY CLAY, occasional red brown layer		3.81	5	50 DO	WH				
				58.02							
		Grey SANDY SILT		4.57							Silica Sand
		Grey SILTY CLAY, occasional red brown layer		4.69	6	50 DO	1				
5											Bentonite Seal
					7	50 DO	WH				
6					8	50 DO	WH				32mm Diam. PVC #10 Slot Screen A
				55.43							
7		End of Borehole		7.16							
											Water level in screen A at elev. 59.63 m on Oct. 24, 2005
8											Water level in screen B at elev. 60.76 m on Oct. 24, 2005
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

PROJECT: 05-1120-760

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

RECORD OF BOREHOLE: 05-5

BORING DATE: June 22, 2005

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○; 20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		62.70							
		TOPSOIL		0.00							
		Grey brown silty clay (FILL)		62.52							
		Brown SANDY SILT		0.18							
		Grey brown and red brown SILTY CLAY, occasional very thin silt seam (Weathered Crust)		0.30							
1				0.46	1	50 DO	7				Bentonite Seal
											Native Backfill
2					2	50 DO	5				Bentonite Seal
											Silica Sand
3					3	50 DO	4				
		Grey SILTY CLAY, occasional red brown layer		59.71							32mm Diam. PVC #10 Slot Screen
				2.99	4	50 DO	WH				
4					5	50 DO	WH				Silica Sand
		End of Borehole		58.28							
				4.42							
5											Water level in screen at elev. 62.55 m on Oct. 24, 2005
6											
7											
8											
9											
10											

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

RECORD OF BOREHOLE: 05-6

PROJECT: 05-1120-760

LOCATION: See Site Plan

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: June 23, 2005

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		62.95							
0	Power Auger 200mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Grey brown silty clay (FILL)		0.15							
				62.49							
		Brown SANDY SILT		0.46							
		Grey brown and red brown SILTY CLAY, occasional very thin silt seam (Weathered Crust)		0.61							
1					1	50 DO	5				Bentonite Seal
					2	50 DO	3				Silica Sand
2					3	50 DO	1				32mm Diam. PVC #10 Slot Screen B
				59.99							
3		Grey SILTY CLAY, occasional red brown layer		2.96	4	50 DO	WH				
4					5	50 DO	WH				Bentonite Seal
											Silica Sand
				58.07	6	50 DO	1				
5		Grey SANDY SILT		4.88							32mm Diam. PVC #10 Slot Screen A
		Grey SILTY CLAY, occasional red brown layer		5.00	7	50 DO	WH				
6				56.85							
		End of Borehole		6.10							Water level in screen A at elev. 61.78 m on Oct. 24, 2005
7											Water level in screen B at elev. 62.29 m on Oct. 24, 2005
8											
9											
10											

BOREHOLE 05-1120-760.GPJ GLDR_CAN.GDT 2/12/06

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: P.H.

APPENDIX D

RISING HEAD TEST ANALYSIS

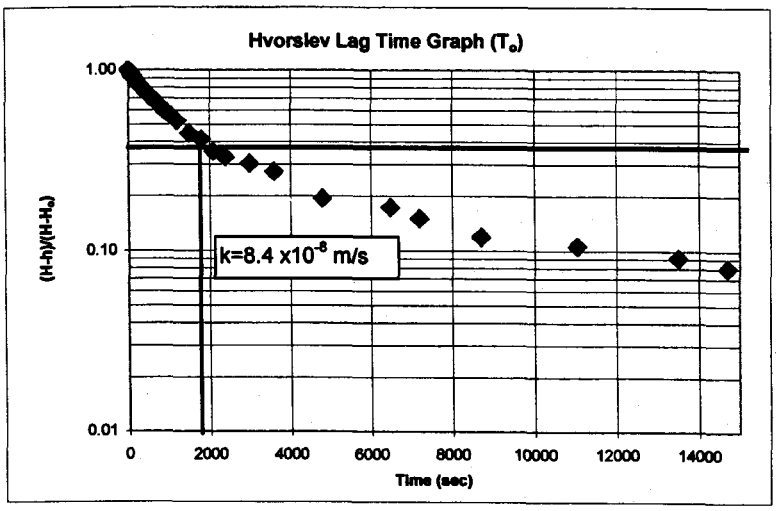
Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

Well Name = **MW05-1A**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	2.14 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	2.440 m	(use entire sand pack)
$H-H_o$ =	3.065 m	
Lag time (T_o) =	1950 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**8.42E-08 m/s**	
	8.42E-06 cm/s	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	5.21	3.07	1.00
10	5.18	3.04	0.99
20	5.15	3.01	0.98
30	5.14	3.00	0.98
40	5.12	2.98	0.97
50	5.09	2.95	0.96
60	5.07	2.93	0.96
70	5.04	2.90	0.94
80	5.02	2.88	0.94
90	5.01	2.87	0.93
100	4.99	2.85	0.93
110	4.95	2.81	0.92
120	4.94	2.80	0.91
150	4.90	2.76	0.90
180	4.84	2.70	0.88
210	4.75	2.61	0.85
240	4.72	2.58	0.84
270	4.69	2.55	0.83
300	4.63	2.49	0.81
360	4.56	2.42	0.79
420	4.45	2.31	0.75
480	4.40	2.26	0.74
540	4.33	2.19	0.71
600	4.255	2.12	0.69
720	4.135	2.00	0.65
840	4.015	1.88	0.61
960	3.925	1.79	0.58
1080	3.835	1.70	0.55
1200	3.745	1.61	0.52
1500	3.505	1.37	0.45
1800	3.405	1.27	0.41
2100	3.22	1.08	0.35
2400	3.145	1.01	0.33
3000	3.065	0.93	0.30
3600	2.975	0.84	0.27
4800	2.735	0.60	0.19
6480	2.67	0.53	0.17
7200	2.6	0.46	0.15
8700	2.505	0.37	0.12
11040	2.465	0.33	0.11
13500	2.42	0.28	0.09
14700	2.385	0.25	0.08



Prepared by: PH
Checked by: KAM

Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

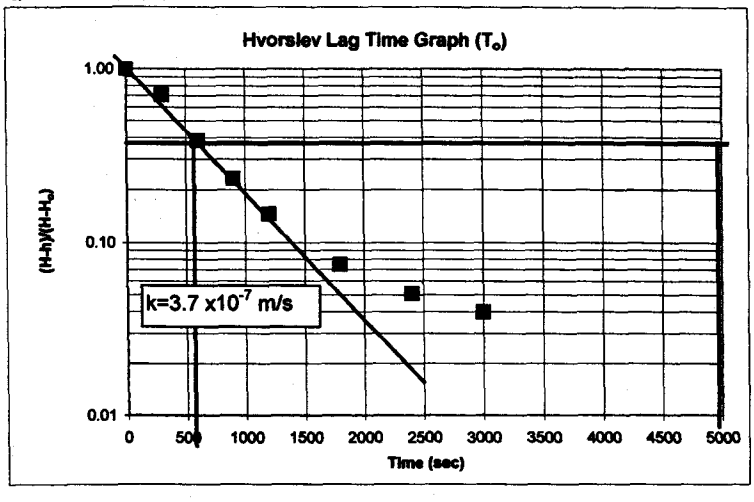
Well Name = **MW05-1B**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H) =	1.990 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	1.530 m	(sand pack)
$H-H_o$ =	0.885 m	
Lag time (T_o) =	600 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**3.7E-07 m/s**	
	3.7E-05 cm/s	

Lag time (T_o) = 600 sec (time at $(H-h)/(H-H_o)$ = 0.37 on graph)

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	2.875	0.89	1.00
300	2.616	0.63	0.71
600	2.330	0.34	0.38
900	2.195	0.21	0.23
1200	2.119	0.13	0.15
1800	2.056	0.07	0.07
2400	2.035	0.05	0.05
3000	2.025	0.03	0.04



Prepared by: PH
Checked by: KAM

February 2006

05-1120-760

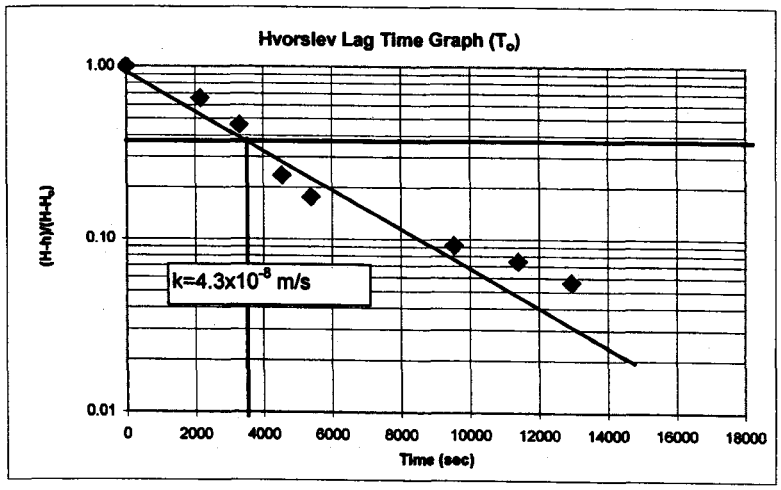
Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

Well Name = **MW05-2**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	1.830 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	2.440 m	(sand pack)
$H-H_o$ =	1.685 m	
Lag time (T_o) =	3800 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =		**4.32E-08 m/s** **4.32E-06 cm/s**

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.52	1.69	1.00
2160	2.94	1.11	0.66
3300	2.61	0.78	0.46
4560	2.23	0.40	0.23
5400	2.13	0.30	0.18
9540	1.99	0.16	0.09
11400	1.96	0.13	0.07
12960	1.93	0.10	0.06



Prepared by: PH
Checked by: KAM

Golder Associates

February 2006

05-1120-760

Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

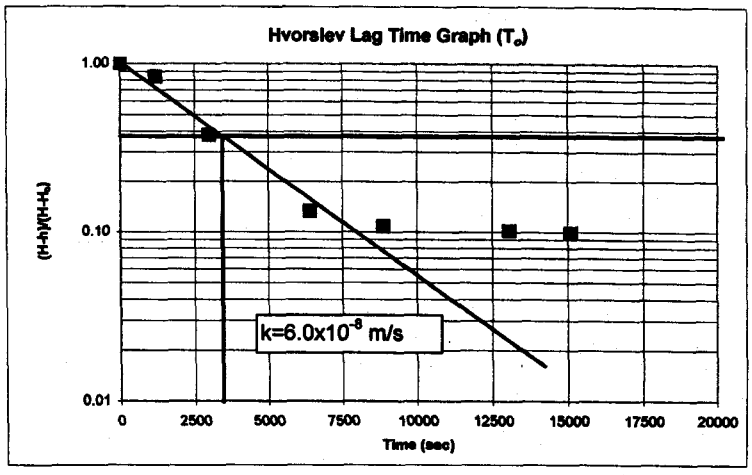
Well Name = **MW05-3**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	1.555 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	1.530 m	(sand pack)
$H-H_o$ =	1.580 m	
Lag time (T_o) =	3700 sec	(time at $(H-h)/(H-H_o) = 0.37$ on graph)

Hydraulic Cond.(K) = 6.04E-08 m/s
6.04E-06 cm/s

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.135	1.58	1.00
1200	2.875	1.32	0.84
3000	2.150	0.60	0.38
6420	1.765	0.21	0.13
8880	1.725	0.17	0.11
13080	1.715	0.16	0.10
15120	1.710	0.16	0.10



Prepared by: PH
Checked by: KAM

Golder Associates

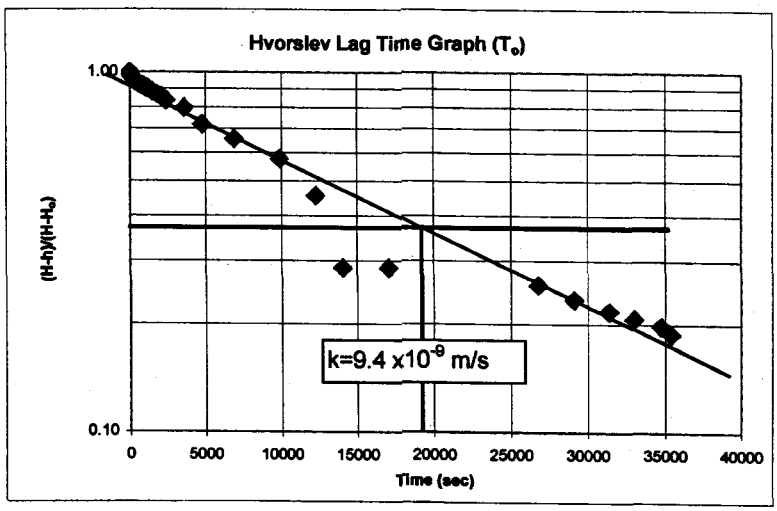
Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

Well Name = **MW05-4B**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	3.355 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	2.140 m	(sand pack)
$H-H_o$ =	1.520 m	
Lag time (T_o) =	19000 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**9.44E-09 m/s**	
	9.44E-07 cm/s	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	4.875	1.52	1.00
10	4.870	1.52	1.00
20	4.865	1.51	0.99
30	4.860	1.51	0.99
40	4.855	1.50	0.99
50	4.850	1.50	0.98
60	4.845	1.49	0.98
70	4.840	1.49	0.98
80	4.835	1.48	0.97
90	4.835	1.48	0.97
100	4.830	1.48	0.97
110	4.830	1.48	0.97
120	4.825	1.47	0.97
150	4.825	1.47	0.97
180	4.815	1.46	0.96
210	4.815	1.46	0.96
240	4.815	1.46	0.96
270	4.810	1.46	0.96
300	4.800	1.45	0.95
360	4.785	1.43	0.94
420	4.780	1.43	0.94
480	4.775	1.42	0.93
540	4.770	1.42	0.93
600	4.765	1.41	0.93
720	4.755	1.40	0.92
840	4.750	1.40	0.92
960	4.740	1.39	0.91
1080	4.730	1.38	0.90
1200	4.725	1.37	0.90
1500	4.695	1.34	0.88
1800	4.675	1.32	0.87
2100	4.655	1.30	0.86
2400	4.625	1.27	0.84
3600	4.565	1.21	0.80
4800	4.445	1.09	0.72
6900	4.350	1.00	0.65
9900	4.230	0.88	0.58
12300	4.045	0.69	0.45
14100	3.790	0.44	0.29
17100	3.790	0.44	0.29
26760	3.745	0.39	0.26
29100	3.710	0.36	0.23
31380	3.685	0.33	0.22
33000	3.670	0.32	0.21
34740	3.655	0.30	0.20
35400	3.640	0.29	0.19



Prepared by: PH
Checked by: KAM

Golder Associates

February 2006

05-1120-760

Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

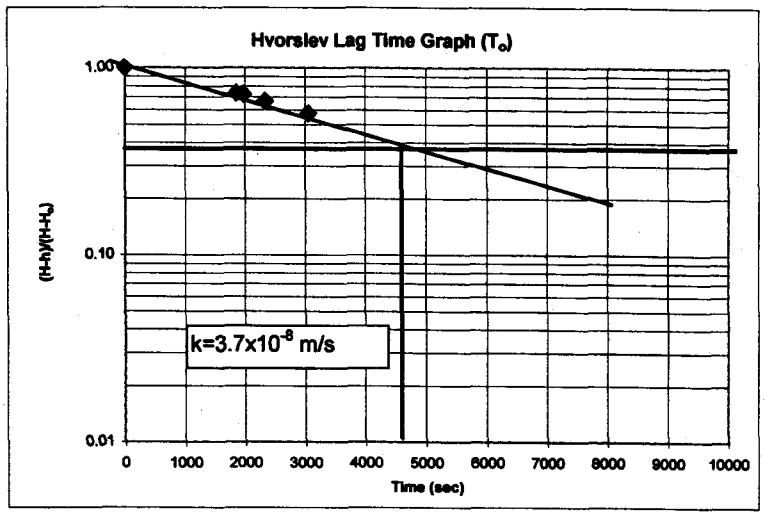
Well Name = **MW05-5**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	1.545 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	2.380 m	(sand pack)
$H-H_o$ =	1.545 m	
Lag time (T_o) =	4500 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)

Hydraulic Cond.(K) = 3.71E-08 m/s
3.71E-06 cm/s

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.09	1.55	1.00
1860	2.68	1.14	0.73
1980	2.67	1.12	0.72
2340	2.58	1.03	0.67
3060	2.43	0.89	0.57



Prepared by: PH
Checked by: KAM

Golder Associates

February 2006

05-1120-760

Hvorslev Calculation
(for Hydraulic Conductivity from Rising Head Tests)

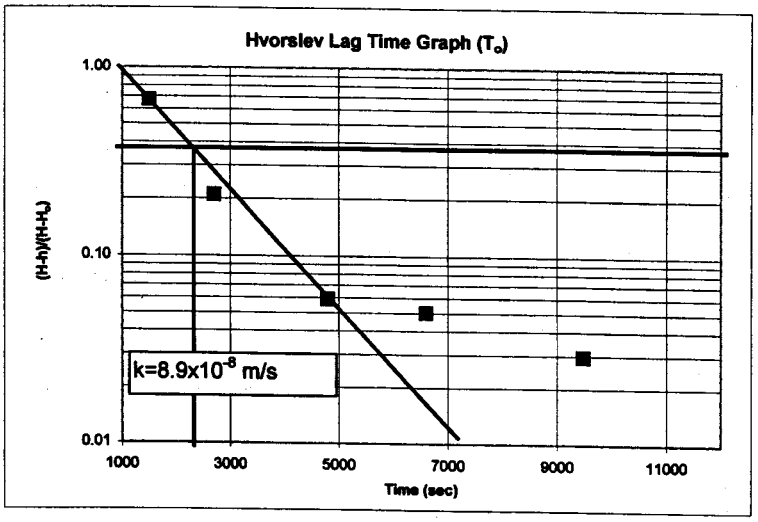
Well Name = **MW05-6B**

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Initial WL (H_o) =	1.565 m	(Static)
Radius of pipe (r) =	0.016 m	(1.25 inch diameter)
Radius of hole (R) =	0.102 m	(8 inch diameter)
Length of screen (L) =	1.890 m	(sand pack)
$H-H_o$ =	1.695 m	
Lag time (T_o) =	2200 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)

Hydraulic Cond.(K) = 8.86E-08 m/s
8.86E-06 cm/s

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.26	1.70	1.00
300	3.22	1.65	0.97
1500	2.71	1.14	0.67
2700	1.92	0.36	0.21
4800	1.67	0.10	0.06
6600	1.65	0.09	0.05
9480	1.62	0.05	0.03
15000	1.62	0.05	0.03
22260	1.62	0.05	0.03



Prepared by: PH
Checked by: KAM

Golder Associates

APPENDIX E

PHOTOS OF SURFACE WATER STATIONS