2006 SUPPLEMENTAL HYDROGEOLOGY PROGRAM

WASTE MANAGEMENT CANADA INC., RICHMOND LANDFILL

TOWN OF GREATER NAPANEE, ONTARIO

Prepared for:

Waste Management Of Canada Corporation
R.R. # 6 (Beechwood Road)
Napanee, ON   K8R 3L1

October 2008

WESA
A Better Environment For Business

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1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION / SCOPE OF INVESTIGATION

WESA Inc. was retained by Waste Management of Canada Corporation (WM) to complete a hydrogeological evaluation at the Richmond landfill, aimed at supplementing the available data and site knowledge.

The work presented in this document was conducted in 2006 in order to supplement site information, in particular to verify and, if necessary, to update the site hydrogeologic conceptual model. Since that time, a significant amount of additional work was done in consultation with MOE to address their remaining concerns related to the site hydrogeologic conceptual model, in particular with respect to the direction of shallow groundwater flow at the site. Other than a few specific elements (borehole logs, photographs), the information derived from the present study and presented here was not previously presented to the Ministry of the Environment (MOE).

Although the investigation described herein pre-dates the most recent hydrogeologic work conducted at the site[1], the results are entirely consistent with, and corroborate, the site hydrogeologic conceptual model developed and refined through the course of numerous studies conducted over the past 30 years.

The purpose of this study was to investigate the bedrock hydrogeology on the site to a depth of up to 30 metres between the landfill footprint and the western landfill property boundary and north of Marysville Creek. The objectives were to:

- examine the structure, fracture patterns and vertical fracturing of the bedrock at the site by additional testing, in particular in the portion of the site located north of Marysville Creek;
- assess the hydrogeological significance of fracture zones encountered during the investigation; and
- utilise the collected information to refine the hydrogeologic conceptual model for the facility, if necessary.

The main focus of this investigation targeted the identification of potential fracture zones by conducting a phased field program by gradually narrowing down on the areas of the site where potentially water bearing fractures were identified.

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[1] WESA, 2008: *June 2008 Supplemental Hydrogeologic Investigation – Richmond Landfill,* Memorandum to Christopher Prucha and Randy Harris (WM) dated July 23, 2008.

2.0 METHODOLOGY

A multidisciplinary approach was adopted to identify, characterize and locate potential transport pathways in the bedrock. Field work completed during the course of this investigation included the following components:

- Geophysics (~9 km of galvanic resistivity survey lines);
- Excavation of seven overburden trenches to bedrock at locations corresponding to identified geophysical anomalies where sub-vertical fractures in the bedrock were potentially present;
- Advancement of 5 angled boreholes to a depth of 30 m below the bedrock surface;
- Hydraulic testing at discrete 3 m intervals for the entire length of the angled boreholes;
- Installation of groundwater monitors in the angled holes;
- Drilling of vertical boreholes and installation of groundwater monitors at locations adjacent to angled holes;
- Monitoring well hydraulic testing;
- Water quality sampling including purging/development of all new groundwater monitors; and
- Completion of kinematic differential GPS survey of all new monitors and trench locations.

2.1 GEOPHYSICS

Dillon Consulting Limited (Dillon) was retained to perform a galvanic resistivity survey to locate geophysical anomalies that may be indicative of potential fractures zones in the shallow bedrock at the site, to assist in the identification of the targets for trenching and borehole drilling, and to provide insight to the hydrogeologic nature of the bedrock at the site. This work consisted of two phases of field investigation (spring and autumn) and subsequent data analysis and reporting. Combined, the two rounds of geophysics account for approximately 9 km of transects that provide detailed coverage of the northern portion of the site and coverage of select areas of the southern portion of the site. The geophysics transects are plotted on FIGURE 1.

2.2 TRENCHING

The objective of the trenching investigation was to target the most significant anomalies observed in the geophysical survey and document the general condition of the bedrock surface. The goal was the identification of vertical fracturing on the bedrock surface.

The location and orientation of seven (7) trenches were selected based on the identification of anomalies by the geophysical investigation. Trenching was conducted using a 235C CAT tracked excavator, operated by Waste Management staff and supervised by WESA staff. The locations of the trenching excavations are plotted on FIGURE 1. Figures and photographs showing bedrock features are provided in Appendix B

2.3 BOREHOLE DRILLING

A total of eight (8) boreholes were drilled between September 20 to October 5 (5 angled holes), and October 23-24 (3 vertical holes). The locations of the boreholes were carefully selected to intersect the potential fracture zones that were identified by the earlier geophysics investigation and subsequent trenching.

The first phase of drilling comprised the advancement of 5 angled HQ (95 mm) boreholes to a depth of approximately 30 m below bedrock surface. Drilling was completed by Downing Estate Drilling using a Boart Longyear LF70 core drill. These boreholes are identified as M91-1, M92, M93, M94-1 and M95-1 as shown on FIGURE 1. Boreholes were drilled at an angle of 30° off vertical on a strike to intersect any sub-vertical feature that may have been responsible for the anomaly identified in the geophysics survey or identified as a result of the trenching program.

After drilling through the overburden, steel casing was installed from ground surface and set into the upper portion of the bedrock. Continuous core sampling was done for each 1.5 m of the borehole. Core was logged in the field and placed into core boxes for later additional inspection and photography. Logging of the core included observations on the rock type, total length of core and the number, distribution and orientation of fractures. The core was also described quantitatively using Rock Quality Designation (RQD). Additionally, during the drilling procedure the operator and supervising WESA staff noted relative advancement rates and zones of drilling water loss.

Based on the results of the hydraulic testing of the angled holes, 3 additional vertical boreholes were drilled by MPI Drilling (995598 Ontario, Inc.) using a CME 45 drill rig equipped with an air hammer drill. Boreholes (6” 152mm diameter) were advanced through the overburden and cased off to bedrock and continued as 4” (102mm) diameter holes through bedrock to finished depth.

The objective of drilling these vertical boreholes was to intersect and instrument zones of higher hydraulic conductivity identified by the discrete zone hydraulic testing in the angled boreholes. Vertical boreholes were installed adjacent to M91-1, M94-1 and M95-1 and named M91-2, M94-2 and M95-2 respectively. Locations and screened intervals of the completed groundwater monitors installed in the vertical holes, and angled boreholes are discussed in the following sections.

2.4 FORMATION HYDRAULIC TESTING

Hydraulic testing of each angle borehole was conducted to obtain direct measurements of the bulk rock transmissivity of the formations at each location. Testing was done using a straddle packer injection system designed by WESA in collaboration with Dr. K. Novakowski, Associate Professor in the Department of Civil Engineering at Queen's University in Kingston, Ontario. The system was designed to measure a range of bulk rock transmissivities in the range from 10^{-4} m^2/s to 10^{-11} m^2/s based on a 3 metre test section.

Discrete sections of each borehole were isolated using a pair of pneumatically inflated packers and then hydraulically tested using an injection system. Water was injected using a series of manometers of varying diameters at ground surface, hydraulically connected via polyethylene tubing to the isolated zone in the borehole. The rate of decline of the water level in the manometer was monitored and recorded to obtain a measurement of the volumetric flow rate of the injected water. This provided a quantitative measurement of the permeability of the test interval. The range of bulk rock transmissivities was measured using either the large diameter tubing for the higher permeabilities or the smaller diameter tube for the lower permeability test intervals. Water level measurements were recorded for a minimum of 20 minutes or until the level had dropped below the manometer. Down hole pressure-transducer readings were also recorded and logged in the field to provide information on the static head of the injection interval. Transducer data were logged electronically on a portable computer.

Each borehole (M91, M92, M93, M94 and M95) was tested sequentially from bottom to top to provide a continuous record of permeability/hydraulic conductivity with depth.
To interpret the hydraulic testing data collected during the packer testing described above, WESA used data analysis methods developed by Dr. K Novakowski to estimate the relative transmissivity of each of the intervals tested in the angle boreholes. The data analysis methodology is based on the Thiem equation modified for single well injection tests.

It should be noted that transmissivities (T) on the order of 10^{-11} m^2/s represent the lower limit of the testing method. Hydraulic conductivity is calculated from transmissivity using K=T/b where b is the formation thickness. The formation thickness being tested is the space between the packer assembly, in this case 3 m. Therefore the lower limit of derived transmissivity converts to a lower limit for determined hydraulic conductivity of 3.3 X 10^{-12} m/s. The hydraulic conductivity values at the lower limit of the testing method were represented by a conservative value on the order of 10^{-11} m/s, however, values in this range are more accurately represented as "less than 10^{-11} m/s", and indicate extremely low rates of advective groundwater movement. A detailed description of the straddle packer injection system, the testing methods, QA/QC protocol used during testing, data interpretation and results are included in Appendix C.

2.5 GROUNDWATER MONITOR INSTALLATION AND DEVELOPMENT

The target zone for the groundwater monitors in the angled boreholes was selected based on the hydraulic conductivity results, focusing on the most permeable zone in each borehole. The monitor was installed at the targeted depth by first pumping a 20% solids bentonite quick grout through a tremie pipe to bring the bottom of the borehole close to the desired installation depth. A layer of #1 silica sand and then #3 silica sand was placed on top of the quick grout bringing each hole to the desired installation depth. A 3.05 m Slot 20 PVC screen was placed in each hole on the silica sand base. #3 silica sand filter packs were installed around each screen and #1 silica sand was placed above each filter pack to prevent grout from entering the screened zones. To complete the installation a 20% solids bentonite quick grout was pumped through a tremie pipe from the top of the finished sand pack to surface. Protective steel (6") casings were pushed over the 4" drill casing and fitted with locking covers.

Vertical monitors were completed with 3.05 m Slot 20 PVC screen surrounded by a #3 silica sand filter pack. Each monitor was isolated in its respective bedrock zone with 3/8" bentonite hole plug above the filter pack to surface. 6" protective steel casing with locking covers were installed at surface. Boreholes were air lifted by the driller at completion of the hole to remove cuttings and assist in purging out non-formation water. Borehole logs including groundwater monitor installation details are included in Appendix D. Screened intervals for the completed monitors are listed in Table 1, which also identifies the hydrostratigraphic interval for the screened interval. Note that because of the extremely low permeability observed in borehole M92 from the hydraulic testing, no groundwater monitor was installed at this location.

Table 1: Summary of Monitored Intervals

Monitor	Borehole Type	Overburden Thickness (m)	Screened interval (mbgs)*		Hydrostratigraphic Interval
			top of screen	Bottom of Screen	
M91-1	Angle	8.35	19.97	22.61	Deeper Bedrock
M91-2	Vertical	7.62	8.75	12.25	Shallow Bedrock
M92	Angle	0.38	Extremely low K - no groundwater monitor installed		
M93	Angle	0.92	7.13	9.77	Shallow Bedrock
M94-1	Angle	1.91	16.63	19.27	Deeper Bedrock
M94-2	Vertical	2.13	3.40	6.40	Shallow Bedrock
M95-1	Angle	1.31	14.52	17.16	Deeper Bedrock
M95-2	Vertical	1.37	2.60	5.60	Shallow Bedrock

** Depths corrected to vertical for angle boreholes (M91-1, M93, M94-1 and M95-1)*

After groundwater monitors were installed, standing water was hand purged until the monitor was dry or several well volumes were removed. Groundwater levels were measured on November 28, 2006 and the monitors were further developed by hand purging. During purging, field pH, conductivity and temperature were monitored. On all occasions, all monitors where quickly purged dry with the exception of M95, where hand purging or mechanical purging with a Waterra Hydrolift pump did not result in any notable change to the groundwater level.

2.6 GROUNDWATER MONITOR HYDRAULIC TESTING

Recovery tests to determine the hydraulic conductivity of the installed monitors were conducted on November 17, 2006. The field procedure for this testing included the rapid drawdown of the standing water in the monitor to a near empty condition using a Waterra™ power pump, followed by monitoring of the water level recovery using a Solinst level logger data logger. Measurement interval was initially set to less then 5 seconds and decreased over time as the rate of water level recovery decreased over the duration of the test. Hydraulic conductivity was calculated using AquiferTest™ software. Results are included in Appendix C and discussed in Section 3.0.

2.7 GROUNDWATER MONITOR SAMPLING

Groundwater samples were collected in general accordance with the Waste Management Groundwater, Surface Water, and Leachate Sampling Guide (March, 2004). Groundwater monitors M91-1/-2, M93, M94-1/-2 and M95-1/-2 were sampled on November 28, 2006. Prior to sampling water levels in the monitors were recorded. Groundwater samples were collected using a dedicated Waterra™ inertial lift pump connected to dedicated polyethylene tubing and foot valve.

Monitor M91-2 had approximately 0.48 m of water in the monitor and was insufficient for representative sampling after purging. Monitor M95-2 had approximately 0.63 m of water but recovered sufficiently after purging and was sampled.

A minimum of three times the volume of water standing in the monitor was purged prior to sampling. During purging, field measurements of pH, conductivity and temperature were recorded on a regular basis. Low producing wells were purged dry prior to sampling and allowed to recover prior to sampling. Groundwater samples were field filtered through 0.45 micron filters into sample bottles supplied by the laboratory with preservatives appropriate for parameters suites to be analysed for.

The samples were refrigerated after sampling, at approximately 4°C, until they were submitted to the laboratory. Samples were kept under strict chain of custody control and delivered by WESA sampling personnel directly to the analytical laboratory. All samples for inorganic and organic parameters were analyzed by Accutest Laboratories Ltd. of Nepean, Ontario.

The parameter list was comprised of the parameters listed in Column 1 - Comprehensive List for Groundwater and Leachate from O.reg. 232/98 SCHEDULE 5 plus select additional parameters. A Table of parameters analysed for is included in Appendix E, along with laboratory reports for groundwater quality and summary tables.

3.0 RESULTS

3.1 GEOPHYSICAL SURVEYS

The Dillon report “Report on the Geophysical Surveys Conducted at Richmond Landfill Napanee, Ontario” is included as Appendix A. The data collected for the resistivity survey are considered to be very good to excellent. The resistivity survey successfully mapped weathered and potential fracture zones in the shallow bedrock.

Transects conducted in the southern portion of the site exhibited excellent correlation both with the previous Very Low Frequency (VLF) interpretations and the adjacent boreholes’ pumping test results. The resistivity results show good correlation with several geophysical anomalies identified in the previous VLF surveys in both the north and south portions of the site. The VLF surveys (conducted at the site in 1998 and 2003) may be considered as a reconnaissance level tool, while the resistivity technique used in the present study is considered a more appropriate or decisive method of detecting the locations of fractures or other anomalies in the shallow bedrock.

Anomalies were interpreted as two types of features based on the resistivity signature. Anomalies of high to moderate resistivity pockets or distinct discontinuities in the resistivity signature were interpreted as potential fractures and anomalies of relatively uniform, moderate resistivity were interpreted as areas of weathering or horizontal bedding. Bedrock surface features observed during the trenching phase of the investigation support these interpretations.

In the southwest corner, in the vicinity of the drumlin, there is grouping of anomalies interpreted as indicative of increased weathering of the bedrock and/or potentially granular material directly above the bedrock.

Of the various anomalies identified in the resistivity data, there does not appear to be any grouping or trend that extends across the site nor was there evidence of subvertical fracture extensiveness or lateral continuity of fractures or other features.

3.2 BEDROCK GEOLOGY

The bedrock underlying the site consists of Middle Ordovician limestone of the Simcoe Group. These formations consist predominantly of lithographic to sublithographic limestone with occasional shaley beds (mudstone).

Five boreholes were advanced to approximately 30 mbgs at an angle of 30 degrees from vertical. Bedrock core retrieved from the angled holes drilled as part of this investigation included observations on the rock type and the number, distribution and orientation of fractures. The core was also described quantitatively using Rock Quality Designation (RQD).

Results of the bedrock coring indicated that fracturing of the bedrock is generally limited to the upper portion of the bedrock. With depth, fracture spacings increased and RQD values were greater than 80% at 7 metres or greater below ground surface. These results are consistent with those from previous coring investigations.

Borehole logs (Appendix D) include fracture frequency, RQD values in addition to stratigraphic/lithographic and monitor installation details.

3.3 TRENCHING

Trenches were excavated to bedrock to examine any surface expression of the anomalies identified in the geophysics survey. The geophysical surveys identified anomalies that were broadly classified into two categories. Moderate to high resistivity pockets appearing as more spatially discrete correlated with fracture features observed in the bedrock surface of the trenches; the broader, moderate and irregular moderate resistivity anomalies correlated with weathered bedrock surfaces observed in the trenched excavations.

In total approximately 885 m of trenching was completed between Oct 20 and 26, 2006. Overburden thickness ranged from 0.47 m to 2.86 m across all trenching, but was generally limited to 2 m or less. This information, along with bedrock surface features, is summarized in Table 2. Refer to Figure 1 for the trench locations.

Table 2: Summary of Trenching Results

Trench ID	Length (m)	Overburden Thickness (m)	Summary of Bedrock Surface Features
L-6	45.0	1.01 to 2.01	Flat. Generally very smooth and unweathered with east-west glacial striations. Small area of surface weathering. Dry, no groundwater seepage observed
L-9	100.0	1.70 to 2.39	Flat. With several small ledges/bedding surfaces 2 to 8 cm thick. Very small amount of groundwater seepage observed from bedding layers.
L-12	48.0	1.20 to 1.90	Flat. Generally smooth and unweathered. Till filled fracture and one ledge. Very small amount of groundwater discharge from small vertical fracture.
L-13	77.5	2.12 to 2.86	Generally very smooth and unweathered with east-west glacial striations. Some small bedding ledges. 10 to 25 cm of seepage overnight from overburden/bedrock contact.
L-15	70.0	1.77 to 2.07	Flat. Two small discontinuous vertical fractures with groundwater seepage. Generally smooth unweathered surface except for 32 m length of weathered surface
L-17	52.0	0.80 to 0.83	Generally smooth and unweathered with east-west glacial striations. One 12.8 m long section of weathered surface. One vertical fracture trending east-west.
L-18	60.0	0.47 to 0.88	Smooth and unweathered sections with east-west glacial striations. One 23 m long section of weathered surface. One vertical fracture trending NW-SE.

The majority of the exposed bedrock surface was smooth and unweathered, and exhibited glacial striations (east-west) and polishing. Minimal groundwater seepage or discharge was observed in the trenches with the notable exception of Trench L-13, located immediately adjacent to the compost pond as shown on Figure 1. Approximately 0.1 to 0.25 m of groundwater seepage from the overburden-bedrock contact entered the Trench L-13 overnight. Small, discrete areas of groundwater discharge were observed in Trench L-9, along thin horizontal bedding, and in Trench L-12 from a thin, discontinuous subvertical fracture. A common feature observed in the trenching investigation was small horizontal step-like bedding (a few centimeters). This is characteristic of the horizontal bedding of the Verulam Formation.

3.4 HYDRAULIC TESTING

Transmissivity and hydraulic conductivity values were calculated for each hydraulic test interval using the Thiem equation methodology as described in Appendix C. Data used for each calculation included static hydraulic heads, select pressure transducer readings and volumetric flow rates of the injection water are also reported in Appendix C and the results are summarised in Table C-1 for each test interval in the seven angle boreholes. A value reported as 10^{-11} m/s is considered to be maximum possible hydraulic conductivity for the test intervals at the lower measurement limit of the testing method and equipment.

Hydraulic conductivity of the bedrock was found to range from 10^{-5} m/s to the lower testing limit of 10^{-11} m/s. In general, each borehole exhibited a range in hydraulic conductivity of a minimum of 4 orders of magnitude between discrete test intervals. Hydraulic conductivity variations between boreholes were also observed.

The bulk rock hydraulic conductivities with depth for each borehole are illustrated on Figure 2. Examination of hydraulic conductivities with depth in each borehole indicates that in general (three of the five boreholes tested), zones of higher relative conductivity are found in the upper 10 metres of the bedrock. While the shallow bedrock exhibits higher relative borehole conductivities, in many cases the hydraulic conductivities of this zone are on the order of 10^{-7} to 10^{-9} m/s and are still considered to be of low permeability. This discrete shallow zone of relatively higher hydraulic conductivity was noted specifically at borehole locations M91, M93 and M94.

A second zone of elevated relative conductivity from approximately 12 to 18 mbgs was noted in two of the five boreholes: M93 and M94. Hydraulic conductivities for this interval range from 10^{-6} m/s at M94 to 10^{-8} m/s in M93. It should be noted that while this range of hydraulic conductivities is relatively high compared with overall conductivities measured on site, it is considered to be in the low to moderate range compared with general bulk rock conductivities. Within the boreholes M93 and M94, this interval is bounded above and below by low permeability bedrock with hydraulic conductivity values in the range of 10^{-9} m/s to 10^{-11} m/s. An exception to this distribution was noted in M91 and M95. In M91 elevated relative conductivities are observed as in the previous boreholes tested between 11.5 and 21.5 m bgs but a zone of very low hydraulic conductivity (less than 10^{-11} m/s) divides the zone and extends between 14.5 and 19 mbgs. The zone of very low hydraulic conductivity ultimately divides the second zone into two distinct zones of higher relative conductivities. M95 shows a zone of higher relative conductivities (between 10^{-5} to 10^{-8} m/s) extending from approximately 9.6 to 22 mbgs. This zone is isolated above and below by bedrock exhibiting decreasing hydraulic conductivities as one moves away (both up and down) from this relatively higher zone.

Zones of low to very low hydraulic conductivities were observed at depth in four of the five boreholes (M91, M93, M94 and M95). Test intervals with low hydraulic conductivities were observed between 20 and 30 mbgs in the boreholes tested. Hydraulic conductivities that define the zones range 10^{-9} to 10^{-11} m/s. Borehole M92 exhibited a unique distribution of hydraulic conductivity with depth (Figure 2). Hydraulic conductivities measured in the upper 27 metres of the bedrock were less than 10^{-11} m/s. A zone of elevated relative hydraulic conductivity was noted between 27 and 29.5 mbgs at 10^{-7} m/s.

Throughout the hydraulic testing, two duplicate tests were conducted to test the reproducibility of the injection flow rates and the equipment assembly. Duplicate tests were reproducible within less than one third of an order of magnitude indicating that both the manometer readings for the flow rate calculations and the equipment assembly were consistent during the hydraulic testing on site.

3.5 GROUNDWATER QUALITY

Groundwater quality results for samples collected on November 28, 2006 are included in Appendix E and tabulated below in Table 3.

Previous investigations and monitoring at the landfill indicate that natural groundwater quality varies across the site and with depth in the bedrock. Salinity (as defined by chloride, conductivity and other dissolved constituents) is found at high concentrations in some monitors, often deep but sometimes shallow, and naturally occurring hydrocarbon compounds such as benzene, toluene, ethylbenzene and xylene (BTEX) are frequently detected.

The elevated sodium, chloride and other parameters observed at M94-1 are within the ranges of concentrations observed at some other deeper monitors where naturally saline water has been encountered. The groundwater quality at location M94-2 (screened shallower than M94-1) is not similar to that observed at the deeper M94-1, although it exhibits slightly saline characteristics. The elevated concentrations of some parameters observed at M94-1 reflect the naturally poor water quality that is historically documented at many monitors across the site.

Table 3: Summary of Groundwater Quality Results

Parameter	Units	M91-1	M93	M94-1	M94-2	M95-1	M95-2
Inorganics							
Alkalinity	mg/L	336	344	259	297	337	305
Aluminum	mg/L	< 0.01	0.04	< 0.1	0.02	0.02	0.01
Ammonia	mg/L	2.94	2.03	8.95	0.7	0.19	0.33
Arsenic	mg/L	< 0.001	0.004	0.14	0.006	< 0.001	0.001
Barium	mg/L	0.05	0.01	1.1	0.1	0.09	0.07
Boron	mg/L	0.35	0.6	1.2	0.37	0.03	0.37
Cadmium	mg/L	< 0.0001	< 0.0001	< 0.001	< 0.0001	< 0.0001	< 0.0001
Calcium	mg/L	65	43	958	185	113	246
Chloride	mg/L	52	108	10900	353	13	66
Chromium	mg/L	0.001	0.002	< 0.01	0.002	0.002	0.002
Conductivity	us/cm	1070	1250	28100	2390	766	1760
Copper	mg/L	< 0.001	< 0.001	< 0.01	0.001	< 0.001	0.002
Hardness	mg/L	232	169	5390	602	389	816
Iron	mg/L	0.03	0.07	< 0.3	0.08	0.18	0.29
Lead	mg/L	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001
Magnesium	mg/L	17	15	728	34	26	49
Manganese	mg/L	0.07	0.04	< 0.1	0.1	0.02	0.08
Mercury	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nitrate	mg/L	< 0.1	< 0.1	< 0.1	0.18	0.27	< 0.1
Nitrite	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
pH	unitless	8.23	8.2	7.58	8.11	8.02	7.95
Phosphorus (total)	mg/L	0.04	0.26	0.24	0.37	0.12	0.19
Potassium	mg/L	19	19	87	12	2	8
Silver	mg/L	< 0.0001	< 0.0001	< 0.001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	123	191	3970	271	11	95
Sulphate	mg/L	129	128	21	424	76	561
Total Dissolved Solids	mg/L	696	813	18300	1670	498	1320
Total Kjeldahl Nitrogen	mg/L	3.02	2.15	10.7	1.27	0.32	0.83
Zinc	mg/L	< 0.01	< 0.01	< 0.1	0.01	< 0.01	< 0.01
Organics							
1,4-Dichlorobenzene (p)	mg/L	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004
Benzene	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chemical Oxygen Demand	mg/L	10	38	390	15	< 5	16
Dichloromethane	mg/L	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Dissolved Organic Carbon	mg/L	2.8	2.9	1.5	6.2	2.0	6.0
Ethylbenzene	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
m+p-Xylene	mg/L	< 0.001	< 0.001	0.0041	< 0.001	< 0.001	< 0.001
o-Xylene	mg/L	< 0.0005	< 0.0005	0.001	< 0.0005	< 0.0005	< 0.0005
Phenols	mg/L	< 0.001	0.012	0.035	< 0.001	< 0.001	< 0.001
Total Organic Carbon	mg/L	2.9	3.0	1.5	5.8	3.0	6.0
Toluene	mg/L	< 0.0005	0.0025	0.0226	< 0.0005	< 0.0005	< 0.0005
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

4.0 DISCUSSION AND CONCLUSIONS

The objective of this investigation was to identify and characterise bedrock fracture patterns and structural features to a depth of 30 metres, in particular for the northern portion of the site. A phased field program consisting of geophysics, trenching, drilling, hydraulic testing and groundwater sampling was conducted to assess the hydrogeological significance of possible groundwater flowpaths and their implications with respect to potential leachate migration. Groundwater sampling was conducted to characterize the existing groundwater conditions in the new monitors.

A more detailed geophysical method (galvanic resistivity) was used for detecting fractures or other anomalies in the shallow bedrock, to supplement and refine the earlier reconnaissance geophysical results (VLF). Trenching to top of bedrock surface at locations where anomalies were identified by the geophysical surveys substantiated the geophysical interpretations of bedrock weathering and potential subvertical fractures. No evidence of subvertical fracture extensiveness or lateral continuity of fractures or other features was apparent. Angled boreholes were drilled to intersect potential water bearing fractures observed at the bedrock surface following trenching, and were hydraulically tested along their entire length at discrete depth intervals isolated by packers. Bedrock coring and hydraulic testing indicated that fracturing of the bedrock is largely limited to the upper portion of the bedrock as previously identified. The following conclusions can be drawn from the data collected as part of this investigation:

- Geophysics resistivity transects conducted in the southern portion of the site exhibited excellent correlation both with the previous VLF interpretations and the adjacent borehole pumping test results.
- The significant chainage of resistivity survey completed in the north footprint identified various anomalies that were interpreted as potential vertical fracture features or weathering features.
- There does not appear to be any geophysical anomaly grouping or trend that extends across the site nor was evidence of subvertical fracture extensiveness or lateral continuity of fractures or other features apparent.
- Almost 900 m of trenching was completed to bedrock surface to examine surface expression of observed geophysical anomalies. Overburden was predominantly till and ranged in thickness from approximately 0.5 m to 2.9 m. The bedrock was generally smooth, typically unweathered and flat lying. Very little groundwater seepage was observed.

- There was excellent correlation between interpreted geophysics anomalies and observed bedrock surface weathering features and subvertical fractures.
- Results of the bedrock coring indicates that fracturing of the bedrock is largely limited to the upper most portion of the bedrock and that with depth the spacing between fractures increases. These results are consistent with those from previous coring investigations.
- Discrete interval bulk hydraulic transmissivity/conductivity testing along the length of the angled boreholes indicated that generally the formations are tight and have low transmissivity.
- Hydraulic testing of the installed groundwater monitors correlated well with the bulk hydraulic testing at similar depth intervals in the borehole.
- The groundwater quality results were consistent with those observed across the site and with historical data. Monitor M94-1 intersected groundwater that is naturally saline with detectable BTEX components. Similar conditions have been previously documented at this site.

The hydrogeological investigation described herein yielded data that correlated very well with previous investigations and further substantiated the existing hydrogeological model for the site. Additional field programs developed in consultation with the MOE were conducted after the present study had been completed, and results from this more recent work fully support and corroborate the site hydrogeologic conceptual model.

Respectfully submitted,

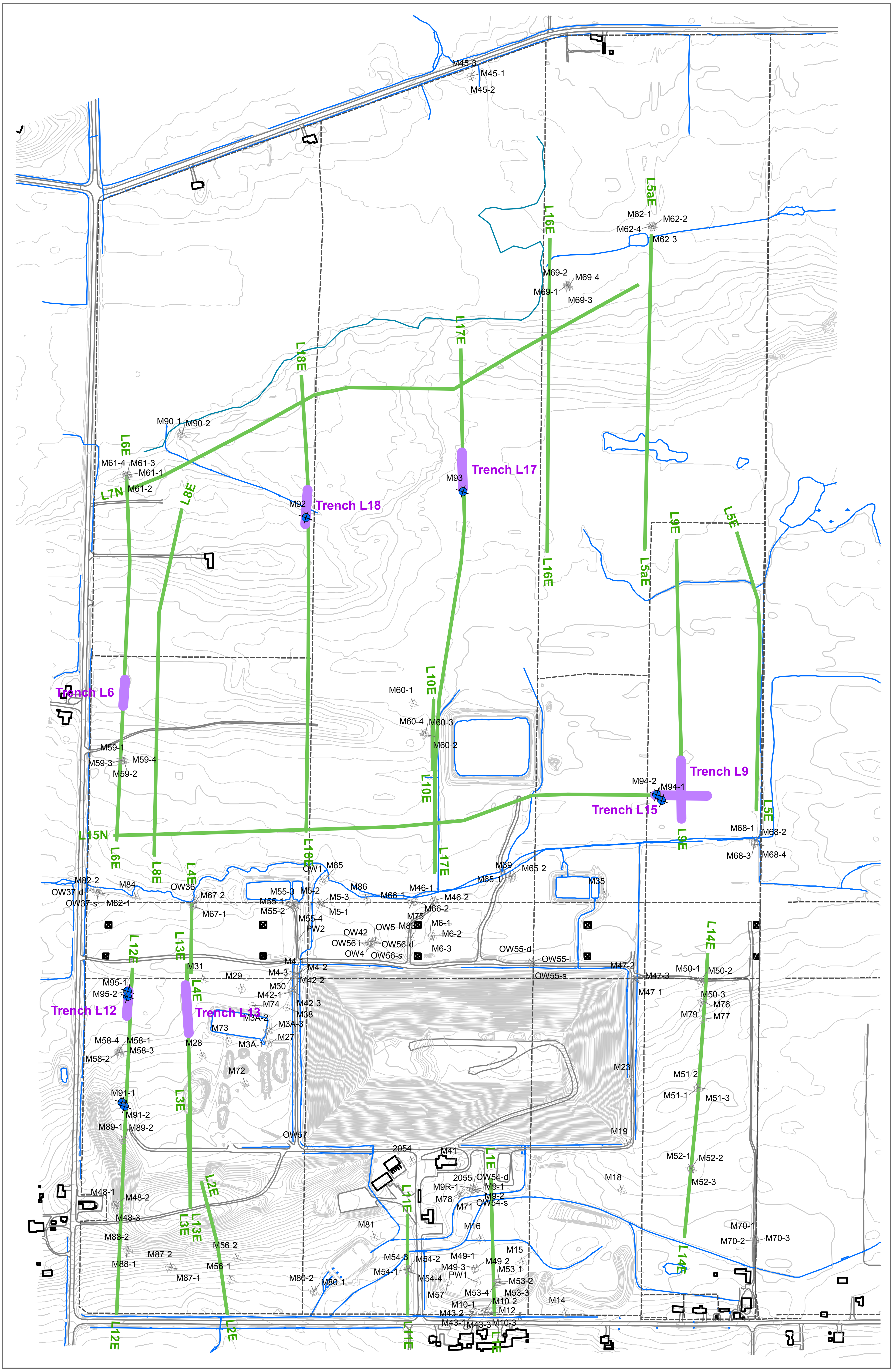
David Harding

Philip A. Tibble, M. Sc. P.Geo.
Project Hydrogeologist

David Harding, M.Sc. P.Eng.
Senior Consulting Engineer

François A. Richard, Ph.D. P.Geo.
Senior Hydrogeologist

List Of Figures



WASTE MANAGEMENT RICHMOND LANDFILL

Figure 1:
WMC Richmond Landfill
2006 Supplemental Hydrogeological Investigation

LEGEND

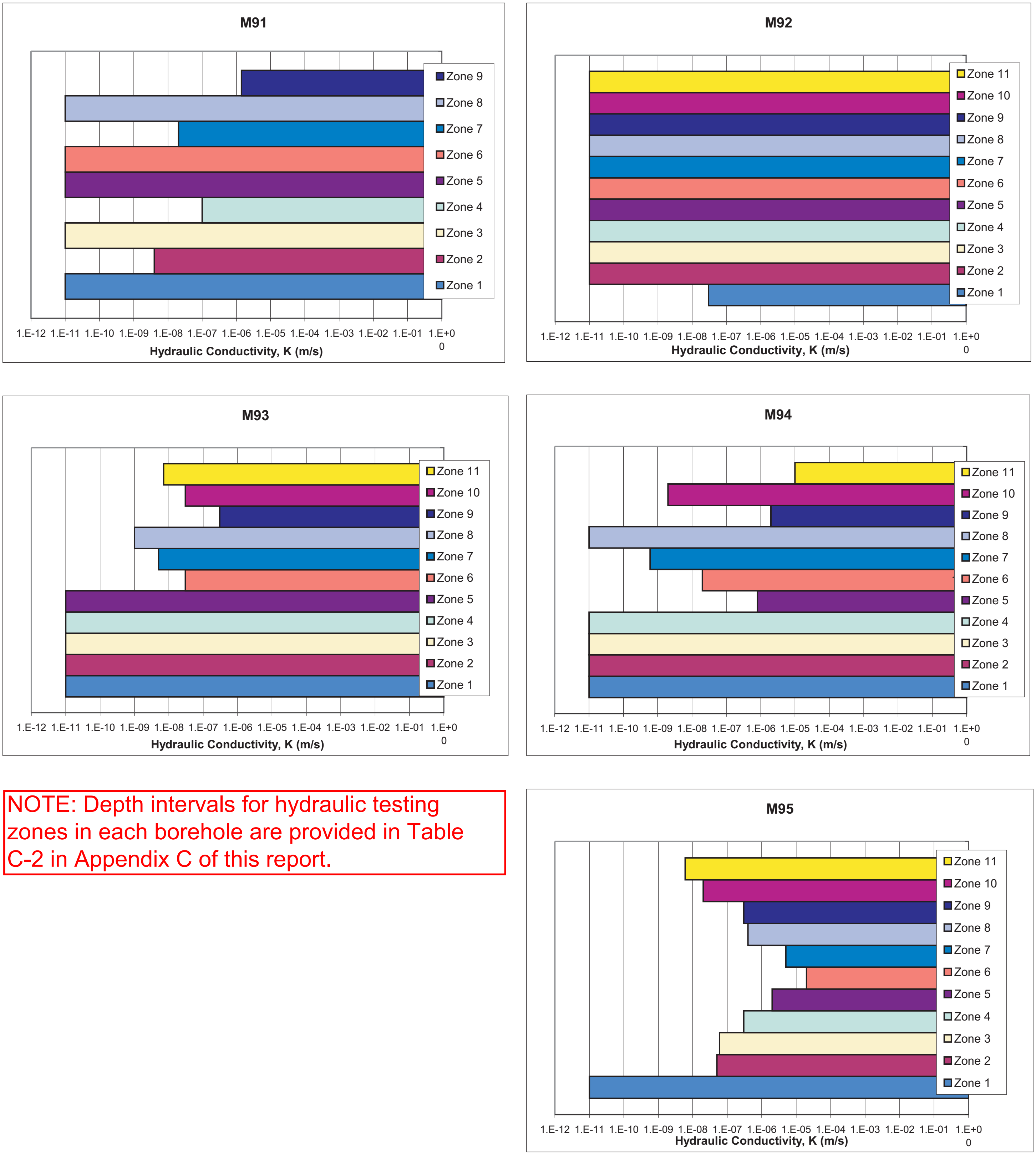
- Resistivity Survey Transects
- Trenches - September 2006
- ⊕ Monitoring Wells - October 2006
- ✛ Existing Monitoring Wells
- ☒ High Voltage Tower

Project : K-A756-5
Data Source: WM Canada, WESA, HPA Ltd., Dillon Consulting
Date: February 21, 2007

0 12.5 25 50 75 100
Meters

Prepared by:
WESA Geomatics

Units:
UTM NAD 83 Zone 18
Scale: 1:6000



NOTE: Depth intervals for hydraulic testing zones in each borehole are provided in Table C-2 in Appendix C of this report.

FIGURE: 2

HYDRAULIC TESTING SUMMARY - RICHMOND LANDFILL

A756-5-TS

WESA
A Better Environment For Business

Appendix A

Resistivity Survey Report

Report on the Geophysical Surveys Conducted at Richmond Landfill
Napanee, Ontario

October, 2008

Project No.: 06-6457

Submitted to:

Water and Earth Science Associates Ltd.

Submitted by:

Dillon Consulting Limited
5 Cherry Blossom Road, Unit 1
Cambridge, ON
N3H 4R7

December 20, 2006

Water and Earth Science Associates Ltd.
3108 Carp Road
Carp, Ontario
K0A 1L0

Tel. 613-839-3053
Fax. 613-839-5376

Attention:	Mr. Francois Richard:

Report on the Geophysical Surveys Conducted at Richmond Landfill, Napanee, Ontario

Please find enclosed the above referenced report.

Yours sincerely,

DILLON CONSULTING LIMITED

Darren Mortimer, P.Eng. P.Geoph
Project Manager / Geophysicist

DM/kp

Our File: 06-6457

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1.0 Introduction

The Richmond Landfill located near Napanee, Ontario, has been identified as having the potential to be expanded through constructing new cells to the north of the existing landfill area; however, concerns exist regarding the competency of the bedrock underlying the site and the potential for fractures to act as pathways for impacted groundwater movement off-site. Previous Very Low Frequency (VLF) electromagnetic surveys[1,2] identified several potentially significant features in the bedrock, one of which was confirmed (through drilling), by the discovery of a hydrogeologically significant feature in the southern part of the site. Toward the north, the drilling program did not intersect fracturing; however, concern persists that fractures exist but were not identified. Dillon Consulting Limited (Dillon) was retained by Water and Earth Science Associates Ltd. (WESA) of Carp, Ontario to conduct an additional geophysical survey at the Richmond Landfill site. This geophysical survey was intended to identify locations where significant fractures within the shallow bedrock underlying the site may exist.

The overburden is reported to be relatively fine-grained and 2 to 3 metres thick, with the exception of the southwestern corner of the site where it reaches 8 to 10 metres thick. The underlying bedrock is the “Gull River” formation, a limestone with shale inter-beds.

As with any geophysical survey, the key to selecting which technique to implement is identifying the “physical” characteristics of both the site and the target feature(s), and then choosing the appropriate technique to best exploit these characteristics. The geophysical methods that are commonly used in detecting fractures in shallow bedrock are ground penetrating radar, seismic refraction/reflection, electromagnetic methods and resistivity. Ground penetrating radar and seismic are not recommended for the Richmond site. The fine-grained and relatively conductive overburden will significantly attenuate the radar signal, preventing adequate penetration. Furthermore, since the fractures may be small, in-filled with till, or have little or no aperture, they will not manifest as seismic anomalies.

Electromagnetic and resistivity techniques are both electrical methods and exploit the fact that the potential fractures will either contain water or be in-filled with clay till, creating an electrical (potential) difference to the surrounding bedrock. Electromagnetic methods (EM, VLF) use electromagnetic induction to create a current flow in the ground and require little or no contact with the ground, making these techniques ideal for reconnaissance surveys. However, the surficial EM methods are not as sensitive or detailed as (galvanic) resistivity, which requires driving metal electrodes directly into the ground. Therefore, resistivity was selected for the survey at the Richmond site, as this geophysical technique does not suffer from the constraints created by the local geology, is reasonably robust, and provides the maximal contrast between the potential fractures (the targets) and the surrounding intact bedrock (the background).

---

[1] Hyd-Eng Geophysics, 1998. VLF Survey conducted near the Richmond Landfill, Empey Hill, Ontario. TJ112

[2] Dillon Consulting Ltd, 2003. VLF Survey conducted at the Richmond Landfill, Empey Hill, Ontario. 02-1251

2.0 Scope of Work

A galvanic resistivity survey was used for this geophysical assessment and the survey was conducted in two phases.

Phase One consisted of two stages:

1. Phase 1A comprised collecting data on several test lines in the southern portion of the site. These test lines were intended to assess areas where previous investigations identified the presence of potential fractures as well as assess the impact of a High Voltage Transmission Line within the survey area on the resistivity data. The Phase 1A data was preliminarily processed and assessed before proceeding with Phase 1B.

2. Phase 1B comprised collecting data on several survey lines in the northern portion of the site. All of the Phase One data were collected from June 29 to July 6, 2006, and the results were reported in July 2006[3].

Phase Two was a continuation of the Phase One work and involved expanding the coverage across the site. The line locations for this phase were chosen in an effort to provide reasonable (approximately uniform) coverage of the majority of the site. The Phase Two data were collected from August 29 to September 14, 2006. This report discusses the results from both phases of work.

3.0 Equipment and Theory

The ease with which electrical currents can be passed through a material, its “resistivity”, can often be used to identify variations in earth materials. In general, sand and gravel overburden have resistivity values ranging from 100 to 1000 ohm.metres while silts and clays will be in the order of 10 to 100 ohm.metres. Compact till units will have a low interconnected porosity and, therefore, high resistivity levels. Bedrock resistivities are typically greater than 1000 ohm.metres for limestone/dolostone. The resistivity of shale depends largely on the degree of weathering and the chemistry of the groundwater; as a general rule, the shallow weathered portion of shale will have very low resistivity values, similar to those observed for clays. Factors such as varying degrees of saturation, compaction, anomalous porosity, and mineralogy can cause bulk material resistivity values to vary widely. Notably, resistivity values will tend to decrease with increasing porosity and porewater conductivity.

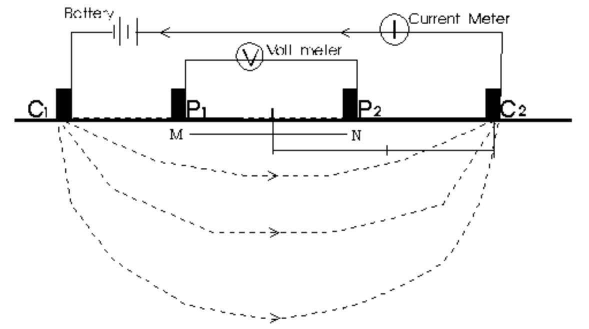

Figure 1: Schematic of electrical measurement

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[3] Dillon Consulting Ltd, 2006. Report on the Geophysical Surveys Conducted at Richmond Landfill, Napanee, Ontario. 06-6457

The electrical properties of the ground can be assessed using galvanic resistivity measurements. An electrical resistivity survey involves the creation of current (I) flow between two electrodes in the ground (Figure 1). The formula to calculate penetration depth of the current is complex, but it is mainly a function of electrode spacing and the resistivity of the ground. As the electrode spacing increases from a fixed point, the sampled volume/depth increases. Two other electrodes are used to measure the potential difference (V) created by the current flow, and the two values are used to calculate an apparent resistivity ($\rho=K\Delta V/I$) for the volume being sampled. The factor, "K", is used in the equation to account for the geometry. There are several electrode configurations possible. In a Wenner configuration, the distance between successive electrodes is the same for any given reading.

4.0 Field Procedures

The field data were collected using a multi-electrode resistivity meter manufactured by Iris Instruments Limited of Orleans, France. Forty-eight electrodes were placed in the ground at any one time. The instrument then sequences through 360 combinations of electrodes (see Figure 2) providing a Wenner array. The data is stored internally and later transferred to a portable computer for processing. The survey lines were located using a differentially corrected global positioning system (DGPS) and are shown on Figure 3.

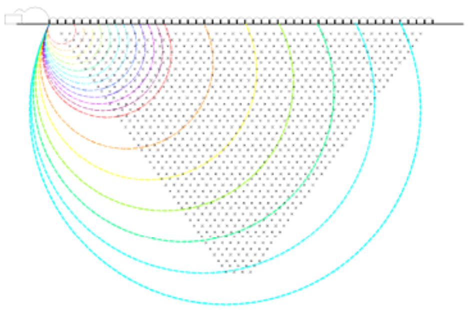


Figure 2: Example of multi-electrode sampling

During Phase 1A, both 2.5 and 5 metre electrode spacings were tested. It was determined that the 2.5 metre spacing provided adequate penetration and resolution and this spacing was, therefore, used for all subsequent data collection where the overburden was known to be relatively thin (up to 2 to 3 metres in depth). However, over the drumlin in the southwestern portion of the site (Empey Hill area), where the overburden is considerably thicker (approximately 8 metres), the 5-metre electrode spacing was used to achieve penetration into the bedrock.

5.0 Data Processing and Presentation

Upon completion of the survey, the data were transferred to a portable computer. The resistivity data were then used to calculate a two-dimensional model of the subsurface. The modelling was completed using the "Res2DInv" software developed by Dr. M.H. Loke[4].

The software uses an iterative process combining a non-linear least-squares optimization technique with a finite difference forward modelling. The subsurface is approximated as a series of blocks of varying size ranging from ½A (1.25 metres) at the ground surface and increasing by 25 percent with depth. The resistivity of each block is iteratively adjusted to

---

[4] Loke D.H. Res2dinv – Rapid 2D Resistivity and IP inversion v3.55.

minimize the difference between the theoretical model response and the actual field observations. The program was also instructed to account for variations in surface topography. The fit between the model results and the survey data was excellent, with an average Root Mean Error (RMS) of 3.75%. Table 1 shows the RMS errors for each of the survey lines. The final results of the modelling process were plotted to scale using *Oasis Montaj*® and *AutoCAD*® and are presented on Figure 4.

Line	RMS Error (%)
1	3.46
2	1.38
3	1.04
4	12.45
5	5.40
5a	2.60
6	3.68
7	3.80
8	3.60
9	5.06
10	6.44
11	2.23
12	1.95
13	1.08
14	2.78
15	4.45
16	4.76
17	4.49
18	3.44

Table 1: Root Mean Error for the resistivity models.

6.0 Interpretation of the Results

In the resistivity data, a potential fracture zone will manifest as a zone of relatively low resistivity due to the localized increased water content. The quality of the data was generally very good to excellent and exhibited little noise. The only exception to this was the test line (Line 4) directly beneath the high voltage transmission lines where inference from the transmission line apparently impacted the data. Model sections are shown on Figure 4.

On the model sections, the resistivity values are depicted using a series of colour contours. Typically, the overburden (silty sand to silty clay) is shown as green, in some locations the overburden has a very low resistivity (likely due to an increased clay content) and is depicted in blue. The resistivity data indicates the overburden to be relatively thin, 2 to 5 metres, for the northern section and most of the southern section of the site. The overburden thickness increases in the southwestern corner to 10 to 15 metres thick over the drumlin as expected. The bedrock is represented as a series from yellow to red on the model sections. The high resistivity (dark red) is indicative of relatively solid limestone and grades through to low resistivity (yellow) that is indicative of weathered or fractured limestone or possibly coarse granular materials at the base of the overburden.

To simplify the results of the survey, the zones of low resistivity are classified based on their similar attributes; this classification is summarized in Table 2. These zones are identified on the interpretation maps (Figures 5a and 5b) using coloured segments that extend across the approximate expression along the bedrock surface of the feature. There are two major zone classifications, Type 1 and Type 2. Type 1 features have an overall high resistivity as compared to the Type 2 features, likely indicative of a more massive limestone rock unit versus one that is more weathered. Within each type, there are several sub-types based on the slightly varying characteristic observed in the data.

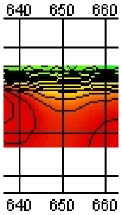
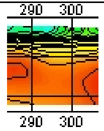
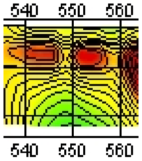
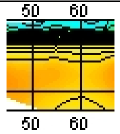
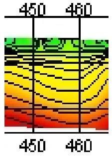
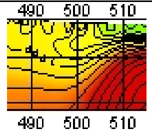
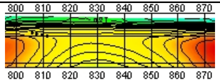
Resistivity Classification		Representation in the Resistivity Data	Data Example
1	1A	Break in the high resistivity contour associated with a shallow moderate resistivity pocket.	 Line 17
	1B	Moderate to high resistivity associated with a shallow moderate resistivity pocket.	 Line 8
	1C	High to moderate resistivity in the upper portion of the bedrock associated with a decreasing resistivity with depth.	 Line 18
2	2A	Relatively uniform moderate resistivity zone.	 Line 9
	2B	Relatively uniform moderate resistivity zone associated with an increasing resistivity with depth.	 Line 12
	2C	A zone of shallow and irregular moderate resistivity.	 Line 7
	2D	Moderate resistivity zone associated with decreasing resistivity with depth.	 Line 7

Table 2: Classification of Resistivity features.

Of the various features identified in the resistivity data, there does not appear to be any grouping or trend that extends across the entire site. However, in the southwest corner, there does appear to be a grouping of Type 2b features. This is in the vicinity of the drumlin and may result from an increased weathering of the bedrock in this area and/or potentially granular material directly above the bedrock. Also of note are several areas where the Type 2b feature is considerably thicker when compared to the other 2b features. These thicker 2b features are indicated by double line segments and are interpreted to be buried / weathered channels within the bedrock.

Though the resistivity technique is the best method of detecting the locations of fractures in shallow bedrock, as is the case of many geophysical methods, the interpretation does not represent a unique solution (i.e., there is more than one possible explanation).

Other potential causes of zones of low resistivity are:

- Weathering of the bedrock surface,
- Variations in mineralogy such as increased porosity or shale content, and
- Presence of conductive material such as brine.

To help clarify the interpretation of the resistivity data, the results were compared with previous Very Low Frequency (VLF) surveys and data from several boreholes and test excavations or trenches.

The resistivity results show good correlation with several trends identified in the previous VLF surveys in both the north and south sections. In some cases, there is a slight offset with the VLF results and this is to be expected due to nature of the (large) EM fields employed; the VLF survey is intended as a reconnaissance level tool. In addition, the test lines in the southern portion of the site (Lines 1, 2, and 3, see Figure 4 and 5b) show an excellent correlation both with the previous VLF interpretations and the adjacent boreholes' pumping test results. During Phase 1A, data were collected using both a 2.5 and 5 metre electrode *A*-spacings along Line 1 and using a 5-metre electrode spacing along Line 2. As overburden across most of the site is known to be up to 2 to 3 metres thick, the 2.5 metre electrode spacing was determined to provide adequate penetration with continuous coverage to a depth of 10 metres below bedrock surface (maximum penetration of 19 metres), while also having the ability to detect narrow features. The larger 5-metre spacing provides deeper penetration than does the 2.5 metre spacing, and is required in the south-west corner of the site due to the presence of a thicker overburden existing over the crown of the drumlin. While the wider spacing reduces the capability of detecting narrow features, it was adequate to detect a feature previously identified by a VLF survey and confirmed with drilling at M56-2 (see Line 2, Figure 4).

Though there is a good correlation between resistivity features and the results from the previous VLF survey, the resistivity data do not strongly indicate trends or lineations across the survey area. The VLF data is not as detailed as the resistivity data; potentially resulting in dissimilar features being grouped together. While the VLF (low resistivity) trends may exist, the resistivity data indicate that there is a lack of lateral continuity across the site. For example in the middle of the northern section, VLF lineation L4 is shown to coincide with resistivity features on lines L5a, L16, L17 and L18. On Lines 17 and 18, fractures are interpreted to exist, while on Line 5a and 18 the lineation coincide with interpreted weathered zones. The vertical extent or lateral continuity or connectivity between features cannot be discerned from this resistivity data.

Upon completion of a preliminary interpretation of the Phase 1 and 2 resistivity data, several trench and borehole locations were selected. WESA completed the excavation of the trenches and the installation of the boreholes (for further details see the WESA report[5]). Based on the results provided by WESA, there is a strong correlation between the features observed in the resistivity data and in the excavated trenches. The locations of the trenches are shown on Figure 6. Table 3 summarizes resistivity classification and interprets the immediate lithology, incorporating the trench observations where available.

The observations for the trenches support the interpretation that the Type 1 features are interpreted to be potential fractures, whereas the Type 2 features are interpreted to be mainly zones of weathered bedrock. However, due to weathering, these zones may also contain some fractures. The Type 2 features are also associated with areas of noteworthy horizontal bedding.

---

[5] WESA 2006

Resistivity Classification		Representation in the Resistivity Data	Lithology Interpretation	Trench / Location
1	1A	Break in the high resistivity contour associated with shallow, moderate resistivity pocket.	Relatively narrow single fracture with little or no infill - water noted.	Trench L17 Line 17 [660]
	1B	Moderate to high resistivity associated with shallow, moderate resistivity pocket.	Fracture with infill and possibly water present.	Trench L12 Line 12 [552]
	1C	High to moderate resistivity in the upper portion of the bedrock associated with a decreasing resistivity with depth.	Fractured Limestone bedrock interbedded with shale.	Trench L18 Line 18 [547]
2	2A	Relatively uniform, moderate resistivity zone.	Weathered bedrock, potentially thinly bedded.	Trench L9 Line 9 [30]
	2B	Relatively uniform, moderate resistivity zone associated with an increasing resistivity with depth.	Upper portion of bedrock weathered relatively uniformly and underlain by competent rock.	NA Line 12 [660]
	2C	A zone of shallow and irregular moderate resistivity.	Shallow (< 0.5m) bedrock, highly weathered, underlain by competent rock.	NA Line 7 [490]
	2D	Moderate to low resistivity zone associated with decreasing resistivity with depth.	Weathered bedrock with some shale seams or interbedding	Trench L15 Line 15 [940]

Table 3: Interpretation for Resistivity Classification incorporating WESA trench data.

7.0 Conclusion

The overall quality of the resistivity data is considered very good to excellent. The resistivity survey mapped several weathered and potential fracture zones in the shallow bedrock that were correlated and verified with a field excavation and drilling program by WESA personnel. Based on the resistivity data alone, it is not possible to determine the vertical extent or degree of lateral continuity of the interpreted resistivity features; however, there does not appear to be any strong or clear trends in the resistivity data across the entire survey area.

8.0 Limitations of Report

Dillon Consulting Limited prepared this report for Water and Earth Science Associates Ltd. The material in this report reflects Dillon's judgement in context of the information available at the time of preparation. This report is based on data and information collected during the investigation conducted by Dillon personnel and is based solely on the conditions of the property at the time of the site reconnaissance, as described in this report. No intrusive or direct sampling was conducted as part of this survey.

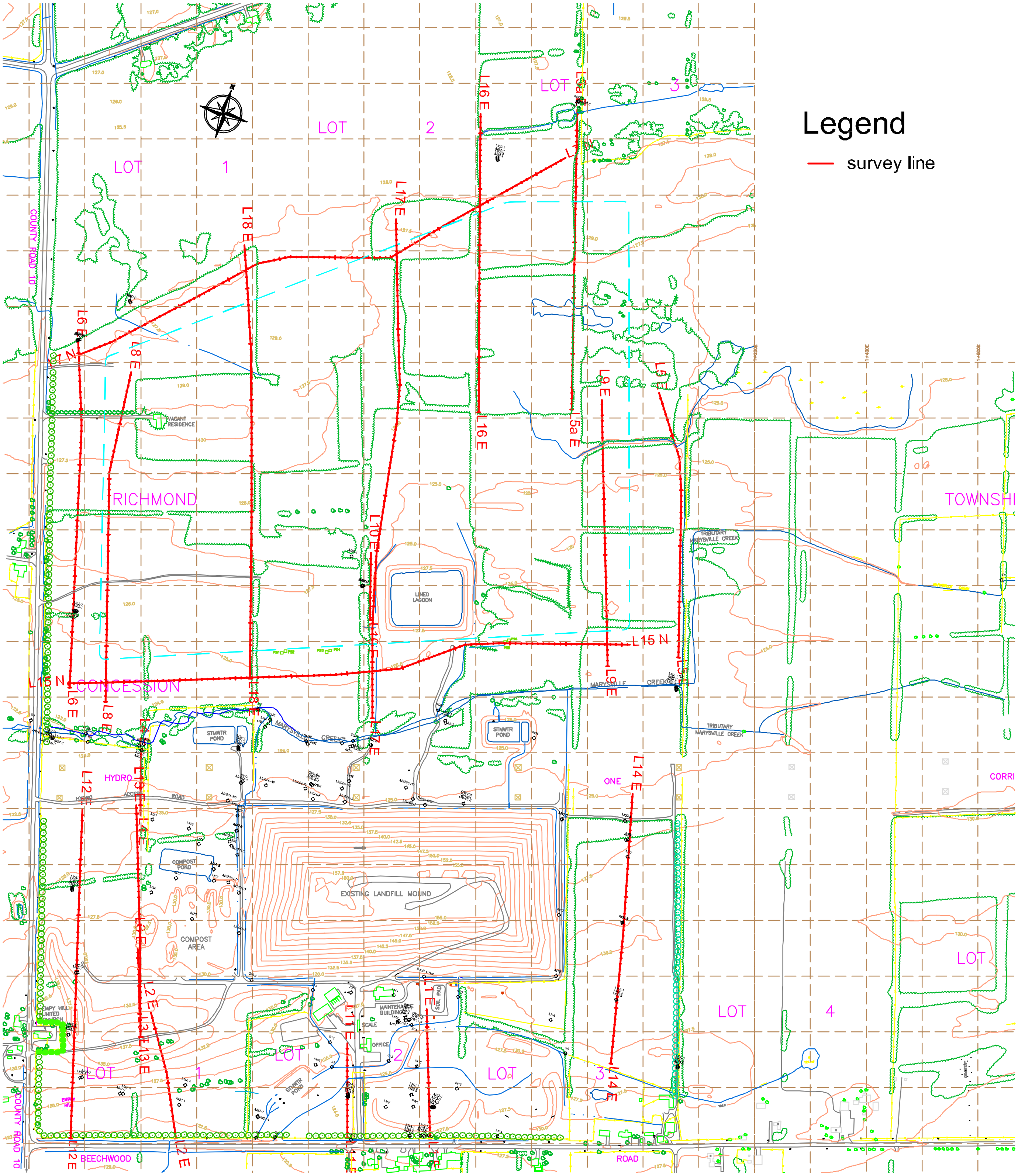
Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.

Dillon makes no warranty, expressed or implied, and assumes no liability with respect to the use of information contained within this report. No changes to the report form or content may be made without Dillon's written approval.

DILLON CONSULTING LIMITED

Darren Mortimer, P.Eng., P.Geoph.
Geophysicist

FIGURES



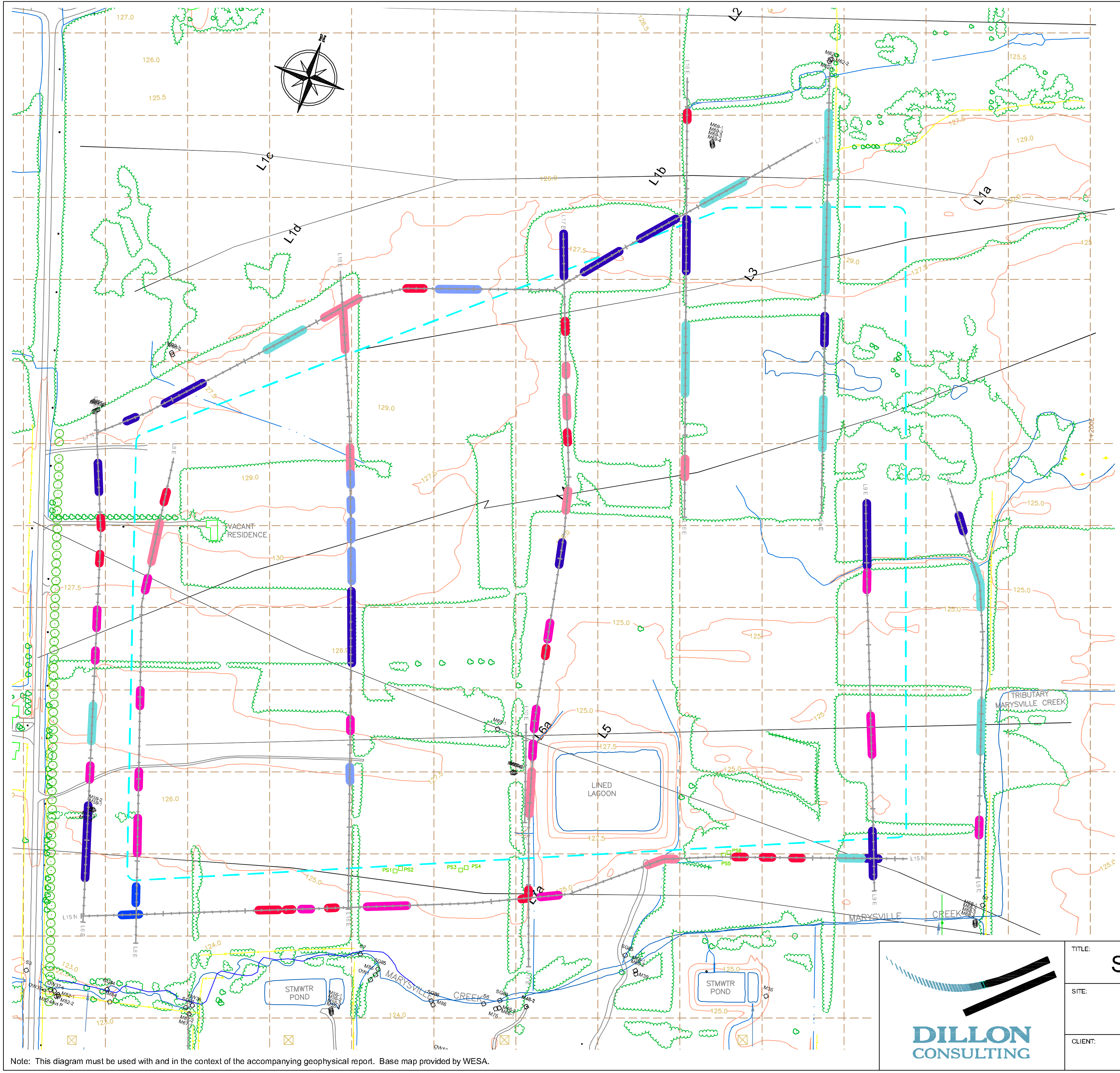
Note: This diagram must be used with and in the context of the accompanying geophysical report. Base map provided by WESA.

File: G:\GEO\066457 Richmond Landfill Resistivity\Plan2\Figure – Plan2.dwg Layout: Lines

Plotted: Nov 22, 2006 – 2:38pm

DILLON
CONSULTING

TITLE: Resistivity Survey Lines	PROJECT NO. 06-6457
SITE: Richmond Landfill Napanee, Ontario	SCALE: 1:10 000 SURVEY DATE: July - September, 2006 INSTRUMENT: Iris Syscal R1 Plus
CLIENT: Water and Earth Science Associates Ltd.	FIGURE NO. 3



Legend

— survey line
— VLF lineation

Interpreted Zones

(Zones of low resistivity)

▬ 1a
▬ 1b } Potential Fracture Zone
▬ 1c
▬ 2a
▬ 2b } Weathered Fracture Zone
▬ 2c
▬ 2d

Scale 1:5000

50 0 50 100 150 200 250 300

metres

(UTM Zone 18N, NAD83)

Note: Base Site plan has been translate from locate coordinates.
Local origin was moved to 334735.0, 4902958.0 and rotated 18.7°.

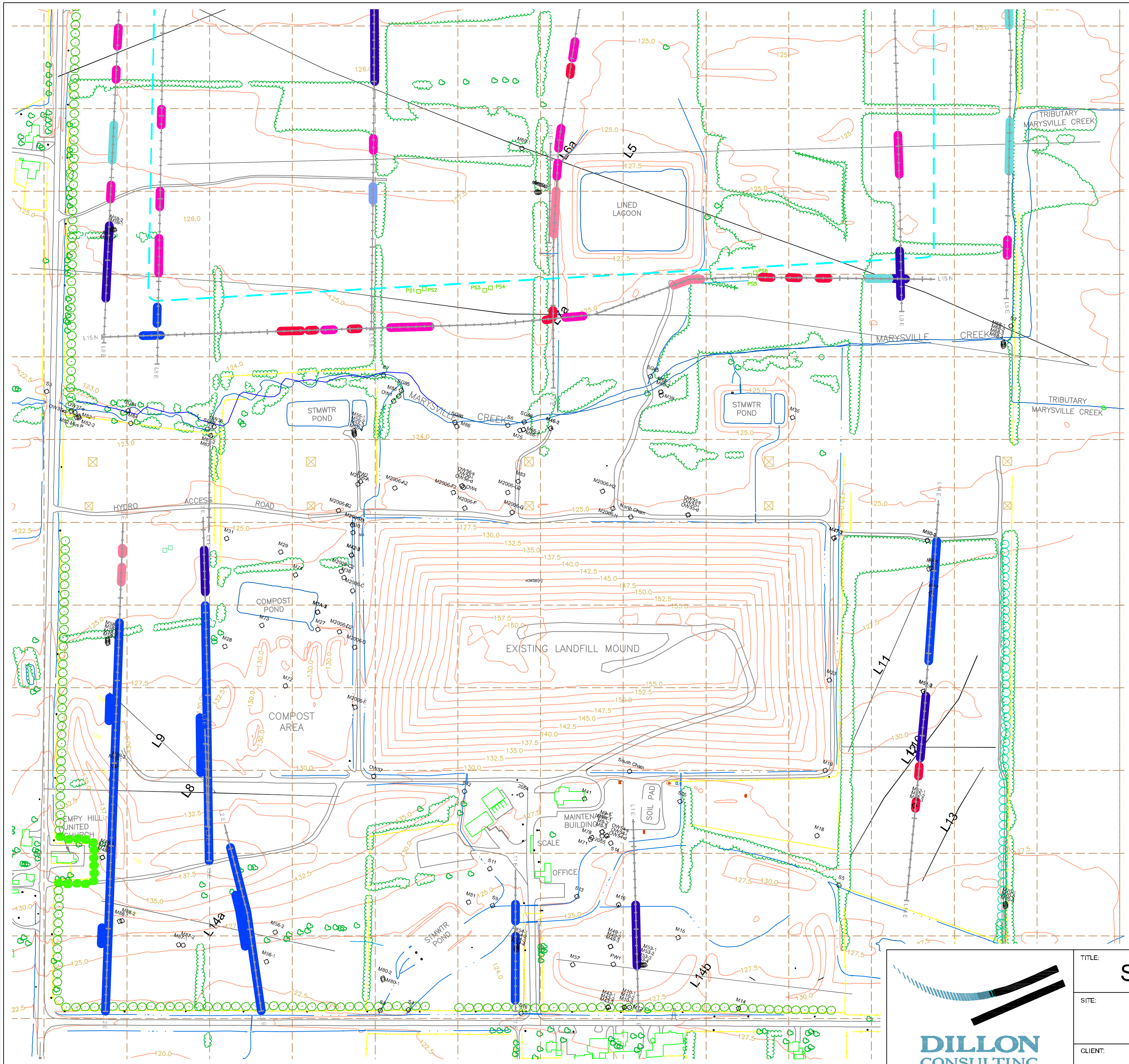
Note: This diagram must be used with and in the context of the accompanying geophysical report. Base map provided by WESA.

Plotted: Dec 19, 2006 – 2:51pm File: G:\GEO\066457 Richmond Landfill Resistivity\Plan2\Figure – Plan2.dwg Layout: North Section

DILLON CONSULTING

TITLE:	Survey Lines and Interpreation	PROJECT NO. 06-6457
SITE:	Richmond Landfill Napanee, Ontario	SCALE: 1:5000 SURVEY DATE: July - September, 2006 INSTRUMENT: Iris Syscal R1 Plus
CLIENT:	Water and Earth Science Associates Ltd.	FIGURE NO. 5a

Plotted: Dec 19, 2006 – 2:52pm File: G:\GEO\066457 Richmond Landfill Resistivity\Plan2\Figure – Plan2.dwg Layout: South Section



Note: This diagram must be used with and in the context of the accompanying geophysical report. Base map provided by WESA.

Legend

— survey line
— VLF lineation

Interpreted Zones

(Zones of low resistivity)

- ▬ 1a } Potential Fracture Zone
- ▬ 1b
- ▬ 1c
- ▬ 2a } Weathered Fracture Zone
- ▬ 2b
- ▬ 2c
- ▬ 2d

Scale 1:5000

50 0 50 100 150 200 250 300

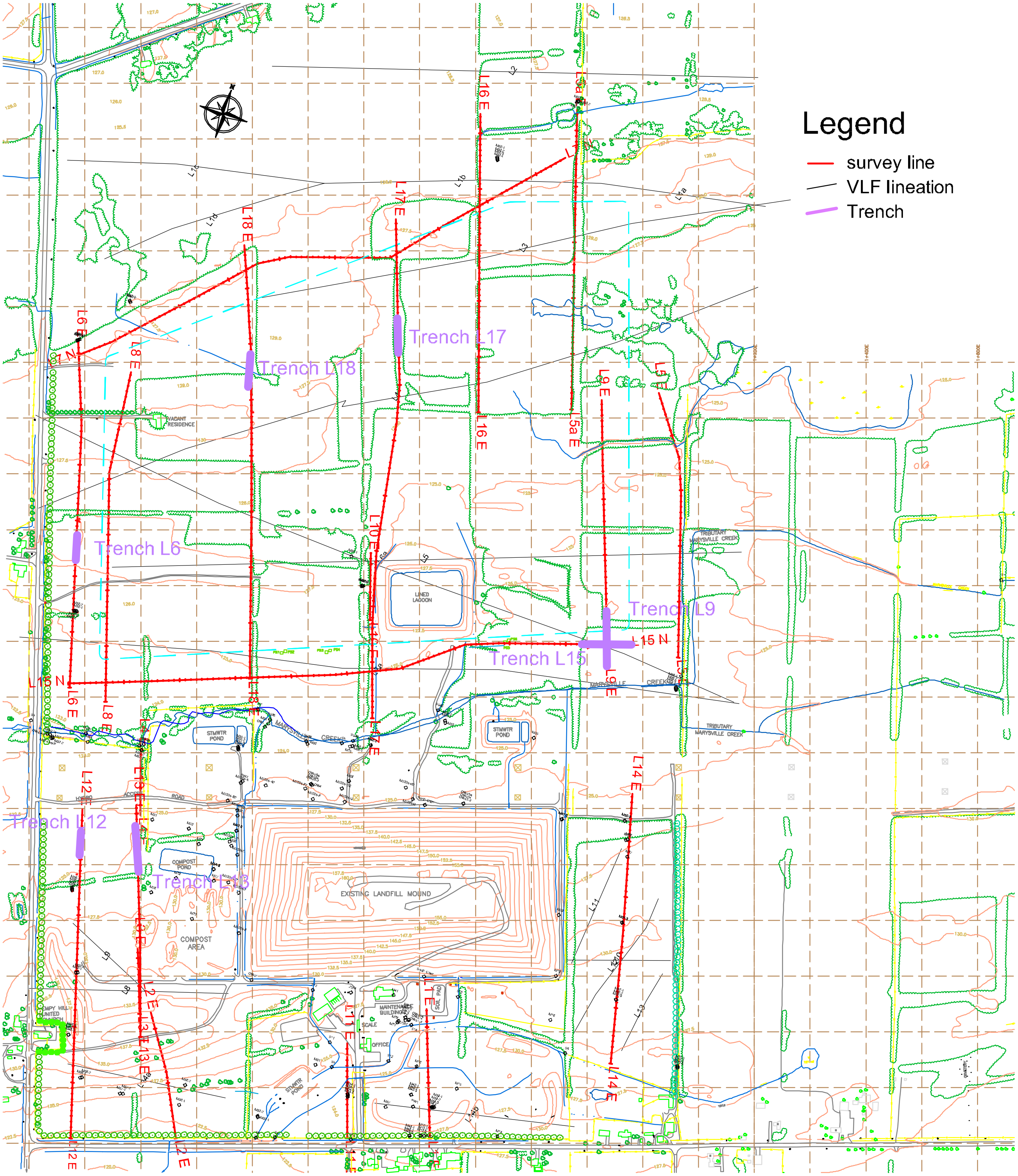
metres

(UTM Zone 18N, NAD83)

Note: Base Site plan has been translate from locate coordinates.
Local origin was moved to 334735.0, 4902958.0 and rotated 18.7°.

DILLON CONSULTING

TITLE:	Survey Lines and Interpreation
SITE:	Richmond Landfill Napanee, Ontario
CLIENT:	Water and Earth Science Associates Ltd.
PROJECT NO.	06-6457
SCALE:	1:5000
SURVEY DATE:	July - September, 2006
INSTRUMENT:	Iris Syscal R1 Plus
FIGURE NO.	5b



Note: This diagram must be used with and in the context of the accompanying geophysical report. Base map provided by WESA.

File: G:\GEO\066457 Richmond Landfill Resistivity\Plan2\Figure – Plan2.dwg Layout: Lines & Trenches

Plotted: Nov 22, 2006 – 2:40pm

DILLON
CONSULTING

TITLE:
Resistivity Survey Lines & Trenches

SITE:
Richmond Landfill
Napanee, Ontario

CLIENT:
Water and Earth Science Associates Ltd.

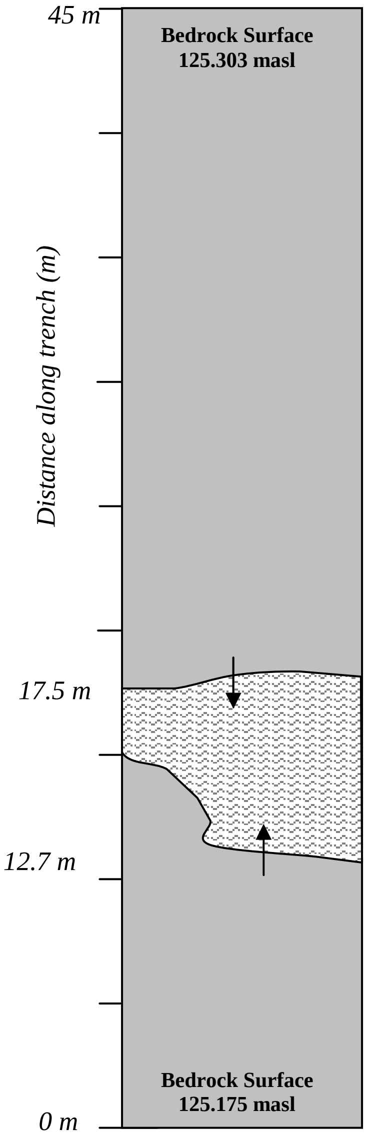
PROJECT NO. 06-6457
SCALE: 1:10 000
SURVEY DATE: September, 2006
INSTRUMENT: -
FIGURE NO. 6

Appendix B

Trenching Figures

Trench L-6

North footprint near Deseronto Rd.
Orientated north-south



Overburden
thickness
1.01 m

17.5 to 45 m
Smooth limestone with east-west glacial striations.

21.7 to 17.5 m
Slightly weathered limestone surface.

0 to ~17.5 m
Fairly smooth limestone with east-west glacial striations.

Overburden
thickness 2.01 m

Sketch of bedrock surface along trench. Not to scale

Photo L6-1

Looking south along Trench L6.

Photo L6-2

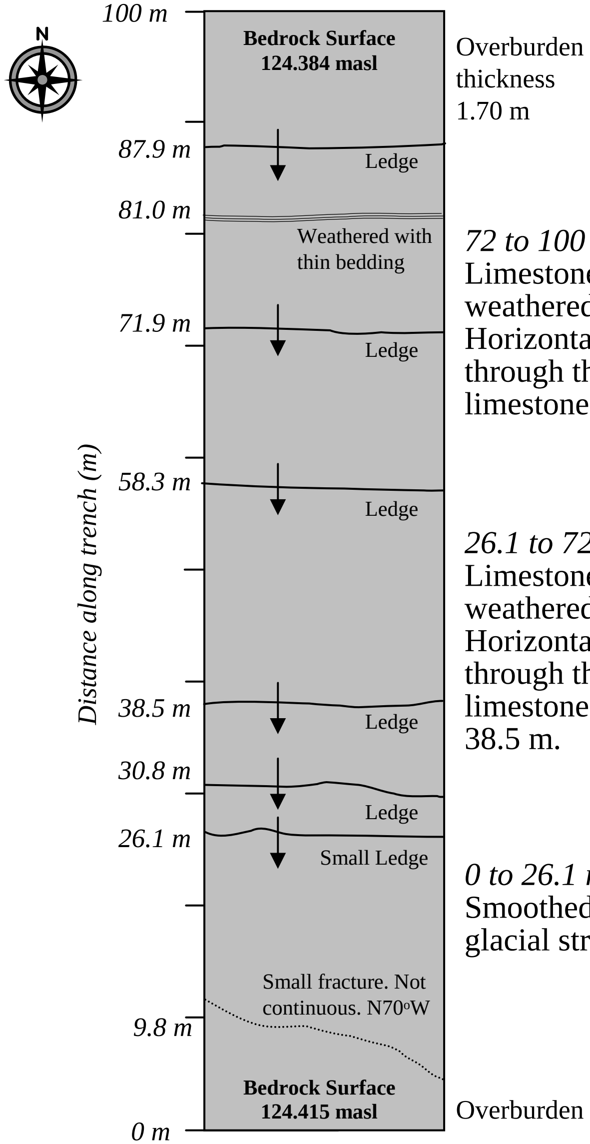
Weathered limestone surface at 245.3 m.

Photo L6-3

Looking south from approx 275 m.

Trench L-9

North footprint, East quadrant of site.
Orientated north-south



Sketch of bedrock surface along trench. Not to scale

72 to 100 m
Limestone with slightly weathered surface. Horizontal water movement through thinly bedded limestone at 81 and 87.9 m.

26.1 to 72 m
Limestone with slightly weathered surface. Horizontal water movement through thinly bedded limestone at 26.1, 30.8 and 38.5 m.

0 to 26.1 m
Smoothed “polished” limestone with glacial striations (east-west).

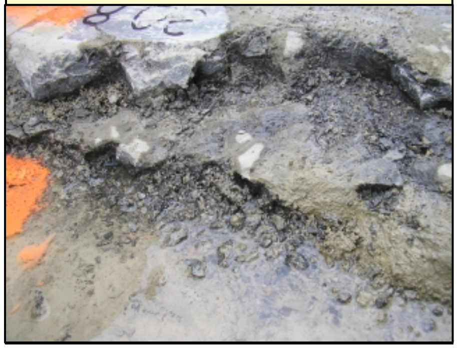
Photo L9-1

Looking south along Trench L9.

Photo L9-2

Looking north along Trench L9.

Photo L9-3

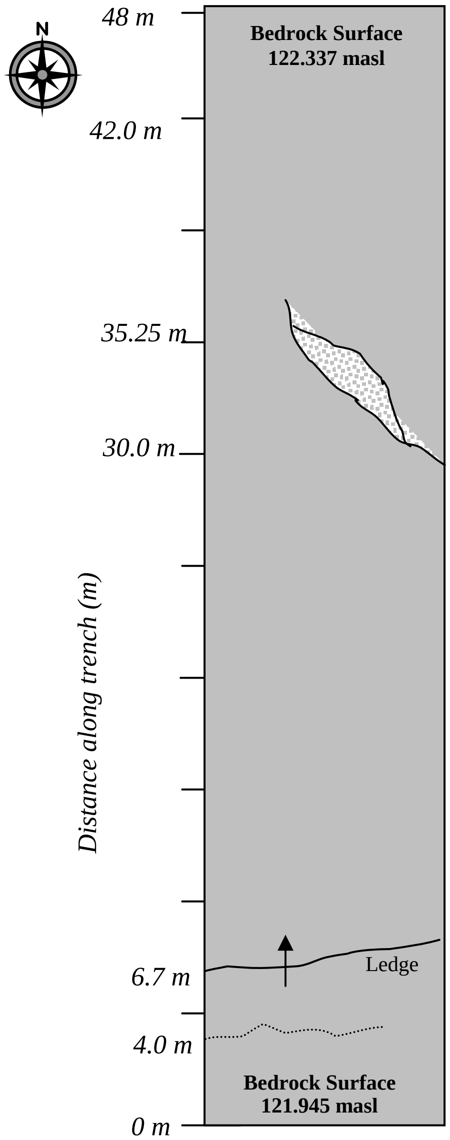


Bedding and water seepage at 30.8 m.

Trench L-12

South footprint, east quadrant of site.

Orientated north-south



Overburden thickness 1.90 m

46.0 to 48.0 m
Weathered limestone surface with secondary mineralization.

30.0 to 35.25 m
Till filled feature. Max width 0.34 m. Orientated M33°W.

Overburden thickness 1.30 m

6.7 m
0.11 to 0.12 high Limestone bedrock ledge.

4.0 m
Small fracture with groundwater seepage.

Overburden thickness 1.20 m

Sketch of bedrock surface along trench. Not to scale

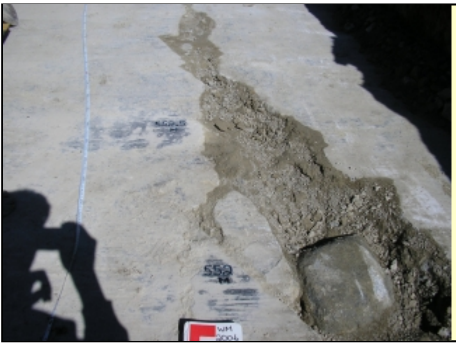


Photo L12-1

Till filled feature at 30 -35.25 m.

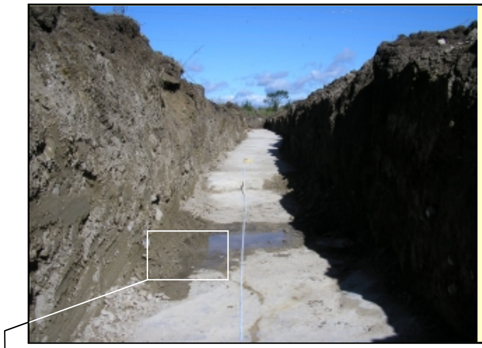


Photo L12-2

Looking north along Trench L12.

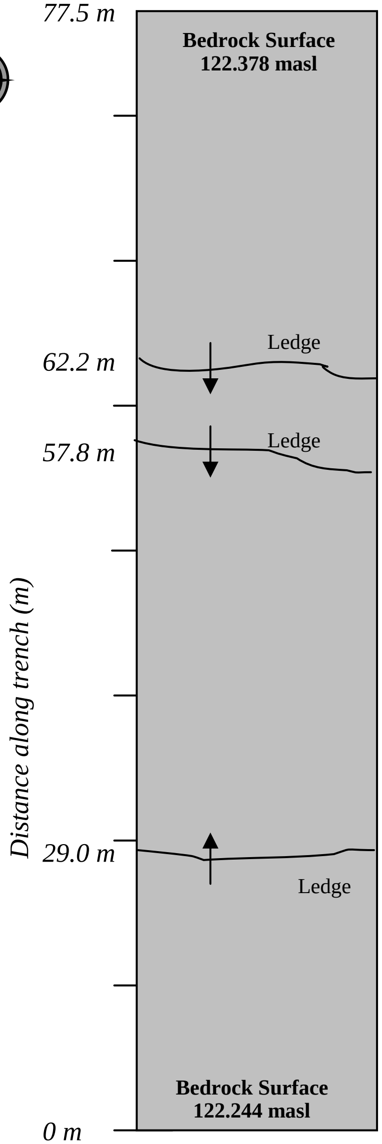
Photo L12-3

Small fracture with upward groundwater seep.

Trench L-13

South footprint, adjacent to compost pond.

Orientated north-south



Sketch of bedrock surface along trench. Not to scale

Overburden thickness 2.12 m

Limited information as trench collected 0.1 to 0.25 m of groundwater seepage overnight. Seepage occurred from overburden / bedrock contact. Initial observations indicate generally smooth limestone bedrock with glacial striations trending east-west.

62.2 m
Limestone bedrock ledge.
Approximately 0.15 m high.

57.8 m
Limestone bedrock ledge.
Approximately 0.06 m high.

40.0 m
Limestone bedrock. Approximate centre of low area.

29.0 m
Limestone bedrock ledge.
Approximately 0.15 m high.

4.0 m
Small fracture with groundwater seepage.

Overburden thickness 2.86 m

Photo L13-1

Trench L13 with GW seepage. Looking north.

Photo L13-2

Smooth limestone bedrock surface with striations.

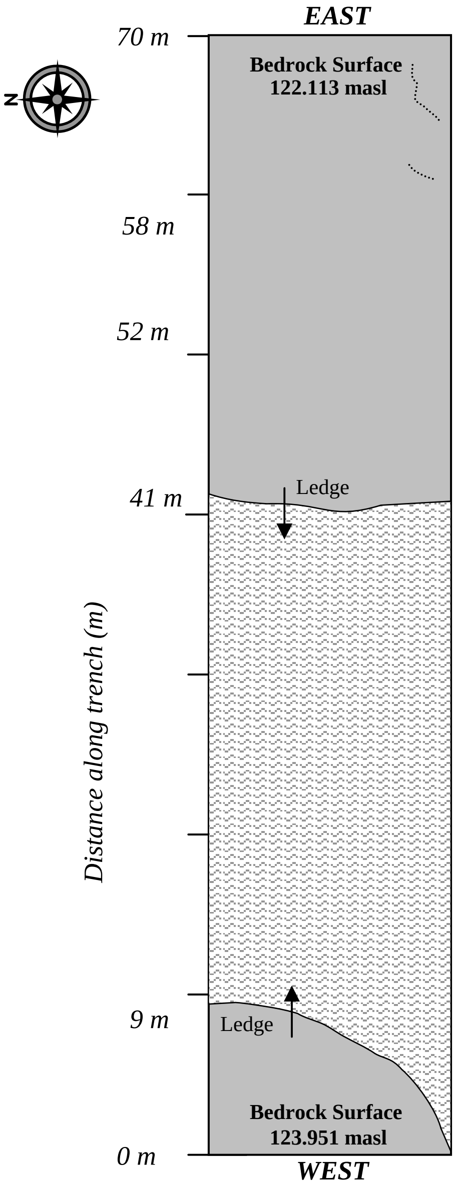
Photo L13-3

Limestone bedrock ledge. Looking south.

Trench L-15

North footprint, East quadrant of site.

Orientated east-west



Sketch of bedrock surface along trench. Not to scale

Overburden
Thickness
1.77 m

62 m and 67 to 69 m
Limestone bedrock with small discontinuous fracture with groundwater seepage.

41 m
Limestone bedrock ledge. Approximately 0.09 m high.

0/9m – 41 m
Surface weathered limestone bedrock. Thinly bedded with shaley seams.

0 to 9.0 m
Limestone bedrock ledge. Approximately 0.15 m high.

Overburden thickness 2.07 m

Photo L15-1

Small fracture with GW seepage.

Photo L15-2

Weathered limestone bedrock surface.

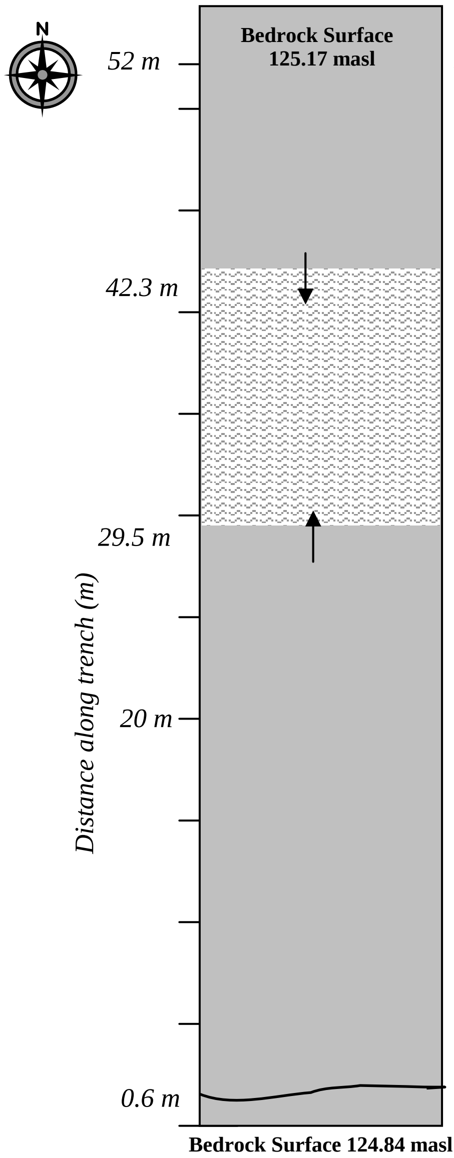
Photo L15-3

Trench L15 looking east.

Trench L-17

North footprint, north of North Lagoon.

Orientated north-south



Sketch of bedrock surface along trench. Not to scale

Overburden thickness 0.80 m

42.3 to 52 m
Limestone bedrock. Smooth with glacial striations trending east-west.

29.5 to 42.3 m
Thinly bedded weathered limestone layers with a 0.725 m rise from south to north.

0.6 to 29.5 m
Limestone bedrock. Smooth with glacial striations trending east-west.

Overburden thickness 1.1 m

0.6 m
Vertical fracture (see Photo L17-3). Fracture was filled with saturated till. After excavating standing water was observed.

Overburden thickness 0.83 m

Photo L17-1

Trench L17 looking north.

Photo L17-2

Trench L17 looking south.

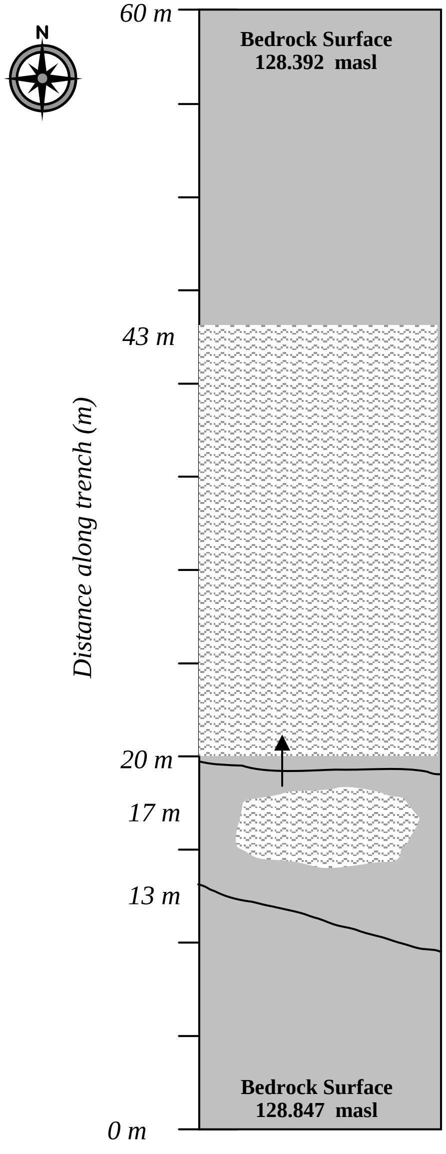
Photo L17-3

Vertical fracture at south end of trench.

Trench L-18

North footprint, northwest of North Lagoon.

Orientated north-south



Overburden thickness 0.47 m

43 to 60 m
Limestone. Smooth and un-weathered Limestone bedrock.

20 to 43 m
Weathered thinly bedded limestone bedrock.

19 m
Limestone. Small ledge (~1cm) with thin layers.

17 m
Weathered limestone bedrock.

9 to 13 m
Vertical fracture filled with till (see Photo L18-3). Oriented approx. NW-SE.

0 to 9/13 m
Smooth limstone.

Overburden thickness 0.88 m

Sketch of bedrock surface along trench. Not to scale


Photo L18-1

Trench L18 looking north.


Photo L18-2

Trench L18 looking south.


Photo L18-3

Vertical fracture near south end of trench.

Appendix C:

Hydraulic Testing Methodology and Results

1 Introduction

This appendix describes the methodology and presents results of single well hydraulic tests performed at the WM Richmond landfill site, including hydraulic recovery tests (Section 2) and continuous down hole straddle packer tests (Section 0).

2 Bedrock Groundwater Monitor Recovery Tests

Hydraulic testing (recovery test) was conducted on seven (7) groundwater monitoring wells on November 17, 2006. The monitor was rapidly pumped down to near dry conditions or in the case of M95-1 pumped at a constant rate with little or no drawdown. Recovery was measured and recorded using Solinst Level loggers.

The water level recovery data was interpreted using AquiferTest[1] for Windows version 2.57. The data was interpreted using the Theis Recovery Method

The data outputs from AquiferTest were interpreted to determine the hydraulic conductivity at those locations. A best fit line was applied to the early portion of the recovery curve and was calculated to estimate a hydraulic conductivity for the aquifer properties at that location.

RESULTS

All results from single well hydraulic tests (slug tests) were analyzed as described in the previous section. The results are compiled in Table C-1. Monitor M95-1 did not drawdown very much when pumped so the hydraulic conductivity was also estimate at a constant rate pumping (7.5 L/min). The results from the two methods are similar.

Table C-1: Estimated Hydraulic Conductivity of completed Groundwater Monitors.

Location	K (m/s) *
M91-1	3.77E-09
M91-2	6.36E-08
M93	3.87E-09
M94-1	9.93E-10
M94-2	6.51E-07
M95-1	1.07E-05
M95-1 (7.5 L/min)	1.68E-05
M95-2	6.51E-07

3 Bedrock (Straddle Packer System)

Continuous down hole straddle packer tests were conducted on five boreholes (M91 to M95) between September 27 and October 13, 2006. The methodology, data interpretation and results are discussed below.

---

[1] Waterloo Hydrogeologic, Inc. (WHI), Waterloo, Ontario.

METHODOLOGY

Figures C1 to C3 illustrate the straddle packer injection system used for the hydraulic testing. Two low pressure packers equipped with packer inflation tubing, straddled with 3 m of perforated stainless steel tubing, were used to conduct the in situ permeability tests. The upper packer was connected to a steel splitter providing a hydraulic connection from the injection zone in the borehole to the pressure transducer and the injection tubing to ground surface.

Pressure transducer readings were recorded using an In-Situ PXD-261 pressure piezometer fitted onto the packer assembly head, thus providing a direct connection to the splitter. Piezometer readings were recorded using a Hermit 3000 data logger (In-Situ Inc.) with real-time pressure data output accessed from a laptop computer. The packer system was connected to the surface by a wire line support cable, used to lower the assembly down the borehole along with the water injection tubing and the electronic cable carrying the signal for the pressure transducer.

At the beginning of each test, the packer system was lowered to the desired depth. After allowing sufficient time for the system to return to static conditions, open-hole pressure was measured using the transducer and a static water level taken using a Solinst water level tape. Pressure transducer readings were initiated and logged every 10 seconds for the duration of the test. Once the open borehole water level had returned to static conditions (as recorded on the down hole pressure transducer and water level tape), the down hole solenoid valve was closed to isolate the injection tubing from the borehole interval to be tested. The injection tubing was then flushed with water to remove any air bubbles out of the closed loop, by forcing water through one of the injection lines using a pump at ground surface.

Once the system was saturated, the packers were inflated using compressed nitrogen to a pressure of approximately 100-150 pounds per square inch (psi). A pulse of pressure was generated in the isolated vertical interval during packer inflation, and allowed to decay. The magnitude of the pressure pulse is indicative of the relative permeability of the rock formation (faster pressure dissipation being indicative of permeable depth intervals). This initial qualitative response was used to determine which manometer tube diameter (1.3 or 10.2 cm I.D.) was most effective for the injection. The injection of water was then initiated by opening the down hole valve, marking the beginning of the test and allowing water from the appropriate manometer to flow through the HDPE tubing, and down to the isolated interval in the borehole. The decrease in head during the injection was measured both visually at the manometer, and within the packer interval with the pressure transducer. For permeable test intervals, the falling head test was conducted until the water level in the manometer had decreased over the entire length of the manometer. For lower permeability test sections, the test was conducted for a minimum of 15 minutes. Following the completion of the test, the packers were deflated, the pressure transducer data stored in the data logger downloaded, and the packer assembly moved up to the next test section.

QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

A comprehensive protocol was developed to ensure that the equipment was assembled and functioning correctly. Below is a list of this quality assurance and quality control procedure:

(a) Confirmation of the manufacturer's calibration of the pressure transducer was conducted on-site during the hydraulic testing. This was accomplished by lowering the transducer down an open borehole to specified depths below the water surface. The voltage read by the transducer through the data logger was compared to the calculated pressure of the water column to ensure that the calibration factor provided by the manufacturer was within 10% of the known hydrostatic pressure.

(b) Periodically, the packer system and injection system was be completely assembled at ground surface and tested in a section of 6" diameter PVC pipe. The packers were inflated and the inflation line and all air connections checked for leaks by visual inspection and by monitoring pressure gages. Similarly, each connection from the water injection system to the packer system was checked to ensure that the system is watertight.

(c) Duplicate tests were conducted to ensure the reproducibility of the manometer measurements. If a difference in total test time of 10 % or greater was observed the system was checked for leaks.

DATA INTERPRETATION

To interpret the hydraulic testing data collected during the packer testing described above, the data analysis methods described below were used to estimate the relative transmissivity of each of the intervals tested in the boreholes. The data analysis methodology is based on the Thiem equation modified for single well injection tests, and was used to analyse the dataset acquired at the CWS Richmond facility (WESA, 2000). The hydraulic testing system was designed to measure a range of bulk rock transmissivities from 10^{-4} to 10^{-11} m^2/s. It should be noted that transmissivities on the order of 10^{-11} m^2/s represent the lower limit of the testing method.

The approach described here uses the average volumetric flow rate of the injection water calculated from the change in hydraulic head in the manometer over discrete time intervals to estimate the permeability of the test section. Below is a summary of the Thiem equation including assumptions associated with the method and a description of the variables.

Thiem Equation:

$$Q = (\Delta h * T * 2\pi)/\ln(r_e/r_w) \qquad (1)$$

$$r_e = 2*(T/S*t)^{1/2} \qquad (2)$$

where:

Q	average flow rate of water that entered the system during the duration of the test. Calculated from the change in head vs. time over discrete time intervals observed in the ½" or 4" tubing.
Δh	$H_{\text{initial}} - H_{\text{static}}$
H_{initial}	Head in ½" or 4" tubing in cm above ground surface
H_{static}	Static head within the test interval. This value is calculated from the equilibrated pressure transducer readings after shut in or estimated to be the open borehole static head.
T	Transmissivity: to be calculated in (1), and must also be estimated in (2) (iterative procedure)
r_e	radius of influence: estimated from (2).
r_w	radius of the well
S	Storativity (assumed to be approximately 10^{-6})
t	total elapsed time of the hydraulic test

An iterative process was used to calculate the transmissivity for each of the injection zones. First a *T* was assumed to estimate the radius of influence. The estimated radius of influence was then used in (1) to obtain a better estimate of *T*, a process that was repeated iteratively until the values of *T* in (1) and (2) converged. The assumptions necessary to perform this type of data analysis are as follows:

(a) Δh is constant. This is considered valid where Δh is significantly greater than the change in head used to calculate *Q*.

(b) A storativity of 10^{-6}. Sensitivity analyses of this parameter have previously (WESA, 2000) indicated that changing *S* by a few orders of magnitude changes the value of *T* by a factor of less than 3.

The transmissivity determined using the Thiem equation methods, considered to be directly proportional to the bulk rock hydraulic conductivity, was converted to hydraulic conductivity (*K*) by dividing the estimated transmissivity by the length of the test interval (3 m). The length of the test interval was used with the underlying assumption that due to the presence of both horizontal and vertical fractures at the site, groundwater flow may enter the borehole from any direction.

Due to the limit of the hydraulic testing field methods, the transmissivities calculated using this method are estimated to be in the range from 10^{-4} to 10^{-11} m^2/s.

RESULTS

All results are summarized below in Table C-2.

Table C-2: Estimated Hydraulic Conductivity of completed Groundwater Monitors.

Well M91 - Packer Testing Results

Zone	Down Hole Depth (m)		Vertical Depths (m bgs)		T (m2/s)	K (m/s)
1	34.14	31.22	29.57	27.04	3.00E-11	1.00E-11
2	31.22	28.3	27.04	24.51	1.20E-08	4.00E-09
3	28.3	25.38	24.51	21.98	3.00E-11	1.00E-11
4	25.38	22.46	21.98	19.45	3.04E-07	1.00E-07
5	22.46	19.54	19.45	16.92	3.00E-11	1.00E-11
6	19.54	16.62	16.92	14.39	3.00E-11	1.00E-11
7	16.62	13.7	14.39	11.86	6.09E-08	2.03E-08
7 dup					5.55E-08	1.85E-08
8	14.21	11.29	12.31	9.78	3.00E-11	1.00E-11
9	12.42	9.5	10.76	8.23	4.21E-06	1.40E-06
Well M92 - Packer Testing Results						
1	33.7	30.78	29.19	26.66	8.00E-08	3.00E-08
2	30.78	27.86	26.66	24.13	3.00E-11	1.00E-11
3	27.86	24.94	24.13	21.60	3.00E-11	1.00E-11
4	24.94	22.02	21.60	19.07	3.00E-11	1.00E-11
5	22.02	19.19	19.07	16.62	3.00E-11	1.00E-11
6	19.19	16.18	16.62	14.01	3.00E-11	1.00E-11
7	16.18	13.26	14.01	11.48	3.00E-11	1.00E-11
8	13.26	10.34	11.48	8.95	3.00E-11	1.00E-11
9	10.34	7.42	8.95	6.43	3.00E-11	1.00E-11
10	7.42	4.5	6.43	3.90	3.00E-11	1.00E-11
11	5.71	2.79	4.95	2.42	3.00E-11	1.00E-11
Well M93 - Packer Testing Results						
1	35	32.08	30.31	27.78	3.00E-11	1.00E-11
2	32.08	29.16	27.78	25.25	3.00E-11	1.00E-11
3	29.16	26.24	25.25	22.72	3.00E-11	1.00E-11
4	26.24	23.32	22.72	20.20	3.00E-11	1.00E-11
5	23.32	20.4	20.20	17.67	3.00E-11	1.00E-11
6	20.4	17.48	17.67	15.14	8.00E-08	3.00E-08
6 dup					7.00E-08	2.00E-08
7	17.48	14.56	15.14	12.61	2.00E-08	5.00E-09
8	14.56	11.64	12.61	10.08	3.00E-09	1.00E-09
9	11.64	8.72	10.08	7.55	8.00E-07	3.00E-07
10	8.72	5.8	7.55	5.02	8.00E-08	3.00E-08
11	6.82	3.9	5.91	3.38	2.00E-08	7.00E-09
Well M94 - Packer Testing Results						
1	33.92	31	29.38	26.85	3.00E-11	1.00E-11
2	31	28.08	26.85	24.32	3.00E-11	1.00E-11
3	28.08	25.16	24.32	21.79	3.00E-11	1.00E-11
4	25.16	22.24	21.79	19.26	3.00E-11	1.00E-11
5	22.24	19.32	19.26	16.73	2.00E-06	8.00E-07
6	19.32	16.4	16.73	14.20	6.00E-08	2.00E-08
7	16.4	13.48	14.20	11.67	2.00E-09	6.00E-10
8	13.48	10.56	11.67	9.15	3.00E-11	1.00E-11
9	10.56	7.64	9.15	6.62	5.00E-06	2.00E-06
10	7.64	4.72	6.62	4.09	5.00E-09	2.00E-09
11	5.44	2.52	4.71	2.18	4.00E-05	1.00E-05
Well M95 - Packer Testing Results						
1	34.50	31.58	29.88	27.35	3.00E-11	1.00E-11
2	31.60	28.70	27.37	24.85	1.00E-07	5.00E-08
3	28.70	25.70	24.85	22.26	2.00E-07	6.00E-08
4	25.70	22.80	22.26	19.75	9.00E-07	3.00E-07
5	22.80	19.90	19.75	17.23	5.00E-06	2.00E-06
6	19.90	17.00	17.23	14.72	6.00E-05	2.00E-05
7	17.00	14.10	14.72	12.21	2.00E-05	5.00E-06
8	14.10	11.10	12.21	9.61	1.00E-06	4.00E-07
9	11.10	8.22	9.61	7.12	8.00E-07	3.00E-07
10	8.22	5.30	7.12	4.59	7.00E-08	2.00E-08
11	6.20	3.30	5.37	2.86	2.00E-08	6.00E-09

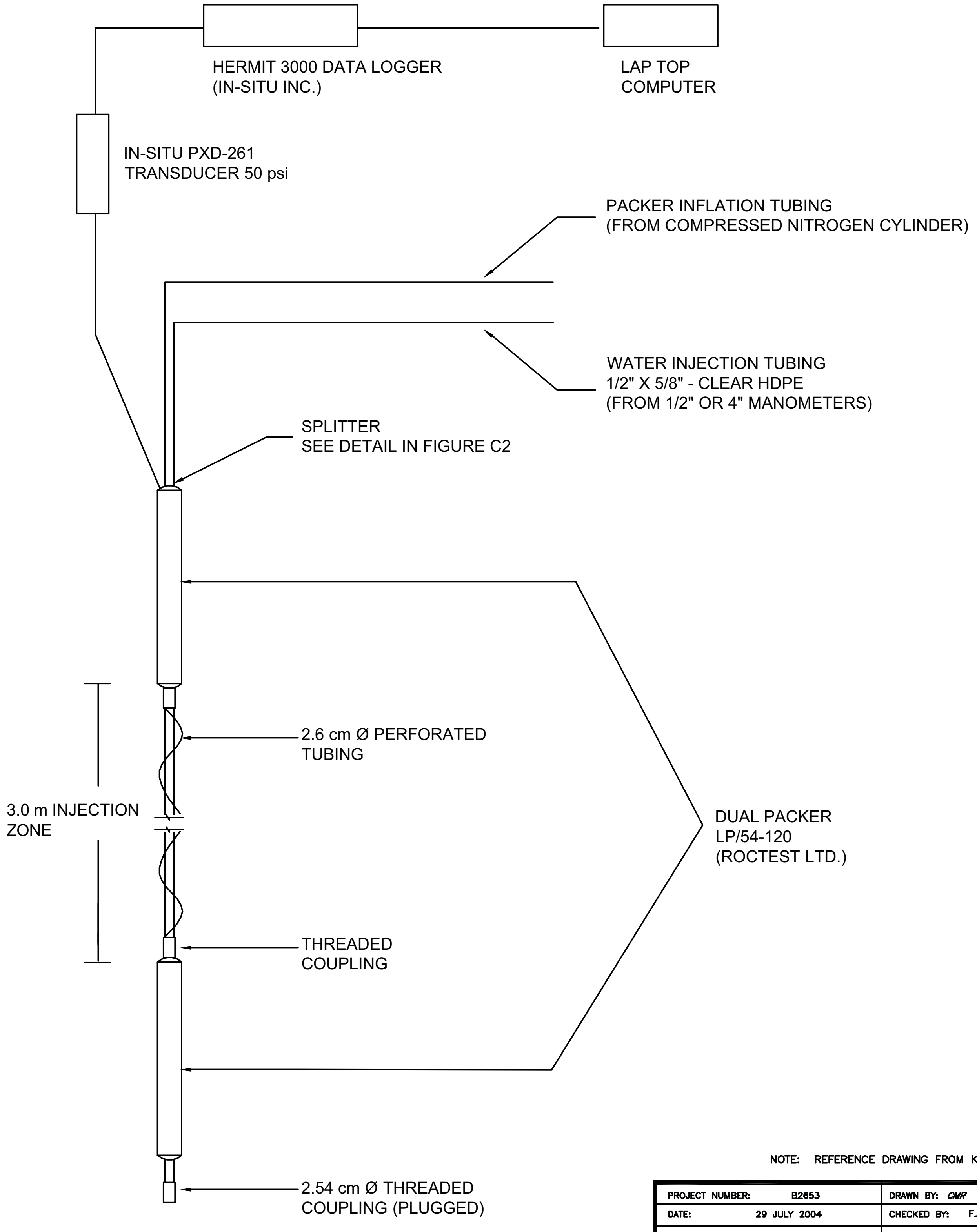
4 References

Freeze, R.A, and J.A. Cherry 1979. *Groundwater*. Engle-Wood Cliffs, New Jersey: Prentice Hall.

Bouwer, H. and R.C. Rice, 1976. *A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells*, Water Resources Research, vol. 12, no.3, pp.423-428.

Hvorslev, M.J., 1951. *Time lag and soil permeability in ground water observations*. U.S. Army Corps of Engineers Waterway Experimentation Station, Bulletin 36.

Water and Earth Science Associates Ltd. (WESA), 2000. *Supplemental Hydrogeology Program, Canadian Waste Services Inc., Richmond landfill, Town of Greater Napanee*.



NOTE: REFERENCE DRAWING FROM K. NOVAKOWSKI

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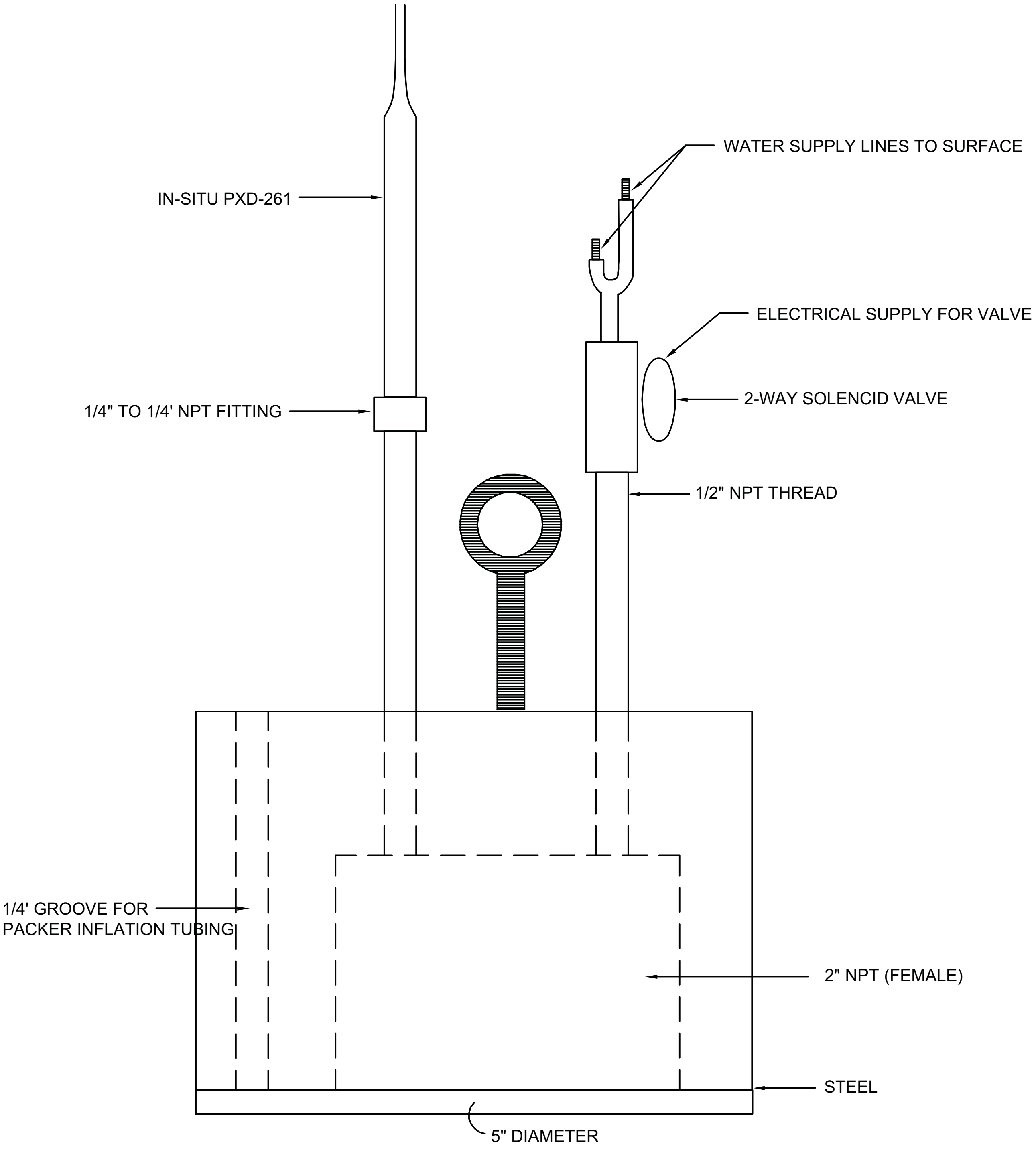
DATE: 29 JULY 2004		CHECKED BY: F.A.R.	
SCALE: NOT TO SCALE		CAD FILE NO.: B2653-OS-R	

Figure C1

STRADDLE PACKER INJECTION SYSTEM

WESA
A Better Environment For Business



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DATE: 29 JULY 2004		CHECKED BY: F.A.R.	
SCALE: NOT TO SCALE		CAD FILE NO.: B2653--S-R	

Figure C2

DETAIL OF SPLITTER

WESA

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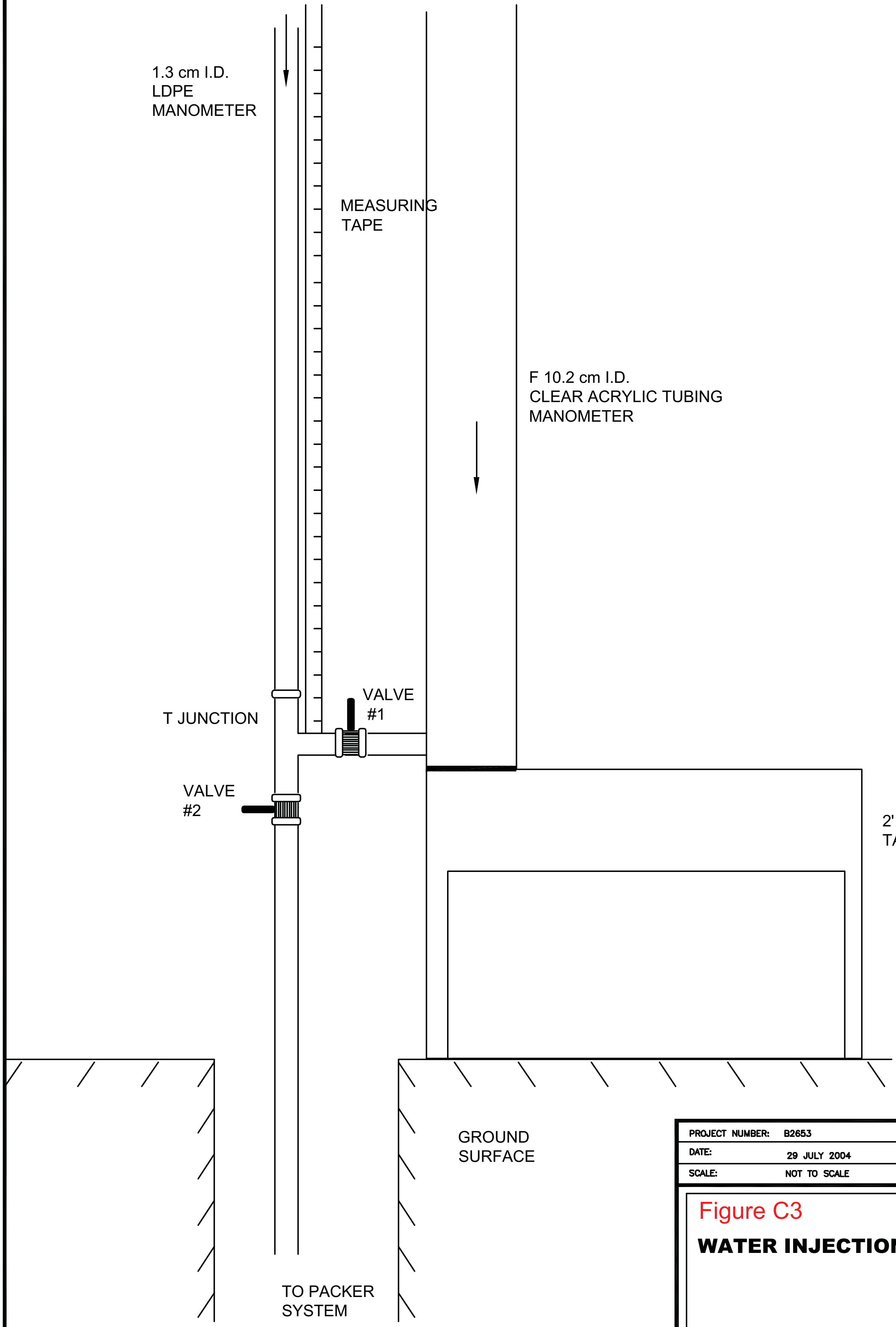

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DATE:	29 JULY 2004	CHECKED BY: F.A.R.	
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Figure C3

WATER INJECTION SYSTEM

WESA
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Appendix D:

Borehole Logs

Project No: K-A756-5

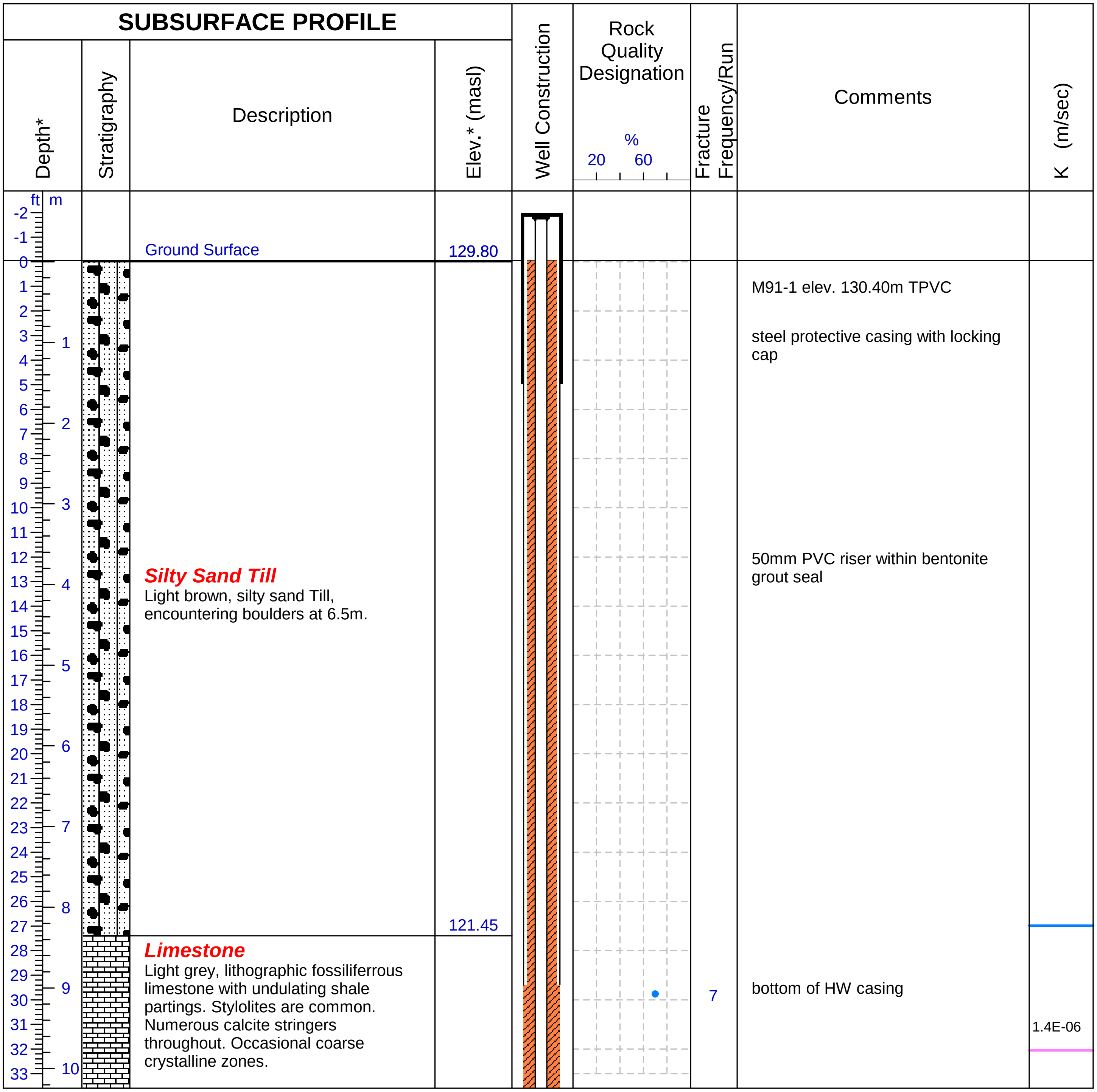
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M91-1 Angle Hole

Easting: 4902730
Northing: 334798
Field Personnel: B.A.



Ground Surface

Silty Sand Till
Light brown, silty sand Till, encountering boulders at 6.5m.

Limestone
Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occasional coarse crystalline zones.

M91-1 elev. 130.40m TPVC

steel protective casing with locking cap

50mm PVC riser within bentonite grout seal

bottom of HW casing

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 25,26, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 344 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

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* Depth and Elevation corrected to vertical

Project No: K-A756-5

Project: 2006 Angle Well Installations

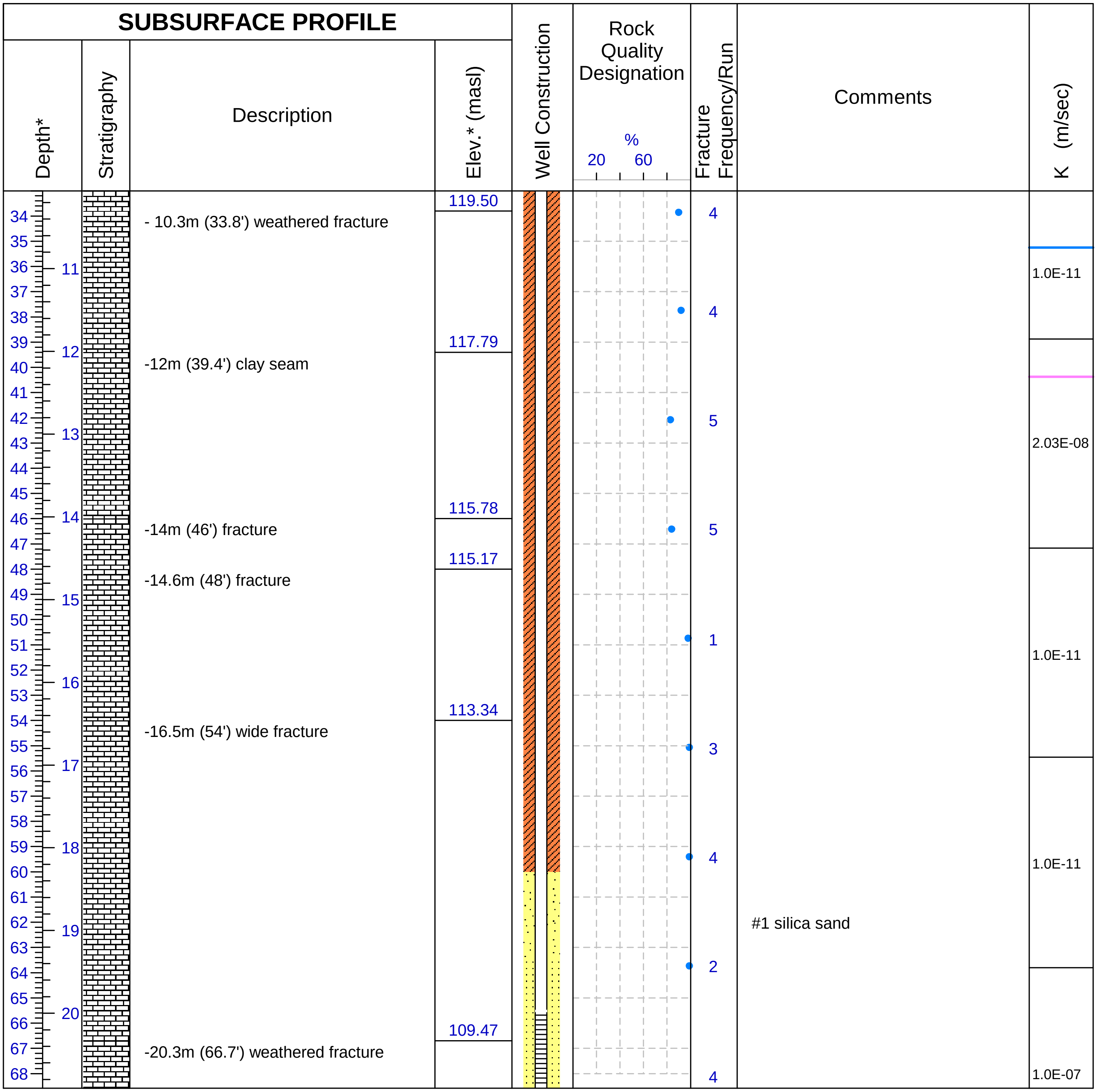
Client: Waste Management

Location: Napanee, Ontario

Well ID: M91-1 Angle Hole

Easting: 4902730
Northing: 334798
Field Personnel: B.A.

SUBSURFACE PROFILE



- 10.3m (33.8') weathered fracture

-12m (39.4') clay seam

-14m (46') fracture

-14.6m (48') fracture

-16.5m (54') wide fracture

-20.3m (66.7') weathered fracture

Elev.* (masl)
119.50
117.79
115.78
115.17
113.34
109.47

Fracture Frequency/Run
4
4
5
5
1
3
4
2
4

Comments: #1 silica sand

K (m/sec)
1.0E-11
2.03E-08
1.0E-11
1.0E-11
1.0E-07

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 25,26, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 344 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
A Better Environment For Business

* Depth and Elevation corrected to vertical

Project No: K-A756-5

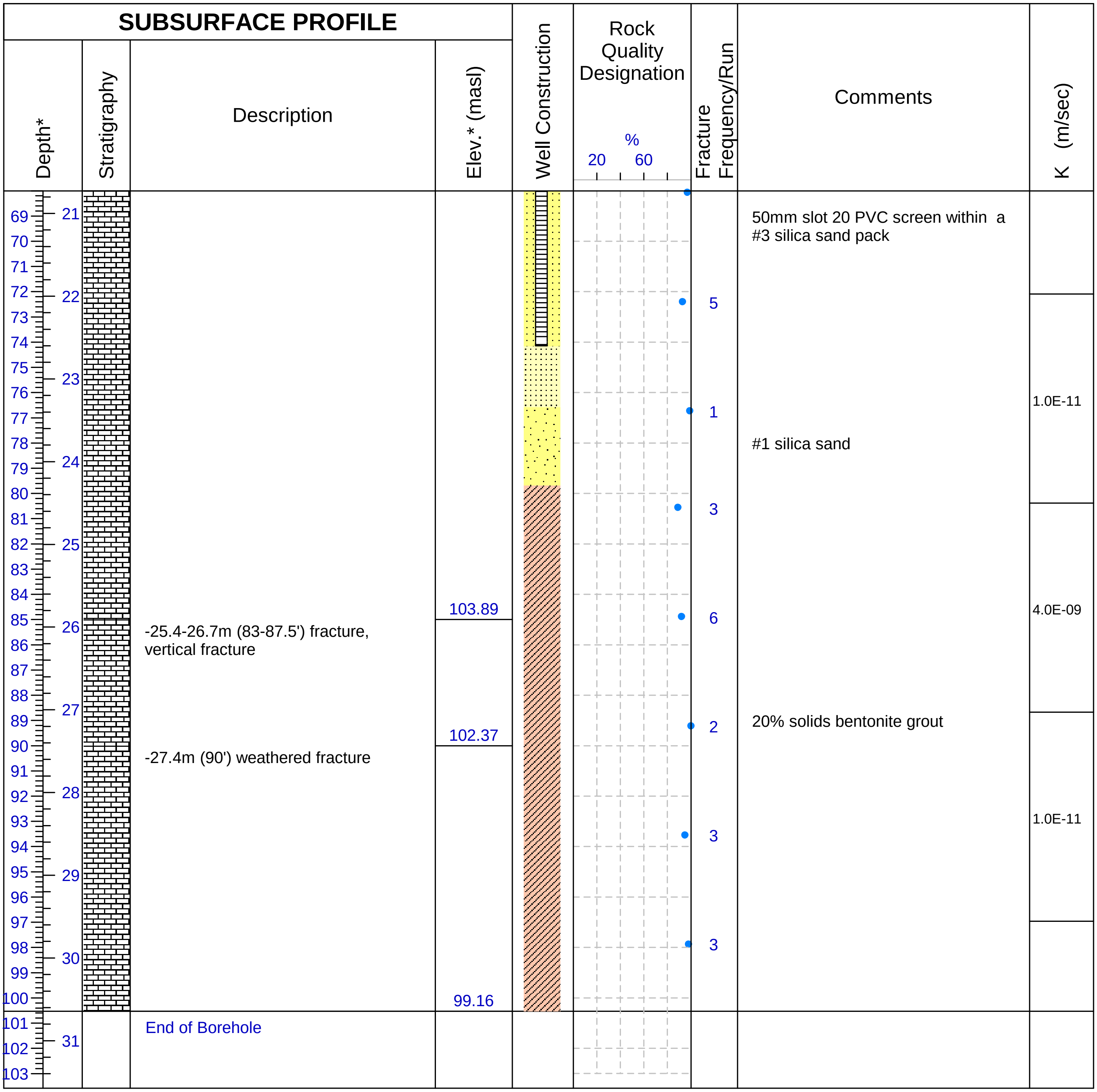
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M91-1 Angle Hole

Easting: 4902730
Northing: 334798
Field Personnel: B.A.



-25.4-26.7m (83-87.5') fracture, vertical fracture

-27.4m (90') weathered fracture

End of Borehole

50mm slot 20 PVC screen within a #3 silica sand pack

#1 silica sand

20% solids bentonite grout

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 25,26, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 344 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

* Depth and Elevation corrected to vertical

Sheet: 3 of 3

Project No: K-A756-5

Project: 2006 Vertical Well Installations

Client: Waste Management

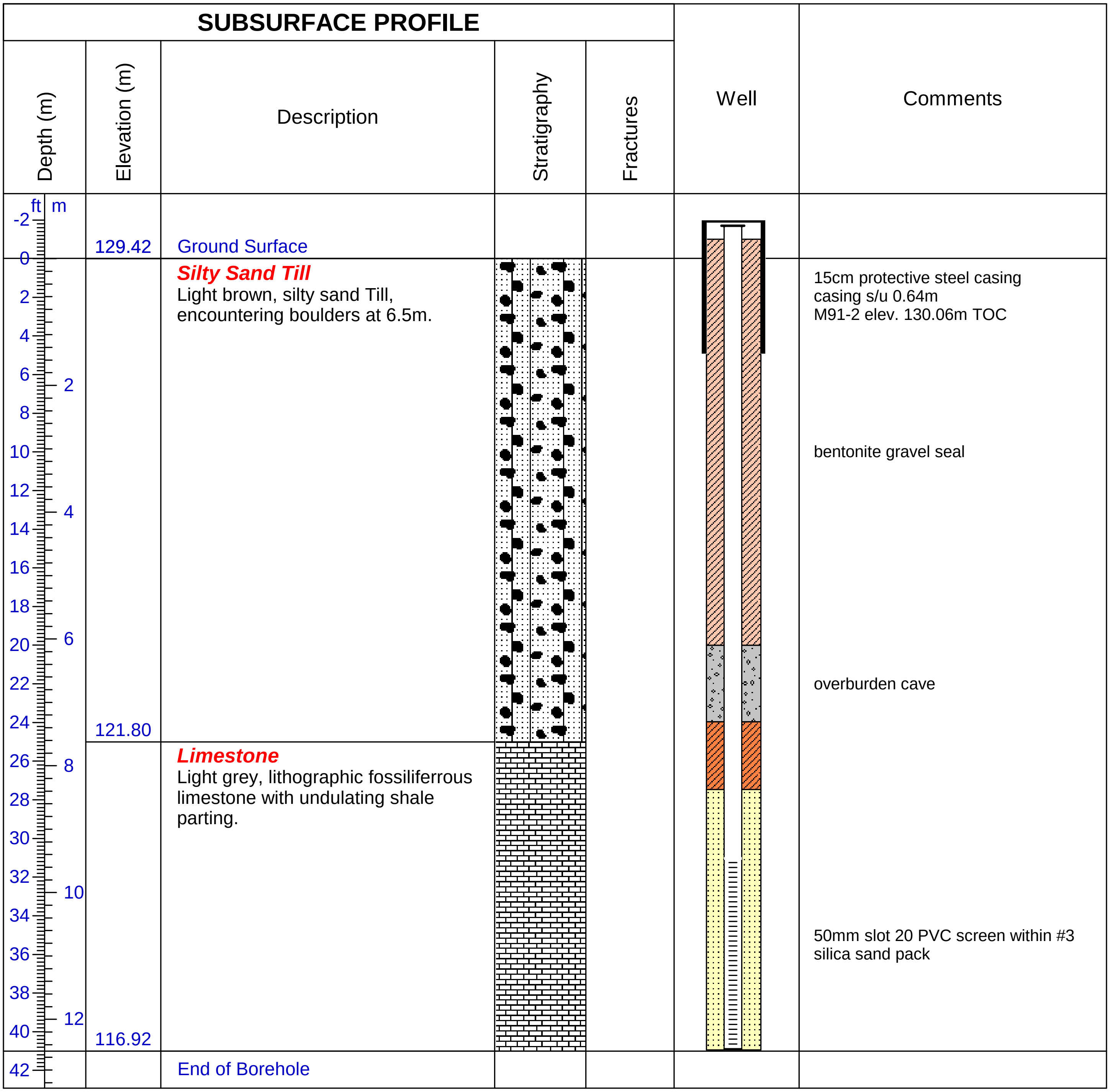
Location: Napanee, ON

Well ID: M91-2

Easting: 4902735
Northing: 334792

Field Personnel: B.McC.

SUBSURFACE PROFILE



Elevation (m)	Description	Comments
129.42	Ground Surface	
121.80	**Silty Sand Till** Light brown, silty sand Till, encountering boulders at 6.5m.	15cm protective steel casing casing s/u 0.64m M91-2 elev. 130.06m TOC bentonite gravel seal overburden cave
116.92	**Limestone** Light grey, lithographic fossiliferrous limestone with undulating shale parting.	50mm slot 20 PVC screen within #3 silica sand pack
	End of Borehole	

Drilled By: MPI Drilling Ltd.
Drill Method: Air Hammer
Drill Date: Oct.23, 2006
Hole Size: 10cm/4"

Datum: m.a.s.l.
Checked by: FAR

Sheet: 1 of 1

Project No: K-A756-5

Project: 2006 Angle Well Installations

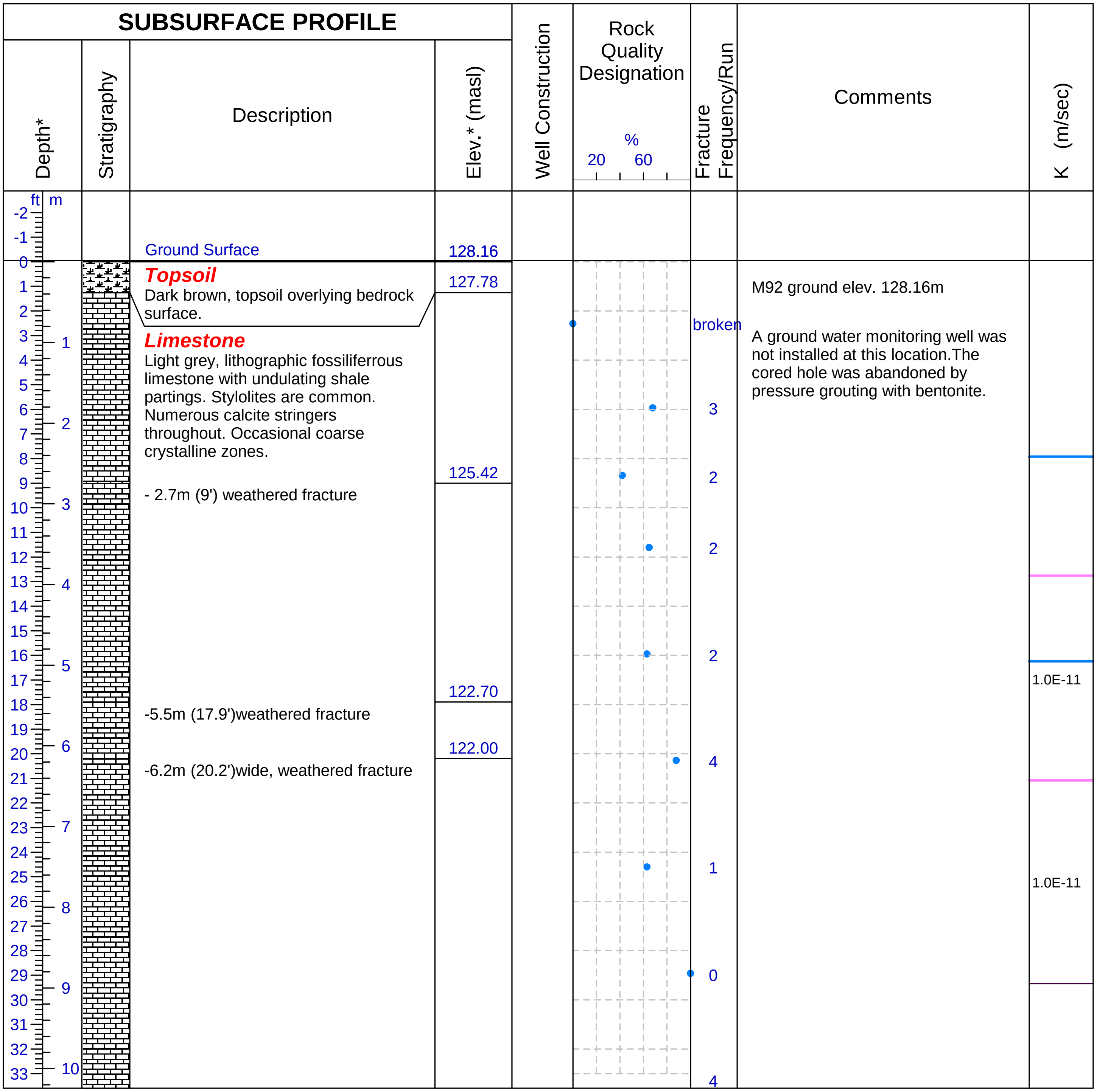
Client: Waste Management

Location: Napanee, Ontario

Well ID: M92 Angle Hole

Easting: 4903781
Northing: 334767
Field Personnel: B.A./ B.McC.

SUBSURFACE PROFILE



Ground Surface

Topsoil
Dark brown, topsoil overlying bedrock surface.

Limestone
Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occasional coarse crystalline zones.

- 2.7m (9') weathered fracture

-5.5m (17.9')weathered fracture

-6.2m (20.2')wide, weathered fracture

M92 ground elev. 128.16m

A ground water monitoring well was not installed at this location.The cored hole was abandoned by pressure grouting with bentonite.

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 28-Oct.2, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Project No: K-A756-5

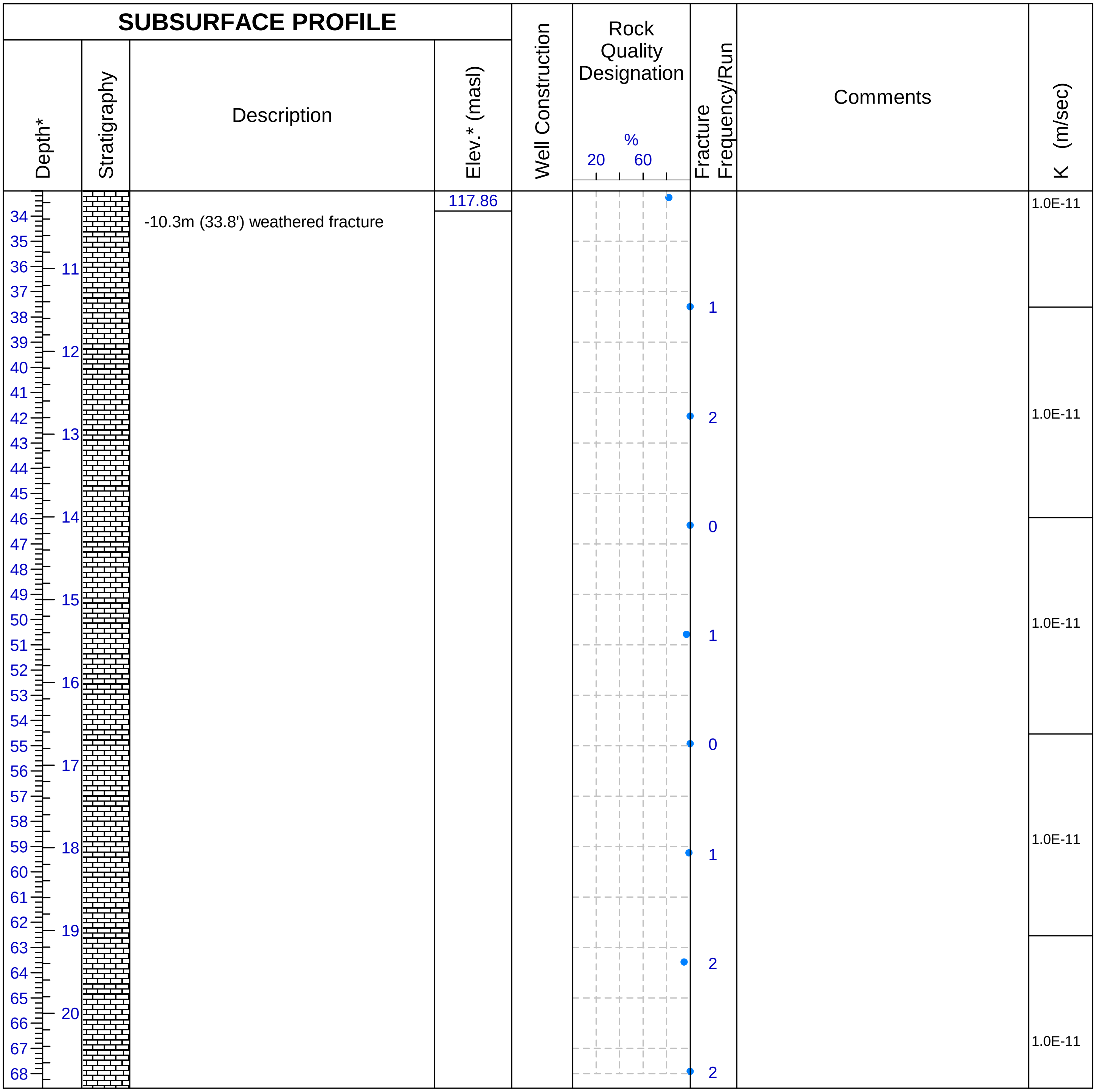
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M92 Angle Hole

Easting: 4903781
Northing: 334767
Field Personnel: B.A./ B.McC.



Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 28-Oct.2, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

* Depth and Elevation corrected to vertical

Project No: K-A756-5

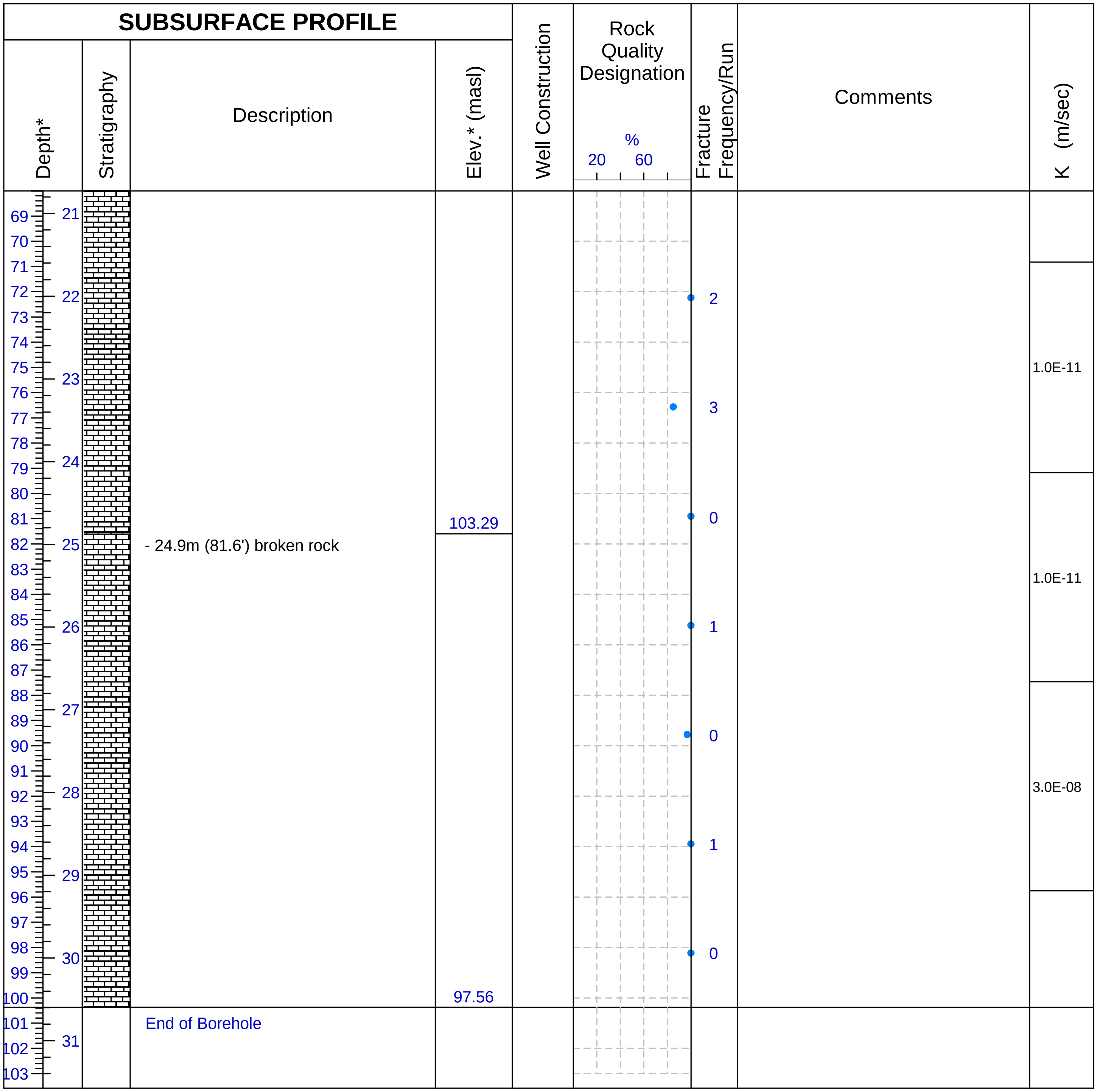
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M92 Angle Hole

Easting: 4903781
Northing: 334767
Field Personnel: B.A./ B.McC.



Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept. 28-Oct.2, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Sheet: 3 of 3

Project No: K-A756-5

Project: 2006 Angle Well Installations

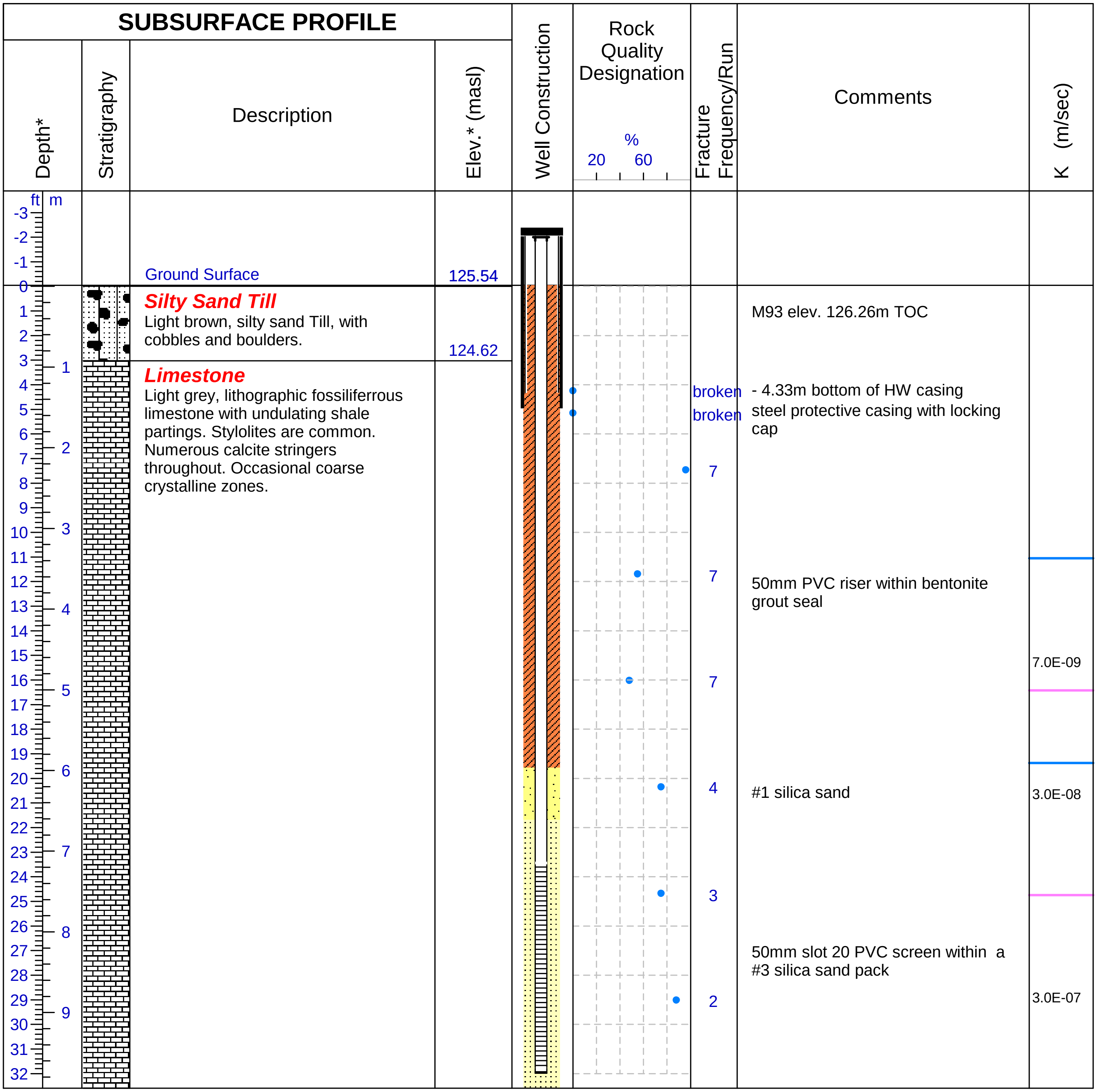
Client: Waste Management

Location: Napanee, Ontario

Well ID: M93 Angle Hole

Easting: 4903909
Northing: 335006
Field Personnel: B.McC.

SUBSURFACE PROFILE



Ground Surface

Silty Sand Till
Light brown, silty sand Till, with cobbles and boulders.

Limestone
Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occasional coarse crystalline zones.

M93 elev. 126.26m TOC

- 4.33m bottom of HW casing steel protective casing with locking cap

50mm PVC riser within bentonite grout seal

#1 silica sand

50mm slot 20 PVC screen within a #3 silica sand pack

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct. 3,4, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Sheet: 1 of 3

Project No: K-A756-5

Project: 2006 Angle Well Installations

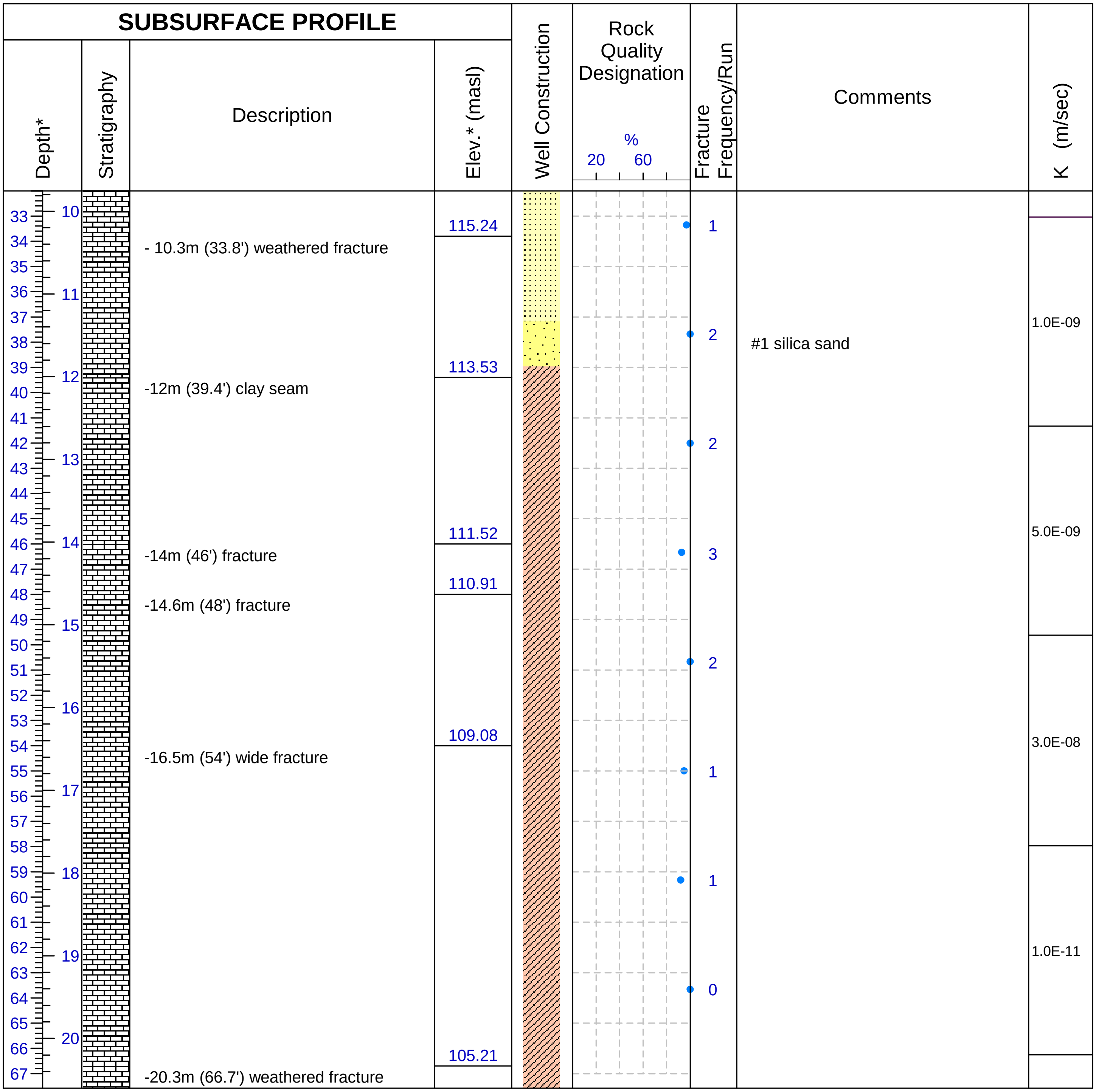
Client: Waste Management

Location: Napanee, Ontario

Well ID: M93 Angle Hole

Easting: 4903909
Northing: 335006
Field Personnel: B.McC.

SUBSURFACE PROFILE



Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct. 3,4, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

WESA
A Better Environment For Business

* Depth and Elevation corrected to vertical

Sheet: 2 of 3

Project No: K-A756-5

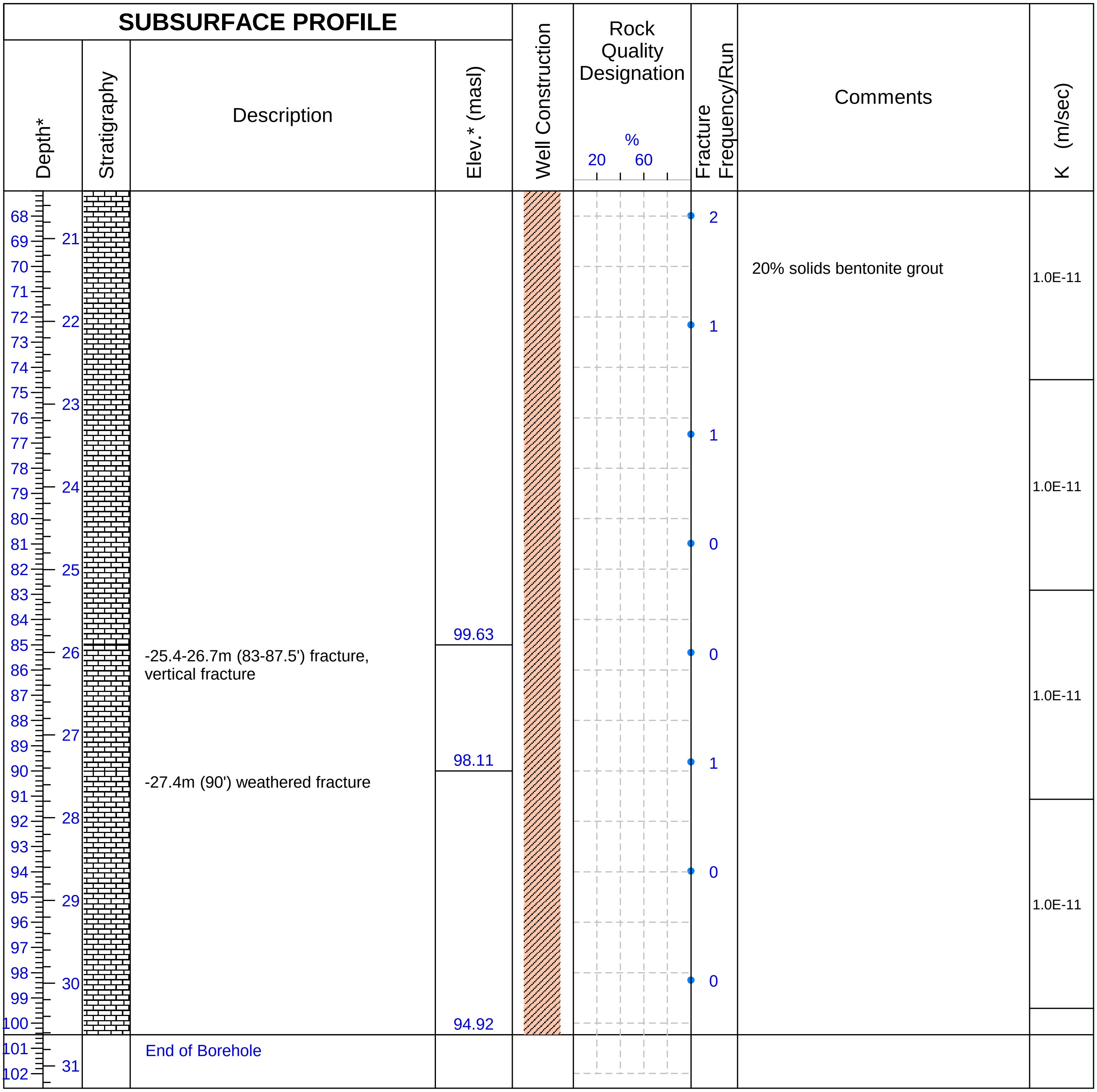
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M93 Angle Hole

Easting: 4903909
Northing: 335006
Field Personnel: B.McC.



-25.4-26.7m (83-87.5') fracture, vertical fracture

-27.4m (90') weathered fracture

End of Borehole

20% solids bentonite grout

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct. 3,4, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 0 degrees (due north)
Datum: m.a.s.l.
Checked By: FAR

WESA
A Better Environment For Business

* Depth and Elevation corrected to vertical

Project No: K-A756-5

Project: 2006 Angle Well Installations

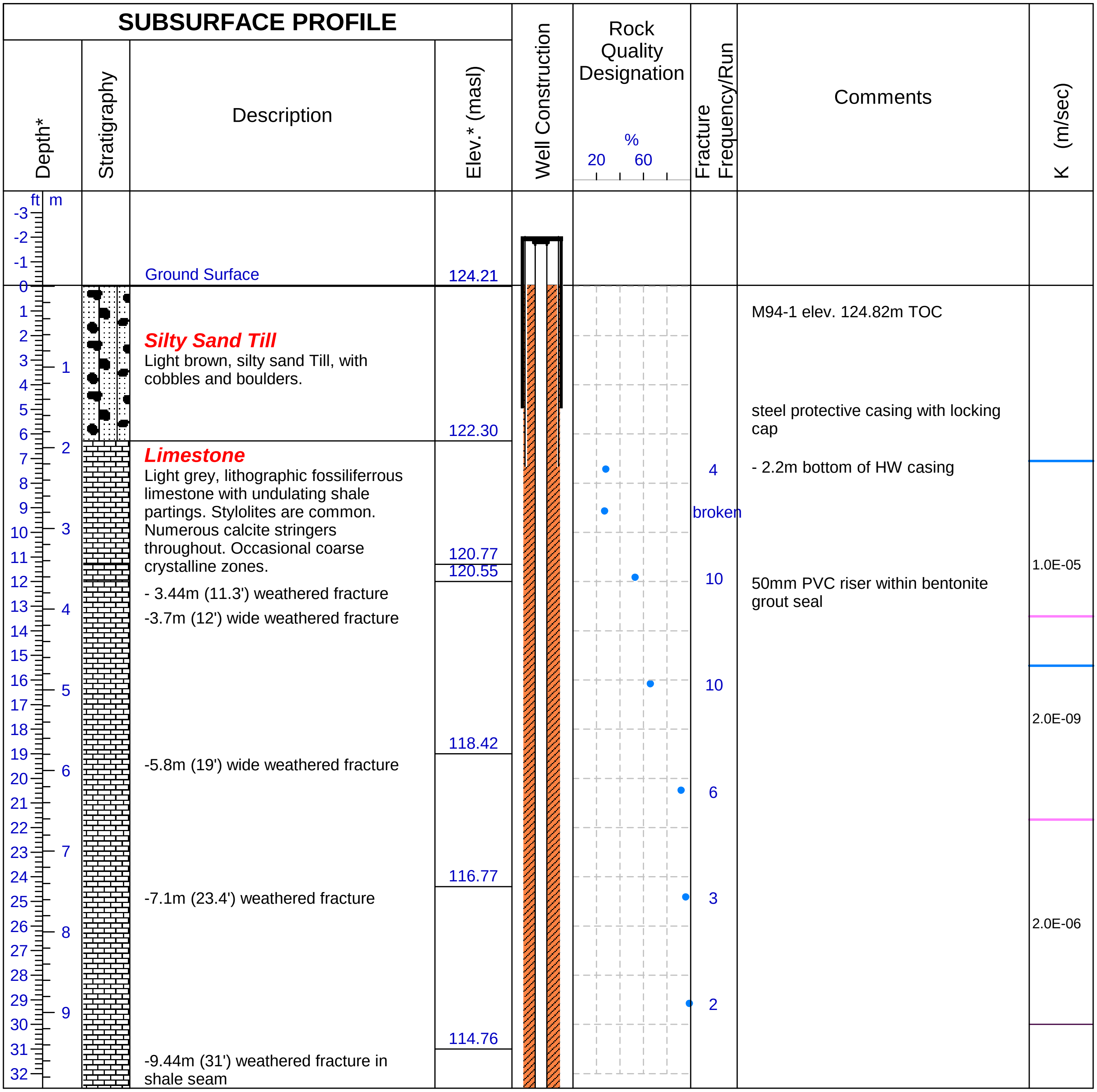
Client: Waste Management

Location: Napanee, Ontario

Well ID: M94-1 Angle Hole

Easting: 4903520
Northing: 335497
Field Personnel: B.A.

SUBSURFACE PROFILE



Ground Surface

Silty Sand Till

Light brown, silty sand Till, with cobbles and boulders.

Limestone

Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occasional coarse crystalline zones.

- 3.44m (11.3') weathered fracture

-3.7m (12') wide weathered fracture

-5.8m (19') wide weathered fracture

-7.1m (23.4') weathered fracture

-9.44m (31') weathered fracture in shale seam

M94-1 elev. 124.82m TOC

steel protective casing with locking cap

- 2.2m bottom of HW casing

50mm PVC riser within bentonite grout seal

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept.26,27, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 6 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Sheet: 1 of 3

Project No: K-A756-5

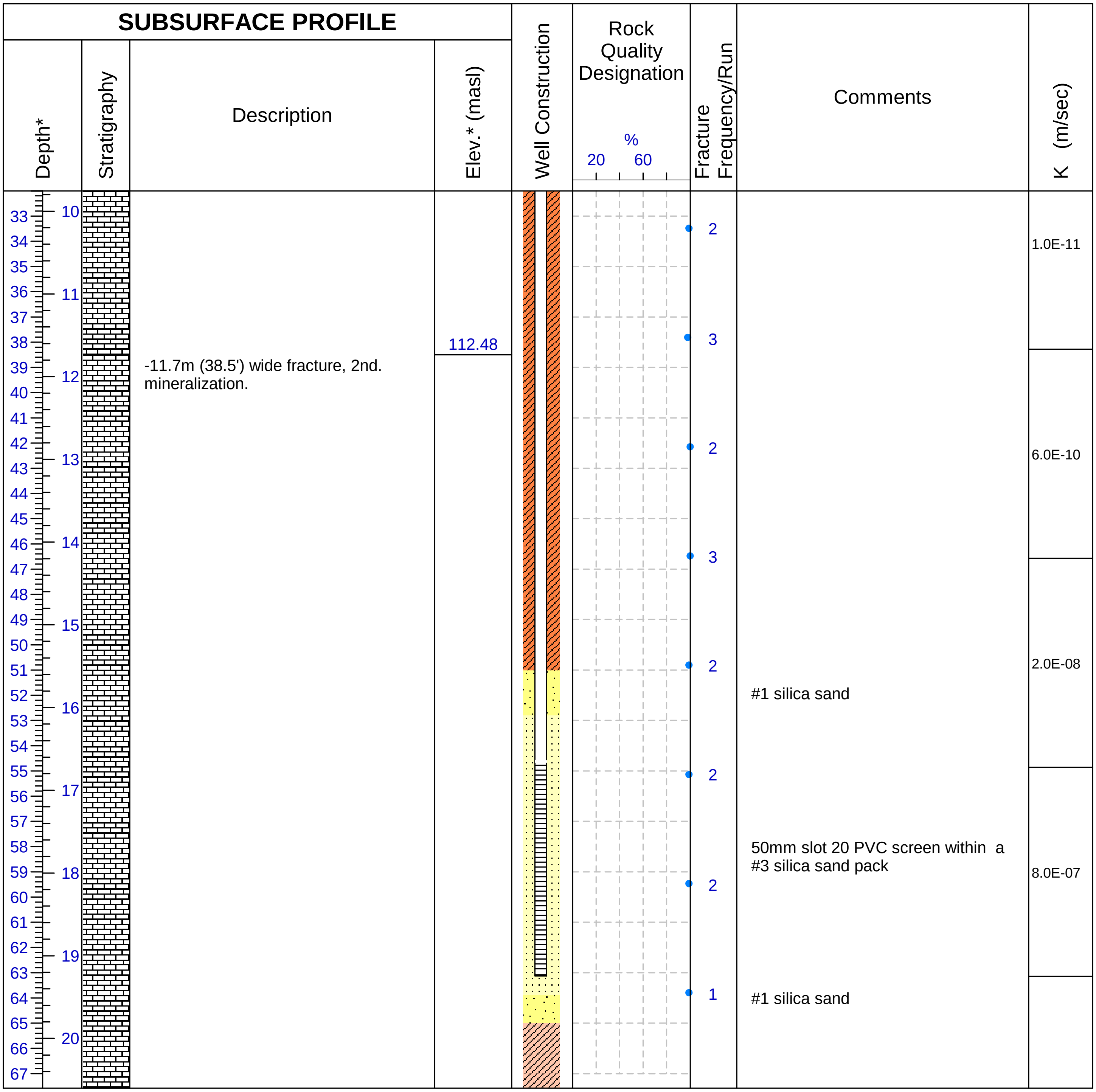
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M94-1 Angle Hole

Easting: 4903520
Northing: 335497
Field Personnel: B.A.



-11.7m (38.5') wide fracture, 2nd. mineralization.

#1 silica sand

50mm slot 20 PVC screen within a #3 silica sand pack

#1 silica sand

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept.26,27, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 6 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Sheet: 2 of 3

Project No: K-A756-5

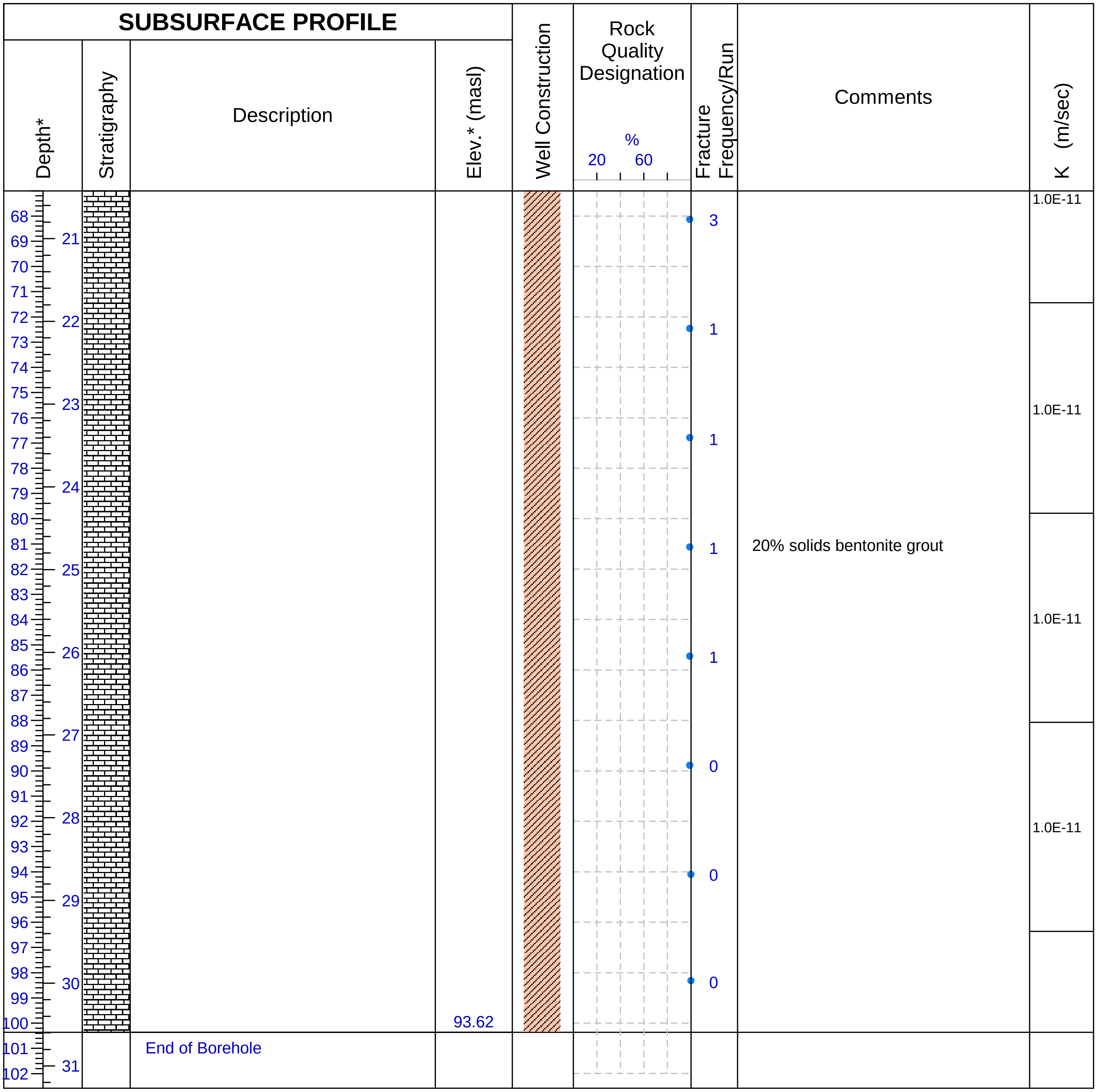
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M94-1 Angle Hole

Easting: 4903520
Northing: 335497
Field Personnel: B.A.



Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Sept.26,27, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 6 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Project No: K-A756-5

Project: 2006 Vertical Well Installations

Client: Waste Management

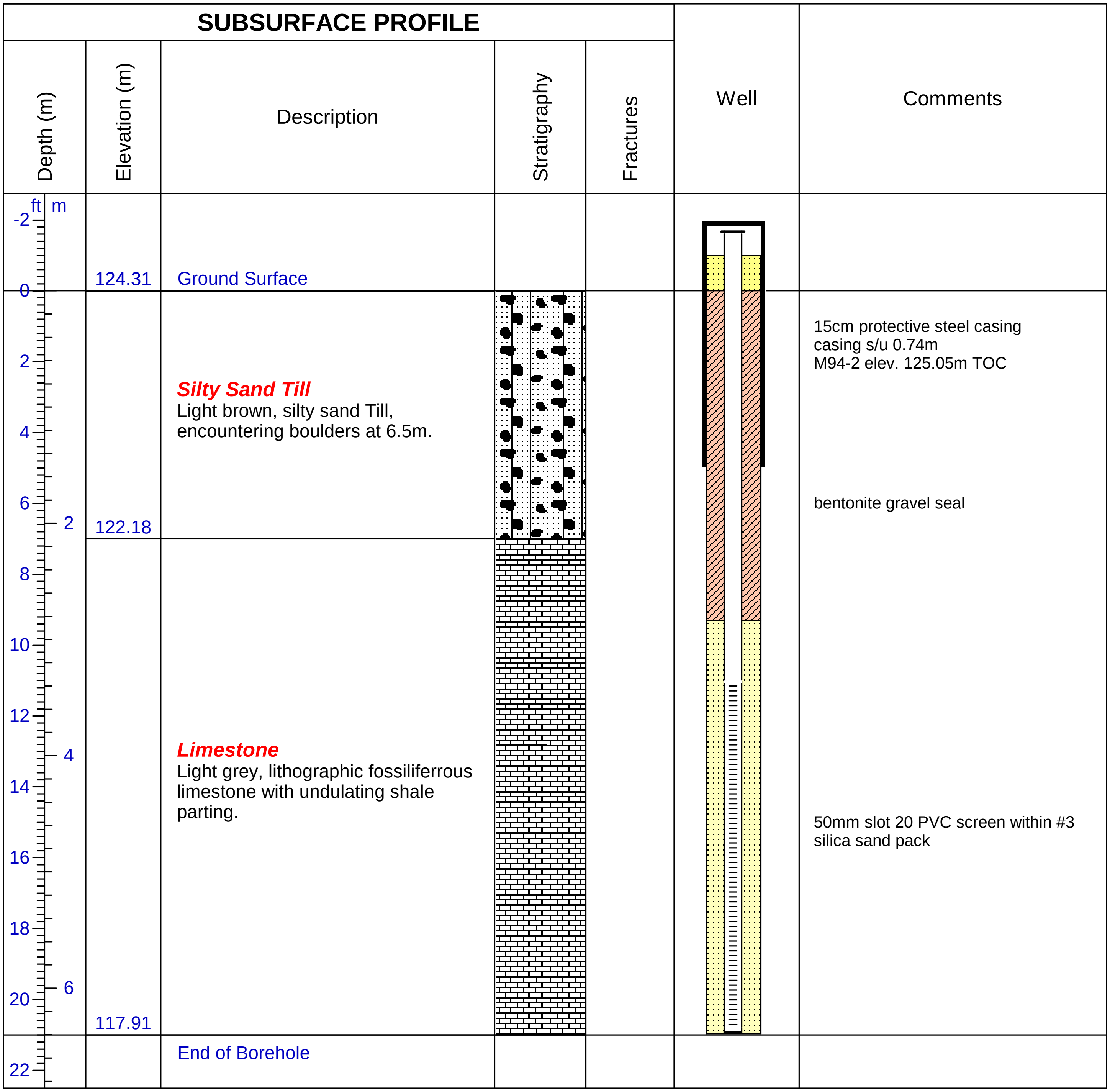
Location: Napanee, ON

Well ID: M94-2

Easting: 4903527
Northing: 335486

Field Personnel: B.McC.

SUBSURFACE PROFILE



Ground Surface

Silty Sand Till
Light brown, silty sand Till, encountering boulders at 6.5m.

Limestone
Light grey, lithographic fossiliferrous limestone with undulating shale parting.

End of Borehole

15cm protective steel casing
casing s/u 0.74m
M94-2 elev. 125.05m TOC

bentonite gravel seal

50mm slot 20 PVC screen within #3 silica sand pack

Drilled By: MPI Drilling Ltd.
Drill Method: Air Hammer
Drill Date: Oct.24, 2006
Hole Size: 10cm/4"

Datum: m.a.s.l.
Checked by: FAR

Sheet: 1 of 1

Project No: K-A756-5

Project: 2006 Angle Well Installations

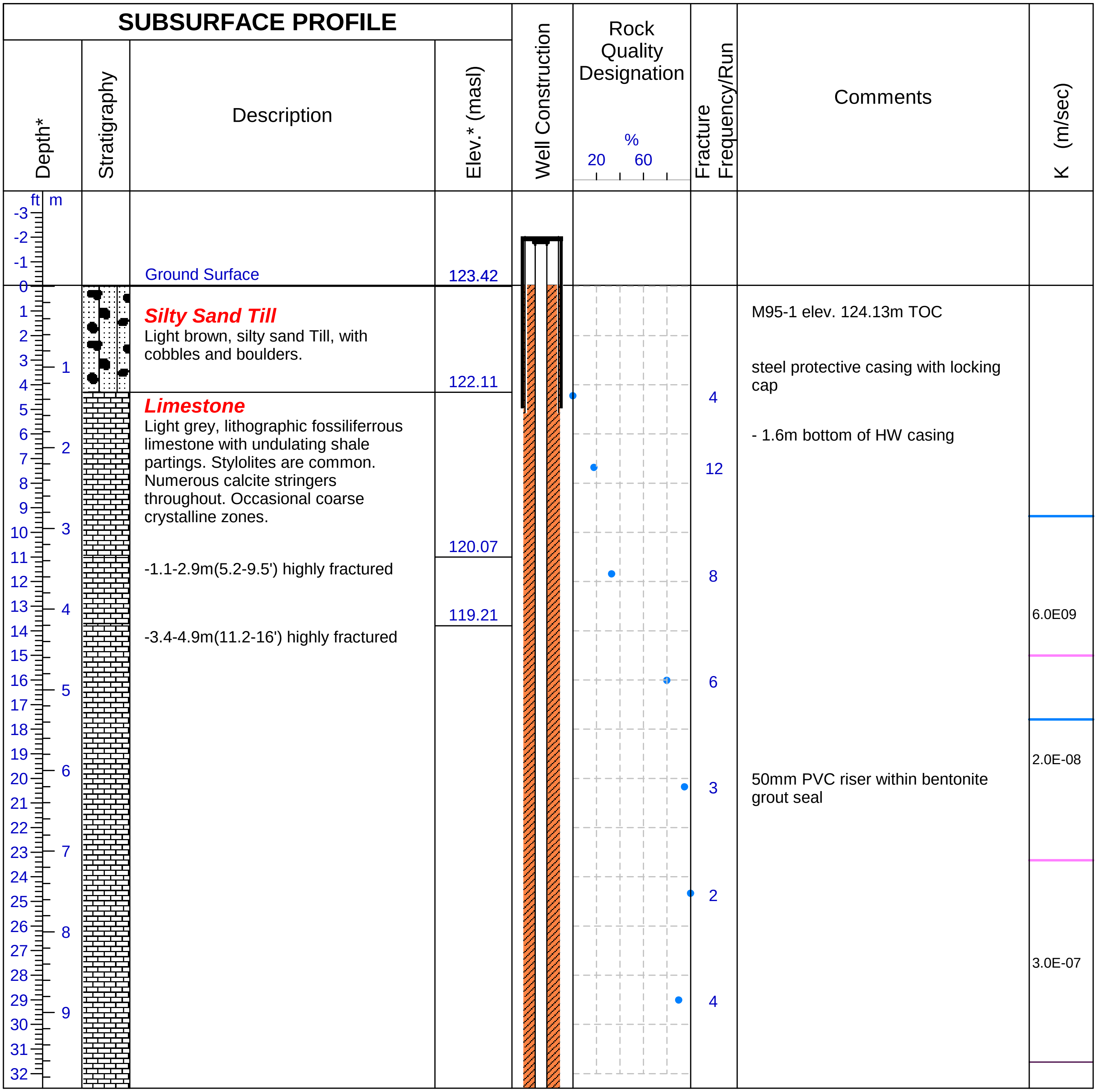
Client: Waste Management

Location: Napanee, Ontario

Well ID: M95-1 Angle Hole

Easting: 4902910
Northing: 334742
Field Personnel: B.McC.

SUBSURFACE PROFILE



Ground Surface

Silty Sand Till
Light brown, silty sand Till, with cobbles and boulders.

Limestone
Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occasional coarse crystalline zones.

-1.1-2.9m(5.2-9.5') highly fractured

-3.4-4.9m(11.2-16') highly fractured

M95-1 elev. 124.13m TOC

steel protective casing with locking cap

- 1.6m bottom of HW casing

50mm PVC riser within bentonite grout seal

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct.4,5, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 19 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

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* Depth and Elevation corrected to vertical

Sheet: 1 of 3

Project No: K-A756-5

Project: 2006 Angle Well Installations

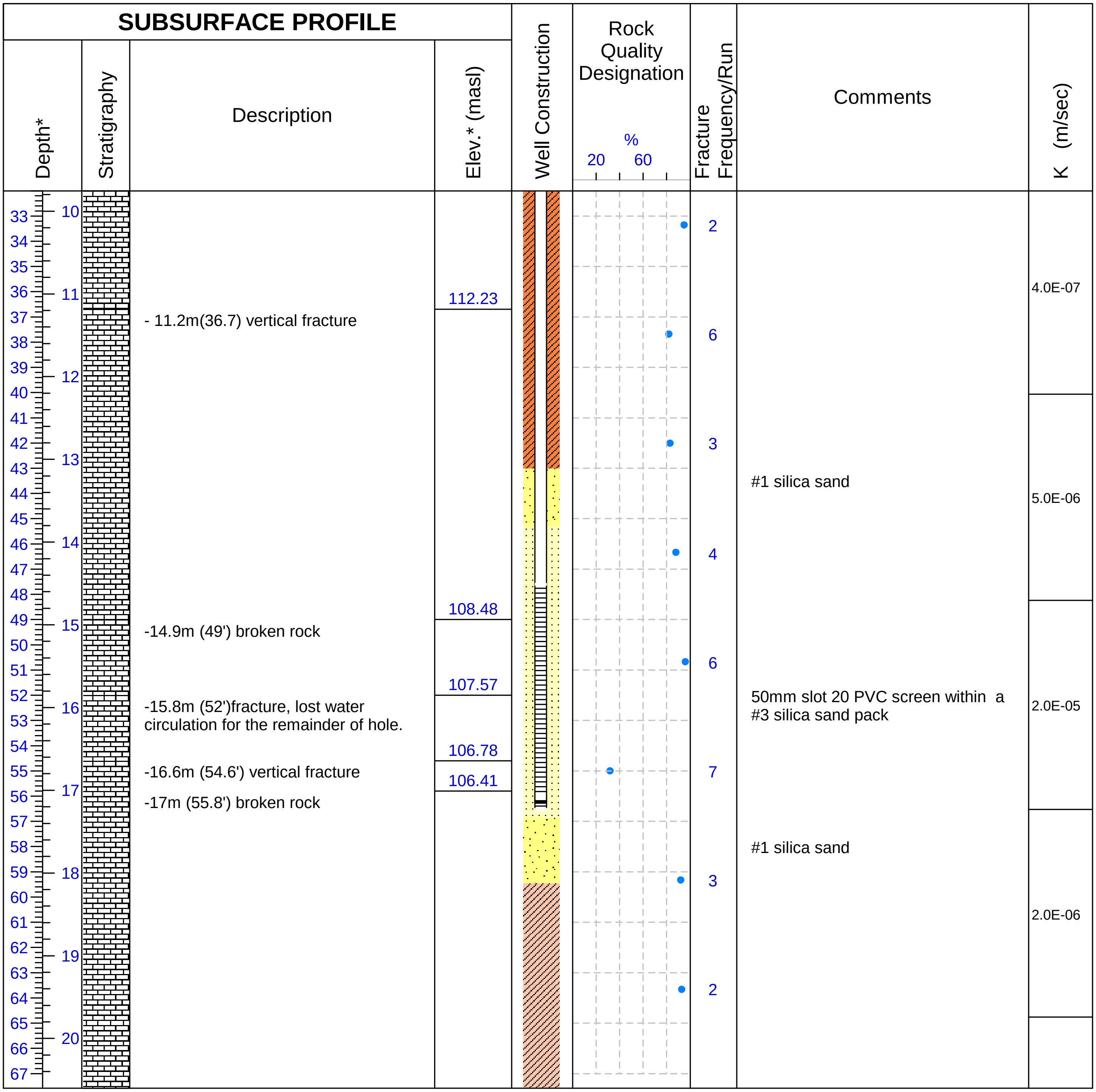
Client: Waste Management

Location: Napanee, Ontario

Well ID: M95-1 Angle Hole

Easting: 4902910
Northing: 334742
Field Personnel: B.McC.

SUBSURFACE PROFILE



- 11.2m(36.7) vertical fracture

-14.9m (49') broken rock

-15.8m (52')fracture, lost water circulation for the remainder of hole.

-16.6m (54.6') vertical fracture

-17m (55.8') broken rock

#1 silica sand

50mm slot 20 PVC screen within a #3 silica sand pack

#1 silica sand

Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct.4,5, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 19 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
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* Depth and Elevation corrected to vertical

Sheet: 2 of 3

Project No: K-A756-5

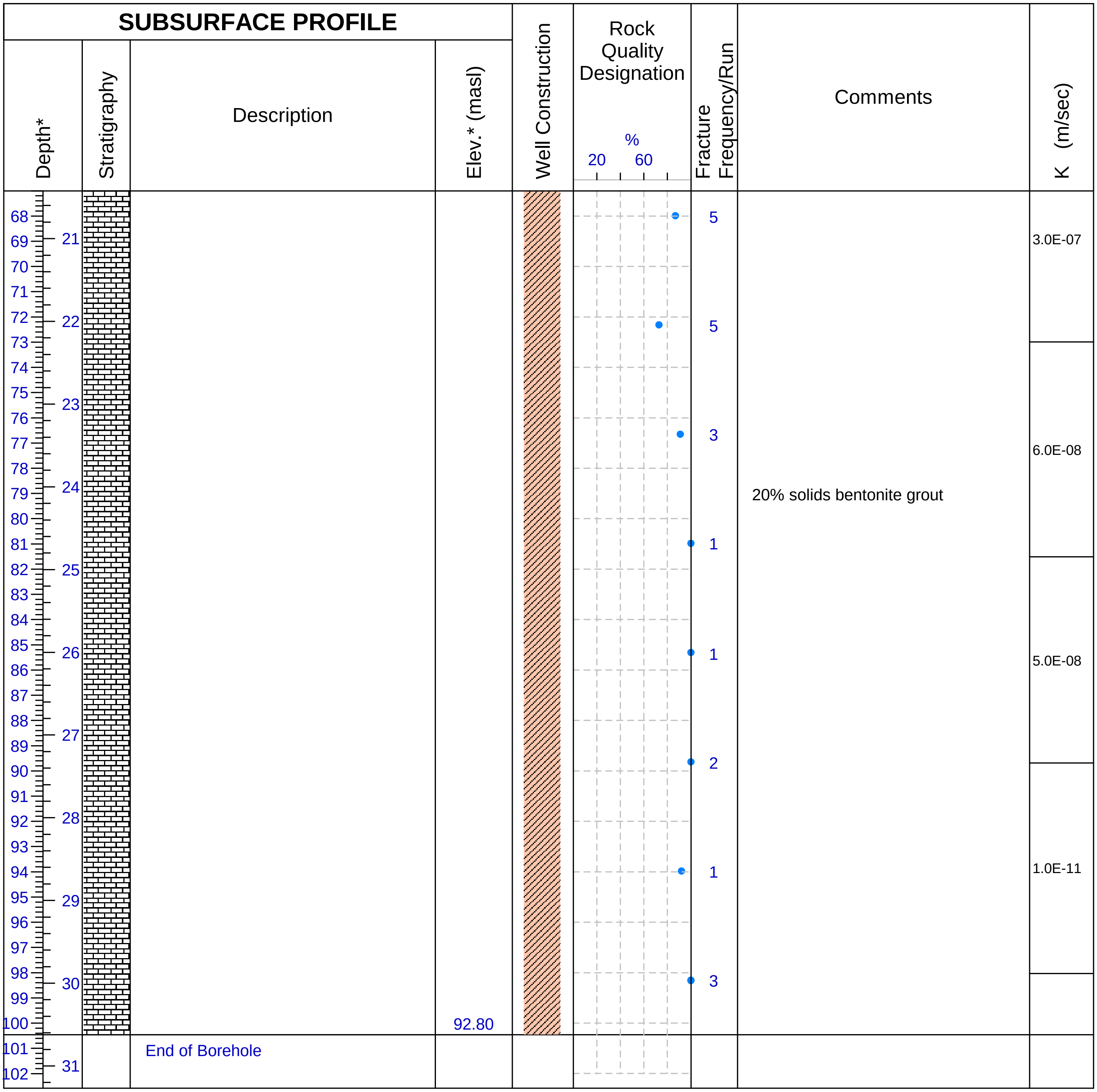
Project: 2006 Angle Well Installations

Client: Waste Management

Location: Napanee, Ontario

Well ID: M95-1 Angle Hole

Easting: 4902910
Northing: 334742
Field Personnel: B.McC.



Drilled By: Downing Drilling
Drill Method: Diamond Drill
Hole Size: HW(4.5")/HQ3(3.78")
Drill Date: Oct.4,5, 2006

Drill Angle: 60 degrees from horiz.
Azimuth: 19 degrees clockwise from north
Datum: m.a.s.l.
Checked By: FAR

WESA
A Better Environment For Business

* Depth and Elevation corrected to vertical

Sheet: 3 of 3

Project No: K-A756-5

Project: 2006 Vertical Well Installations

Client: Waste Management

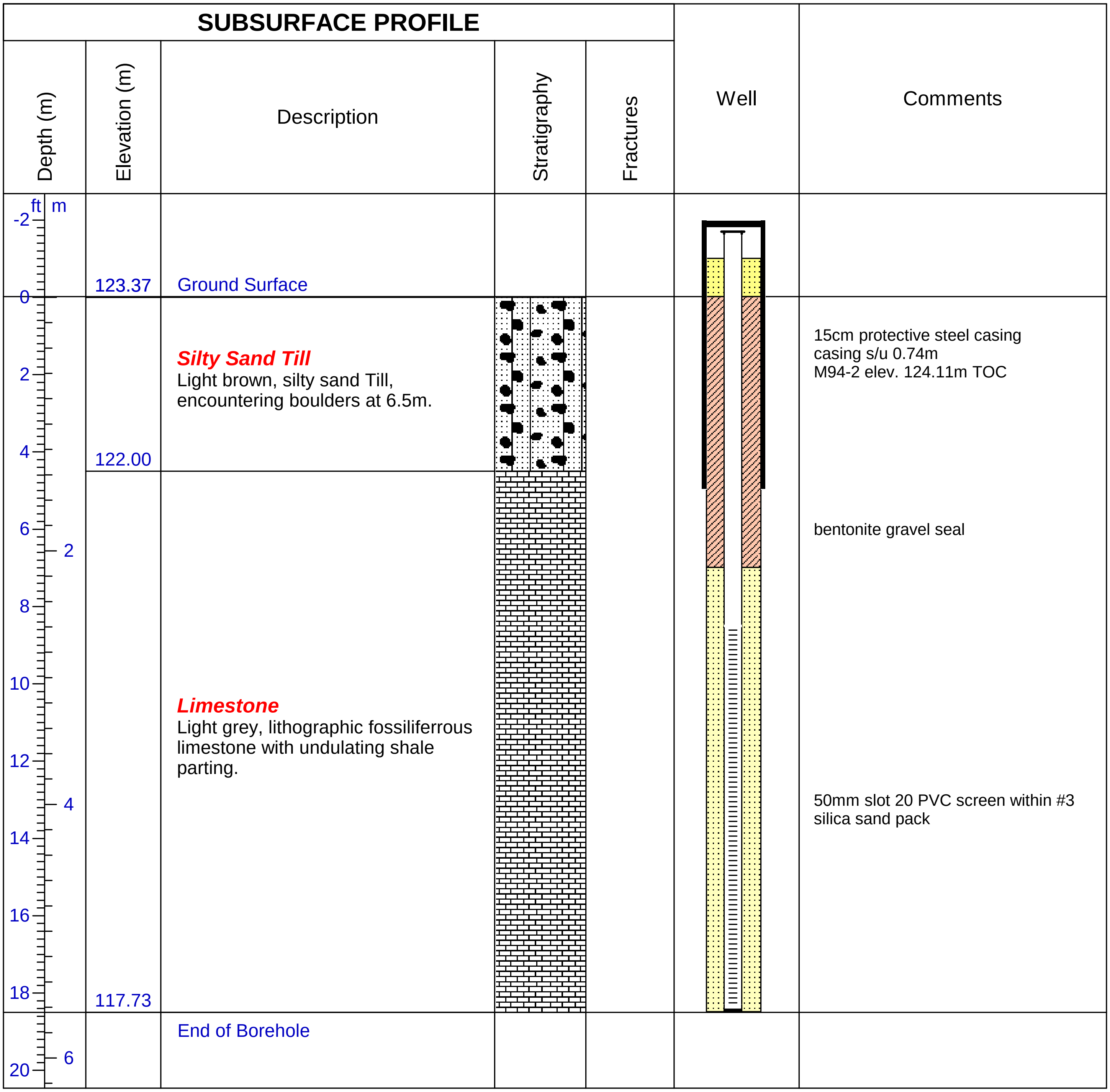
Location: Napanee, ON

Well ID: M95-2

Easting: 4902918
Northing: 334740

Field Personnel: B.McC.

SUBSURFACE PROFILE



Depth (m)	Elevation (m)	Description	Stratigraphy	Fractures	Well	Comments
	123.37	Ground Surface				
	122.00	***Silty Sand Till*** Light brown, silty sand Till, encountering boulders at 6.5m.				15cm protective steel casing casing s/u 0.74m M94-2 elev. 124.11m TOC
	117.73	***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale parting.				bentonite gravel seal 50mm slot 20 PVC screen within #3 silica sand pack
		End of Borehole				

Drilled By: MPI Drilling Ltd.
Drill Method: Air Hammer
Drill Date: Oct.24, 2006
Hole Size: 10cm/4"

Datum: m.a.s.l.
Checked by: FAR

Sheet: 1 of 1

Appendix E:

Groundwater Quality Information

REPORT OF ANALYSIS

Client: **Waste Management of Canada Corp.**
1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
Date: 2006-12-12
Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: 57365

		LAB ID:	509392	509393	509394	509395	509396	**GUIDELINE**		
		Sample Date:	2006-11-28	2006-11-28	2006-11-28	2006-11-28	2006-11-28	ODWSOG		
		Sample ID:	M91-1	M93	M94-1	M94-2	M95-1			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
Alkalinity as CaCO3	mg/L	5	336	344	259	297	337	OG	500	mg/L
Chemical Oxygen Demand	mg/L	5	10	38	390	15	<5			
Chloride	mg/L	1	52	108	10900	353	13	AO	250	mg/L
Conductivity	uS/cm	5	1070	1250	28100	2390	766			
Dissolved Organic Carbon	mg/L	0.5	2.8	2.9	1.5	6.2	2.0	AO	5	mg/L
N-NH3 (Ammonia)	mg/L	0.02	2.94	2.03	8.95	0.70	0.19			
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	<0.10	0.18	0.27	MAC	10.0	mg/L
pH			8.23	8.20	7.58	8.11	8.02	AO	6.5-8.5	pH Units
Phenols	mg/L	0.001	<0.001	0.012	0.035	<0.001	<0.001			
Sulphate	mg/L	1	129	128	21	424	76	AO	500	mg/L
TDS (COND - CALC)	mg/L	5	696	813	18300	1670	498	AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	3.02	2.15	10.7	1.27	0.32			
Total Organic Carbon	mg/L	0.5	2.9	3.0	1.5	5.8	3.0			
Total Phosphorus	mg/L	0.01	0.04	0.26	0.24	0.37	0.12			
Hardness as CaCO3	mg/L	1	232	169	5390	602	389	OG	100	mg/L
Calcium	mg/L	1	65	43	958	185	113			
Magnesium	mg/L	1	17	15	728	34	26			
Potassium	mg/L	1	19	19	87	12	2			
Sodium	mg/L	2	123	191	3970	271	11	AO	20	mg/L
Aluminum	mg/L	0.01	<0.01	0.04	<0.1	0.02	0.02	OG	0.1	mg/L
Arsenic	mg/L	0.001	<0.001	0.004	0.14	0.006	<0.001	IMAC	0.025	mg/L
Barium	mg/L	0.01	0.05	0.01	1.1	0.10	0.09	MAC	1.0	mg/L
Boron	mg/L	0.01	0.35	0.60	1.2	0.37	0.03	IMAC	5.0	mg/L
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.0001	MAC	0.005	mg/L
Chromium	mg/L	0.001	0.001	0.002	<0.01	0.002	0.002	MAC	0.05	mg/L
Copper	mg/L	0.001	<0.001	<0.001	<0.01	0.001	<0.001	AO	1.0	mg/L
Iron	mg/L	0.03	0.03	0.07	<0.3	0.08	0.18	AO	0.3	mg/L
Lead	mg/L	0.001	<0.001	<0.001	<0.01	<0.001	<0.001	MAC	0.01	mg/L
Manganese	mg/L	0.01	0.07	0.04	<0.1	0.10	0.02	AO	0.05	mg/L

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

Comment:

509394: Metals MDL elevated due to matrix interference.

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

REPORT OF ANALYSIS

Client: **Waste Management of Canada Corp.**
1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
Date: 2006-12-12
Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: 57365

			509392	509393	509394	509395	509396	GUIDELINE		
			39049	2006-11-28	2006-11-28	2006-11-28	2006-11-28	ODWSOG		
			M91-1	M93	M94-1	M94-2	M95-1			
								TYPE	**LIMIT**	**UNITS**
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	MAC	0.001	mg/L
Silver	mg/L	0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.0001			
Zinc	mg/L	0.01	<0.01	<0.01	<0.1	0.01	<0.01	AO	5.0	mg/L

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

REPORT OF ANALYSIS

Client: **Waste Management of Canada Corp.**
1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
Date: 2006-12-12
Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: **57365**

			509397	509398				GUIDELINE		
			2006-11-28	2006-11-28				ODWSOG		
			M95-2	QAQC GW						
								TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	305	336				OG	500	mg/L
Chemical Oxygen Demand	mg/L	5	16	6						
Chloride	mg/L	1	66	13				AO	250	mg/L
Conductivity	uS/cm	5	1760	762						
Dissolved Organic Carbon	mg/L	0.5	6.0	1.9				AO	5	mg/L
N-NH3 (Ammonia)	mg/L	0.02	0.33	0.18						
N-NO2 (Nitrite)	mg/L	0.10	<0.10	<0.10				MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10	0.27				MAC	10.0	mg/L
pH			7.95	8.01				AO	6.5-8.5	pH Units
Phenols	mg/L	0.001	<0.001	<0.001						
Sulphate	mg/L	1	561	75				AO	500	mg/L
TDS (COND - CALC)	mg/L	5	1320	495				AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	0.83	0.30						
Total Organic Carbon	mg/L	0.5	6.0	2.4						
Total Phosphorus	mg/L	0.01	0.19	0.14						
Hardness as CaCO3	mg/L	1	816	394				OG	100	mg/L
Calcium	mg/L	1	246	115						
Magnesium	mg/L	1	49	26						
Potassium	mg/L	1	8	2						
Sodium	mg/L	2	95	10				AO	20	mg/L
Aluminum	mg/L	0.01	0.01	0.01				OG	0.1	mg/L
Arsenic	mg/L	0.001	0.001	<0.001				IMAC	0.025	mg/L
Barium	mg/L	0.01	0.07	0.09				MAC	1.0	mg/L
Boron	mg/L	0.01	0.37	0.03				IMAC	5.0	mg/L
Cadmium	mg/L	0.0001	<0.0001	<0.0001				MAC	0.005	mg/L
Chromium	mg/L	0.001	0.002	0.001				MAC	0.05	mg/L
Copper	mg/L	0.001	0.002	<0.001				AO	1.0	mg/L
Iron	mg/L	0.03	0.29	0.18				AO	0.3	mg/L
Lead	mg/L	0.001	<0.001	<0.001				MAC	0.01	mg/L
Manganese	mg/L	0.01	0.08	0.03				AO	0.05	mg/L

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

REPORT OF ANALYSIS

Client: **Waste Management of Canada Corp.**
1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
Date: 2006-12-12
Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: **57365**

			509397	509398				**GUIDELINE**		
			2006-11-28	2006-11-28						
			M95-2	QAQC GW				ODWSOG		
								TYPE	**LIMIT**	**UNITS**
Mercury	mg/L	0.0001	<0.0001	<0.0001				MAC	0.001	mg/L
Silver	mg/L	0.0001	<0.0001	<0.0001						
Zinc	mg/L	0.01	<0.01	<0.01				AO	5.0	mg/L

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Comment:

APPROVAL:
Ewan McRobbie
Inorganic Lab Supervisor

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Chain of Custody Number: **57365**

			LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED		GUIDELINE ODWSOG		
								TYPE	**LIMIT**	**UNITS**
Alkalinity as CaCO3	mg/L	5	<5	98	95-105	2006-12-02		OG	500	mg/L
Chemical Oxygen Demand	mg/L	5	<5	100	80-120	2006-12-05				
Chloride	mg/L	1	<1	100	90-110	2006-12-02		AO	250	mg/L
Conductivity	uS/cm	5	<5	101	95-105	2006-12-02				
Dissolved Organic Carbon	mg/L	0.5	<0.5	98	84-116	2006-12-04		AO	5	mg/L
N-NH3 (Ammonia)	mg/L	0.02	<0.02	95	85-115	2006-12-04				
N-NO2 (Nitrite)	mg/L	0.10	<0.10	99	90-110	2006-12-02		MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.10	<0.10	103	90-110	2006-12-02		MAC	10.0	mg/L
pH			6.03	101	90-110	2006-12-02		AO	6.5-8.5	pH Units
Phenols	mg/L	0.001	<0.001	86	36-167	2006-12-01				
Sulphate	mg/L	1	<1	100	90-110	2006-12-04		AO	500	mg/L
TDS (COND - CALC)	mg/L	5	<5		-	2006-12-05		AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	102	77-123	2006-12-01				
Total Organic Carbon	mg/L	0.5	<0.5	98	84-116	2006-12-04				
Total Phosphorus	mg/L	0.01	<0.01	105	85-115	2006-12-04				
Hardness as CaCO3	mg/L	1	<1		-	2006-12-05		OG	100	mg/L
Calcium	mg/L	1	<1	100	80-120	2006-12-01				
Magnesium	mg/L	1	<1	113	80-120	2006-12-01				
Potassium	mg/L	1	<1	101	80-120	2006-12-01				
Sodium	mg/L	2	<2	100	80-120	2006-12-01		AO	20	mg/L
Aluminum	mg/L	0.01	<0.01	103	88-112	2006-12-02		OG	0.1	mg/L
Arsenic	mg/L	0.001	<0.001	100	82-118	2006-12-02		IMAC	0.025	mg/L
Barium	mg/L	0.01	<0.01	103	90-110	2006-12-02		MAC	1.0	mg/L
Boron	mg/L	0.01	<0.01	100	81-119	2006-12-02		IMAC	5.0	mg/L
Cadmium	mg/L	0.0001	<0.0001	97	87-113	2006-12-02		MAC	0.005	mg/L
Chromium	mg/L	0.001	<0.001	100	80-120	2006-12-02		MAC	0.05	mg/L
Copper	mg/L	0.001	<0.001	100	82-118	2006-12-02		AO	1.0	mg/L
Iron	mg/L	0.03	<0.03	95	87-113	2006-12-02		AO	0.3	mg/L
Lead	mg/L	0.001	<0.001	100	84-116	2006-12-02		MAC	0.01	mg/L
Manganese	mg/L	0.01	<0.01	93	92-108	2006-12-02		AO	0.05	mg/L

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Comment:

APPROVAL:
Herb Yu
QC Coordinator

ACCUTEST LABORATORIES LTD

REPORT OF ANALYSIS

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1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
Date: 2006-12-12
Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: **57365**

								GUIDELINE		
			LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED		ODWSOG		
								TYPE	**LIMIT**	**UNITS**
Mercury	mg/L	0.0001	<0.0001	102	81-119	2006-12-04		MAC	0.001	mg/L
Silver	mg/L	0.0001	<0.0001	96	70-130	2006-12-02				
Zinc	mg/L	0.01	<0.01	91	89-111	2006-12-02		AO	5.0	mg/L

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Comment:

APPROVAL:
Herb Yu
QC Coordinator

Results relate only to the parameters tested on the samples submitted for analysis.

REPORT OF ANALYSIS

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Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: **57365**

		LAB ID:	509392	509393	509394	509395	509396	**GUIDELINE**		
		Sample Date:	2006-11-28	2006-11-28	2006-11-28	2006-11-28	2006-11-28	ODWSOG		
		Sample ID:	M91-1	M93	M94-1	M94-2	M95-1			
PARAMETER	**UNITS**	**MDL**						**TYPE**	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,4-dichlorobenzene	ug/L	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	MAC	5	ug/L
Benzene	ug/L	0.5						MAC	5	ug/L
Dichloromethane	ug/L	4.0	<4.0	<4.0	<4.0	<4.0	<4.0	MAC	50	ug/L
Ethylbenzene	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	AO	2.4	ug/L
m/p-xylene	ug/L	1.0	<1.0	<1.0	4.1	<1.0	<1.0			
o-xylene	ug/L	0.5	<0.5	<0.5	1.0	<0.5	<0.5			
Toluene	ug/L	0.5						AO	24	ug/L
Vinyl Chloride	ug/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	MAC	2	ug/L
VOC SURROGATES										
1,2-dichloroethane-d4	%		94	98	99	92	97			
4-bromofluorobenzene	%		104	103	102	100	106			
Toluene-d8	%		108	103	100	103	111			

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Comment:

APPROVAL:
Mina Nasirai
Organic Lab Supervisor

REPORT OF ANALYSIS

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1271 Beechwood Rd., R.R. #6
Napanee, ON
K7R 3L1
Attention: **Mr. Randy Harris**

Report Number: 2625409
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Date Submitted: 2006-11-28

Project: K-A756-5

P.O. Number:
Matrix: Groundwater

Chain of Custody Number: 57365

			509397	509398	509399			GUIDELINE		
			39049	2006-11-28	2006-11-28			ODWSOG		
			M95-2	QAQC GW	TB#1					
								TYPE	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,4-dichlorobenzene	ug/L	0.4	<0.4	<0.4				MAC	5	ug/L
Benzene	ug/L	0.5			<0.5			MAC	5	ug/L
Dichloromethane	ug/L	4.0	<4.0	<4.0				MAC	50	ug/L
Ethylbenzene	ug/L	0.5	<0.5	<0.5	<0.5			AO	2.4	ug/L
m/p-xylene	ug/L	1.0	<1.0	<1.0	<1.0					
o-xylene	ug/L	0.5	<0.5	<0.5	<0.5					
Toluene	ug/L	0.5			<0.5			AO	24	ug/L
Vinyl Chloride	ug/L	0.2	<0.2	<0.2				MAC	2	ug/L
VOC SURROGATES										
1,2-dichloroethane-d4	%		110	94						
4-bromofluorobenzene	%		107	104						
Toluene-d8	%		100	102	95					

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Organic Lab Supervisor

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			LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED		**GUIDELINE** ODWSOG		
								TYPE	**LIMIT**	**UNITS**
VOLATILE ORGANIC COMPOUNDS - VOCs										
1,4-dichlorobenzene	ug/L	0.4	<0.4	95	80-120	2006-12-05		MAC	5	ug/L
Benzene	ug/L	0.5	<0.5	101	80-120	2006-12-01		MAC	5	ug/L
Dichloromethane	ug/L	4.0	<4.0	99	60-200	2006-12-05		MAC	50	ug/L
Ethylbenzene	ug/L	0.5	<0.5	96	80-120	2006-12-05		AO	2.4	ug/L
m/p-xylene	ug/L	1.0	<1.0	101	80-120	2006-12-05				
o-xylene	ug/L	0.5	<0.5	100	80-120	2006-12-05				
Toluene	ug/L	0.5	<0.5	89	80-120	2006-12-01		AO	24	ug/L
Vinyl Chloride	ug/L	0.2	<0.2	107	70-130	2006-12-05		MAC	2	ug/L
VOC SURROGATES										
1,2-dichloroethane-d4	%		95	100	70-130	2006-12-05				
4-bromofluorobenzene	%		107	98	70-130	2006-12-05				
Toluene-d8	%		104	98	70-130	2006-12-05				

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Comment:

APPROVAL:
Herb Yu
QC Coordinator

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