2000 Ground and Surface Water Monitoring Report Mountain Landfill

Prepared for:

Township of North Dundas
P.O. Box 489
Winchester, Ontario
K0C 2K0

Oliver, Mangione, McCalla & Associates
a division of Trow Consulting Engineers Ltd.

154 Colonnade Road South
Nepean, Ontario K2E 7J5
Telephone: (613) 225-9940
Facsimile: (613) 225-7337

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Executive Summary

Oliver, Mangione, McCalla & Associates, a division of Trow Consulting Engineers Limited Trow/OMM) was retained by the Township of North Dundas to undertake the 2000 ground and surface water monitoring program for the Mountain Waste Disposal Site. This report presents the results of the monitoring program.

The Mountain Landfill Ground and Surface Water Monitoring Program consists of the collection of groundwater elevations and ground and surface water samples at a frequency established through on-going studies, currently twice per year. The water level information is used to determine local groundwater flow direction and gradients. All samples are analyzed by a certified commercial laboratory. Groundwater samples are analyzed for a specific suite of parameters including parameters commonly used to evaluate water quality at landfill sites. The surface water samples are analyzed for a core parameter list contained in the Ministry of Environment (MOE) landfill surface water guidelines.

Work accomplished in 2000 included the construction of two new multi-level bedrock monitoring wells located to the north and east of the landfill, respectively.

The monitoring program reveals that the shallow groundwater flow direction near the facility remains towards the northeast. Groundwater quality monitoring indicates that a leachate contaminant plume is being generated by the waste disposal operations. This plume, which is characterized by elevated concentrations of many inorganic parameters, is moving northeast within the overburden/shallow bedrock upper aquifer. The concentrations of several aesthetic parameters within the plume exceed the MOE Policy B7 limits established for the property boundary. None of the parameters has a health related criteria. Note too that the Township owns lands adjacent the landfill to the north and east; hence, the analytical data is not representative of site boundary conditions and/or indicative of off-site impact. It is recommended that additional monitors be drilled along the property boundary or slug tests be conducted on existing monitors to determine the extent of the leachate plume in order to properly address the issue of Policy B7.

Surface water was not present during the two monitoring sessions and therefore no sampling was undertaken.

Recommendations are presented regarding the frequency and nature of the monitoring program exercises, mitigation of the leachate contaminant plume and the collection of additional data.

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1.0 Introduction

1.1 Terms of Reference

Oliver, Mangione, McCalla and Associates, a division of Trow Consulting Engineers Limited (Trow/OMM) was retained by the Township of North Dundas to conduct an annual ground and surface water monitoring program for the Township's two landfill sites.

The following report presents the monitoring data collected as well as interpretations, conclusions and recommendations for the Mountain Landfill for the 2000 calendar year. A report of similar scope for the other waste disposal facility (Boyne Road Landfill) is presented under separate cover.

1.2 Previous Studies

An Operation Plan for the Mountain Township Landfill was prepared by Dillon Consulting Engineers & Planners Limited (DCE) in 1992. That document, based on terms of reference prepared by the Ministry of the Environment (MOE), presented a design for the landfilling development, recommendations for day to day operations of the site, staffing, equipment and types of wastes acceptable at the site.

Golder Associates Limited (GAL) conducted a hydrogeological investigation of the landfill in 1992/1993. The work undertaken consisted of the construction of overburden and bedrock boreholes, the installation of monitoring wells in the boreholes and the collection and analysis of ground and surface water samples. A report prepared following the investigation (GAL, 1993) presented the results of the investigation and made recommendations for conducting ground and surface water monitoring at the facility. Copies of the GAL borehole logs are included in Appendix "B".

Ground and surface water monitoring was conducted by Trow/OMM for the 1998 and 1999 calendar years. Two reports including one for 1998 (Trow/OMM, August 1999) and one for 1999 (Trow/OMM, June 2000) were prepared to document the work accomplished during that period.

2.0 Site Description

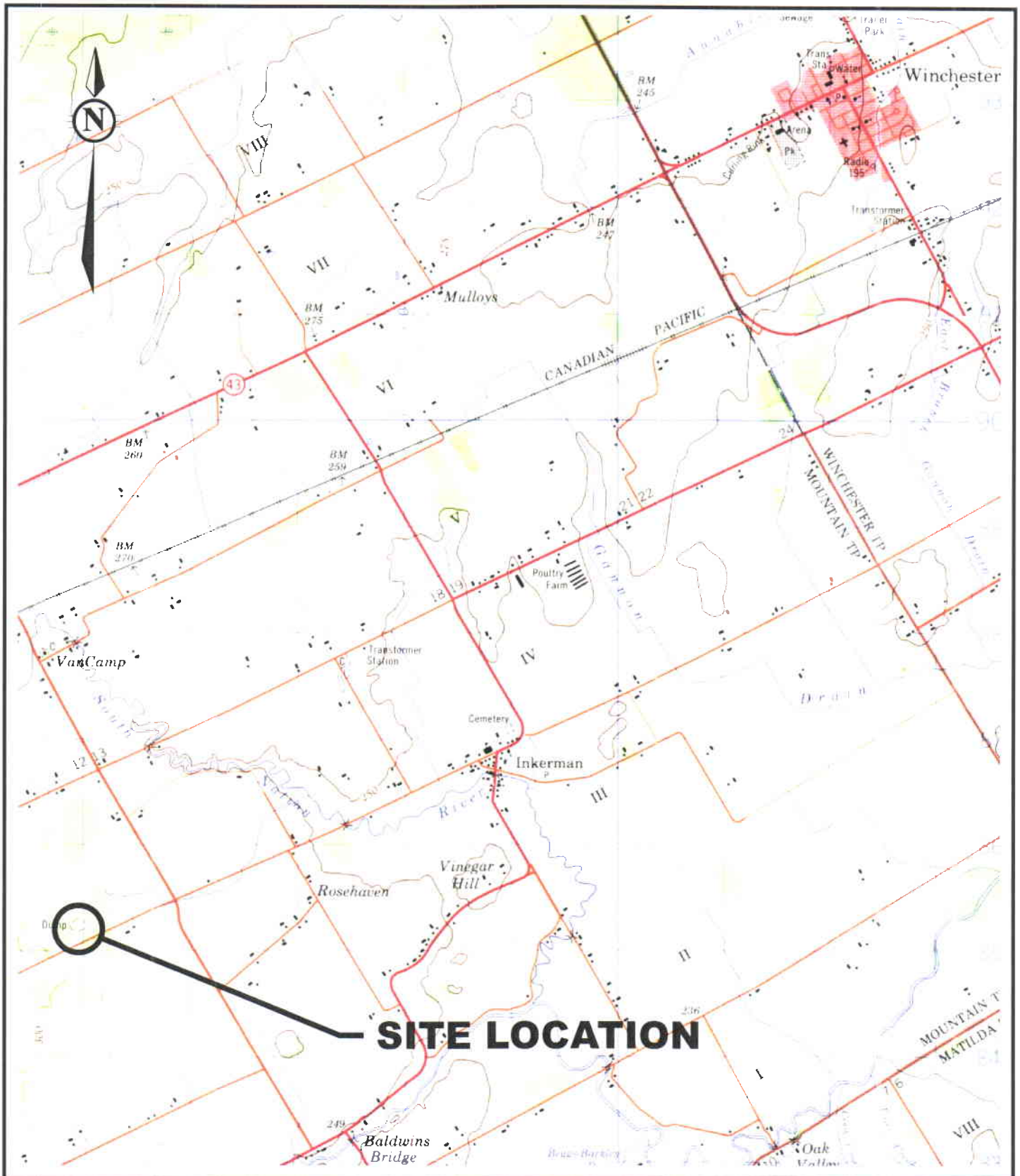
2.1 Site Location and Description

The Mountain Township landfill site is located in Lot 11, Concession IV in North Dundas Township (Formerly Mountain Township), on Cameron Road, about four kilometres west of the Hamlet of Inkerman and ten kilometres southwest of the Village of Winchester (Figure 1). Several municipalities, including Mountain Township, amalgamated to form the new Township of North Dundas in 1998. Prior to amalgamation, Mountain Landfill was the principal waste disposal facility for the Township of Mountain. The site operated under a Provisional Certificate of Approval during the period 1960 to 1998. A new Provisional Certificate of Approval (A481702) was issued in January 1998. This document is included as Appendix "A" of this report.

The landfill property is 4.6 hectares in size, with 2.4 hectares licensed for waste disposal. The provisional Certificate of Approval permits the transfer and processing of recyclables, which was undertaken on site prior to the municipal amalgamation. Under the new municipal waste management structure, blue box recyclables are collected door to door and delivered to the Boyne Road Landfill, for processing. Any recyclable material, such as tires and white goods delivered to the Mountain site will now be stockpiled in designated areas and periodically transferred to the Boyne Road facility as required.

2.2 Site Physiography and Drainage

The Mountain Landfill is located in an area of low topography, characterized by open fields and bush. The land slopes gently downward to the east. The facility is located between the north branch and the main channel of the South Nation River (Figure 1). A small drainage course runs east-west to the immediate north of the landfill. This intermittent stream flows eastward, and eventually reaches the north Branch of the South Nation, about two kilometres to the east of the site.



OLIVER, MANGIONE, McCALLA & ASSOCIATES
a division of Trow Consulting Engineers Ltd
154 COLONNADE ROAD SOUTH
NEPEAN, ONTARIO K2E 7J5
Tel: (613) 225-9940
Fax: (613) 225-7337

DATE	CLIENT	DWG. No.
MARCH 2001	TOWNSHIP OF NORTH DUNDAS	MC12684A
SCALE 1:50,000	TITLE MOUNTAIN LANDFILL SITE LOCATION PLAN	FIG 1

2.3 Surficial Geology

Available mapping (Richard, 1982) indicates that surficial materials in the immediate area of the Mountain Landfill area consist of thin deposits of glacial till and/or organic material which overlie limestone bedrock. To the east and north of the landfill, the surficial materials consist of fine marine clays and silts. Drilling conducted on site by previous consultants indicate the overburden thickness to be in the range of 2.1 to greater than 4.7 metres (Appendix "C"). During construction of two new monitoring wells near the northeast corner of the landfill in August 1999, the glacial till overburden was found to be less than one metre in thickness.

2.4 Bedrock Geology

Mapping by Wilson (1946) indicates that the Mountain Landfill area is underlain by limestone and dolomite of the Oxford formation. This unit is part of a sequence of Ordovician aged Paleozoic sedimentary rocks deposited in a deep water marine environment. The Oxford Formation, which overlies the transitional limestone/sandstone March formation and the underlying Nepean Sandstone, is in excess of 100 metres thick in some areas. Ministry of the Environment (MOE) water well record information indicates that the Oxford is in excess of 55 metres in thickness locally.

2.5 Hydrogeology

Water well records are submitted to the MOE by the well drilling contractor after the construction of a well. These records contain information about the location, depth, depth at which water was encountered, static level, well yield, drilling method and water quality for each well. A review of 53 water well records for wells constructed within three kilometres of the landfill was conducted. The average depth to water was 27.5 metres with a range of 12.9 to 65.5 metres. Well yields varied from a low of 9 L/min to a high of 91 L/min, with an average of 57.7 L/min. The water was reported as fresh in 50 wells with two reported sulphurous and one salty. Static levels were between 15.2 metres depth and above the ground surface (flowing well). The average static level was 5.0 metres depth. All wells reviewed were reportedly completed in limestone bedrock.

The static level and elevation information contained in water well records can be used to determine the direction of groundwater flow within an aquifer. The information collected from the review of the wells near the Mountain Landfill indicates that the bedrock groundwater regionally flows north to northeast at an average gradient of approximately 0.007 metres per metre.

3.0 Landfill Monitoring Network

3.1 Introduction

A ground and surface monitoring network consisting of five groundwater monitoring wells (MW1-MW5) and six surface water monitoring stations (SW1-SW6) was established by GAL in 1993. The monitor MW4, located north of the northeast corner of the facility, was discovered by Trow/OMM to have collapsed prior to the 1998 field program and was neither usable nor repairable. At monitor MW5, located within the fill area, the steel well casing had been extended approximately three metres above grade to permit the eventual placement of additional waste. This occurred sometime prior to 1998 and precluded collecting samples in 1998. This monitor was then apparently destroyed by waste disposal operations sometime in 1999. Two new multilevel bedrock monitors (MW6 and MW7) were constructed to the north and east of the fill area in 1999 (Section 3.2).

The locations of the wells and surface water monitoring locations are illustrated on Figure 2. Borehole logs for monitors MW1 to MW5, as prepared by GAL, are presented in Appendix "B". GAL report that all boreholes were continued to below the first available aquifer, which in four of the five boreholes was within limestone bedrock, and was found at depths between 4.7 to 6.3 metres. Monitoring wells were constructed within the bedrock in four of the five boreholes, and within the overburden deposits in MW5. Each well consists of 38 mm ID Schedule 40 threaded PVC pipe with a 1.5 metre length of No. 10 (0.25 mm) slot well screen. The annulus surrounding and above the screened interval was gravel packed with clean silica sand material. A hydraulic seal consisting of bentonite clay above the gravel pack prevents the vertical migration of ground and surface water through the borehole.

Groundwater static levels and ground and surface water samples were collected in 1993 as part of a study by GAL. Monitoring records for the period 1993 to 1998 were not available for this report.

3.2 Monitoring Well Construction in 1999

Two multi-level bedrock monitoring wells were constructed by Olympic Drilling Company in August 1999, using air rotary drilling techniques. These wells were constructed to replace the malfunctioning monitor MW4; to provide information towards the north and northwest of the site; and to provide hydraulic and chemical data for deeper bedrock groundwater downgradient of the landfill.

Monitor MW6, which is located adjacent to the former monitor MW4, was constructed as 152 mm diameter open hole to a depth of 15.2 metres. The well was equipped with 508 mm

diameter Schedule 40 PVC monitoring well pipe with a 3 metre length of No. 10 slot well screen set at the bottom of the borehole. A silica sand gravel pack was placed in the annulus surrounding and above the screened interval and a bentonite clay seal was placed above the gravel pack. A second monitor, also including a 3 metre screen was installed above 4.6 metres depth. An additional gravel pack and bentonite seal was installed for this monitor. A 1.5 metre section of 152 mm protective steel well casing was installed at the ground surface.

Monitor MW7, which is located east of the northeast corner of the landfill, was constructed similarly to MW6. Water well records for both new monitoring wells are presented in Appendix "C".

3.2 Monitoring Program

The 2000 Ground and Surface Water Monitoring program consisted of the measurement of water level elevations and the collection of water samples from all available wells in May and November 2000. All water samples were submitted to an accredited analytical laboratory for chemical and physical analyses.

The groundwater samples were analysed for a specific suite of parameters based on the chemical characteristics of the leachate contaminant plume generated by the landfill as established by the previous consultant. The measured parameters are: *alkalinity, hardness, conductivity, chloride, sulphate, calcium, magnesium, sodium, potassium, iron, manganese, nitrate, pH, total nitrogen, dissolved organic carbon DOC, BOD_5, COD_5, TDS.* In addition, samples from specific monitors were analyzed for volatile organic compounds (VOC's) once during the 2000 monitoring session.

The collection and analysis of surface water samples is part of the monitoring for the Mountain Landfill. Samples are usually collected at up to six locations in an intermittent creek, which runs from west to east to the immediate north of the landfill property. Surface water samples were collected at two locations in May 2000 and not at all in November because the creek was dry.

3.4 Sampling Protocols

The monitoring wells were sampled following established scientific practices. Prior to the collection of a sample, a minimum of three well volumes of water was flushed from the well. Alternately, if the groundwater was visibly turbid after three volumes, the well was pumped until the water was clear. An electric submersible pump was used to remove the standing water and to collect the samples. After sampling was completed at each well, the pump was thoroughly cleaned before being immersed in the next well. Measurements of pH and conductivity were collected in the field.

All samples were collected in laboratory supplied bottles prepared for the specific parameter or group of parameters, and the samples were refrigerated until delivery to the lab. Suitable preserving agents were added to those samples requiring preservation prior to shipment to the lab.

4.0 Groundwater Flow

4.1 Horizontal Groundwater Flow

Data collected by GAL (1993) and Trow/OMM in 1998 indicates that the groundwater flows through both the overburden and shallow bedrock deposits in the immediate vicinity of the waste disposal site. The 1993 studies indicate that flow through the overburden is intermittent and dependent upon precipitation. During the borehole drilling program conducted in May 1993, which was reported to have been a comparatively dry spring, no groundwater was noted in the overburden. However, leachate seeps noted by GAL, as well as the changes in surface water quality noted in the stream flowing north of the site (Section 7) indicate that groundwater is present within the overburden for at least part of the year. No leachate seeps have been noted by Trow/OMM staff during any field exercises over the past three years.

Groundwater static levels from the five shallow bedrock wells were collected by GAL in 1993. Static level information was collected by Trow/OMM at six of the monitoring wells in May 2000 and seven in November 2000. During the May sampling session, monitoring well MW1 was observed to be slightly flowing; therefore, a static water level was not available. It is recommended that a mechanical device be installed on this well in order to control flowing conditions. The data is presented in Table 1.

Table 1 – Groundwater Elevations

Monitor	Measuring Point*	1993	Nov-98	Aug-99	Jan-00	May-00	Nov-00
MW1	99.04	98.19	98.15	96.53	Frozen	Flowing	96.59
MW2	99.37	97.75	97.19	95.86	97.70	97.93	96.04
MW3	98.88	97.09	96.95	95.65	97.15	97.30	95.94
MW4	98.48	96.70	Destroyed	Destroyed	Destroyed	Destroyed	Destroyed
MW5		96.51	Not available	Destroyed	Destroyed	Destroyed	Destroyed
MW6D	98.57			94.26	95.36	95.60	94.04
MW6S	98.54			95.39	96.78	96.59	95.62
MW7D	97.51			95.11	96.06	96.08	95.14
MW7S	97.50			95.59	96.28	96.33	95.77

* Datum assumed. All measurements in metres

The data indicates that groundwater flow in the shallow overburden/bedrock aquifer is generally to the north/northeast. A hydraulic gradient of approximately 0.006 metres per metre was calculated using data from May 2000. The data from November 2000 indicated that a slightly lower gradient and similar flow direction existed. The individual groundwater elevations were approximately 1.2 metres lower in November as compared to May.

The groundwater velocity cannot be accurately determined without testing to measure hydraulic conductivity. GAL attempted to measure the permeability through rising head (slug) tests in 1993, but were unsuccessful due to the extremely rapid recovery in the wells. GAL concluded that the horizontal hydraulic conductivity of the fractured bedrock exceeded 10^{-3} cm/sec and that groundwater velocities in this unit likely exceed 25 metres per year. It is recommended that slug testing be performed using electronic water level measuring and recording instruments.

4.2 Vertical Groundwater Flow

The construction of the two multilevel bedrock monitors in 1999 has enabled an evaluation of the vertical hydraulic gradients within the local bedrock deposits. The measurement of static levels in both May and November indicates that a downward hydraulic gradient exists at both locations. The gradients were calculated to be 0.094 m/m and 0.024 m/m at monitor MW6 in May 2000 and November 2000 respectively, and were 0.15 m/m and 0.059 m/m at monitor MW7 at the same times.

The vertical movement of groundwater depends not only upon the vertical hydraulic gradients present, but also upon the degree of hydraulic connection between the upper and lower water producing zones. The chemical data collected as part of the monitoring program (Sections 5 and 6) indicates that the deeper bedrock aquifer has not been significantly impacted as a result of landfill operations. However, the potential for downward migration of both groundwater and leachate from the waste disposal site does exist.

5.0 Groundwater Chemistry

5.1 Previous Results and Conclusions

Groundwater sampling was performed by Golder Associates Limited (GAL) in 1993 and by Trow/OMM in 1998. GAL determined that leachate impact was present in MW5, located in the waste pile and to a lesser extent at monitor MW4. The leachate was characterized by elevated concentrations of most inorganic and organic parameters, notably chloride, total dissolved solids, hardness, sulphate, alkalinity, total nitrogen and chemical oxygen demand. GAL concluded that the impact to groundwater quality at monitoring well MW4 was not significant.

Groundwater samples were collected at monitors MW1, MW2 and MW3 in November 1998. The results indicated that the groundwater chemistry at these locations was essentially unchanged from 1993. No evidence of leachate contamination was present in any of the samples. Similar results were observed for MW1, MW2 and MW3 in the August 1999 and January 2000 sampling sessions.

The samples collected at the four newer monitors (MW6S, MW6D, MW7S and MW7D) showed elevated concentrations in 1999 of most inorganic parameters measured as compared to groundwater collected at the older wells. Considerable variations in concentrations in several parameters were also noted.

5.2 Recent Results

Groundwater samples were collected at wells MW1, MW2, MW3, MW6S, MW6D, MW7S and MW7D in both May and November 2000. The results of all analyses along with previous sampling data are presented in Table 2.

Water quality at the older wells (MW1, MW2 and MW3) was essentially unchanged from previous years. No evidence of leachate impact is noted in these wells.

The samples collected at the four new monitors (MW6S, MW6D, MW7S and MW7D) show elevated concentrations of most of the inorganic parameters measured as compared to groundwater collected at the older wells. Variations in concentrations of several parameters between the spring and fall sampling periods is still evident, but not as much as the previous year.

Samples from monitors MW6S, MW6D, MW7S and MW7D in May 2000 were analysed for volatile organic compounds (VOC) according to the USEPA Method 624. No detectable concentrations of any of these compounds were noted.

6.0 Groundwater Impact Assessment

6.1 Background

In order to assess the nature and degree of the chemical impact on the groundwater as a result of waste disposal operations, the concentrations of various parameters in the samples collected from the monitoring well network are compared to background groundwater quality as determined through the analysis of samples collected at a point which is unaffected by the waste disposal operations. Monitor MW1, located to the south of the waste area, was used to determine background groundwater quality in the overburden aquifer at the Mountain Landfill. The average concentrations of parameters as determined in analyses of samples collected from this well in 1993, 1998 and August 1999 were used to determine the background aquifer water quality at this location.

6.2 Ontario Policy B-7

The potential impact of the leachate contaminant plume on local groundwater resources is addressed by Ontario Policy B-7, usually referred to as the "Reasonable Use" Policy. This policy establishes maximum allowable concentrations of various parameters at the downgradient site boundary. These maximum concentrations are based on the background concentration of a specific compound in the aquifer, the nature of the parameter (whether it has an applicable health or aesthetic criteria) and the present or potential future use of the downgradient groundwater resources. Unless there is specific evidence to the contrary, the assumed downgradient groundwater use is normally assumed to be drinking water. At the Mountain Landfill, drinking water criteria is considered appropriate.

Table 3 presents the calculated Reasonable Use concentrations for those parameters at the Mountain Landfill which have either a health related Maximum Acceptable Concentration (M.A.C.), an Interim related Maximum Acceptable Concentration (I.M.A.C.) or an Aesthetic Objective (A.O.) in the Ontario Drinking Water Objectives.

Table 3 – Reasonable Use Criteria

Parameter	Units	Criteria	Type of Criteria	Background (MW1)	Reasonable Use Limit
Chloride	mg/L	250	Aesthetic	24	137
Iron	mg/L	0.3	Aesthetic	0.11	0.21
Manganese	mg/L	0.05	Aesthetic	0.02	0.04
Sodium	mg/L	200	Aesthetic	1.8	101
Sulphate	mg/L	500	Aesthetic	31	265
Total Dissolved Solids	mg/L	500	Aesthetic	392	445
Dissolved Organic Carbon	mg/L	5.0	Aesthetic	1.85	3.4
Lead	mg/L	0.01	Health	<0.002	0.004
Cadmium	mg/L	0.005	Health	<0.002	0.003
Boron	mg/L	5	Health	<0.01	1.26
Barium	mg/L	1	Health	0.16	0.37

Background is average concentration of June 1993, November 1998 and August 1999 at MW1

The data collected from the previously existing monitoring well network in past years indicated that only at the well located within the fill area (MW5) were the concentrations of any parameters in excess of the Reasonable Use Criteria. However, the data collected from the new monitoring wells indicates that a leachate contaminant plume extends northwest of the fill area.

Monitoring well MW7S exceeded the Reasonable Use Guidelines for manganese, nitrate and DOC in May 2000 and for chloride, manganese, sulphate, total dissolved solids (TDS) and dissolved organic carbon (DOC) in November 2000.

At monitor MW6S, iron, manganese and TDS exceeded the criteria in both sampling sessions. DOC concentrations were above the criteria in November 2000. Again the elevated nitrate concentration in January 2000 remains anomalous based on historical concentrations in the monitoring well network.

The results from the deeper bedrock monitors (MW6D and MW7D) indicate that the leachate contaminant plume is currently restricted to the shallow aquifer, and the strong downward hydraulic gradient noted in Section 4.2 has not resulted in a reduction in deeper groundwater quality to date. The only elevated parameter in these wells is iron. Review of data from the

upgradient monitors indicates that iron concentrations are naturally variable and not related to waste disposal activities.

The chemical analyses indicate that no leachate impact is present in the remaining monitors.

6.4 Potential Mitigation Measures

Based on the available data, there is evidence that a leachate contaminant plume extends northeast of the fill area. It should be noted, however, that the Township owns lands adjacent the landfill to the north and east; hence, the analytical data is not representative of site boundary conditions and/or indicative of off-site impact. It is recommended that additional monitors be drilled along the property boundary or slug tests be conducted on existing monitors to determine the extent of the leachate plume (see Section 4.1) in order to properly address the issue of Policy B7.

The variability of the data between the two sampling events documented in this report indicates that additional monitoring is required to properly define the chemical nature of the leachate plume.

Should concentrations of one or more parameters in the groundwater at the downgradient property exceed the criteria established by Policy B-7, there are several methods available to address the issue. The first method is to allow dilution and/or dispersion to sufficiently reduce the concentrations of various chemical species within the plume to acceptable levels. This method generally involves the purchase of downgradient lands, although in some cases it has been possible to buy the "water rights" to the land without actually buying the land itself.

Covering of the waste within the landfill with low permeability material (capping) can greatly reduce the volume of liquid (rainfall) percolating through the landfill and therefore reduce the volume of leachate generated within a specified time frame. The Township has implemented a more rigorous capping program. This program should be continued.

If on the basis of future monitoring, it is determined that leachate impact at the property boundary is problematic, it is recommended that a detailed assessment be undertaken to determine the most practical mitigation alternative.

7.0 Surface Water Monitoring

Surface water quality is evaluated on the basis of samples collected from monitoring stations located along the intermittent watercourse that extend in an east-west direction to the north of the fill area (Figure 2). In May 2000, surface water samples were collected at SW2 and SW4. In November 2000, the creek was dry and sampling could not be performed. It is recommended that in future sampling events that samples be collected during the spring runoff period and up to three other times during the year, if flow conditions permit.

The results of surface water sampling from the 2000 monitoring year and from previous years are presented in Table 4.

Table 4 – Historic Surface Water Quality

Parameter	Units	PWQO	SW1 June 1993	SW1 Nov. 1998	SW6 June 1993	SW6 Nov. 1998	SW2 May 2000	SW4 May 2000
Alkalinity	mg/L		270	324	335	388	272	417
Ammonia	mg/L		<0.01		0.02			
Ammonia (Un-	mg/L	0.02	<0.020		<0.020			
BOD_5	mg/L		1	4	<1	4	20	174
Calcium	mg/L		62	87.5	101	102	68	128
Chloride	mg/L		<1	1.9	37	37.9	2	47
COD_5	mg/L		13	13	15	18	23	62
Conductivity	uhmos/c		700	604	1000	923	492	1170
Hardness	mg/L		270	369	478	467	298	567
Iron	mg/L	0.3	0.02	0.18	0.02	0.37	<0.01	0.15
Magnesium	mg/L		28	36.1	55	50.8	31	60
Manganese	mg/L		0.07	0.02	0.12	0.19	<0.01	0.28
Nitrate	mg/L			<0.1		0.3	0.10	1.48
Nitrite	mg/L							
Diss. Oxygen	mg/L		7.2		12.2			
pH	-	6.5-8.5	7.6	7.18	7.6	7.56	7.43	7.34
Phosphorous	mg/L	0.03	0.3	0.04	0.2	0.08	0.37	5.48
Phenols	mg/L	0.001		0.009		0.009	<0.001	<0.001
Potassium	mg/L		<1	0.8	13	11.1	1	33
Sodium	mg/L		2	1.5	24	27.1	1	47
Sulphate	mg/L		6	16	126	99	7	151
TDS	mg/L		290		560			
TKN	mg/L		0.31	0.36	0.5	0.63	0.71	2.31
DOC	mg/L			5		7.9	9.7	25.4

8.0 Summary and Recommendations

A Ground and Surface Water Monitoring program was conducted at the Mountain Landfill in 2000. Site visits were conducted in May and November 2000. The monitoring network at the waste disposal site currently consists of six surface water sampling locations and seven bedrock monitoring wells.

Water level measurements were collected at each installation. This information, when corrected for elevation, was used to determine the direction of groundwater flow. Groundwater samples were analysed for a standard suite of landfill site parameters. Surface water samples were collected in May 2000 at two locations.

Groundwater flow in the shallow bedrock/overburden aquifer is towards the north/northeast. The local hydraulic gradient in the overburden/shallow bedrock aquifer is approximately 0.006 metres per metre. Based on calculations presented by GAL (1993), the groundwater velocity through this unit likely exceeds 25 metres per year.

The groundwater chemical data collected during the monitoring exercises indicates that a leachate contaminant plume is being generated by the landfill and is moving within the overburden/shallow bedrock groundwater. This plume is characterized by elevated concentrations of a number of inorganic and organic parameters. Concentrations of several non-health related parameters exceeded Ontario Policy B7 at monitoring wells MW6S and MW7S during one or both of the sampling events.

Based on the results of the monitoring program, the following recommendations are presented for the consideration of the Township:

1. Groundwater flow velocities are required to permit an accurate prediction of the leachate propagation rate. In order to calculate these velocities, hydraulic conductivity testing is required. It is recommended that aquifer "slug tests" be conducted on the existing monitoring wells. Due to the high permeability of the aquifer materials, electronic data logging instruments will be required.

2. The aggressive waste capping program should be continued, in order to limit the generation of leachate.

3. Groundwater monitoring should proceed according to the established methodology. Samples should be collected from all monitoring wells during the spring or summer of 2001 and again in the autumn. The samples should be analyzed for the same parameter list used in previous exercises, with the addition of a full metal scan on all monitors. Volatile organic chemical (VOC) analyses should be conducted on all wells once per year.

4. Surface water monitoring should continue according to the established methodology with the following exceptions:

   - Surface water samples should be collected in the spring, during the runoff period, and in the autumn, prior to freeze up.
   - Samples should be collected four times during the year, if possible.
   - Surface water analyses should contain a detailed metal scan.
   - The collection and analysis of samples at all six stations is not considered necessary. Sample collection at upstream station SW1, midstream station SW5 and downstream station SW6 should be sufficient to define the nature of any changes to surface water quality as a result of the waste disposal operations.

   Depending upon the results of the analyses, a more detailed monitoring plan and/or abatement program may be required.

9.0 Closure

This report was prepared for the exclusive use of the Township of North Dundas. Any other party should not rely upon the contents of this report without the express written consent of Trow/OMM. Conclusions regarding the environmental conditions at this site are based solely on the extent of observations and the information referenced herein.

Trow/OMM has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied is included or intended in this document.

Oliver, Mangione, McCalla & Associates
a division of Trow Consulting Engineers Ltd.

Jennifer L. Green, B.Sc. (Eng.)
Project Manager
GeoEnvironmental Division

Stephen R. Wilson B.Sc.
Senior Hydrogeologist
GeoEnvironmental Division

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Appendix A:
Certificate of Approval

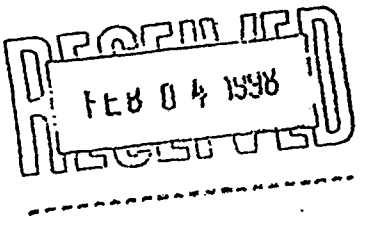
1:45 (cm) 937-6402

Ministry of the Environment
Approvals Branch
250 Davisville Avenue
3rd Floor
Toronto ON M4S 1H2

Ministère de l'Environnement
Direction des autorisations
250, avenue Davisville
3e étage
Toronto ON M4S 1H2

Ontario

14 January 1998



Township of Mountain
P.O. Box 9
2245 Simms Street
MOUNTAIN, Ontario
KOE 1S0

Attention: Doreen DeVries, Clerk-Treasurer

Dear Ms DeVries:

Re: Township of Mountain
Provisional Certificate of Approval for a Waste Disposal Site
Approval No. A481702

Please find enclosed a copy of Provisional Certificate of Approval No. A481702 which is issued to the Township of Mountain by the Ministry for the continued operation of a waste disposal site to landfill domestic waste and non-hazardous solid industrial waste. The site is located at 10891 Cameron Road in the Township of Mountain.

This Provisional Certificate of Approval replaces all previously issued Certificates of Approval and Notices of Amendment issued for the site under the same number. It is recommended that you review this Certificate in detail, so that the terms and conditions by which this site may be operated are fully understood. Failure to operate this site according to the terms and conditions listed on the Certificate will be considered a violation of the *Environmental Protection Act*.

Reasons for the conditions on the Certificate and the procedures to be followed should you wish to appeal any of these conditions are provided as part of the Certificate.

...2/

If you have any questions regarding the Certificate, please contact Kim Lendvay at (416) 326-5620, or questions regarding site operations contact John Firth, Kingston District Office at (613) 549-4000.

Yours truly,

A. Dominski
Director

Attachment

cc: MOE, Kingston District Office, J. Bishop / J. Firth
– United Counties of Stormont, Dundas & Glengarry, 20 Pitt Street, Cornwall, Ontario K6J 3P2, Attention: Clerk
– MOE, Eastern Regional Office, Brian R. Ward, Director
bcc: MOE, Eastern Regional Office, Approvals Main Binder Copy (c/o J. Mulder)
– MOE, Eastern Regional Office, File Room Copy: STAR #321 / CofA No. A481702 / SI DU MT 250, East Part of Lot 11, Conc.4
– MOE, Toronto District Office, K. Lendvay (STAR #13418)
– MOE, Approvals Branch, Waste Unit, File Room Copy (c/o G. Carpentier)

"**Operator**" means Township of Mountain, its officers, employees, agents, contractors or assignees.

"**EPA**" means The Environmental Protection Act, Chapter E.19, R.S.O. 1990.

"**Site**" means the landfill Site located in the Township of Mountain, East Part of Lot 11, Concession 4, 10891 Cameron Road, approved under this Certificate.

GENERAL

1. The requirements specified in this Provisional Certificate of Approval are the requirements under the **Environmental Protection Act**, R.S.O. 1990. The issuance of this Provisional Certificate of Approval in no way abrogates the Operator's legal obligations to take all reasonable steps to avoid violating other applicable provisions of this legislation and other legislation and regulations.

2. The requirements of this Provisional Certificate of Approval are severable. If any requirement of this Provisional Certificate of Approval, or the application of any requirement of this Provisional Certificate of Approval to any circumstance, is held invalid, the application of such requirement to other circumstances and the remainder of this Provisional Certificate of Approval shall not be affected in any way.

3. The Operator shall ensure compliance with all the terms and conditions of this Provisional Certificate of Approval. Any non-compliance constitutes a violation of the **Environmental Protection Act**, R.S.O. 1990 and is grounds for enforcement.

4. The Operator shall allow Ministry personnel, or a Ministry authorized representative(s), upon presentation of credentials, to:

   (a) carry out any and all inspections authorized by Section 156, 157 or 158 of the **Environmental Protection Act**, R.S.O. 1990, Section 15, 16 or 17 of the **Ontario Water Resources Act**, R.S.O. 1990, or Section 19 or 20 of the **Pesticides Act**, R.S.O. 1990, as amended from time to time, of any place to which this Provisional Certificate of Approval relates; and,

   without restricting the generality of the foregoing, to:

   (b) (i) enter upon the premises where the records required by the conditions of this Provisional Certificate of Approval are kept;

   (ii) have access to and copy, at reasonable times, any records required by the conditions of this Provisional Certificate of Approval;

(iii) inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations required by the conditions of this Provisional Certificate of Approval; and

(iv) sample and monitor at reasonable times for the purposes of assuring compliance with the conditions of this Provisional Certificate of Approval.

5. a) Where there is a conflict between a provision of any document referred to in Schedule "A", and the conditions of this Provisional Certificate of Approval, the conditions in this Provisional Certificate of Approval shall take precedence.

b) Where there is a conflict between documents listed in Schedule "A", the document bearing the most recent date shall prevail.

6. The Operator shall ensure that all communications/correspondence made pursuant to this Provisional Certificate of Approval includes reference to the Provisional Certificate of Approval number.

7. The Operator shall notify the Director in writing of any of the following changes within thirty (30) days of the change occurring:

(a) change of owner or Operator of the System or both;

(b) change of address or address of the new Owner;

(c) change of partners where the Owner or operator is or at any time becomes a partnership, and a copy of the most recent declaration filed under the **Business Names Act**, 1991 shall be included in the notification to the Director;

(d) any change of name of the corporation where the owner or Operator is or at any time becomes a corporation, and a copy of the most current "Initial Notice or Notice of Change" (form 1 or 2 of O. Reg. 182, Chapter C-39, R.R.O. 1990 as amended from time to time), filed under the **Corporations Information Act** shall be included in the notification to the Director; and

(e) change in directors or officers of the corporation where the owner or Operator is or at any time becomes a corporation, and a copy of the most current "Initial Notice or Notice of Change" as referred to in 8(d), supra.

8. In the event of any change in ownership of the Site, the Operator shall notify in writing the succeeding Operator of the existence of this Provisional Certificate of Approval, and a copy of such notice shall be forwarded to the Director.

9. The Operator shall, forthwith upon request of the Director, District Manager, or Provincial Officer (as defined in the Act), furnish any information requested by such persons with respect to compliance with this Provisional Certificate of Approval, including but not limited to, any records required to be kept under this Provisional Certificate of Approval; and

   (a) In the event the Operator provides the Ministry with information, records, documentation or notification in accordance with this Provisional Certificate of Approval (for the purposes of this condition referred to as "Information"),

      (i) the receipt of Information by the Ministry;
      (ii) the acceptance by the Ministry of the Information's completeness or accuracy; or
      (iii) the failure of the Ministry to prosecute the Operator, or to require the Operator to take any action, under this Provisional Certificate of Approval or any statute or regulation in relation to the Information shall not be construed as an approval, excuse or justification by the Ministry of any act or omission of the Operator relating to the Information, amounting to non-compliance with this Provisional Certificate of Approval or any statute or regulation.

10. Any information relating to this Provisional Certificate of Approval and contained in Ministry files may be made available to the public in accordance with the provisions of the **Freedom of Information and Protection of Privacy Act**, R.S.O. 1990, C. F-31.

11. All records and monitoring data required by the conditions of this Provisional Certificate of Approval must be kept on the Operators's premises for a minimum period of at least two (2) years from the date of their creation.

12. This Provisional Certificate of Approval replaces all previous Provisional Certificates of Approval and Notices of Amendment identified by No. A481702 issued under Part V of the EPA.

13. Within sixty (60) days of the issuance of this Certificate, the Operator shall ensure this Certificate and a survey of the lands has been registered on the title to the lands comprising the Site and submit a certified copy to the District Manager.

14. The Operator shall ensure that training is provided on an ongoing basis, as required, to all on-Site personnel relating to the legal, operational and maintenance requirements for the operation of the Site and in emergency response procedures.

SITE OPERATIONS

15. Only domestic waste and non-hazardous solid industrial waste, generated by the Township of Mountain, shall be accepted at the Site.

16. No liquid industrial wastes or hazardous wastes as defined under Regulation 347 shall be disposed, transferred or processed at the Site.

17. a) The Operator shall place a sign at the main entrance to the Site on which is displayed in prominent letters the following information:

- the Operator of the Site
- the hours of operation
- the Certificate of Approval number for the Site
- the hours the Site is open to accept waste from the public
- the wastes acceptable for landfilling
- the telephone number for reporting emergency situations occurring at the Site during non-operating hours
- admission restrictions

b) The Operator shall place signs along on-Site roads giving directions to waste disposal areas and at waste disposal locations indicating the types of waste accepted at each location.

18 (a) The hours of operation at this Site are limited to: Wednesdays between 8:00 a.m. and 6:00 p.m. inclusive; and Saturdays between 8:00 a.m. and 3:30 p.m. inclusive.

(b) During non-operating hours, the entrance gate to the Site shall be locked to prevent access to the Site by unauthorized persons.

19. Should an outbreak of vermin or vector occur at the Site, the Operator shall immediately take all steps necessary to control the outbreak, including if necessary, the services of a licenced exterminator.

20. The Operator shall ensure this Site is operated in a manner which minimizes the impacts of odour, dust, litter, noise and traffic on the natural environment and the public.

21. The Operator shall ensure that waste for processing or transfer is stored in a safe and secure manner and that waste is properly handled and contained so as not to pose any threat to the public, Site personnel or the natural environment.

CONTINGENCY PLAN

29. (a) Within ninety (90) days of issuance of this Certificate, the Operator shall ensure contingency procedures for this Site, as identified in the plans and specifications listed in Schedule "A" which is attached, are available at the Township Office in the case of an emergency situation and for inspection by authorized Ministry personnel. The contingency plan should include, as a minimum, the following:

i) the procedures on how to deal with the receipt of any unauthorized waste;
ii) the procedures on how to deal with illegal dumping; and
iii) the procedures on how to handle an emergency situation, such as a fire or a significant spill, at the Site;

(b) The Operator shall, as a minimum, review the contingency plan on an annual basis; and

(c) The Operator shall ensure staff are trained in the operation and maintenance of this Site and in emergency response procedures.

REPORTING

30. a) The Operator shall maintain a weekly written record of the approximate quantity and types of waste received at the Site for disposal; and

b) The Operator shall maintain a written record of all recyclable material received at, processed and transferred from this Site including waste type, approximate quantity and their destination.

31. The following information shall be recorded on loads refused access to the Site for disposal purposes:

- date
- name of person
- company name on vehicle
- vehicle description and licence number
- quantity and description of waste refused
- reason for the refusal

32. An Annual Report on the development and operation of the Site shall be prepared and retained at the Township of Mountain office, by March 31st of the year following the calendar year covered by the report. The report shall include but is not limited to the following information:

- delineation of the existing limits of the fill area of the disposal Site
- quantity and types of waste received and deposited on-Site
- remaining Site capacity
- conformance with development and operations plan
- operational problems encountered and/or complaints received and the remedial action taken
- groundwater and surface water monitoring program results, trends (past and present), data interpretation, conclusions and recommendations
- waste deposition locations for the next 12 month period
- an annual mass balance of all recyclable material received at and transferred from the Site, including their waste type, quantity and destination
- a descriptive summary of any emergency situation which occurred at the Site

CLOSURE PLAN

33. When the Operator estimates that only twenty-four (24) months remain before waste disposal ceases at the Site, the Operator shall submit to the Director a plan for the closure of the Site, long term maintenance and long term monitoring.

SCHEDULE "A"

This Schedule "A" forms part of this Provisional Certificate of Approval No. A481702.

1. Document dated January 31, 1992, entitled "*Operations Plan, Township of Mountain Sanitary Landfill*" prepared by Dillon Consulting Engineers & Planners on behalf of the Township of Mountain.

2. Application form dated April 2, 1992, for Approval for a Waste Disposal Site (Landfill).

3. Document dated July 1993, entitled "*Hydrogeological Investigation Landfill Site Lot 11, Concession IV Township of Mountain, Ontario*" prepared by Golder Associates for the Township of Mountain.

4. Facsimile dated April 3, 1995, to Brian Kaye, Ministry of Environment and Energy, from K. Marketvette, Golder Associates, Re: "*Site Plan Figure 2*" indicating topography dated June 28, 1993.

5. Application form dated May 2, 1995, for Approval of a Waste Disposal Site.

6. Revised Application form dated July 10, 1995, for Approval of a Waste Disposal Site.

The reasons for the imposition of the above Conditions are as follows:

1. Conditions 1, 2, 3, 5, 6, 7, 8, 9 and 10 is to clarify the legal rights and responsibilities of the Operator.

2. Condition 4 is to ensure that the appropriate Ministry staff have ready access to the operations of the Site which are approved under this Certificate. The Condition is supplementary to the powers of entry afforded a Provincial Officer pursuant to the **Environmental Protection Act**, the **Ontario Water Resources Act**, and the **Pesticides Act**, as amended.

3. Conditions 11, 30 and 32 is to maintain a written record of all waste received at and transferred from the Site which can then be used to prepare the Annual Report.

4. Condition 12 is to make the Operator aware that this Certificate replaces all previous Certificates of Approval and Notices of Amendment issued for the Site.

5. Condition 13 is to ensure that future Operators of the land on which the Site is located are made aware of the fact that the land has been used as a landfill or contaminant attenuation zone and that no use may be made of the land for a period of twenty-five years after such use without the approval of the Minister, (EPA, Section 46).

6. Condition 14 is to ensure that personnel involved in the management and operation of the Site receive instructions about the Conditions on this Certificate and the documents in Schedule "A", as well as, other pertinent information necessary to operate the Site in a legal and environmentally safe manner.

7. Conditions 15, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27 and 29 are to ensure that the Site is operated in a responsible manner in order to minimize any adverse impacts on the natural environment or the public and to ensure it is operated in accordance with the application and documentation submitted in support of the application and not in a manner which the Director has not been asked to consider.

8. Condition 17 is to ensure that the public is aware of the hours of operation of the Site and provides pertinent information regarding the use of the Site.

9. Condition 28 is to ensure the necessary monitoring programs, which are an integral part of the operation and development of the Site, are conducted properly and, should the monitoring show an impact or potential impact on or off Site, corrective measures may be required. The operation of this Site without such a Condition may create a hazard to the health and safety of any person and would not be in the public interest.

10. Condition 31 is to discourage the illegal dumping of loads which have been refused access to the Site for disposal purposes.

11. Condition 33 is to ensure that the Site is closed in accordance with Ministry standards and to protect the health and safety of the public and the environment.

You may, by written notice served upon the Director and the Environmental Appeal Board within fifteen (15) days after receipt of this Certificate, require a hearing by the Board. Section 142 of the Environmental Protection Act, R.S.O. 1990 c. E-19 as amended, provides that the notice requiring the hearing shall state:

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

In addition to these statutory requirements, the notice should include:

3. **The name of the appellant;**
4. **The address of the appellant;**
5. **The Certificate of Approval number;**
6. **The date of the Certificate of Approval;**
7. **The name of the Director;**
8. **The municipality within which the works are located;**

and the notice should be signed and dated by the appellant.

This notice should be served upon:

The Secretary
Environmental Appeal Board
P.O. Box 2382
2300 Yonge Street, 12th Floor
TORONTO, Ontario
M4P 1E4

AND

The Director
Section 39, E.P.A.
Ministry of the Environment
250 Davisville Avenue
3rd Floor
TORONTO, Ontario
M4S 1H2

AND

Environmental Commissioner
1075 Bay Street, Suite 605, 6th Floor
TORONTO, Ontario
M5G 2W5

Dated at Toronto this 14 **day of January, 1998.**

Director
Section 39, E.P.A.
Ministry of the Environment

Appendix B:
Borehole Logs MW1-MW5

PROJECT: 921-2778
LOCATION: See Plan
DIP:

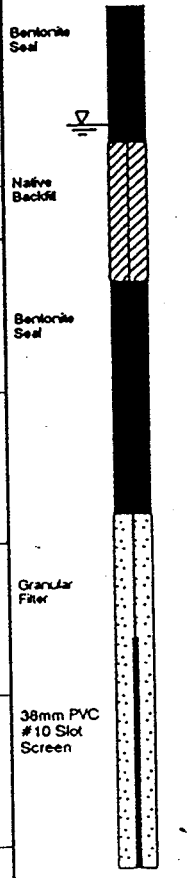
RECORD OF BOREHOLE 2

BORING DATE: May 6, 1993

SHEET 1 OF 1
DATUM: Local
SAMPLER HAMMER, 63.5kg; DROP, 760 mm

BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	RECOVERY %	LAB. TESTING	GAS CONCENTRATION ( ) / %LEL	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	INSTALLATIONS
	Ground Surface		98.53 / 0.00								
	TOPSOIL		98.33 / 0.20								
	Brown SILTY SAND and GRAVEL		97.93 / 0.60								
Power Auger / NW Casing	Very dense brown sandy silt, some gravel, occasional cobbles and boulders. Large weathered bedrock fragments from 2.38m to 2.64m (GLACIAL TILL)			1	SO DO	> 50					
			95.89 / 2.64								
Rotary Drilling / NQ Core	Fresh to faintly weathered light grey to dark grey very fine to fine grained massive DOLOMITIC LIMESTONE; stylolites and shale partings common; fractures commonly coincident with stylolites; subvertical fracture at 4.27m depth; some vuggy zones with some vugs infilled with calcite			2	NQ RC				T.C.R. 89% S.C.R. 78% R.Q.D. 67%		
				3	NQ RC				T.C.R. 82% S.C.R. 35% R.Q.D. 12%		
				4	NQ RC				T.C.R. 100% S.C.R. 91% R.Q.D. 76%		
			92.84 / 5.69								
	End of Hole										

INSTALLATIONS



WL. in Screen at Elev. 97.75m June 10, 1993

LOGGED: K.A.M

DEPTH SCALE (ALONG HOLE)

RECORD OF BOREHOLE 1

PROJECT: 921-2778
LOCATION: See Plan
DIP:

BORING DATE: May 6, 1993

SHEET 1 OF 1
DATUM: Local

SAMPLER HAMMER, 63.5kg; DROP, 760 mm

METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	RECOVERY %	LAB. TESTING	GAS CONCENTRATION ⊕ ( ) %LEL □	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	INSTALLATIONS
		Ground Surface		97.87								
0	Power Auger	TOPSOIL		0.00 0.12								Native Backfill
1	NW Casing	Dense to very dense brown sandy silt, some gravel, occasional cobbles and boulders (GLACIAL TILL)			1	SO DO	50					Bentonite Seal
2				95.58 2.29	2	NQ RC				T.C.R. 100% S.C.R. 99% R.Q.D. 90%		
3	Rotary Drilling NQ Core	Fresh to faintly weathered light grey to dark grey very fine to fine grained massive vuggy DOLOMITIC LIMESTONE; stylolites common, fractures commonly coincident with stylolites; occasional shaly parting, prominent vuggy zone from 4.3m to 4.6m with some vugs infilled with calcite			3	NQ RC				T.C.R. 75% S.C.R. 60% R.Q.D. 28%		Granular Filter
4					4	NQ RC				T.C.R. 100% S.C.R. 99% R.Q.D. 99%		38mm PVC #10 Slot Screen
5					5	NQ RC				T.C.R. 78% S.C.R. 74% R.Q.D. 69%		
				92.18 5.69								
6		End of Hole										WL. in Screen at Elev. 98.19m Above Ground Surface June 10, 1993
7												
8												
9												
10												

DEPTH SCALE (ALONG HOLE)

LOGGED: K.A.M
CHECKED:

Golder Associates

PROJECT: 921-2778

LOCATION: See Plan

DIP:

RECORD OF BOREHOLE 3

BORING DATE: May 7, 1993

SHEET 1 OF 1

DATUM: Local

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	RECOVERY %	LAB. TESTING	GAS CONCENTRATION (%LEL)	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT, PERCENT (Wp, W, Wl; 20 40 60 80)	INSTALLATIONS
0	Power Auger	Ground Surface		97.99								
		TOPSOIL		97.84 / 0.00								
				97.69 / 0.15								Bentonite Seal
1		Brown silty sand, some gravel and cobbles; cobbles and boulders predominant from 1.34m to 1.82m depth (GLACIAL TILL)										
	NW Casing			96.17 / 1.82								Native Backfill
2		Very dense brown to grey sandy silt, some gravel, cobbles and boulders (GLACIAL TILL)			1	50 DO	72					
3					2	NQ RC						Bentonite Seal
	Rotary Drilling			94.36 / 3.63	3	NQ RC				T.C.R. 21% S.C.R. 0% R.Q.D. 0%		
4	NQ Core	Fresh to faintly weathered light grey to dark grey very fine grained to fine grained massive DOLOMITIC LIMESTONE, occasional stylolite and shale parting with fractures commonly coincident with stylolite zones; vuggy zones present with some vugs infilled with calcite			4	NQ RC				T.C.R. 30% S.C.R. 0% R.Q.D. 0%		Granular Filter
					5	NQ RC				T.C.R. 61% S.C.R. 27% R.Q.D. 0%		
5					6	NQ RC				T.C.R. 99% S.C.R. 78% R.Q.D. 77%		38mm PVC #10 Slot Screen
6					7	NQ RC				T.C.R. 100% S.C.R. 96% R.Q.D. 56%		
		End of Hole		91.69 / 6.30								
7												WL. in Screen at Elev. 97.09m June 10, 1993
8												
9												
10												

DEPTH SCALE (ALONG HOLE)

1 to 50

Golder Associates

LOGGED: K.A.M

CHECKED: KAM

PROJECT: 921-2778

LOCATION: See Plan

DIP:

RECORD OF BOREHOLE 4

BORING DATE: May 7, 1993

SHEET 1 OF 1

DATUM: Local

SAMPLER HAMMER, 63.5kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	SAMPLES: RECOVERY %	LAB. TESTING	GAS CONCENTRATION (%LEL)	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT, PERCENT (Wp, W, Wl; 20 40 60 80)	INSTALLATIONS
		Ground Surface		97.56 / 0.00								
0	Power Auger, NW Casing	Brown SILTY SAND and GRAVEL										Bentonite Seal
1												Native Backfill
				95.85 / 1.71	1	SS DO	98					Bentonite Seal
2		Very dense brown to grey sandy silt, some gravel, cobbles (GLACIAL TILL)		95.43 / 2.13	2	NQ RC				T.C.R. 100% S.C.R. 66% R.Q.D. 66%		
					3	NQ RC				T.C.R. 75% S.C.R. 42% R.Q.D. 0%		
3	Rotary Drilling, NQ Core	Fresh to faintly weathered light grey to dark grey very fine grained to fine grained massive DOLOMITIC LIMESTONE, occasional shale interbed and stylolite.			4	NQ RC				T.C.R. 88% S.C.R. 79% R.Q.D. 68%		Granular Filter
4					5	NQ RC				T.C.R. 100% S.C.R. 100% R.Q.D. 93%		38mm PVC #10 Slot Screen
					6	NQ RC				T.C.R. 93% S.C.R. 78% R.Q.D. 61%		
5				92.47								
		End of Hole		5.09								
6												WL, in Screen at Elev. 96.70m June 10, 1993
7												
8												
9												
10												

DEPTH SCALE (ALONG HOLE)

LOGGED: K.A.M

RECORD OF BOREHOLE 5

PROJECT: 921-2778
LOCATION: See Plan
DIP:

BORING DATE: May 10, 1993

SHEET 1 OF 1
DATUM: Local
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	RECOVERY %	LAB. TESTING	GAS CONCENTRATION (%LEL)	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT, PERCENT (Wp, W, Wl; 20 40 60 80)	INSTALLATIONS
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		98.46 / 0.00								Bentonite Seal
1		Very loose fine to medium SAND, some gravel, wire , plastic (WASTE FILL)			1	SS	2					Native Backfill
2					2	SS	21					Bentonite Seal ▽
3		Compact brown SILTY SAND and GRAVEL		95.63 / 2.83	3	SS	46					Granular Filter
		Dense brown sandy silt, some gravel, occasional cobbles (GLACIAL TILL)		95.26 / 3.20								38mm PVC #10 Slot Screen
4		Very dense brown to grey sandy silt to silt, trace fine to coarse gravel (GLACIAL TILL)		94.65 / 3.81	4	SS	73					
5		End of Hole Sampler Refusal		93.74 / 4.72	5	SS	>100					WL. in Screen at Elev. 96.51m June 10, 1993
6												
7												
8												
9												
10												

DATA INPUT: Disk 14, Screighton

DEPTH SCALE (ALONG HOLE)

LOGGED: K.A.M

CHECKED: KAM

Golder Associates

Appendix C:
Water Well Records – MW6 & MW7

The Ontario Water Resources Act
WATER WELL RECORD

County or District	Township/Borough/City/Town/Village	Con block tract survey etc.	Lot
[illegible]	[illegible]	Con 4	11
Address: 5110 St. Lawrence Street		Date completed	5 08 [illegible]

OVERBURDEN AND BEDROCK MATERIALS

General colour	Most common material	Other materials	General description	Depth – feet From	To
Grey	Limestone	Fracture		0	5
Grey	Limestone	Soft		5	8
	Limestone	Med		8	50

MW6

CASING & OPEN HOLE RECORD

Inside diam. inches	Material	Wall thickness inches	Depth – feet From	To
6	Open hole		0	50
2	Plastic	Sch 40	+3	10
2	Plastic	Sch 40	+3	30
6	Steel	.188	+4	1

SCREEN

Slot no.	Diameter	Length
10	2 inches	10 feet

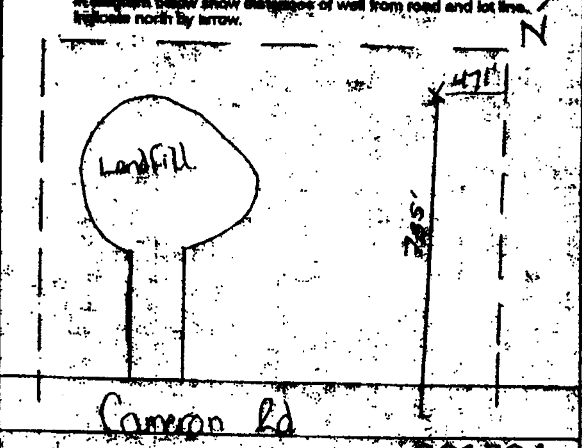
Material and type: Plastic

PLUGGING & SEALING RECORD

From	To	Material and type
[illegible]	[illegible]	# Filter stone
[illegible]	[illegible]	[illegible]
[illegible]	14	Back [illegible]
16	[illegible]	[illegible]
[illegible]	0	[illegible]

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



201724

Name of Well Contractor	Well Contractor's Licence No.
Olympic Drilling Co Ltd	4006
Address: [illegible] Dr Metcalfe	
Name of Well Technician: Wayne [illegible]	Well Technician's Licence No.: 10-327

1 CONTRACTOR'S COPY

Steve Wilson

Ministry of Environment and Energy, Ontario

The Ontario Water Resources Act
WATER WELL RECORD

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
North Dundas	North Dundas Mountain	Con 4	11
Township of North Dundas	Address: 547 St Lawrence Street	Date completed: 04 08 99 (day month year)	

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General colour	Most common material	Other materials	General description	Depth - feet From	To
Grey	Limestone	Fracture		0	7
Grey	Limestone	Soft		7	18
Grey	Limestone	Med		18	50

MW7

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth From	Depth To
6	Open hole		0	50
2		Sch 40	+3	15
2	Plastic	Sch 40	+3	50
6	Steel	.188	+4	1

SCREEN

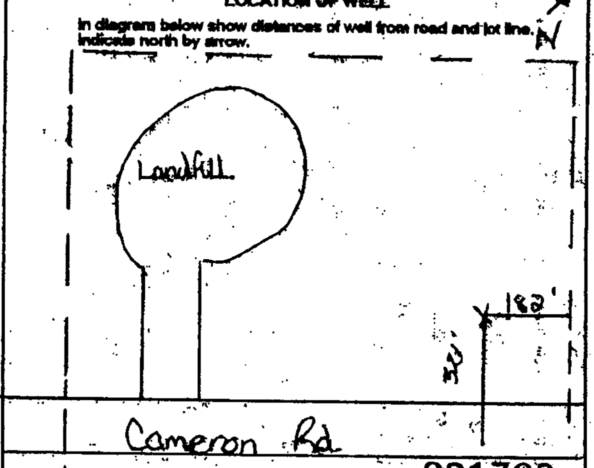
Slot No.	Diameter	Length	Material and type	Depth at top of screen
10	2 inches	10 feet	Plastic	40 / #2-5 feet

PLUGGING & SEALING RECORD

Depth set at - feet From	To	Material and type
50	37	#3 Filterstone
37	34	Holeplug
34	16	Rock cuttings
16	4	Filterstone
4	0	Hole plug

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



201723

Name of Well Contractor	Well Contractor's Licence No.
Olympic Drilling Co. Ltd	4006
Address: 2320 Sawmills Dr Metcalfe	
Name of Well Technician: Wayne Reaume	Well Technician's Licence No.: T0327

1 - CONTRACTOR'S COPY

Appendix D:
Laboratory Analysis Sheets

Seprotech Laboratories

Certificate of Analysis

Client:
Oliver, Mangione, McCalla
154 Colonnade Rd. S.
Nepean, ON
K2E 7J5

Attention: **Blaine Coons**

Report: **200007323**
Project: Winchester Mountain
Date Sampled: November 2, 2000
Date Received: November 2, 2000
Date Printed: December 07, 2000
Matrix: Groundwater

Parameter	Unit	MDL	Sample Identification						
			1MW	2MW	3MW	6D	6S	7D	7S
Chloride	mg/L	0.5	45.2	9.0	24.0	3.2	53.0	1.7	151
Nitrate- Nitrogen	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1
Sulphate	mg/L	1	44	52	76	44	113	20	282
Hardness as CaCO3	mg/L	1	476	456	607	231	595	280	896
Total Dissolved Solids	mg/L	1	426	392	448	362	678	284	1340
Alkalinity as CaCO3	mg/L	1	370	359	378	342	516	288	748
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Ammonia Nitrogen	mg/L	0.01	0.04	<0.01	0.04	0.16	0.29	0.14	4.38
Total Phosphorus	mg/L	0.01	0.02	0.13	1.17	0.05	1.27	0.16	0.03
Calcium	mg/L	0.03	97.7	92.6	123	47.4	121	56.4	189
Iron	mg/L	0.02	0.21	0.26	2.97	0.37	2.16	0.28	0.08
Potassium	mg/L	0.4	1.1	2.2	2.5	6.2	1.8	3.6	28.3
Magnesium	mg/L	0.01	56.4	54.6	72.7	27.3	71.1	33.7	103
Manganese	mg/L	0.01	0.01	0.01	0.12	0.03	0.17	0.02	1.69
pH	units	0.10	7.65	7.92	7.85	8.13	7.72	8.11	7.58

Seprotech Laboratories
2378 Holly Lane, Ottawa, Ontario, K1V 7P1, Canada
Tel: (613)523-1641, Fax: (613)731-0851

Dave Peeler, Lab Supervisor

Seprotech Laboratories

Certificate of Analysis

Client:
Oliver, Mangione, McCalla
154 Colonnade Rd. S.
Nepean, ON
K2E 7J5

Attention: **Blaine Coons**

Report: **200007323**
Project: Winchester Mountain
Date Sampled: November 2, 2000
Date Received: November 2, 2000
Date Printed: December 07, 2000
Matrix: Groundwater

Parameter	Unit	MDL	Sample Identification						
			1MW	2MW	3MW	6D	6S	7D	7S
Dissolved Organic Carbon	mg/L	0.2	0.7	0.6	1.0	0.4	3.9	0.5	10.5
BOD5	mg/L	1	<1	<1	<1	<1	<1	<1	<1
Conductivity	µMho/cm	1	758	665	761	634	1090	496	1890

Seprotech Laboratories
2378 Holly Lane, Ottawa, Ontario, K1V 7P1, Canada
Tel: (613)523-1641, Fax: (613)731-0851

Dave Peeler, Lab Supervisor

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW

ATT: Mr. Steve Wilson

Report Number: 2004392
Date: 2000-06-02
Date Submitted: 2000-05-17
Date Collected: 2000-05-17
Project: MC12684A

P.O. Number:
Matrix: Surfacewater

PARAMETER	UNITS	MDL	67366 SW 2	67367 SW 4			
Alkalinity as CaCO3	mg/L	5	272	417			
COD	mg/L	4	23	62			
Ag	mg/L	0.0001	<0.0001	<0.0001			
Al	mg/L	0.05	0.05	0.35			
As	mg/L	0.001	<0.001	0.002			
B	mg/L	0.01	0.01	0.31			
Be	mg/L	0.002	<0.002	<0.002			
BOD5	mg/L	1	20	174			
Ca	mg/L	1	68	128			
Cd	mg/L	0.00006	<0.00006	<0.00006			
Cl	mg/L	1	2	47			
Conductivity	uS/cm	5	493	1170			
Cr	mg/L	0.01	<0.01	<0.01			
Cu	mg/L	0.005	<0.005	<0.005			
DOC	mg/L	0.4	9.7	25.4			
Fe	mg/L	0.01	<0.01	0.15			
Hardness as CaCO3	mg/L	1	298	567			
Sb	mg/L	0.001	<0.001	<0.001			
Pb	mg/L	0.001	<0.001	<0.001			
Mg	mg/L	1	31	60			
Mn	mg/L	0.01	<0.01	0.28			
Mo	mg/L	0.01	<0.01	<0.01			
Ni	mg/L	0.01	<0.01	<0.01			
N-NO3	mg/L	0.10	0.10	1.48			
pH			7.43	7.34			
Phenols	mg/L	0.001	<0.001	<0.001			
K	mg/L	1	1	33			
Se	mg/L	0.001	<0.001	<0.001			
Na	mg/L	1	1	47			
SO4	mg/L	3	7	151			

MDL = Method Detection Limit INC = Incomplete

Comment:

Sample 67366 - BOD (174) is higher than COD (62) due to the occurrence of organic sediments in the bottle.

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW

ATT: Mr. Steve Wilson

Report Number: 2004392
Date: 2000-06-02
Date Submitted: 2000-05-17
Date Collected: 2000-05-17
Project: MC12684A

P.O. Number:
Matrix: Surfacewater

PARAMETER	UNITS	MDL	67366 SW 2	67367 SW 4			
Tl	mg/L	0.001	<0.001	<0.001			
Total Kjeldahl Nitrogen	mg/L	0.05	0.71	2.31			
Total P	mg/L	0.01	0.37	5.48			
V	mg/L	0.002	0.003	0.005			
Zn	mg/L	0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW

ATT: Mr. Steve Wilson

Report Number: 2004391
Date: 2000-05-31
Date Submitted: 2000-05-17
Date Collected: 2000-05-17
Project: MC12684A

P.O. Number:
Matrix: Water

PARAMETER	UNITS	MDL	67359 MW 6S	67360 MW 6D	67361 MW 7S	67362 MW 7D	67363 MW 1
Alkalinity as CaCO3	mg/L	5	316	338	436	259	251
COD	mg/L	4	8	8	21	5	8
BOD5	mg/L	1	4	2	<1	1	<1
Ca	mg/L	1	80	48	155	53	61
Cl	mg/L	1	6	5	82	1	3
Conductivity	uS/cm	5	636	724	1410	498	476
DOC	mg/L	0.4	1.4	1.7	7.0	1.3	1.5
Fe	mg/L	0.01	1.96	0.07	0.03	0.14	0.16
Hardness as CaCO3	mg/L	1	373	235	688	264	278
Mg	mg/L	1	42	28	73	32	31
Mn	mg/L	0.01	0.17	0.02	0.31	0.02	<0.01
N-NO3	mg/L	0.10	<0.10	<0.10	10.7	0.11	<0.10
pH			7.32	7.48	7.19	7.49	7.26
K	mg/L	1	2	7	27	5	1
Na	mg/L	1	10	77	48	9	1
SO4	mg/L	3	56	67	219	20	16
Total Kjeldahl Nitrogen	mg/L	0.05	0.49	16.5	1.79	1.91	1.04

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

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ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW

ATT: Mr. Steve Wilson

Report Number: 2004391
Date: 2000-05-31
Date Submitted: 2000-05-17
Date Collected: 2000-05-17
Project: MC12684A

P.O. Number:
Matrix: Water

PARAMETER	UNITS	MDL	67364 MW 2	67365 MW 3			
Alkalinity as CaCO3	mg/L	5	298	282			
COD	mg/L	4	8	8			
BOD5	mg/L	1	<1	<1			
Ca	mg/L	1	72	73			
Cl	mg/L	1	4	15			
Conductivity	uS/cm	5	568	587			
DOC	mg/L	0.4	2.0	1.3			
Fe	mg/L	0.01	1.31	1.27			
Hardness as CaCO3	mg/L	1	341	343			
Mg	mg/L	1	39	39			
Mn	mg/L	0.01	0.07	0.05			
N-NO3	mg/L	0.10	0.11	0.10			
pH			7.24	7.36			
K	mg/L	1	2	<1			
Na	mg/L	1	1	4			
SO4	mg/L	3	27	37			
Total Kjeldahl Nitrogen	mg/L	0.05	0.36	0.42			

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW
Attn: Mr. Steve Wilson

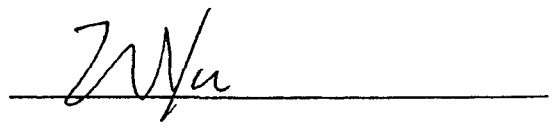
Lab Report No: 2004391
Date: May 26,2000
Date Submitted: May 17,2000
Date Collected: May 17,2000
Project: MC12684A

Sample Matrix: water

PARAMETER	UNITS	MDL	RN# 67359	RN# 67360	RN# 67361	RN# 67362	lab replicate
			MW 6S	MW 6D	MW7S	MW7D	MW6S
Benzene	µg/L	0.5	ND	ND	ND	ND	ND
Bromodichloromethane	µg/L	0.3	ND	ND	ND	ND	ND
Bromoform	µg/L	0.4	ND	ND	ND	ND	ND
Bromomethane	µg/L	0.5	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	0.9	ND	ND	ND	ND	ND
Chlorobenzene	µg/L	0.2	ND	ND	ND	ND	ND
Chloroethane	µg/L	1.0	ND	ND	ND	ND	ND
Chloroform	µg/L	0.5	ND	ND	ND	ND	ND
Chloromethane	µg/L	1.0	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	0.3	ND	ND	ND	ND	ND
1,2-Dibromoethane	µg/L	1.0	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	0.4	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	0.4	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	0.4	ND	ND	ND	ND	ND
1,1-Dichloroethane	µg/L	0.4	ND	ND	ND	ND	ND
1,2-Dichloroethane	µg/L	0.7	ND	ND	ND	ND	ND
1,1-Dichloroethylene	µg/L	0.5	ND	ND	ND	ND	ND
c-1,2-Dichloroethylene	µg/L	0.4	ND	ND	ND	ND	ND
t-1,2-Dichloroethylene	µg/L	0.4	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	0.7	ND	ND	ND	ND	ND
c-1,3-Dichloropropylene	µg/L	0.2	ND	ND	ND	ND	ND
t-1,3-Dichloropropylene	µg/L	0.2	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	0.5	ND	ND	ND	ND	ND
Methylene Chloride	µg/L	4.0	ND	ND	ND	ND	ND
Styrene	µg/L	0.5	ND	ND	ND	ND	ND

ND = Not Detected (< MDL) MDL = Method Detection Limit

Comment:

APPROVAL: 

146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: OMM-TROW
Attn: Mr. Steve Wilson

Lab Report No: 2004391
Date: May 26,2000
Date Submitted: May 17,2000
Date Collected: May 17,2000
Project: MC12684A

Sample Matrix: water

PARAMETER	UNITS	MDL	RN# 67359	RN# 67360	RN# 67361	RN# 67362	lab replicate
			MW 6S	MW 6D	MW7S	MW7D	MW6S
1,1,1,2-tetrachloroethane	ug/L	0.6	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	0.6	ND	ND	ND	ND	ND
Tetrachloroethylene	µg/L	0.3	ND	ND	ND	ND	ND
Toluene	µg/L	0.5	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	µg/L	0.4	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	µg/L	0.4	ND	ND	ND	ND	ND
Trichloroethylene	µg/L	0.3	ND	ND	ND	ND	ND
Trichlorofluoromethane	µg/L	0.5	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	0.3	ND	ND	ND	ND	ND
Vinyl Chloride	µg/L	0.5	ND	ND	ND	ND	ND
m/p-Xylene	µg/L	1.0	ND	ND	ND	ND	ND
o-Xylene	µg/L	0.5	ND	ND	ND	ND	ND
Surrogate Recoveries							
1,2-Dichloroethane-d4	% Recovery	1	106	96	104	105	103
Toluene-d8	% Recovery	1	104	97	97	100	100
4-Bromofluorobenzene	% Recovery	1	108	95	98	98	107

ND = Not Detected (< MDL) MDL = Method Detection Limit

Comment:

APPROVAL: _____

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