

January 26, 2010

SHELBURNE PUBLIC LIBRARY
10/09/08/07 Prev Year Comparison

	Budget 08	Budget 09	Budget 10
Income			
Rental - Facility	6148	6000	6000
Program Income			3000
Amaranth	26310	27224	27941
Melancthon	33176	34329	35201
Mono	18002	18627	19140
Mulmur	17482	18089	18480
Shelburne	112441	116348	119243
Subtotal Municipal Partners	207411	214617	220005
Southgate	1470	2500	2500
Provincial Operating Grant	6283	6283	6283
Government Grants	0		
Pay Equity/Rev.Can. Cr.	0		
Student - Summer	1032	1000	1000
Library Sales & Services	9050	8000	5000
Book Sales Income	2011	1500	1500
Total Donations	13282	2500	5000
Miscellaneous Income	0		500
Transfer from Reserves	0	9500	10000
transfer from database reserve	3000	33654	26132
Building Fund GIC Interest	0		
Interest Income	1183	700	250
Total Income	250870	286254	287170

MAR 18 2010

SHELBURNE PUBLIC LIBRARY
10/09/08/07 Prev Year Comparison

	Budget 08	Budget 09	Budget 10
Expense			
Database	3000	33654	26000
Elevator	3456	3500	3500
Collection Purchases	40910	41500	40000
Program Expense	871	1000	3300
Utilities and Telephone	8530	9650	10000
Maintenance	11506	11000	11000
Insurance	10094	7000	7400
Payroll Expenses	142079	148000	160000
Supplies	5533	5500	8000
Advertising & Promotion	579	800	1000
Licenses and Memberships	288	300	300
Accounting Fees	5000	6000	5000
Bank charges		50	50
Professional Development	355	1000	700
Employee travel		200	200
Honorariums/Memorials	891	300	300
Furniture & Equipment	1757	1000	1000
Miscellaneous	3219	800	800
Service Ontario Grant Exp	0		
Computers- capital reserve		5000	2000
Web site		1500	120
Computers - operating	3296	3500	1500
Building Capital Expenses	2000	5000	5000
Special Projects from Donations	3051		
Grant Expenses	0		
Total Expense	246416	286254	287170
Net Income	4454	0	0

**ANNUAL GROUNDWATER
MONITORING AND SAMPLING REPORT
2009**

**TOWNSHIP OF MELANCTHON LANDFILL SITE
4TH LINE
TOWNSHIP OF MELANCTHON, ONTARIO**

Project No. BG-290

Prepared for:

**THE CORPORATION OF THE TOWNSHIP OF MELANCTHON
R.R. #6
SHELBURNE, ON.
ATTN: MS. DENISE HOLMES, CLERK-TREASURER**

FEBRUARY 2010

By:


BLUEWATER
GEOSCIENCE CONSULTANTS Inc.

MAR 18 2010

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 PREVIOUS INVESTIGATIONS 1

2.1 R.J. Burnside & Associates Limited – Annual Groundwater Monitoring Reports 1993-2000 1

2.2 Rubicon Environmental Inc. – Groundwater Monitoring and Hydrogeological Investigations – Spring 2001 1

2.3 Rubicon Environmental Inc. – Groundwater Monitoring and Hydrogeological Investigations – Spring 2002 2

2.4 Rubicon Environmental Inc. – Landfill Monitoring – March 24, 2004..... 2

2.5 Bluewater Geoscience Consultants Inc. – Annual Groundwater Monitoring and Sampling Reports 2004 - 2008 2

3.0 SITE BACKGROUND 2

3.1 Site Inspection..... 2

4.0 GROUNDWATER MONITORING WELLS AND METHODOLOGY 3

4.1 Existing Monitoring Wells in 2009 3

4.2 Wells Installed in 2006 4

4.3 Water Level Monitoring 5

4.4 Groundwater Sampling 5

4.5 Surface Water Sampling 5

4.6 Groundwater Flow 6

5.0 GROUNDWATER QUALITY 6

5.1 Groundwater 6

5.2 Surface Water..... 8

5.3 Methane Monitoring 8

6.0 SUMMARY AND CONCLUSIONS 9

7.0 RECOMMENDATIONS..... 10

8.0 REFERENCES 10

9.0 LIMITATIONS..... 11

10.0 CLOSURE 12

Appendix A – Figures

Appendix B – 2009 Groundwater and Methane Monitoring Data, Laboratory Results Tables

Appendix C – Laboratory Certificates of Analyses

Appendix D – Chloride, Sulphate and manganese Concentration Trend Curves

BLUEWATER GEOSCIENCE CONSULTANTS INC.

42 Shadyridge Place
Kitchener, Ontario
N2N 3J1

Tel: (519) 744-4123
Fax: (519) 744-1863
E-mail: blemieux@rogers.com

1.0 INTRODUCTION

The Corporation of The Township of Melancthon (Township) retained Bluewater Geoscience Consultants Inc. (Bluewater) to complete the 2009 landfill (LF) groundwater monitoring and sampling program and to generate the annual report detailing the findings. The landfill site monitoring was undertaken to continue to assess any environmental impacts to surface and groundwater created by the LF operations. This landfill monitoring report was completed in accordance with the requirements of the Ministry of the Environment's Certificate of Approval for the LF site.

The site monitoring included completing two site inspections, measuring groundwater levels in all 35 observation wells during the Spring and Fall of the year and determination of the resulting groundwater flow patterns in and around the LF. Groundwater sampling was conducted on 31 selected sampling wells during both the Spring and Fall of each year. The groundwater samples for 2009 were submitted to a MOE-accredited analytical laboratory for analysis. The results of the completed laboratory analyses were compared to MOE's Ontario Drinking Water Standards (ODWS) (for on-site monitors) and the Reasonable Use Policy (RUP) for off-site monitors.

2.0 PREVIOUS INVESTIGATIONS

2.1 R.J. Burnside & Associates Limited – Annual Groundwater Monitoring Reports 1993-2000

Annual groundwater monitoring reports for the LF were completed by R.J. Burnside & Associates Limited (Burnside) from 1993 – 2000. These reports included the sampling and analysis of groundwater samples from seventeen existing monitoring wells located in and around the LF site. Eleven of the monitors are located in the overburden aquifer while six are installed within the underlying bedrock aquifer. A summary of these reports indicates that no exceedance of the MOE RUP had been determined during the groundwater sampling events. In general, on-site monitoring locations indicated that exceedance of the MOE's ODWS for on-site monitors were rare and not sustained.

2.2 Rubicon Environmental Inc. – Groundwater Monitoring and Hydrogeological Investigations – Spring 2001

During 2001 Rubicon added another fourteen groundwater monitors to the existing network of monitors in and around the LF site. Eight of these monitors were installed in the overburden aquifer while six were installed in the bedrock aquifer.

During the 2001 investigations, the existing monitoring wells installed by Burnside were sampled and analysed. The additional monitoring wells were tied into the site survey, but not sampled.

BLUEWATER GEOSCIENCE

2.3 Rubicon Environmental Inc. – Groundwater Monitoring and Hydrogeological Investigations – Spring 2002

This report included results of the Spring and Fall 2002 site monitoring and groundwater sampling and analysis program. The monitoring and sampling included the new monitors added during 2001.

2.4 Rubicon Environmental Inc. – Landfill Monitoring – March 24, 2004

This report provides details of the 2003 LF groundwater monitoring and sampling program completed at the site. The report details that some minor exceedances of the ODWS were determined for on-site monitoring wells.

2.5 Bluewater Geoscience Consultants Inc. – Annual Groundwater Monitoring and Sampling Reports 2004 - 2008

These reports detail the 2004 - 2008 LF groundwater monitoring and sampling program completed at the site. The report details that some minor exceedances of the ODWS were determined for on-site and off-site monitoring wells.

3.0 SITE BACKGROUND

The LF site has been in operation since ~1973 at its current location at Lot 12, Concession 4, Township of Melancthon, County of Dufferin. The LF serves the population of ~2,400 people in the Township. The nearest residence is located ~450 m south of the LF site. The location of the LF is remote and distant from any significant population centres.

The LF presently operates under Provisional Certificate of Approval (C of A) A180703. The total LF property comprises an area of ~33.038 ha., of which 6.1 ha. has been approved for landfilling. In 2009, waste placement was proceeding aboveground in the north-central portion of the approved filling area. This fill area has been in use since late 2003 and is immediately adjacent to the west of the former fill area (Figure 1, Appendix A).

3.1 Site Inspection

During both Spring and Fall monitoring events, a site inspection was completed. The main refuse disposal area has been covered with soil and grades have been established to reduce the amount of rainwater infiltration into the waste pod. Temporary fencing has been placed around the fill area to control windblown waste in this area. Current waste placement is being conducted in the 2006 waste placement area (Figure 1) and the waste is covered with soil weekly.

The Township's Landfill Superintendent has established ten (10) waste placement stations on the property to promote proper separation of waste for recycling. Recycling areas are being maintained in an orderly manner. Contractors retained by the Township undertake removal of recyclable materials regularly. A burn area for clean wood and brush has been established and burning of these materials is undertaken as required. Bins for glass and plastic are present at the LF. A separate area

for recycling tires is present. Figure 1 presents the locations and names of the 10 recycling stations provided by the Township.

During the Spring 2006 inspection it was noted that OW-4S had been destroyed, likely by equipment working in the area. OW-4S is located within the current filling are. During the Fall inspection it was noted that OW-4D had been destroyed during the summer months. OW-4D was also located within the current filling area

4.0 GROUNDWATER MONITORING WELLS AND METHODOLOGY

4.1 Existing Monitoring Wells in 2009

Thirty-five groundwater-monitoring wells were in existence at the commencement of the 2009 monitoring period. All wells were inspected and found to be in good order, with the exceptions noted just above.

Seventeen monitoring wells had been installed by Burnside pre-2001. Six of these were installed in the deeper bedrock aquifer (denoted "D" for deep) while eleven were installed in the shallow overburden aquifer (denoted "S" for shallow). All existing monitoring wells were constructed of 50 mm diameter Schedule 40 PVC pipe and are fitted with steel protective casings and locks. The locations of all monitoring wells are presented on the Base Site Plan (Figure 1, Appendix A). A brief description of each monitor locations is provided below:

- OW 1 is installed in the overburden aquifer and is located between two former refuse disposal areas
- OW 2S and OW 2D are located downgradient (east) of the current refuse disposal area
- OW 3S and OW 3D are located immediately downgradient (east) of the current refuse disposal area
- OW 4S and OW 4D are located west of the former disposal area and within the 2006 disposal area
- OW 5S is installed in the overburden aquifer and is located north of the disposal area, near the northern property boundary. This monitor is frequently dry in Fall
- OW 6S and OW 6D are located near the south property boundary and had been intended to represent background water quality
- OW 7S and OW 7D are located near the northeast property corner, northeast of the former refuse disposal area
- OW 8 is installed in the overburden aquifer and is located in the main refuse area. OW 8 is considered a 'leachate' well
- OW 9S and OW 9D are located off-site, northeast of the landfill and in the east ditch of the 4th Line
- OW 10S and OW 10D are located east of the main refuse disposal area
- OW 11S and OW 11D are located northwest of the main refuse disposal area. These monitors were intended to provide further clarification of groundwater flow patterns and are not included in the sampling program
- OW 12S and OW 12D are located west of the main refuse disposal area. These monitors

were intended to provide further clarification of groundwater flow patterns and were newly-included in the 2006 sampling program

- OW 13S and OW 13D are located immediately south of the main refuse disposal area. These wells were located to provide better delineation of the groundwater mounding in the refuse area and provide chemical data south of the refuse area
- OW 14S is located southeast of the main refuse disposal area and was intended to help clarify groundwater flow patterns distant from the refuse disposal area
- OW 15S and OW 15D are located southeast of the main refuse disposal area and were intended to help clarify groundwater flow patterns distant from the main refuse disposal area. These monitors were sampled for the first time during 2006.
- OW 16S and OW 16D are located along the north property boundary. These monitors were intended to provide clarification of groundwater flow patterns and provide chemical analysis of groundwater at the north property boundary. Both monitors were sampled during the 2006 program.
- OW 17S is located off-site in the overburden aquifer. The monitor is located in the east ditch of the 4th Line. This monitor was intended to provide better information on shallow groundwater flow patterns and potentially provide chemical data regarding the contribution of road salt to noted groundwater impacts
- OW 18S and OW 18D are located off-site east of the 4th Line. These monitors were intended to help refine groundwater flow patterns in the overburden and bedrock aquifers and provide chemical data in that area

4.2 Wells Installed in 2006

During 2006 an additional six monitoring wells were installed at the landfill. The six new wells consisted of three sets of two wells (OW-19S and 19I, OW-20S and 20D and OW-21S and 21D). The locations of the new wells are shown on Figure 1, Appendix A. A description of the location and rationale for each of the new wells is presented below:

- OW-19S and OW-19I are located in the southeast corner of the landfill property, just west of the 4th Line. These wells were installed to provide additional points for determining groundwater flow patterns and to provide chemical data at this downgradient property boundary. OW-19S is set in the shallow till overburden while OW-19I (intermediate) is set in a lower till unit. These two wells were included in the 2007 sampling and lab analysis program for the first time.
- OW-20S and OW-20D are located just southeast of the 'old closed landfill' in the northeast portion of the landfill property. These wells will provide further groundwater flow data as well as providing additional chemical data. OW-20S is set in the shallow overburden, just above the bedrock. OW-20D is sealed into the bedrock. These two wells were included in the 2007 sampling and lab analysis program for the first time.
- OW-21S and OW-21D are located along the north landfill property boundary, well west of the active landfilling area. These wells will be utilized to provide additional groundwater flow information as well as providing chemical data at locations well upgradient of the fill area. OW-21S is set in the shallow overburden, just above the bedrock. OW-21D is sealed

into the dolostone bedrock. These two wells were included in the 2007 sampling and lab analysis program for the first time.

All groundwater-monitoring wells have been surveyed relative to a geodetic datum and ground surface and top of monitoring well pipe elevations have been recorded. During 2006, waste placement was taking place in the immediate area of OW-4S and OW-4D. These wells were destroyed by the heavy equipment.

4.3 Water Level Monitoring

On May 1 and October 27, 2009 groundwater levels were measured in all 37 existing monitoring wells installed at the LF. The depth to water relative to the top of monitoring well pipe was measured using a Solinst water level gauge. The determined water depths were recorded and the resulting groundwater elevations were determined. Table 1, Appendix B provides the tabular representation of the groundwater elevation data, including historic groundwater levels.

After completion of the water level measurements, the monitors selected for sampling were thoroughly purged of a minimum of 3 casing volumes of water in anticipation of the groundwater sampling.

4.4 Groundwater Sampling

The 2009 groundwater sampling and analysis program consisted of sampling 32 selected groundwater monitoring locations at and around the LF property. Samples were obtained from both overburden and bedrock aquifer wells. Prior to obtaining the groundwater samples, the selected monitors had been purged of a minimum of three casing volumes of water in order to facilitate provision of representative samples.

Groundwater samples from the selected monitoring wells were obtained using dedicated Waterra tubes and foot valves and were placed directly into the laboratory-supplied sample bottles. The groundwater samples were obtained and submitted for analysis of the volatile organic compounds (VOC's), general water chemistry and heavy metals parameters. The heavy metal samples were field filtered and preserved. The groundwater samples were chilled in coolers prior to being submitted under Chain of Custody to ALS Laboratories of Waterloo, ON for analysis. ALS is an MOE accredited laboratory.

4.5 Surface Water Sampling

One surface water sample was obtained at location SW-3 (Figure 1) during the Spring monitoring. This location is a small dugout (possible former gravel extraction pit) located on the property adjacent to the north. It is our understanding that the Township has now purchased this property. During the Fall monitoring event, the dugout was dry, prohibiting the gathering of a sample for lab analysis.

4.6 Groundwater Flow

The determination of groundwater flow patterns in both overburden and bedrock aquifers are essential in determining the potential for off-site impacts and contaminant distribution. In general, groundwater levels in both overburden and bedrock aquifers were lower (~1m) in the Fall than the Spring monitoring. The measured groundwater elevations for each aquifer were determined and plotted on the site plan. The resulting groundwater flow patterns were determined based on this distribution. Figures 2 and 3 present the groundwater flow patterns for the Spring monitoring while Figures 4 and 5 provide the Fall 2009 aquifer flow patterns.

As may be noted from these Figures, mounding of groundwater in both aquifers within the refuse disposal area is occurring. This phenomenon is typical of landfill sites and should be expected to continue. The mounding creates radial flow, outwards, apparently in all directions away from the refuse disposal area. The flow then comes under the influence of background flow patterns. Based on the findings of this, and previous, monitoring events, the overburden groundwater flow is towards the northeast while the bedrock groundwater flow is more-directly eastwards.

Groundwater flow is driven by the gradient of the groundwater. This produces head differences between locations creating the conditions for groundwater movement. The horizontal hydraulic gradient in the overburden aquifer has been determined to be on the order of 0.007 m/m. Based on this gradient, and the characteristics of the overburden, the lateral groundwater flow velocity may be approximately 74 m/yr. The horizontal hydraulic gradient in the bedrock aquifer is lower; approximately 0.002 m/m. Based on this gradient and the characteristics of the aquifer, velocities of approximately 0.03 m/yr are estimated.

Vertical hydraulic gradients between the overburden and bedrock aquifers create the conditions for downward migration of groundwater impacted in the refuse disposal area. Downward vertical gradients allow downward movement of water into the bedrock aquifer. Downward vertical gradients are found in the refuse disposal area allowing shallow impacted groundwater to potentially enter the bedrock aquifer. This is significant because the bedrock aquifer is utilized as a potable water source within the Township and the bedrock aquifer is less able to attenuate groundwater contaminants.

5.0 GROUNDWATER QUALITY

5.1 Groundwater

Groundwater sampling and analysis for the LF site has been undertaken since 1993. Additional wells were added to the sampling regime in 1999 and selected monitoring wells installed in 2001 were added to the sampling list during 2002. Groundwater quality data for the 2009 program are provided in the Tables in Appendix B along with chemistry data from 2004 - 2008. Copies of the detailed Certificates of Analysis for the 2009 monitoring data are provided in Appendix C.

Inorganic parameters such as chloride, sulphate, hardness and alkalinity are frequently utilized to determine the extent of landfill leachate impacts in groundwater. Hardness and alkalinity are

naturally elevated at the landfill property and throughout Melancthon Township. Chloride levels in both overburden and bedrock aquifers are elevated in the refuse disposal area. In general, concentrations in the bedrock aquifer are slightly higher than in the associated overburden wells. This is a reflection of the downward gradient from the overburden to the bedrock coupled with the lower attenuation capabilities in the bedrock. None of the on-site or off-site monitors exceeded the MOE ODWS concentration for chloride during the 2009 monitoring events. None of the wells sampled during 2009 exceeded the MOE RUP for chloride (125.5 mg/L) concentration. Elevated chloride concentrations in this vicinity of the 4th Line, east of the LF, may be partially attributable to the application of road salt during winter. OW -18 S and D (as well as OW-9S and D) are located within the roadside ditch of the 4th Line and are likely to collect runoff from the road. Chloride concentration was also elevated (but below RUP) at OW-3D, located just downgradient of the current fill area.

In general, the background groundwater quality at the LF site consists of hard water with elevated hardness, alkalinity, manganese and iron content. During the 2009 monitoring, all wells sampled had determined hardness in excess of the ODWS. Alkalinity concentrations in excess of the ODWS were noted at OW's 2S, 2D, 3D, 7S, 7D, 9D, 12S and 18S. Iron concentrations in excess of the ODWS were determined at all sampled wells including upgradient locations. Manganese concentrations in excess of the ODWS were determined for OW's 2S, 2D, 3S, 3D, 6S, 6D, 7S, 7D, 9S, 9D, 10S, 10D, 13S, 13D, 15D, 16S, 16D, 17S, 18S, 18D, 19S, 20S and 20D. As this list includes all sampled location except OW-1, OW-5 and OW-8 these elevated concentrations are likely reflective of background groundwater quality in the area. The lack of elevated manganese concentrations at OW-8, which is considered a leachate well, and displays elevated sulphate concentrations, further suggests that elevated manganese concentrations are not landfill related.

The sulphate concentrations at OW 8 of 1,540 mg/L in Spring 2009 and 1,320 mg/L in Fall 2009 were in excess of the ODWS of 500 mg/L and RUP of 253.9 mg/L. This elevated concentration is likely related to leachate groundwater impacts in the refuse disposal area. During the Fall 2007 monitoring the sulphate concentrations at OW-2D (285 mg/L) marginally exceeded the RUP. This exceedance for Sulphate was not repeated during 2009. No other on-site or off-site monitor exceeded the RUP for sulphate.

Parameter concentration trends through time for sulphate, chloride and manganese for selected off-site, property boundary and downgradient wells are provided in Appendix E. As can be noted, manganese concentrations trends do not suggest rising levels as would be expected if landfill related. Chloride trends do not suggest rising concentrations for these wells. In fact, several locations have shown slightly declining levels over the last few years. This is likely reflective of an effort on Township personnel's behalf to reduce salting in the area of the landfill entrance after several elevated chloride concentrations were detected in past years. As suggested at that time, those past elevated chloride concentrations appear to have been affected by these road salting activities.

The sulphate concentration trends for the selected wells show rising levels at OW-2S and OW-2D. Sulphate concentrations at the other selected wells do not indicate any discernable rising trends. Sulphate concentrations are generally higher in Fall than Spring. A site plan showing concentration distribution during Spring 2009 for shallow groundwater wells is provided in Figure 6 and for deep groundwater wells is provided in Figure 8, Appendix A. A site plan showing concentration

distribution for Sulphate during Fall 2009 for shallow wells is provided on Figure 10 and for deep groundwater wells is provided on Figure 12, Appendix A.

A site plan showing chloride distribution during Spring 2009 is provided in Figure 7 and for shallow groundwater wells and in Figure 9 for deep groundwater wells. A site plan showing chloride distribution during Fall 2009 is provided in Figure 11 and for shallow groundwater wells and in Figure 13 for deep groundwater wells.

Trace concentrations of VOC parameters, well below ODWS's and close to method detection limits, were determined for the 2008 monitoring at OW's 2D, 3D, 7D, 17S, 18S, and 20D. While these VOC concentrations are likely landfill related, they are not considered to be of significance at this landfill.

There was a general trend towards higher parameter concentrations during the Fall monitoring compared to Spring concentrations. This is a continuing trend, consistent with past findings and normal groundwater conditions.

Bluewater has evaluated the long-term trends in groundwater quality at the LF site. Most parameter concentrations have remained fairly steady over the past several years suggesting that dilution and attenuation are dealing adequately with the refuse area derived leachate impacts. Graphs showing selected parameter trends at selected monitoring locations are included in Appendix D.

5.2 Surface Water

One surface water sample was collected during the Spring 2009 monitoring event from the dugout located just north of the landfill. This dugout was dry during the Fall 2009 monitoring. The surface water sample (SW-3) did not show indications of landfill-related groundwater impacts.

5.3 Methane Monitoring

Methane gas is a by-product of waste decomposition and will be generated in the waste unit until all the organic matter is completely decayed. Methane, while it is a potential explosion hazard, is not a major concern provided that no building is ever permitted within approximately 30 meters of the refuse disposal area. The shallow water table and relatively permeable cover material at the Melancthon landfill are expected to prevent significant migration of methane. Gas produced by the landfill is expected to vent naturally to the atmosphere. It should be noted however, that ice, snow cover, and frozen ground in the winter may prevent methane gas from venting and cause methane gas to migrate laterally from the refuse disposal area.

If methane is present in concentrations between 5% and 15% in air it can become explosive. Below this range, there is an inadequate amount of methane for explosion. Above this range, there is an inadequate amount of oxygen for explosion. Therefore, 5% is considered the Lower Explosive Limit (LEL) and 15% is considered the Upper Explosive Limit (UEL) for methane.

Headspace methane monitoring was completed on all wells during both Spring and Fall 2009 monitoring events. The results of the methane monitoring are presented in Table 2 Appendix B. No

detectable methane concentrations were determined for any of the monitors during the Spring or Fall 2009 monitoring events. On-going methane monitoring should be incorporated in future monitoring events.

6.0 SUMMARY AND CONCLUSIONS

The following section summarizes the findings of the 2009 Annual Groundwater Monitoring Report:

- The Township of Melancthon operates a 'natural attenuation' landfill site in a remote, sparsely populated area of the Township. Surrounding land use is predominantly agricultural and the nearest residence is located ~450 m south of the site,
- Two main hydrogeological units exist in the subsurface of the site. The upper unit, referred to as overburden, consists of sand and gravel and silty sand soils. The groundwater level in the overburden is unconfined and shallow (<2m) and shows seasonal fluctuations with Spring levels generally higher than those in Fall. This fluctuation is likely the result of the addition of snow melt water during the Spring. The second, deeper hydrogeological unit is the underlying dolostone bedrock aquifer. The water level in the bedrock is generally lower than in the overburden. This creates a downward vertical hydraulic gradient that allows landfill-generated impacts to potentially enter the bedrock aquifer,
- Mounding of groundwater occurs within both hydrogeological units within the refuse disposal area. This mounding creates a radial flow pattern in the refuse area that drives flow in all directions away from the mound. The groundwater then comes under the influence of the background (natural) flow regime. Groundwater flow in the overburden aquifer is northeast towards the entrance to the landfill in the northeast corner of the property. Flow in the bedrock aquifer is more-directly to the east and the eastern property boundary.
- Comparison of the laboratory analytical data from the Spring and Fall 2009 monitoring events to the applicable ODWS and RUP objectives indicates that background water quality exceeds ODWS Standards for hardness, alkalinity, iron and manganese.
- Exceedance of the MOE RUP objectives for parameters such as hardness, alkalinity, manganese and iron were determined at most sampled locations during 2009. These concentrations are likely at least partially unrelated to landfill impacts and reflect general water quality in Melancthon Township. No chloride RUP exceedance was noted for any off-site or on-site wells. Exceedance of the RUP for other leachate-indicators such as sulphate was not noted during 2009 near property boundaries. Exceedance of the RUP and ODWS for sulphate occurred at OW-8, located immediately downgradient of the principal fill area and a marginal exceedance of the RUP for sulphate were determined at OW-20D during the Spring monitoring. The sulphate concentration at OW-20D dropped to 184 mg/L during the Fall monitoring, well below the RUP criteria. Further monitoring will be completed during 2010 to track the sulphate concentrations at this location.
- Significant methane concentrations were not determined during 2009.

- The site is currently in compliance with the terms and conditions of its C of A.

7.0 RECOMMENDATIONS

The following recommendations are made regarding the future Groundwater Monitoring and Sampling Program at the Township of Melancthon landfill site:

- Continuation of the semi-annual groundwater monitoring and sampling program including a routine site inspection, recording of static water levels at all 37 monitoring locations and groundwater sampling and laboratory analysis of the selected monitoring wells in both Spring and Fall;
- Preparation and submission of an Annual Monitoring Report to MOE for review.
- Continuation of waste placement in the western fill placement area until grades are continuous with the former waste placement area to the east. Continue waste placement in a westerly direction.
- Natural dilution of contaminants derived in the refuse disposal area coupled with natural attenuation in the overburden appears to be dealing with derived groundwater impacts adequately at this time. The widespread occurrence, including upgradient locations, of ODWS and RUP exceeding manganese, iron, hardness and alkalinity concentrations appears to be more a function of natural geologic conditions than landfill-derived impacts. Lab results for monitors downgradient of the principal fill areas show more elevated chloride and sulphate concentrations, which are not similar to findings in the northeast corner of the property.
- Monitoring for headspace methane concentration in all wells should be continued for the 2010 program.

8.0 REFERENCES

Bluewater Geoscience Consultants Inc., 2004. "Annual Groundwater Monitoring and Sampling Report 2004".

Bluewater Geoscience Consultants Inc., 2005. "Annual Groundwater Monitoring and Sampling Report 2005".

Bluewater Geoscience Consultants Inc., 2006. "Annual Groundwater Monitoring and Sampling Report 2006".

Bluewater Geoscience Consultants Inc., 2007. "Annual Groundwater Monitoring and Sampling Report 2007".

Bluewater Geoscience Consultants Inc., 2007. "Annual Groundwater Monitoring and Sampling Report 2008".

Burnside Environmental Limited, 2000. "Hydrogeological Monitoring Report, Township of Melancthon Landfill Site"

Gwyn, Q.H.I. and Frazer, J.Z., 1975a. "Drift Thickness of the Dundalk Area, Southern Ontario; Ontario Division of Mines, Preliminary Map P.306 (revised), Bedrock Topography Series, Scale 1:50,000. Geological Compilation.

Gwyn, Q.H.I. and Frazer, J.Z., 1975b. "Bedrock Topography of the Dundalk Area, Southern Ontario; Ontario Division of Mines, Preliminary Map P.306 (revised), Bedrock Topography Series, Scale 1:50,000. Geological Compilation.

MOE, August 2000. "Ontario Drinking Water Standards".

MOE, April 1994. "Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities".

MOE, July 1994. "Policies, Guidelines, Provincial Water Quality Objectives".

MOE, 1998 "Landfill Standards"

Rubicon Environmental Inc., 2004. "Landfill Monitoring 2003, Township of Melancthon Landfill Site".

Telford, P.G., Bond, I.J. and Liberty, B.A., 1974. "Palaeozoic Geology of the Dundalk Area, Southern Ontario, Ontario Division of Mines, Preliminary Map P.946 Geological Series", Scale 1:50,000.

9.0 LIMITATIONS

This report was prepared for the exclusive use of The Township of Melancthon. This report is based on information and data collected during the completion of an environmental investigation of the Site carried out by Bluewater Geoscience Consultants Inc., and is based solely on the site conditions encountered at the time of the assessment and the applicable guidelines in place at the time of this investigation.

It should be noted that the observations and recommendations presented in this report are limited to the actual locations explored and laboratory parameters analyzed. The information presented in terms of the thickness and types of the sub-soils encountered, groundwater levels and chemical testing results, etc., are only applicable to the actual locations explored. Variations may be present between these locations. Should significant variation become apparent during later investigations, it may be necessary to re-evaluate the recommendations of this report. The results of an investigation

of this nature should, in no way, be construed as a warranty that the site is free from any and all contamination from past or current practices since conditions may be different from the locations tested. This assessment was carried out using existing historical information as available from various agencies and no assurance is made regarding the accuracy or completeness of this information.

If new information is discovered during future work, including excavation, borings or other studies, Bluewater Geoscience Consultants Inc. should be requested to re-evaluate the conclusions presented in this report and to provide amendments as required. The analytical test results are assumed to be correct and performed according to all current regulations. No audit of the laboratory's methods or procedures was performed.

This assessment does not include, nor is it intended to include, any option regarding the suitability of any structure on the site for any particular function, the integrity of the on-site buildings or the geotechnical conditions on the site. Inspections of buildings do not include compliance with building, gas, electrical or boiler codes, or any other federal, provincial or municipal codes not associated with environmental concerns. Should concerns regarding any issue other than environmental matters arise as a result of our investigations, appropriately qualified professionals should address them.

This report is not to be reproduced or released to any other party, in whole or in part, without the express written consent of Bluewater Geoscience Consultants Inc.

10.0 CLOSURE

Bluewater Geoscience Consultants Inc. operates under a Certificate of Authorization from The Association of Professional Geoscientists of Ontario (APGO). Breton Lemieux is a registered Qualified Person (QP) with MOE and is a licensed Professional Geoscientist with over twenty years of international environmental consulting experience. Mr. Lemieux has a Geologic Technologist Diploma from Fleming College in Lindsay, Ontario, an Honours Bachelor of Science degree in Geology from the University of the West Indies in Kingston, Jamaica and a Master of Science degree in Earth Sciences from the University of Waterloo. His experience includes conducting Phase I, II and III ESAs at a wide variety of contaminated sites, underground storage tank removal supervision, water supply development, environmental building science and other site and landfill environmental monitoring projects.

Respectfully submitted,
BLUEWATER GEOSCIENCE CONSULTANTS INC.



Breton J. Lemieux, M.Sc., P.Geo., QP
President, Senior Geoscientist

