


MMM Group



## Site Specific Landfill Risk Assessment, Plan 704 ET, Mayerthorpe, Alberta

Prepared for the Town of Mayerthorpe/Lac Ste Anne County

COMMUNITIES  
TRANSPORTATION  
BUILDINGS  
INFRASTRUCTURE

 **MMM GROUP**  
October 2007 | 07-4588.2-REP-01

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November 13, 2007

File: 07-4588.2

TOWN OF MAYERTHORPE  
P.O. Box 420  
Mayerthorpe, Alberta T0E 1N0

**Attention: Ms. Karen St. Martin, C.A.O.**

Dear Ms. St. Martin:

**Re: Site Specific Landfill Risk Assessment,  
Plan 704 ET, Mayerthorpe, Alberta**

MMM Group (MMM) is pleased to submit two (2) copies of our Final report on the above-mentioned site.

We trust that the attached reports are satisfactory to you; however, should you require additional information, feel free to contact the undersigned.

We have appreciated the opportunity to work with the Town of Mayerthorpe/Lac Ste. Anne County.

Yours truly,

MMM Group

A handwritten signature in blue ink that reads 'J.R. Thomson'.

J.R. (Jim) Thomson, B.Sc., P.E.A.  
Senior Environmental Consultant

JT/

Attachments

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**Town of Mayerthorpe / Lac Ste. Anne County**

**Site Specific Landfill Risk Assessment,  
Plan 704 ET, Mayerthorpe, Alberta**

**Prepared by**



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**November 2007  
07-4588.2-REP-01**

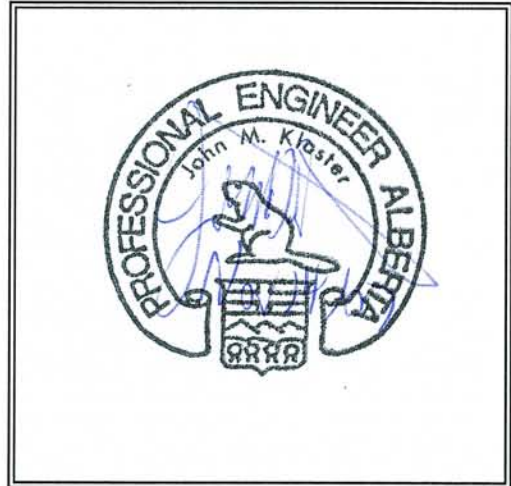
Site Specific Landfill Risk Assessment,  
Plan 704 ET, Mayerthorpe, Alberta

Respectfully Submitted,


Prepared By:

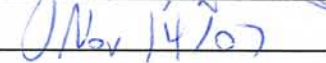
Reviewed By:

07/11/14  
  
Jim Thomson, B.Sc., P.E.A.



**PERMIT TO PRACTICE  
BEL - MK ENGINEERING LTD.**

Signature 

Date 

**PERMIT NUMBER: P 3821**

The Association of Professional Engineers,  
Geologists and Geophysicists of Alberta

## EXECUTIVE SUMMARY

MMM Group (MMM) was retained to carry out a site specific risk assessment of the former “Nuisance Grounds” or landfill site in the Town of Mayerthorpe, the presence of which is impacting future development plans for a number of Town property owners.

For the purpose of meeting the objectives of the Town to determine if there is any supporting rationale for approval of site development permits within 300 m of the former landfill, MMM Group (MMM) completed a Site Specific Risk Assessment of this landfill site.

Based on the Scope of Work carried out and the investigation results, the following conclusions can be made:

1. The results of groundwater monitoring were inconclusive as water wells upgradient of the landfill area were dry and the background water quality was not determined, but the groundwater flow direction is inferred from the soil stratigraphy and area topography, as being northwest towards the creek. There is little likelihood of any of the neighbouring residents being exposed to impacted groundwater due to the gradient away from the residences and significant vertical elevation difference.
2. Landfill gas levels were low and are likely to only decrease as there is very little source organic matter. Therefore, it is not considered to be a concern for neighbouring residents.
3. The adjacent Water Supply Well 6 (WSW6) is considered to be hydraulically isolated from the shallow groundwater due to the presence of 12 metres of clay separating the shallow stratigraphy from the deeper groundwater aquifer.
4. The hydraulic conductivity of the silty clay on site indicates that horizontal migration of groundwater would be relatively slow which would mitigate any potential impacts.
5. Test pitting indicated a significant amount of mostly inert debris including glass, metal, jars, pottery, etc. A test pit closest to the former hospital site also showed pill bottles indicative of garbage from that source.
6. There were no visible signs of leachate breakout, vegetation stress or other evidence of landfill impact. There was also no evidence of flies, vermin or litter that could potentially impact neighbouring properties.

7. The conditions noted in the former landfill do not indicate the necessity for special mitigation or restrictions on development for residences (including basements) on the east side of Highway 22.
8. There is also no reason to restrict development on Lac Ste. Anne County adjacent properties outside the Town Limits if the residents are not using the shallow groundwater for domestic water supply.
9. The existing structures on the Teen Shelter property are not considered at risk of being impacted by the former landfill; however, if additional development is anticipated, particularly downslope closer to the former landfill area, additional investigation would be warranted to confirm the presence/absence of debris or other limiting soil conditions in the area.
10. The use of a mandated landfill setback in development regulations assumes the presence of landfill impacts, either known or unknown. The information from this, or any subsequent investigations, can be used to make development decisions in lieu of setbacks.

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## 1.0 INTRODUCTION

MMM Group (MMM) was retained to carry out a site specific risk assessment of the former “Nuisance Grounds” or landfill site in the Town of Mayerthorpe, the presence of which is impacting future development plans for a number of Town property owners.

The former landfill site is located in NE 29-57-8-W5 on the north side of the Town of Mayerthorpe (**Figure 1.1**). The site is legally described as Plan 704 ET and is approximately 150 m west of Highway 22 (Rge Rd 84) in the valley of the Little Paddle River. The landfill site was reportedly in use until the 1970’s when it was reclaimed by the standards of the time. The site is currently overgrown with trees and brush and the landfill limits are not visually apparent.

In the Town, there are 23 properties within a 300 m radius of the landfill which by regulation is the minimum allowed setback for development. Property development in this area of the Town predates the landfill closure and application of the setback requirement, but any future upgrading or redevelopment of these properties requires that the Town and Subdivision Appeal Board approve a variance from this setback.

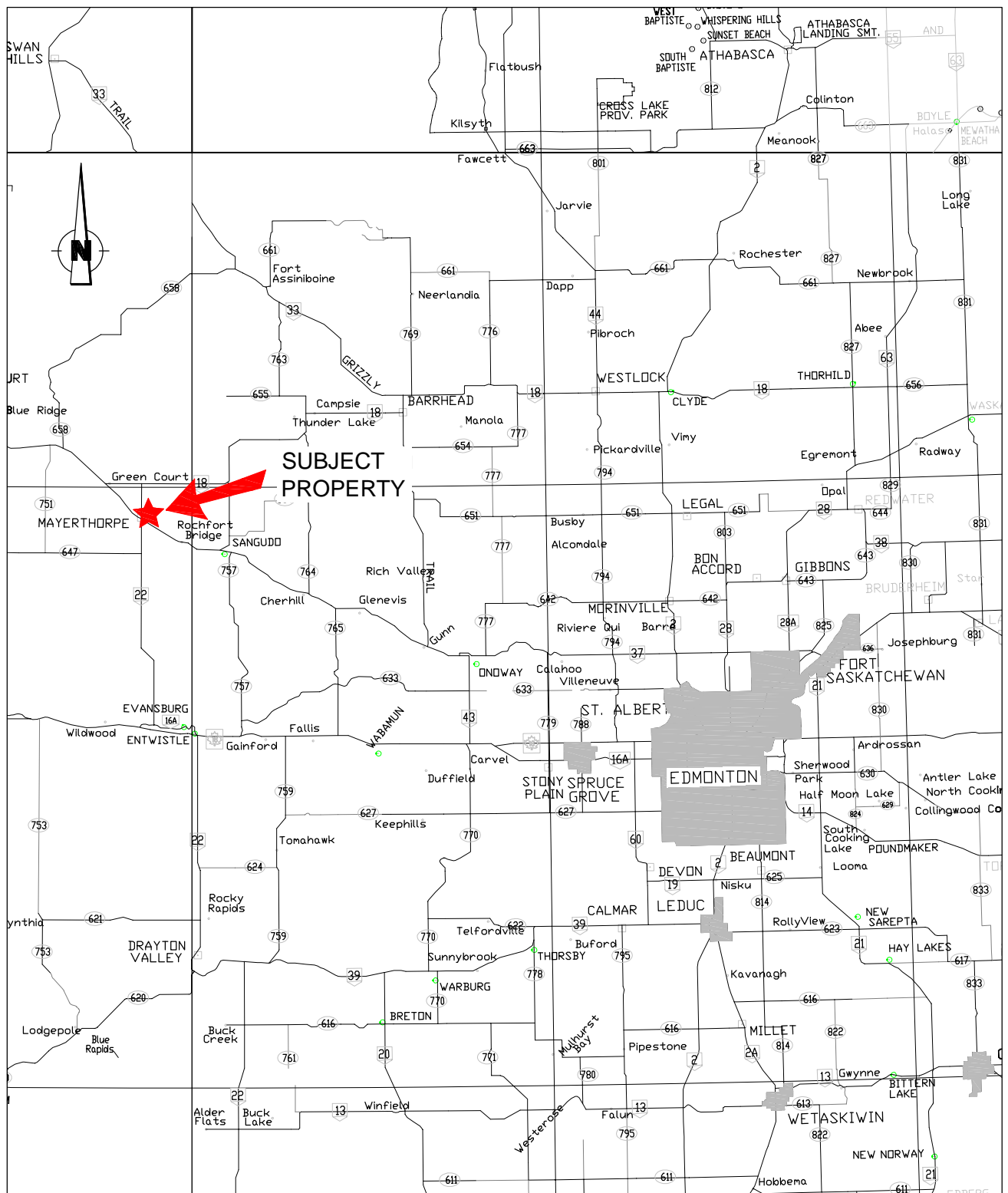
### 1.1 Scope of Work

For the purpose of meeting the objectives of the Town to determine if there is any supporting rationale for approval of site development permits within 300 m of the former landfill, MMM Group (MMM) submitted a proposal on August 3, 2007, that outlined the following proposed methodology for Site-Specific Risk Assessment of this landfill site.

### 1.2 Task 1 – Project Initiation and Opening Meeting

Upon receiving authorization to proceed, we will attend an opening meeting to:

1. Review scope of work and methodology.
2. Review schedule and budget.
3. Review of special requirements regarding land access, safety, confidentiality, photo permission, etc.
4. Obtain any other available site information, reports, etc.



MODIFIED DATE: 2007-10-04  
 S:\Projects\4588 Landfill Risk Assessment\CAD\Drawings\4588 FIG 1.1 SITE LOCATION.dwg

TOWN OF MAYERTHORPE  
 SITE SPECIFIC LANDFILL RISK ASSESSMENT  
 PLAN 704 ET  
 MAYERTHORPE, ALBERTA  
 SITE LOCATION PLAN  
 FIGURE 1.1



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We will also make arrangements with the Town to schedule the fieldwork and complete underground utility locates.

### **1.3 Task 2 – Information Review and Site Inspection**

A review of existing information including prior surveys, environmental investigations, aerial photographs, plus interviews with knowledgeable personnel and other information will be carried out to determine landfill location, history, nature of deposited materials and stakeholder issues. Also, the existing hydrogeological information will be reviewed to determine the potential for hydraulic connection between the nearby municipal water supply well and the shallow groundwater. At this time, a site inspection will be carried out to look for signs of exposed refuse, leachate breakout, vegetation stress and other signs of landfill impact that will assist in providing rationale for the risk assessment and determining monitoring well locations. The inspection will enable us to become familiar with area land use, potentially impacted properties, other receptors, or potential sources of impact.

### **1.4 Task 3 – Monitoring Well Installation**

Four groundwater monitoring wells will be installed in the vicinity of the landfill, one of which will be located upgradient; two downgradient; and one approximately in the middle of the former landfill to confirm existing stratigraphy and presence/absence of odours or visual evidence of landfill impacts on soils or groundwater. The nature and depth of any landfilled material will be recorded. Soil samples will be visually examined for signs of impact. Any unusual odours will be noted.

It is anticipated that the wells will be drilled to a minimum depth of 1 metre below the shallow groundwater interface or to one metre below the disturbed area of the landfill, whichever is deeper. If necessary, one of the wells will be drilled to a deeper depth to confirm at least a 5 metre separation of impermeable material from the Domestic Use Aquifer. The wells will be constructed with SIL-9 sand filter-pack to prevent cross-contamination between soil and groundwater. Following installation, they will be purged/monitored for groundwater depth, hydrocarbon and methane vapour levels. The well locations will also be surveyed for horizontal and vertical control.

### **1.5 Task 4 – Well Monitoring and Landfill Gas Assessment**

After allowing groundwater levels to stabilize following purging, the four wells will be monitored again for methane vapour levels, and groundwater depth. Water samples will be obtained for laboratory analyses. The wells will be sampled and analyzed for routine potability (including major ions) and metals. In addition, a shallow landfill gas survey will be carried around the perimeter of the landfill to confirm the levels (if any) of

soil landfill gas. In addition, surface water samples will be taken from Little Paddle River, one upgradient and one downgradient of the landfill site as an indication of impact on surface water.

## **1.6 Task 5 – Analytical Program**

Four groundwater samples will be submitted for laboratory analyses of Routine Potability and metals. The samples will be analyzed at the Maxxam Analytical Services laboratory in Edmonton. The lab is ISO 17025 Certified.

The results of the groundwater analyses will be compared, in tabulated form, to the appropriate criteria from the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2007) in order to assess the impacts of elevated parameters found.

## **1.7 Task 6 – Data Analysis and Reporting**

Information obtained from the tasks will be provided in a written report. The groundwater data will be compared (as previously discussed) to the appropriate guidelines. The presence or absence of off-site impacts related to the presence of the landfill will be discussed. Conclusions and recommendations will be provided indicating the presence/absence of potential impacts within the 300 m setback radius and potential mitigation options.

Authorization to proceed with the above scope of work was received from the Town of Mayerthorpe on August 10, 2007. The surface water sampling of the Little Paddle River was eliminated upon subsequent discussions with the Town.

## 2.0 FIELD INVESTIGATIONS

### 2.1 Landfill Limit Survey

The approximate limits of the “Nuisance Ground” as delineated in a 1928 survey were surveyed in the field as a guide to correlating field data and observations to the previously established limits. The corners of landfill site (**Figure 2.1**) were staked and, as they are in bush, offset stakes or flagging was placed to assist in finding them.

### 2.2 Location of Utilities

An Alberta One-Call utility locate was carried out prior to installing the monitoring wells to avoid conflicts with their installation and to determine if there are conduits for off-site impact of leachate. All underground utilities were running parallel to Highway 22 or were installed farther south or southeast to service the Teen Shelter or the residences on 53 Avenue. There were no utilities in the historical landfill area and therefore no potential conduit for leachate or landfill gas to impact off-site properties.

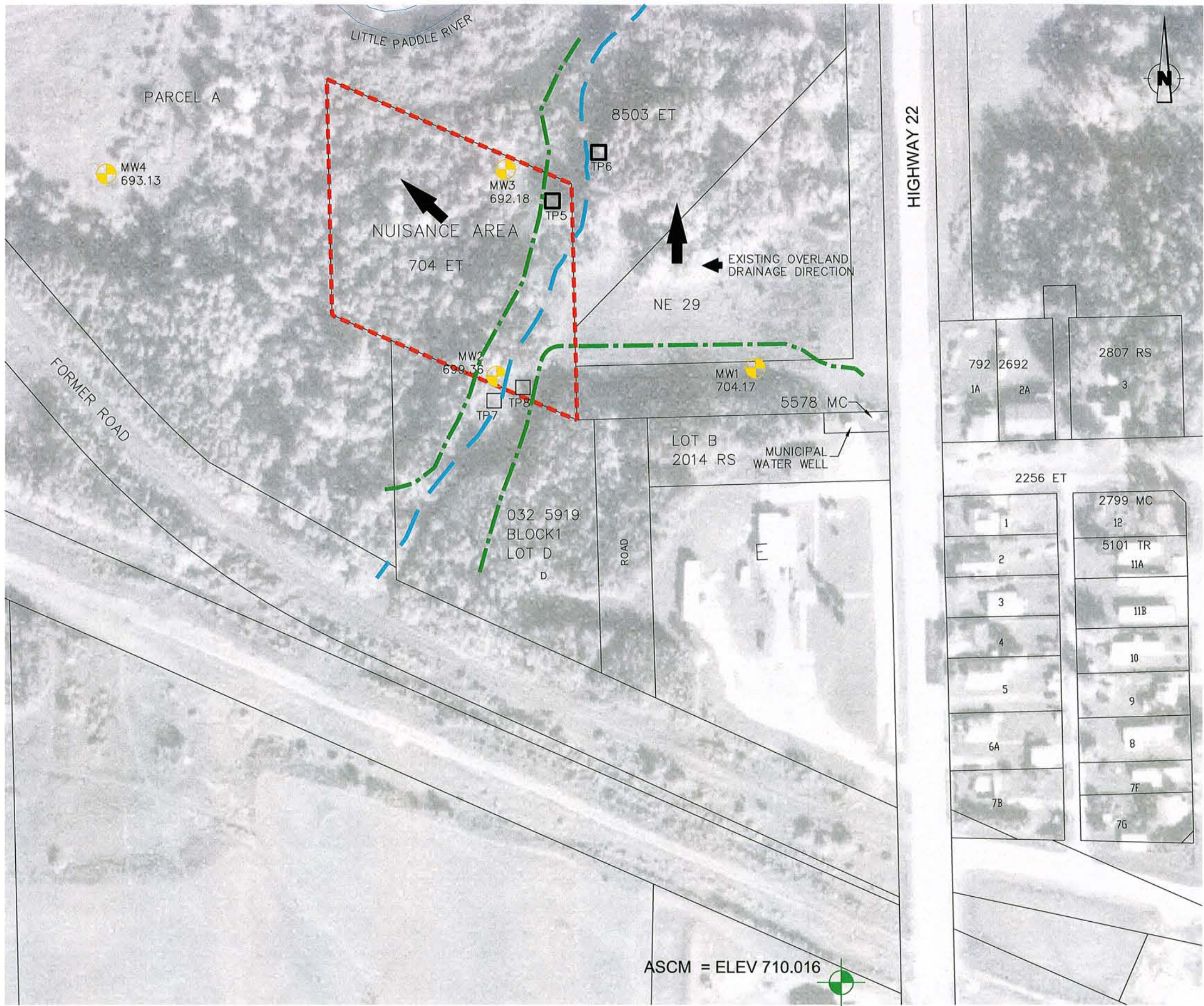
### 2.3 Monitoring Well Installation

Four boreholes (MW1, MW2, MW3 and MW4) were drilled at the site to depths ranging from 4.0 m to 9.75 m deep using a track-mounted solid stem auger drilling rig on September 7 & 13th, 2007. All of the boreholes were terminated within a silty clay or shaley clay till. The borehole locations (**Figure 2.1**) were selected on the basis of availability of access and to provide data from upgradient and downgradient of the former landfill. Borehole MW1 was drilled upgradient of the landfill; Borehole MW2 was drilled at the upper edge of the landfill; and Boreholes MW3 and MW4 were drilled downgradient.

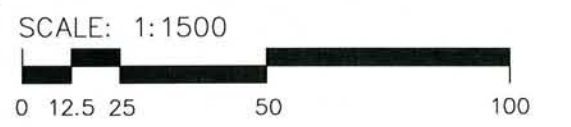
Monitoring wells were completed by inserting a 50 mm diameter PVC pipe consisting of three 3.0 m long solid sections joined to a #10 slotted section of pipe extending to the founding depths. Commercially graded silica sand was placed around the slotted section of pipe. The remainder of each hole was filled with bentonite chips to isolate the well from surface water. A slip cap was installed on the bottom of the standpipe. The top was fitted with a valve adapter for obtaining gas samples. Steel stick-up protectors were grouted in to complete the well installations.

The boreholes were surveyed for vertical elevation as compared to an Alberta Survey Control Marker (ASCM) at the corner of the Mayerthorpe Works Yard property about 200 m south of MW1. The elevations are shown on the Borehole logs (**Appendix A**). The wells were subsequently monitored for methane vapours, and to obtain groundwater samples for analysis.





**TOWN OF MAYERTHORPE  
SITE SPECIFIC LANDFILL  
RISK ASSESSMENT  
PLAN 704 ET  
MAYERTHORPE, ALBERTA**



- LEGEND**
- MW2 699.36 MONITORING WELL/ELEVATION
  - TP7 TEST PIT
  - TRAIL
  - RIDGELINE
  - INFERRED GROUNDWATER FLOW DIRECTION

**MONITORING WELL  
LOCATION PLAN**

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MODIFIED DATE: 20071003  
S:\Projects\4588 Landfill Risk Assessment\CAD\Drawings\4588 fig 2.1 location plan.dwg

**FIGURE 2.1**



### 2.3.1 Soil Stratigraphy

Below the surface covering of topsoil or organic rootmass, the soil stratigraphy was generally characterized by silty clay or silty clay till with some sand lenses, and with greater depth (particularly Boreholes MW3 and MW4), some shale pieces.

The soil stratigraphy is shown on the borehole logs in **Appendix A**.

## 2.4 Test Pit Excavation

Four test pits (TP-5 to TP-8) were excavated by backhoe on September 19<sup>th</sup>, 2007, in areas of visible debris and in the general vicinity of the surveyed landfill area. The locations are shown on **Figure 2.1**. The test pit observations are as follows:

TP-5 – located SE of MW3; part way down embankment

- ▶ Roots top 0.5 m then dark brown silty clay
- ▶ Area 3m x 3m, depth 1.5 m
- ▶ Soil matrix contained glass, bones, pottery, brick, bottles and scrap metal debris below 0.5 m deep

TP-6 – located just east of a trail, downslope of the surveyed area

- ▶ roots and topsoil top 0.6 metres then dark brown silty clay
- ▶ area 4m x 4m x 2m deep
- ▶ bricks, pottery, glass, bones and scrap metal below 0.5 m deep

TP-7 – located 5 m south of MW2

- ▶ roots and topsoil to 0.5 m deep then brown sandy silty clay
- ▶ area 1.5 m x 2 m x 2 m deep
- ▶ soil matrix contained glass, bottles, jars, metal, tin cans, light bulbs, pill containers below 0.5 m deep

TP-8 – located NE of MW2

- ▶ roots and topsoil to 0.25 m deep then high plastic brown silty clay which turned brown below 0.75 m
- ▶ area 4m x 5m x 1.75 m deep

▶ no refuse or debris observed

TP-7 contained the most debris followed by TP-5, TP-6 and no debris in TP-8. There was no evidence of organic matter with the exception of plant roots and some large (beef) bones.

## **2.5 Visual Inspection**

A visual inspection of the site indicated the presence of rusted metal debris (old stoves, canisters, jerry cans, etc.) entrained in and adjacent to the embankment which extended along the south end and to the east of the surveyed nuisance area. There was also the remains of an old car chassis in the northwest portion of the surveyed area. There was no sign of leachate breakout, vegetation stress or other evidence of landfill impact.

## **2.6 Landfill Gas Monitoring**

The four monitoring wells were fitted with a valve to allow sampling of soil gases as an indication of the presence of landfill gas. An Alberta One-Call utility locate was carried out prior to installing the monitoring wells to avoid conflicts with their installation and to determine if there are conduits for off-site impact of leachate. All underground utilities were running parallel to Highway 22 or were installed farther south or southeast to service the Teen Shelter or the residences on 53 Avenue. There were no utilities in the historical landfill area and therefore no potential conduit for leachate or landfill gas to impact off-site properties.



## 3.0 RESULTS AND DISCUSSION

### 3.1 Groundwater Monitoring

Four groundwater monitoring wells were drilled on site to depths ranging from approximately 8 metres deep; one in the surveyed area; one at the edge and downgradient; one cross-gradient to the west; and one upgradient of the site. The background well and the one in the surveyed area were dry; but the other two contained water and were sampled. We can't confirm the groundwater flow direction and gradient by direct measurement, but groundwater flow direction (as shown on **Figure 2.1**) is inferred from the soil stratigraphy and area topography, is likely northwest towards the creek. The monitoring results are shown in the attached **Table 3.1**.

Upon purging by removing three groundwater volumes, the two monitoring wells that had water were sampled for general potability and metals. The samples were preserved as necessary and submitted to Maxxam Analytics laboratory in an ice-filled cooler with a Chain of Custody form.

The results (**Tables 3.3 & 3.4**) indicate some exceedances of the Alberta Tier 1 Groundwater Remediation Guidelines for the inorganic parameters of Total Dissolved Solids and iron. Some metals including arsenic, barium, chromium, lead, nickel and zinc exceed the Tier 1 criteria as well. This is not considered a concern with respect to redevelopment in the adjacent residential areas as there is no exposure pathway given that the areas in question are on piped municipal water and are at least 7 m vertically above any groundwater exposure. Lac Ste. Anne County residents adjacent to the Town Limits would also not be impacted if they are not using the shallow groundwater for domestic water supply.

### 3.2 Landfill Gas

The possible presence of landfill gas was determined by measuring soil gases by means of a valve fitted to the monitoring wells. Vapours were monitored with an Eagle RKI gas vapour detector calibrated to methane. The detector is non-selective in that it will pick all hydrocarbons in addition to methane. The results are indicated in **Table 3.1**.

Vapour levels ranged from 220 – 1200 ppm on full methane response scale which is equivalent to 2.4% LEL, which is low. Subsequent measurements indicated vapour levels were below 200 ppm.

A sample of landfill gas was obtained by Tedlar Bag and analyzed for hydrocarbons. The results (**Appendix B**) indicate 0.011 mole percent of methane which is equivalent to 110 ppm (by volume). No other hydrocarbons were detected. This is confirmation of the gas vapour detector results.

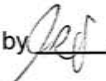
**Table 3.1 - MONITORING WELL DATA**  
**Landfill Risk Assessment, Mayerthorpe, Alberta**

Well I.D.	MW 1		MW 2		MW 3		MW 4	
	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07
Date	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07	Sept. 16/07	Sept. 19/07
Ground Elevation	704.17	704.17	699.36	699.36	692.18	692.18	693.13	693.13
Well Total Depth (m) below ground	7.49	7.49	7.16	7.16	5.10	5.10	2.60	2.60
Depth to Water (m) below ground	-	-	-	-	0.45	0.55	1.49	1.55
Water Level Elevation	-	-	-	-	691.73	691.63	691.64	691.58
Landfill Gas Vapours (as ppm HC incl. methane)	690	0	1200	100	510	0	220	40
Comments:								
Monitoring Wells MW-1 and MW-2 were dry								

**Table 3.2 - TEXTURAL ANALYSES OF SOIL  
Landfill Risk Assessment  
Mayerthorpe, Alberta**

<b>Sample I.D.</b>	<b>MW 1</b>
Depth (m)	1.75
<b>Sieve Analysis</b>	
Sieve - #200 (>0.075)	NA
Sieve < 200 Mesh	NA
<b>Texture by Hydrometer</b>	
% clay	62.2
% silt	37.4
% sand	0.3

**NOTES**

- 1) NA = Not Analyzed
- 2) Data transfer checked by 

**Table 3.3 - INORGANIC ANALYSIS OF GROUNDWATER**  
**Landfill Risk Assessment**  
**Mayerthorpe, Alberta**

Sample I.D.	MW 3	MW 4	Alberta Tier 1 Guidelines <sup>(2)</sup>
			Residential/Parkland
<b>Calculated Parameters</b>			
Hardness (CaCO <sub>3</sub> )	7.00	770	-
Ion Balance	1.01	0.93	-
Total Dissolved Solids	1030	1050	500
<b>Misc. Inorganics</b>			
pH	7.33	7.13	6.5 to 8.5
Conductivity dS/m	1.80	1.65	4 <sup>(3)</sup>
<b>Anions (mg/L = ppm)</b>			
Alkalinity (PP as CaCO <sub>3</sub> )	<0.5	<0.5	-
Alkalinity (Total as CaCO <sub>3</sub> )	439	606	-
Bicarbonate (HCO <sub>3</sub> )	536	740	-
Carbonate (CO <sub>3</sub> )	<0.5	<0.5	-
Hydroxide (OH)	<0.5	<0.5	-
Diss. Sulphate (SO <sub>4</sub> )	171	219	500
Diss. Chloride (Cl)	229	111	230
<b>Dissolved Cations (mg/L = ppm)</b>			
Calcium	207	230	-
Magnesium	43.5	46.9	-
Potassium	9.0	9	-
Sodium	105	36.8	200
Iron	4.82	33.3	0.3
Manganese	1.10	2.57	-
<b>Nutrients (mg/L = ppm)</b>			
Diss. Nitrate (N)	0.003	<0.003	3.2
Nitrate plus Nitrite (N)	0.003	<0.003	45
Diss. Nitrite (N)	<0.003	<0.003	500

**NOTES**

1) NA = Not Analyzed

- = No criteria

< = Less than detection limit as stated

2) Alberta Tier 1 Groundwater Remediation Guidelines - Residential/Parkland - Fine-Grained (2007)  
 Concentrations in excess of Alberta Tier 1 Groundwater Remediation Guidelines - Residential/Parkland - Fine-Grained (2007)

3) Data transfer checked by 

**TABLE 3.4 - TRACE METALS ANALYSIS OF GROUNDWATER - Landfill Risk Assessment  
Mayerthorpe, Alberta**

Chemical Analysis Parameter	MW 3	MW 4	Alberta Tier 1 Guidelines <sup>(2)</sup>
Total Metals	mg/L	mg/L	Res./Parkland
Antimony	<0.0002	<0.0002	0.006
Arsenic	0.084	0.017	0.005
Barium	4.65	1.42	1
Beryllium	0.007	0.006	-
Cadmium	0.0096	0.0023	0.005
Calcium	719	445	-
Chromium	0.50	0.10	0.050
Cobalt	0.178	0.0536	-
Copper	0.382	0.0645	1
Iron	488	179	-
Lead	0.071	0.0499	0.010
Lithium	0.4	0.11	-
Magnesium	170	104	-
Manganese	6.44	6.22	-
Molybdenum	0.0074	0.0018	-
Nickel	0.573	0.133	0.025 - 0.15
Phosphorus	14.0	4.7	-
Potassium	61.7	23.3	-
Selenium	<0.001	<0.001	0.001
Silver	0.0025	0.0005	0.100
Strontium	2.26	1.38	-
Sulphur	62.7	68.5	-
Thallium	0.0012	0.0007	-
Tin	0.006	<0.001	-
Titanium	0.092	0.269	-
Uranium	0.0078	0.0056	0.020
Vanadium	0.765	0.215	-
Zinc	1.45	0.357	0.03

**NOTES**

1) NA = Not Analyzed

- = No criteria

< = Less than detection limit as stated

2) Alberta Tier 1 Soil Remediation Guidelines - Fine-grained Residential (AENV, 2007)

Concentrations in excess of Residential/Parkland

3) Data transfer checked by *JAF*

As the landfill area is primarily bush and grass, what little gas is generated will tend to migrate vertically to the surface and disperse as opposed to horizontally migrate, therefore, there is a low likelihood of horizontal migration of soil gases to nearby residential properties.

The visual inspection indicated very little organic matter, therefore the potential for future methane generation is very low.

### **3.3 Hydraulic Isolation of WSW 6**

The well drilling log of WSW6 shows “clay & rocks” and “clay” down to depth of 29 m below grade and produces from a sand aquifer below 49 m in depth. The shallow groundwater on site was encountered at a depth of 0.5 m in a silty clay with sand seams, which in relation to the ground level of WSW6 was approximately 17 m deep. There is still 12 metres of clay separating the shallow groundwater from the deeper stratigraphy and 32 m total vertical separation from the sand aquifer; therefore, it is reasonable to say that the shallow groundwater and the water supply aquifer are not hydraulically connected.

### **3.4 Permeability and Conductivity**

A sample of silty clay from Borehole MW1 considered representative of subsoils on site between the landfill area and receptor residences was submitted for particle size distribution and hydraulic conductivity analyses. The soil texture (**Table 3.2**) is predominantly silty clay which is relatively impermeable. The hydraulic conductivity was determined to be 0.408 cm/hr. As we didn't find water in three wells, the hydraulic gradient and hence linear velocity was not determined, however the horizontal migration of groundwater at the site would be relatively slow. Possible transport along sand seams or fractures could potentially have a significant effect on groundwater migration rates, but this is difficult to quantify.

The results of the particle size distribution and hydraulic conductivity testing are attached in **Appendix B**.

### **3.5 Test Pits and Borehole Logs**

The borehole logs indicated a primarily clay stratigraphy with some sand lenses and evidence of clay till and shale at greater depths. Test pit excavations indicated a significant amount of general debris including glass, bottles, jars, metal, tin cans, light bulbs and pill containers at the south edge of the surveyed area. Other debris areas were noted further east along the embankment, east of the surveyed area. The debris was inert and no odours were noted.

### **3.6 Visual Inspection**

Visual inspection of the site indicated the presence of rusted metal debris (old stoves, canisters, jerry cans, etc.) entrained in and adjacent to the embankment which extended along the south end and to the

east of the surveyed nuisance area. There was also the remains of an old car chassis in the northwest portion of the surveyed area. There was no sign of leachate breakout, vegetation stress or other evidence of landfill impact. There was also no evidence of flies or vermin that could potentially impact neighbouring properties.

### **3.7 Location and Proximity of Debris**

Most of the identified debris appears to be at the south edge and east of the surveyed area. Although an old car chassis was found in the north half of the surveyed area, it did not appear that this area had significant amounts of debris. Even though there is debris within 100 metres of the Teen Shelter property, it is not considered to potentially impact existing buildings on site. The residences on the east side of Highway 22 are not considered to be potentially impacted.

## 4.0 CONCLUSIONS

1. The results of groundwater monitoring were inconclusive as water wells upgradient of the landfill area were dry and the background water quality was not determined, but the groundwater flow direction is inferred from the soil stratigraphy and area topography, as being northwest towards the creek. There is little likelihood of any of the neighbouring residents being exposed to impacted groundwater due to the gradient away from the residences and significant vertical elevation difference.
2. Landfill gas levels were low and are likely to only decrease as there is very little source organic matter. Therefore, it is not considered to be a concern for neighbouring residents.
3. The adjacent Water Supply Well 6 (WSW6) is considered to be hydraulically isolated from the shallow groundwater due to the presence of 12 metres of clay separating the shallow stratigraphy from the deeper groundwater aquifer.
4. The hydraulic conductivity of the silty clay on site indicates that horizontal migration of groundwater would be relatively slow which would mitigate any potential impacts.
5. Test pitting indicated a significant amount of mostly inert debris including glass, metal, jars, pottery, etc. A test pit closest to the former hospital site also showed pill bottles indicative of garbage from that source.
6. There were no visible signs of leachate breakout, vegetation stress or other evidence of landfill impact. There was also no evidence of flies, vermin or litter that could potentially impact neighbouring properties.
7. The conditions noted in the former landfill do not indicate the necessity for special mitigation or restrictions on development for residences (including basements) on the east side of Highway 22.
8. There is also no reason to restrict development on Lac Ste. Anne County adjacent properties outside the Town Limits if the residents are not using the shallow groundwater for domestic water supply.
9. The existing structures on the Teen Shelter property are not considered at risk of being impacted by the former landfill; however, if additional development is anticipated, particularly downslope closer to the former landfill area, additional investigation would be warranted to confirm the presence/absence of debris or other limiting soil conditions in the area.
10. The use of a mandated landfill setback in development regulations assumes the presence of landfill impacts, either known or unknown. The information from this, or any subsequent investigations, can be used to make development decisions in lieu of setbacks.



## **5.0 LIMITATIONS**

### **5.1 Disclaimer**

This Risk Assessment Report has been prepared by MMM Group (MMM) for submission to the Town of Mayerthorpe / Lac Ste. Anne County (the Client). It is intended to provide the Client with an understanding of the potential hazards that the property evaluated in this report may pose to human health, or to the general environment due to chemical contamination. It describes what MMM believes are reasonable concerns about how the property could potentially become involved in various environmental problems resulting from hazardous or special waste, and hazardous materials. MMM has neither created nor contributed to the creation or existence of any hazardous, radioactive, toxic, irritant, pollutant, special waste, or otherwise dangerous substance, or condition at the site.

This report is based upon data and information obtained from boreholes, surveys, explorations and sampling during a contamination assessment at the property identified herein and is based solely upon the condition of the property on the date of such inspection, supplemented by information and data obtained by MMM and described herein.

The Client recognizes that subsurface conditions may be variable throughout the site, and that there is the potential for variations from conditions encountered at locations where boreholes, surveys or explorations were conducted by MMM. No attempt was made by MMM to delineate the extent and degree of any contamination found.

The data, interpretations and recommendations of MMM are based solely on the information available to them. MMM shall not be responsible for the interpretation by others of the information developed.

MMM has performed the work, made the findings, and proposed the recommendations described in this report in accordance with generally accepted environmental science practices in effect at the time the work was performed. This warranty stands in lieu of all other warranties, expressed or implied. While this report can be used as a guide by the Client, it must be understood that it is neither a rejection nor an endorsement of the property.

### **5.2 Limit of Liability**

The liability of MMM to the owner, and to all third parties shall be limited to injury or loss caused by the negligent acts, error or omissions of MMM. The total aggregate liability of MMM related to this agreement

shall not exceed the lesser of the actual damages incurred, or the total fee of MMM for services rendered on this project.

The Client has, by contract, agreed to defend, indemnify and hold harmless MMM, its affiliates, officers, directors, employees and agents, from any and all liabilities, in excess of the limits of MMM's entire liability set out above, incurred by MMM or any other party, in connection with the services hereunder, or arising from or in any way connected to uninsurable obligations including those arising from the presence, discharge, dispersal, release, escape or effect of radiation, nuclear reaction of radioactive, toxic, explosive or hazardous substances, or any other pollutants including solid, liquid, gaseous, thermal irritants or contaminants. Such indemnity shall include the costs of the time spent and expenses incurred by MMM and its affiliates in connection with the defence of the claims.

### **5.3 Protection Against Errors of Others**

The Client has, by contract, agreed to defend, indemnify and save harmless MMM, agents and employees against any and all claims, costs suites and damages, including attorney's fees, arising out of errors, omissions and inaccuracies in documents and information provided to MMM by the Client, its officers, agents and employees.





CLIENT Town of Mayerthorpe / Lac Ste Anne County

PROJECT NAME Former Landfill Risk Assessment

PROJECT NUMBER 4588.2

PROJECT LOCATION Mayerthorpe, Alberta

DATE STARTED 9/13/07 COMPLETED 9/13/07

GROUND ELEVATION 704.17 m HOLE SIZE 15 cm

DRILLING CONTRACTOR Lark Environmental

GROUND WATER LEVELS:

DRILLING METHOD solid stem

▽ AT TIME OF DRILLING 0.00 m / Elev 704.17 m

LOGGED BY AB CHECKED BY JRT

▼ AT END OF DRILLING 0.00 m / Elev 704.17 m

NOTES \_\_\_\_\_

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	Gas Tech (ppm)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					0.15 Topsoil, rootmass, dark brown CLAY, fine, some silt, smooth, slightly moist, greyish-brown	704.02 Cement seal
2						
					3.00 CLAY, more moisture with depth, high plasticity	701.17
4						
					4.50 CLAY, slightly moist, some gravel, mottling, grey	699.67
6						
					6.00 SILT, sandier as depth increases	698.17
					7.50 Bottom of hole at 7.50 m.	696.67

Backfilled with sand to 1.0m, then bentonite to 0.15m, then concrete to surface. Installed 6.0m slotted pipe then 1.5m of solid pipe to surface.



CLIENT Town of Mayerthorpe / Lac Ste Anne County

PROJECT NAME Former Landfill Risk Assessment

PROJECT NUMBER 4588.2

PROJECT LOCATION Mayerthorpe, Alberta

DATE STARTED 9/13/07 COMPLETED 9/13/07

GROUND ELEVATION 699.36 m HOLE SIZE 15 cm

DRILLING CONTRACTOR Lark Environmental

GROUND WATER LEVELS:

DRILLING METHOD solid stem

▽ AT TIME OF DRILLING 0.00 m / Elev 699.36 m

LOGGED BY AB CHECKED BY JRT

▼ AT END OF DRILLING 0.00 m / Elev 699.36 m

NOTES \_\_\_\_\_

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	Gas Tech (ppm)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					0.25 Topsoil 699.11	
					0.50 SILT, sandy, brown 698.86 CLAY, silty, coal pockets, oxidation present	
2					1.70 697.66 CLAY, salt pockets, sand lense 1 cm thickness at 2.0m	
					2.25 697.11 CLAY, grey	
4					3.00 696.36 CLAY, sand lenses, moist, dark grey	
					4.50 694.86 CLAY, silty, some sand, slightly malleable, moist, grey, darker as depth increases	
6					6.20 693.16 TILL, clay, shale, some gravel	
8					8.00 691.36 Bottom of hole at 8.00 m.	

Backfilled with sand to 2.0m, then bentonite to 0.13m, then concrete to surface. Installed 5.0m slotted pipe then 3.0m of solid pipe to surface.



CLIENT Town of Mayerthorpe / Lac Ste Anne County

PROJECT NAME Former Landfill Risk Assessment

PROJECT NUMBER 4588.2

PROJECT LOCATION Mayerthorpe, Alberta

DATE STARTED 9/13/07 COMPLETED 9/13/07

GROUND ELEVATION 692.18 m HOLE SIZE 15 cm

DRILLING CONTRACTOR Lark Environmental

GROUND WATER LEVELS:

DRILLING METHOD solid stem

▽ AT TIME OF DRILLING 3.50 m / Elev 688.68 m

LOGGED BY AB CHECKED BY JRT

▼ AT END OF DRILLING 3.00 m / Elev 689.18 m

NOTES \_\_\_\_\_

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	Gas Tech (ppm)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					Topsoil, woody, debris, organic	<p>Cement seal</p> <p>Backfilled with sand to 1.0m, then bentonite to 0.15m, then concrete to surface. Installed 3.0m slotted pipe then 1.5m of solid pipe to surface.</p>
				0.50	691.68	
					CLAY, sandy, some mottling, sand lense 0.5cm thick at 1.0m depth, moist, brown	
					sand lense 10.0cm thick at 1.6m depth	
				1.60	690.58	
				1.75	690.43	
2					CLAY, sandy	
					CLAY, silty, stiff, moist, medium grey	
				3.00 ▼	689.18	
				3.60 ▽	688.58	
				3.80	688.38	
4					Gravel, shale	
				4.50	687.68	
					Bottom of hole at 4.50 m.	

CLIENT Town of Mayerthorpe / Lac Ste Anne CountyPROJECT NAME Former Landfill Risk AssessmentPROJECT NUMBER 4588.2PROJECT LOCATION Mayerthorpe, AlbertaDATE STARTED 9/13/07 COMPLETED 9/13/07GROUND ELEVATION 693.13 m HOLE SIZE 15 cmDRILLING CONTRACTOR Lark Environmental

GROUND WATER LEVELS:

DRILLING METHOD solid stem▽ AT TIME OF DRILLING 3.10 m / Elev 690.03 mLOGGED BY AB CHECKED BY JRT▼ AT END OF DRILLING 2.50 m / Elev 690.63 m

NOTES \_\_\_\_\_

AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	Gas Tech (ppm)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					0.10 Topsoil, organic, woody, debris CLAY, silty, brown	693.03 Cement seal
					1.30	691.83
					1.40 CLAY, sandy, moist, brown	691.73
					1.50 CLAY, sandy, black	691.63
2					CLAY, sandy, moist, dark grey Some stones Organic matter, woody debris	
					▼	
					3.00	690.13
					▼ CLAY, sandy, coal mottling, gravel 3.1 water	
4						
					4.50	688.63
					Bottom of hole at 4.50 m.	

Backfilled with sand to 0.75m, then bentonite to 0.15m, then concrete to surface. Installed 2.0m slotted pipe then 0.6m of solid pipe to surface. Sloughed from 4.5m to 2.6m







Report Transmission Cover Page

Bill To: Bel-M K Engineering Ltd.  
Report To: Bel-M K Engineering Ltd.  
#200, 10576 - 113 Street  
Edmonton, AB, Canada  
T5H 3H5  
Attn: Jim Thomson  
Sampled By:  
Company:

Project:  
ID: A588.2  
Name: Risk Assessment  
Location: Mayerthorpe  
LSD:  
P.O.:  
Acct code:

Lot ID: 574537  
Approval Status: Approved  
Invoice Frequency: by Lot  
COD Status: Cash Client  
Control Number: A021761  
Date Received: Sep 19, 2007  
Date Reported: Sep 21, 2007  
Report Number: 1049538

Contact: Jim Thomson  
Company: Bel-M K Engineering Ltd.  
Address: #200, 10576 - 113 Street  
Edmonton, AB T5H 3H5  
Phone: (780) 426-4123  
Email: jthomson@belmk-edm.com  
Fax: (780) 426-0659

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Notes To Client:

Reports associated with this Lot

<u>Id/Format/Report Date</u>	<u>Id/Format/Report Date</u>	<u>Id/Format/Report Date</u>
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Analytical Report

Bill To: Bel-M K Engineering Ltd.  
 Report To: Bel-M K Engineering Ltd.  
 #200, 10576 - 119 Street  
 Edmonton, AB, Canada  
 T5H 3H5  
 Attn: Jim Thomson  
 Sampled By:  
 Company:

Project:  
 ID: A588.2  
 Name: Risk Assessment  
 Location: Mayerthorpe  
 L&D:  
 P.O.:  
 Acct code:

Lot ID: 574537  
 Control Number: A021761  
 Date Received: Sep 19, 2007  
 Date Reported: Sep 21, 2007  
 Report Number: 1049558

Analyte	Reference Number	Sample Date	Sample Location	Sample Description	Matrix	Units	Results	Results	Results	Detection Limit
Physical and Aggregate Properties										
Hydraulic Conductivity	574537-1			MW1	Soil	cm/hr	0.408			
Hydraulic Conductivity						cm/s	0.000119			

Approved by: *Anthony Neumann*  
 Anthony Neumann, MSc  
 Laboratory Operations Manager



**Methodology and Notes**

Bill To: Bel-M K Engineering Ltd.  
 Report To: Bel-M K Engineering Ltd.  
 #200, 10575 - 113 Street  
 Edmonton, AB, Canada  
 T5H 3H5  
 Attn: Jim Thomson  
 Sampled By:  
 Company:

Project:  
 ID: A568.2  
 Name: Risk Assessment  
 Location: Mayerthorpe  
 LSD:  
 P.O.:  
 Acct code:

Lot ID: **574537**  
 Control Number: A021761  
 Date Received: Sep 19, 2007  
 Date Reported: Sep 21, 2007  
 Report Number: 1N49558

**Method of Analysis**

Method Name	Reference	Method	Date Analysis Started	Location
Hydraulic Conductivity	Agronomy No 9, Part 1	Hydraulic Conductivity of Saturated Soils, Chapter 13	20-Sep-07	RTG Edmonton

*\* Bodycote method(s) based on reference method*

**References**

Agronomy No 9, Methods of Soil Analysis, Part 1

**Comments:**

Please direct any inquiries regarding this report to our Client Services group.  
 Results relate only to samples as submitted.

**The test report shall not be reproduced except in full, without the written approval of the laboratory.**

THURBER ENGINEERING LTD.

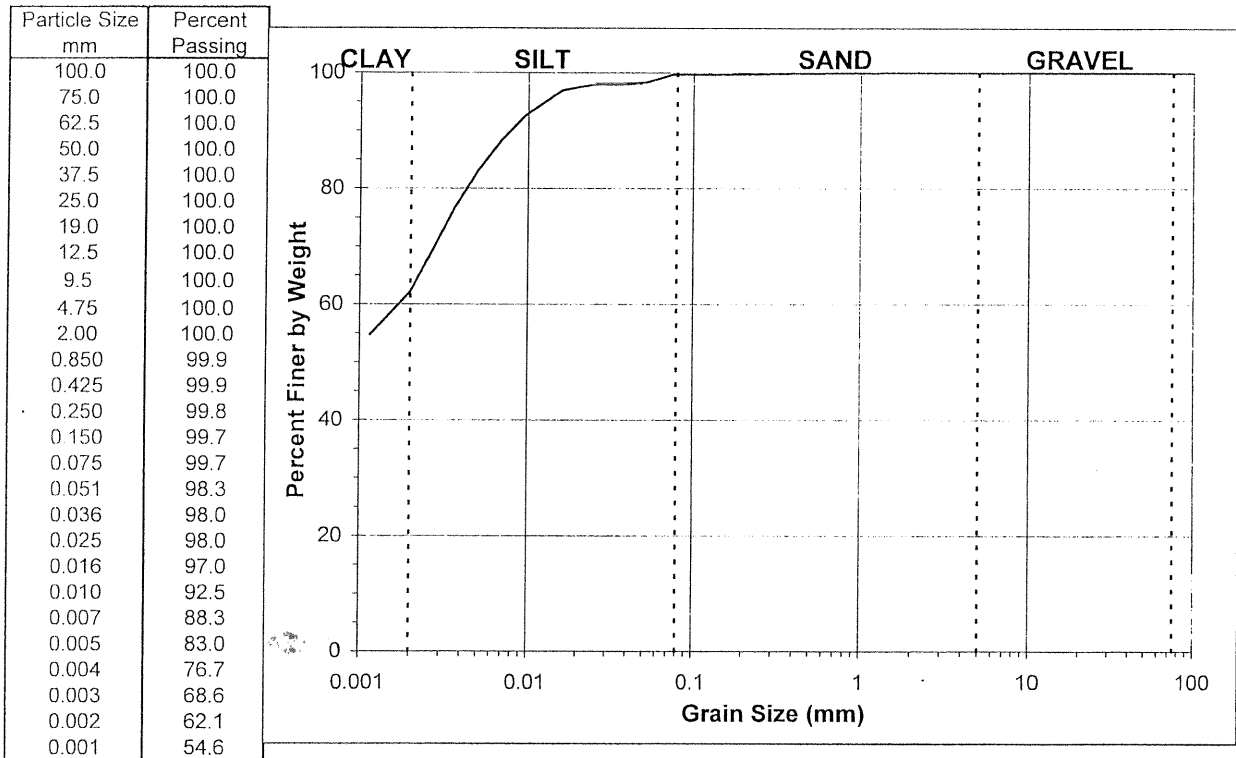
#200, 9636 51 Avenue, Edmonton, T6E 6A5  
 Telephone: (780) 438 - 1460 Facsimile (780) 437- 7125

Soil Gradation Analysis Report

Hydrometer 152 H

Client: MMM GROUP  
 Project: P 4588.2 Lab Testing  
 Job Number: 19-5161-13  
 Test Hole: -  
 Sample No. 6118  
 Depth:

Test Dates: Sept 11 /07 to Sept 21/07



Gravel 0.0%  
 Sand 0.3%  
 Silt 37.4%  
 Clay 62.2%

Comments:

Report Checked: *E.A.* Tested By: SM

Tested in Accordance with ASTM D422, C136 and C117 unless otherwise indicated



Your Project #: 4588.2, LANDFILL RISK ASSESSME  
 Site: MAYERTHORPE  
 Your C.O.C. #: 136815

**Attention: ANNETTE BLAZEIKO**  
 MMM GROUP  
 #200 10576-113TH STREET  
 EDMONTON, AB  
 CANADA T5H 3H5

**Report Date: 2007/10/01**

This report supersedes all previous reports with the same Maxxam job number

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: A744639**  
**Received: 2007/09/21, 10:00**

Sample Matrix: Gas  
 # Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
H2S by GasTec (l)	1	2007/09/24	2007/09/24		

Sample Matrix: Water  
 # Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity (pp, total), CO3,HCO3,OH	2	N/A	2007/09/23	CAL SOP-00037	SM 2320-B
Chloride by Automated Colourimetry	2	N/A	2007/09/23	CAL SOP-00044	EPA 325.2
Conductivity	2	N/A	2007/09/23	CAL SOP-00037	SM 2510-B
Hardness	2	N/A	2007/09/24	CAL WI-00053	AEMM, Method 423
Elements by ICP - Total	2	N/A	2007/09/24	CAL SOP-00004	EPA 200.7
Elements by ICPMS - Total	2	N/A	2007/09/24	CAL SOP-00003 CAL SOP-00008 CAL SOP-00009	EPA 200.8
Ion Balance	2	N/A	2007/09/23	CAL WI-00053	SM 1030E
Nitrate + Nitrite-N (calculated)	2	2007/09/21	2007/09/23	CAL SOP-00060	SM 4110B
Nitrogen, (Nitrite, Nitrate) by IC	2	N/A	2007/09/23	CAL SOP-00060	SM 4110-B
pH (Alkalinity titrator)	2	N/A	2007/09/23	CAL SOP-00037 (PCT) CAL SOP-00066 (MANUAL)	SM 4500-H B
Metals by ICP, Major cations, Fe and Mn	2	N/A	2007/09/24	CAL SOP-00004 CAL SOP-00002	EPA 200.7
Sulphate by Automated Colourimetry	2	N/A	2007/09/23	CAL SOP-00069	EPA 375.4
Total Dissolved Solids (Calculated)	2	N/A	2007/09/24	CAL SOP-00086, EDM SOP-00037	Calculation

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Edmonton Industrial



Your Project #: 4588.2, LANDFILL RISK ASSESSME  
Site: MAYERTHORPE  
Your C.O.C. #: 136815

**Attention: ANNETTE BLAZEIKO**  
MMM GROUP  
#200 10576-113TH STREET  
EDMONTON, AB  
CANADA T5H 3H5

**Report Date: 2007/10/01**

**CERTIFICATE OF ANALYSIS**

-2-

Encryption Key

*Heather Eccles* Heather Eccles  
01 Oct 2007 16:13:14 -06:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

NICOLE CHAN,  
Email: Nicole.Chan@MaxxamAnalytics.com  
Phone# (403) 291-3077

=====  
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CAEAL have approved this reporting process and electronic report format.

Total cover pages: 2

Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone(403) 291-3077 FAX(403) 291-9468

**RESULTS OF CHEMICAL ANALYSES OF GAS**

Maxxam ID		H06226		
Sampling Date		2007/09/19		
COC Number		136815		
	Units	MMM GROUP MAYERTHORPE	RDL	QC Batch

<b>GAS</b>				
In Laboratory Hydrogen Sulphide (H2S)	ppm (mole)	<1	1	1863430

RDL = Reportable Detection Limit

**RESULTS OF CHEMICAL ANALYSES OF WATER**

Maxxam ID		H06223	H06224		
Sampling Date		2007/09/19	2007/09/19		
COC Number		136815	136815		
	<b>Units</b>	<b>MW 3</b>	<b>MW 4</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Calculated Parameters</b>					
Hardness (CaCO3)	mg/L	700	770	0.5	1861241
Ion Balance	N/A	1.01	0.93	0.01	1861739
Total Dissolved Solids	mg/L	1030	1050	10	1861741
<b>Misc. Inorganics</b>					
Conductivity	uS/cm	1800	1650	1	1862265
pH	N/A	7.33	7.13	0.01	1862264
<b>Anions</b>					
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	0.5	1862263
Alkalinity (Total as CaCO3)	mg/L	439	606	0.5	1862263
Bicarbonate (HCO3)	mg/L	536	740	0.5	1862263
Carbonate (CO3)	mg/L	<0.5	<0.5	0.5	1862263
Hydroxide (OH)	mg/L	<0.5	<0.5	0.5	1862263
Dissolved Sulphate (SO4)	mg/L	171	219	0.5	1862273
Dissolved Chloride (Cl)	mg/L	229	111	0.5	1862272
<b>Nutrients</b>					
Dissolved Nitrate (N)	mg/L	0.003	<0.003	0.003	1862213
Nitrate plus Nitrite (N)	mg/L	0.003	<0.003	0.003	1861612
Dissolved Nitrite (N)	mg/L	<0.003	<0.003	0.003	1862213

RDL = Reportable Detection Limit



**ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)**

Maxxam ID		H06223	H06224		
Sampling Date		2007/09/19	2007/09/19		
COC Number		136815	136815		
	<b>Units</b>	<b>MW 3</b>	<b>MW 4</b>	<b>RDL</b>	<b>QC Batch</b>

Elements					
Total Aluminum (Al)	mg/L	295	83.0	0.04	1862519
Total Antimony (Sb)	mg/L	<0.0002	<0.0002	0.0002	1862605
Total Arsenic (As)	mg/L	0.084	0.017	0.001	1862605
Total Barium (Ba)	mg/L	4.65	1.42	0.01	1862519
Total Beryllium (Be)	mg/L	0.007	0.006	0.001	1862605
Total Boron (B)	mg/L	0.31	0.19	0.02	1862519
Total Cadmium (Cd)	mg/L	0.0096	0.0023	0.0002	1862605
Total Calcium (Ca)	mg/L	719	445	0.3	1862519
Total Chromium (Cr)	mg/L	0.50	0.10	0.01	1862519
Total Cobalt (Co)	mg/L	0.178	0.0536	0.0003	1862605
Total Copper (Cu)	mg/L	0.382	0.0645	0.0002	1862605
Total Iron (Fe)	mg/L	488	179	0.06	1862519
Total Lead (Pb)	mg/L	0.0710	0.0499	0.0002	1862605
Total Lithium (Li)	mg/L	0.40	0.11	0.02	1862519
Total Magnesium (Mg)	mg/L	170	104	0.2	1862519
Total Manganese (Mn)	mg/L	6.44	6.22	0.004	1862519
Total Molybdenum (Mo)	mg/L	0.0074	0.0018	0.0002	1862605
Total Nickel (Ni)	mg/L	0.573	0.133	0.0005	1862605
Total Phosphorus (P)	mg/L	14.0	4.7	0.1	1862519
Total Potassium (K)	mg/L	61.7	23.3	0.3	1862519
Total Selenium (Se)	mg/L	<0.001	<0.001	0.001	1862605
Total Silicon (Si)	mg/L	2.9	0.7	0.1	1862519
Total Silver (Ag)	mg/L	0.0025	0.0005	0.0001	1862605
Total Sodium (Na)	mg/L	220	41.3	0.5	1862519
Total Strontium (Sr)	mg/L	2.26	1.38	0.02	1862519
Total Sulphur (S)	mg/L	62.7	68.5	0.2	1862519
Total Thallium (Tl)	mg/L	0.0012	0.0007	0.0002	1862605
Total Tin (Sn)	mg/L	0.006	<0.001	0.001	1862605
Total Titanium (Ti)	mg/L	0.092	0.269	0.001	1862605
Total Uranium (U)	mg/L	0.0078	0.0056	0.0001	1862605
Total Vanadium (V)	mg/L	0.765	0.215	0.001	1862605
Total Zinc (Zn)	mg/L	1.45	0.357	0.003	1862605
<b>Cations</b>					
Dissolved Calcium (Ca)	mg/L	207	230	0.3	1862527
RDL = Reportable Detection Limit					

**ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)**

Maxxam ID		H06223	H06224		
Sampling Date		2007/09/19	2007/09/19		
COC Number		136815	136815		
	<b>Units</b>	<b>MW 3</b>	<b>MW 4</b>	<b>RDL</b>	<b>QC Batch</b>

Dissolved Magnesium (Mg)	mg/L	43.5	46.9	0.2	1862527
Dissolved Potassium (K)	mg/L	9.0	9.0	0.3	1862527
Dissolved Sodium (Na)	mg/L	105	36.8	0.5	1862527
Dissolved Iron (Fe)	mg/L	4.82	33.3	0.01	1862527
Dissolved Manganese (Mn)	mg/L	1.10	2.57	0.004	1862527

RDL = Reportable Detection Limit



Maxxam Job #: A744639  
Report Date: 2007/10/01

MMM GROUP  
Client Project #: 4588.2, LANDFILL RISK ASSESSME  
Site Reference: MAYERTHORPE  
Sampler Initials: AB

**General Comments**

Sample H06226-01: See attached extended gas analysis.

**Results relate only to the items tested.**



MMM GROUP  
 Attention: ANNETTE BLAZEIKO  
 Client Project #: 4588.2, LANDFILL RISK ASSESSME  
 P.O. #:  
 Site Reference: MAYERTHORPE

Quality Assurance Report

Maxxam Job Number: CA744639

QA/QC Batch	Date Analyzed	Parameter	Value	Recovery	Units	QC Limits	
Num Init	QC Type	QC Type	QC Type	QC Type	QC Type	QC Type	
1862213	JD1	Calibration Check	Dissolved Nitrate (N)	2007/09/23	101	%	92 - 111
			Dissolved Nitrite (N)	2007/09/23	98	%	91 - 110
		MATRIX SPIKE	Dissolved Nitrate (N)	2007/09/23	98	%	80 - 120
			Dissolved Nitrite (N)	2007/09/23	91	%	80 - 120
		BLANK	Dissolved Nitrate (N)	2007/09/23	<0.003	mg/L	
			Dissolved Nitrite (N)	2007/09/23	<0.003	mg/L	
		RPD	Dissolved Nitrate (N)	2007/09/23	NC	%	20
			Dissolved Nitrite (N)	2007/09/23	NC	%	20
1862263	JG3	Calibration Check	Alkalinity (Total as CaCO3)	2007/09/23	101	%	99 - 105
		RPD	Alkalinity (PP as CaCO3)	2007/09/23	NC	%	20
			Alkalinity (Total as CaCO3)	2007/09/23	1.2	%	20
			Bicarbonate (HCO3)	2007/09/23	1.2	%	20
			Carbonate (CO3)	2007/09/23	NC	%	20
			Hydroxide (OH)	2007/09/23	NC	%	20
1862264	JG3	Calibration Check	pH	2007/09/23	100	%	99 - 101
		RPD	pH	2007/09/23	0.4	%	5
1862265	JG3	Calibration Check	Conductivity	2007/09/23	100	%	92 - 110
		SPIKE	Conductivity	2007/09/23	101	%	80 - 120
		BLANK	Conductivity	2007/09/23	<1	uS/cm	
		RPD	Conductivity	2007/09/23	0	%	20
1862272	WC2	Calibration Check	Dissolved Chloride (Cl)	2007/09/23	106	%	97 - 110
		MATRIX SPIKE	Dissolved Chloride (Cl)	2007/09/23	93	%	80 - 120
		BLANK	Dissolved Chloride (Cl)	2007/09/23	<0.5	mg/L	
		RPD	Dissolved Chloride (Cl)	2007/09/23	0.3	%	20
1862273	WC2	Calibration Check	Dissolved Sulphate (SO4)	2007/09/23	103	%	97 - 105
		BLANK	Dissolved Sulphate (SO4)	2007/09/23	0.7, RDL=0.5	mg/L	
		RPD	Dissolved Sulphate (SO4)	2007/09/23	6.9	%	20
1862519	VH2	Calibration Check	Total Aluminum (Al)	2007/09/24	104	%	80 - 120
			Total Barium (Ba)	2007/09/24	94	%	80 - 120
			Total Boron (B)	2007/09/24	97	%	80 - 120
			Total Calcium (Ca)	2007/09/24	101	%	80 - 120
			Total Chromium (Cr)	2007/09/24	90	%	80 - 120
			Total Iron (Fe)	2007/09/24	95	%	80 - 120
			Total Lithium (Li)	2007/09/24	90	%	80 - 120
			Total Magnesium (Mg)	2007/09/24	100	%	80 - 120
			Total Manganese (Mn)	2007/09/24	95	%	80 - 120
			Total Phosphorus (P)	2007/09/24	99	%	80 - 120
			Total Potassium (K)	2007/09/24	95	%	80 - 120
			Total Silicon (Si)	2007/09/24	99	%	80 - 120
			Total Sodium (Na)	2007/09/24	97	%	80 - 120
			Total Strontium (Sr)	2007/09/24	94	%	80 - 120
		MATRIX SPIKE	Total Aluminum (Al)	2007/09/24	101	%	80 - 120
			Total Barium (Ba)	2007/09/24	91	%	80 - 120
			Total Boron (B)	2007/09/24	95	%	80 - 120
			Total Calcium (Ca)	2007/09/24	88	%	80 - 120
			Total Chromium (Cr)	2007/09/24	88	%	80 - 120
			Total Iron (Fe)	2007/09/24	96	%	80 - 120
			Total Lithium (Li)	2007/09/24	89	%	80 - 120
			Total Magnesium (Mg)	2007/09/24	94	%	80 - 120
			Total Manganese (Mn)	2007/09/24	93	%	80 - 120
			Total Phosphorus (P)	2007/09/24	98	%	80 - 120
			Total Potassium (K)	2007/09/24	96	%	80 - 120
			Total Silicon (Si)	2007/09/24	95	%	80 - 120
			Total Strontium (Sr)	2007/09/24	90	%	80 - 120
		SPIKE	Total Sulphur (S)	2007/09/24	94	%	80 - 120

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MMM GROUP  
 Attention: ANNETTE BLAZEIKO  
 Client Project #: 4588.2, LANDFILL RISK ASSESSME  
 P.O. #:  
 Site Reference: MAYERTHORPE

Quality Assurance Report (Continued)

Maxxam Job Number: CA744639

QA/QC Batch			Date Analyzed					
Num Init	QC Type	Parameter	yyyy/mm/dd	Value	Recovery	Units	QC Limits	
1862519 VH2	BLANK	Total Aluminum (Al)	2007/09/24	<0.04		mg/L		
		Total Barium (Ba)	2007/09/24	<0.01		mg/L		
		Total Boron (B)	2007/09/24	<0.02		mg/L		
		Total Calcium (Ca)	2007/09/24	<0.3		mg/L		
		Total Chromium (Cr)	2007/09/24	<0.01		mg/L		
		Total Iron (Fe)	2007/09/24	<0.06		mg/L		
		Total Lithium (Li)	2007/09/24	<0.02		mg/L		
		Total Magnesium (Mg)	2007/09/24	<0.2		mg/L		
		Total Manganese (Mn)	2007/09/24	<0.004		mg/L		
		Total Phosphorus (P)	2007/09/24	<0.1		mg/L		
		Total Potassium (K)	2007/09/24	<0.3		mg/L		
		Total Silicon (Si)	2007/09/24	<0.1		mg/L		
		Total Sodium (Na)	2007/09/24	<0.5		mg/L		
		Total Strontium (Sr)	2007/09/24	<0.02		mg/L		
		Total Sulphur (S)	2007/09/24	<0.2		mg/L		
		RPD	Total Barium (Ba)	2007/09/24	0.1		%	20
			Total Boron (B)	2007/09/24	1.7		%	20
			Total Calcium (Ca)	2007/09/24	2.3		%	20
			Total Iron (Fe)	2007/09/24	8.0		%	20
			Total Lithium (Li)	2007/09/24	1.5		%	20
			Total Magnesium (Mg)	2007/09/24	2.2		%	20
			Total Manganese (Mn)	2007/09/24	1.8		%	20
			Total Phosphorus (P)	2007/09/24	NC		%	20
			Total Potassium (K)	2007/09/24	1.3		%	20
			Total Silicon (Si)	2007/09/24	2.8		%	20
			Total Sodium (Na)	2007/09/24	3.2		%	20
			Total Strontium (Sr)	2007/09/24	1.8		%	20
Total Sulphur (S)	2007/09/24		2.3		%	20		
1862527 VH2	Calibration Check		Dissolved Calcium (Ca)	2007/09/24		106	%	80 - 120
		Dissolved Magnesium (Mg)	2007/09/24		106	%	80 - 120	
		Dissolved Potassium (K)	2007/09/24		103	%	80 - 120	
		Dissolved Sodium (Na)	2007/09/24		104	%	80 - 120	
		Dissolved Iron (Fe)	2007/09/24		101	%	80 - 120	
	MATRIX SPIKE [H06223-01]	Dissolved Manganese (Mn)	2007/09/24		102	%	80 - 120	
		Dissolved Calcium (Ca)	2007/09/24		91	%	80 - 120	
		Dissolved Magnesium (Mg)	2007/09/24		95	%	80 - 120	
		Dissolved Potassium (K)	2007/09/24		96	%	80 - 120	
		Dissolved Sodium (Na)	2007/09/24		92	%	80 - 120	
		Dissolved Iron (Fe)	2007/09/24		86	%	80 - 120	
	BLANK	Dissolved Manganese (Mn)	2007/09/24		91	%	80 - 120	
		Dissolved Calcium (Ca)	2007/09/24	<0.3		mg/L		
		Dissolved Magnesium (Mg)	2007/09/24	<0.2		mg/L		
		Dissolved Potassium (K)	2007/09/24	<0.3		mg/L		
Dissolved Sodium (Na)		2007/09/24	<0.5		mg/L			
RPD [H06223-01]	Dissolved Iron (Fe)	2007/09/24	<0.01		mg/L			
	Dissolved Manganese (Mn)	2007/09/24	<0.004		mg/L			
	Dissolved Calcium (Ca)	2007/09/24	1.0		%	20		
	Dissolved Magnesium (Mg)	2007/09/24	0.1		%	20		
	Dissolved Potassium (K)	2007/09/24	0.7		%	20		
	Dissolved Sodium (Na)	2007/09/24	0.2		%	20		
	Dissolved Iron (Fe)	2007/09/24	1.1		%	20		
1862605 MB5	Calibration Check	Dissolved Manganese (Mn)	2007/09/24	0.9		%	20	
		Total Antimony (Sb)	2007/09/24		112	%	80 - 117	
		Total Arsenic (As)	2007/09/24		90	%	80 - 120	

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MMM GROUP  
 Attention: ANNETTE BLAZEIKO  
 Client Project #: 4588.2, LANDFILL RISK ASSESSME  
 P.O. #:  
 Site Reference: MAYERTHORPE

Quality Assurance Report (Continued)

Maxxam Job Number: CA744639

QA/QC Batch	Date Analyzed	Value	Recovery	Units	QC Limits		
Num Init	QC Type	Parameter	yyyy/mm/dd				
1862605 MB5	Calibration Check	Total Beryllium (Be)	2007/09/24	99	%	80 - 120	
		Total Cadmium (Cd)	2007/09/24	98	%	80 - 120	
		Total Cobalt (Co)	2007/09/24	100	%	80 - 120	
		Total Copper (Cu)	2007/09/24	102	%	80 - 120	
		Total Lead (Pb)	2007/09/24	107	%	80 - 120	
		Total Molybdenum (Mo)	2007/09/24	106	%	80 - 120	
		Total Nickel (Ni)	2007/09/24	101	%	80 - 120	
		Total Selenium (Se)	2007/09/24	83	%	80 - 119	
		Total Silver (Ag)	2007/09/24	108	%	80 - 120	
		Total Thallium (Tl)	2007/09/24	110	%	80 - 120	
		Total Tin (Sn)	2007/09/24	112	%	80 - 120	
		Total Titanium (Ti)	2007/09/24	102	%	80 - 120	
		Total Uranium (U)	2007/09/24	110	%	80 - 120	
		Total Vanadium (V)	2007/09/24	106	%	80 - 120	
		Total Zinc (Zn)	2007/09/24	83	%	80 - 120	
		MATRIX SPIKE	Total Antimony (Sb)	2007/09/24	102	%	80 - 120
			Total Arsenic (As)	2007/09/24	101	%	80 - 120
			Total Cadmium (Cd)	2007/09/24	92	%	80 - 120
			Total Cobalt (Co)	2007/09/24	105	%	80 - 120
			Total Copper (Cu)	2007/09/24	101	%	80 - 120
Total Lead (Pb)	2007/09/24		107	%	80 - 120		
Total Molybdenum (Mo)	2007/09/24		106	%	80 - 120		
Total Nickel (Ni)	2007/09/24		102	%	80 - 120		
Total Selenium (Se)	2007/09/24		97	%	80 - 120		
Total Thallium (Tl)	2007/09/24		112	%	80 - 120		
BLANK	Total Titanium (Ti)	2007/09/24	101	%	80 - 120		
	Total Antimony (Sb)	2007/09/24	<0.0002	mg/L			
	Total Arsenic (As)	2007/09/24	<0.001	mg/L			
	Total Beryllium (Be)	2007/09/24	<0.001	mg/L			
	Total Cadmium (Cd)	2007/09/24	<0.0002	mg/L			
	Total Cobalt (Co)	2007/09/24	<0.0003	mg/L			
	Total Copper (Cu)	2007/09/24	<0.0002	mg/L			
	Total Lead (Pb)	2007/09/24	0.0003, RDL=0.0002	mg/L			
	Total Molybdenum (Mo)	2007/09/24	<0.0002	mg/L			
	Total Nickel (Ni)	2007/09/24	<0.0005	mg/L			
	Total Selenium (Se)	2007/09/24	<0.001	mg/L			
	Total Silver (Ag)	2007/09/24	0.0001, RDL=0.0001	mg/L			
	Total Thallium (Tl)	2007/09/24	<0.0002	mg/L			
	Total Tin (Sn)	2007/09/24	<0.001	mg/L			
	Total Titanium (Ti)	2007/09/24	<0.001	mg/L			
	Total Uranium (U)	2007/09/24	<0.0001	mg/L			
	Total Vanadium (V)	2007/09/24	<0.001	mg/L			
	Total Zinc (Zn)	2007/09/24	<0.003	mg/L			
	RPD	Total Antimony (Sb)	2007/09/24	NC	%	20	
		Total Beryllium (Be)	2007/09/24	NC	%	20	
Total Cobalt (Co)		2007/09/24	NC	%	20		
Total Copper (Cu)		2007/09/24	2.0	%	20		
Total Lead (Pb)		2007/09/24	9.6	%	20		
Total Molybdenum (Mo)		2007/09/24	3.1	%	20		
Total Nickel (Ni)		2007/09/24	1.6	%	20		
Total Silver (Ag)		2007/09/24	NC	%	20		
Total Thallium (Tl)		2007/09/24	NC	%	20		
Total Tin (Sn)		2007/09/24	NC	%	20		
Total Titanium (Ti)		2007/09/24	0.8	%	20		
Total Uranium (U)		2007/09/24	4.0	%	20		

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MMM GROUP  
Attention: ANNETTE BLAZEIKO  
Client Project #: 4588.2, LANDFILL RISK ASSESSME  
P.O. #:  
Site Reference: MAYERTHORPE

Quality Assurance Report (Continued)

Maxxam Job Number: CA744639

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1862605 MB5	RPD	Total Vanadium (V)	2007/09/24	NC		%	20
		Total Zinc (Zn)	2007/09/24	NC		%	20

NC = Non-calculable  
RPD = Relative Percent Difference

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Gregory, 2021 - 4161 Ave. HE, TCE B/F?   
 Edinburg, 9619 - 42 Ave., TCE 5/R?   
 Ph: (409) 291-3077 Fax: (409) 291-8408   
 Ph: (786) 466-1212 Fax: (786) 459-4187   
 www.maxxamanalytics.com

**ANALYTICAL REQUEST FORM**

Page: 1 of 1

PO # / AFE #: \_\_\_\_\_  
 Quotation #: \_\_\_\_\_  
 Project #: 4588.2  
 Project Name: Landfill Risk Assessment  
 Location: Haverthorpe  
 Sampler's Initials: AB

Report To:  
 thomsonj@mwm.ca   
 blazizko@mwm.ca   
 PC: \_\_\_\_\_  
 Fax: \_\_\_\_\_

Invoice To:  Require Report? Yes  No  
 Company Name: MWM Group  
 Contact Name: Annette Blazizko  
 Address: 200 10576 - 113 Street  
Edmonton PC-T5H0M9  
 Phone / Fax #: Ph: 423-4123 Fax: 426-0659

**REGULATORY REQUIREMENTS:**  
 AT1 - Soil Contamination  PST  Mail  Fax  
 CCOME  CDMOG  PDF  Excel  Other:  
 CCOME FWAL  G50  Email: See above  
 Regulatory Limits to appear on Final report

**SERVICE REQUESTED:**  
 RUSH (Please ensure you contact the lab)  
 REGULAR Turnaround

**METALS: (WATERS):**  
 Total  Extractable  Dissolved

Sample Identification	Matrix	Date/Time Sampled	Sample Type Grab/Comp	Hold > 60 Days	Sample Container #
1 MW3	Water	Sept 19/07	Grab		
2 MW4	Water		Grab		
3 MW2	Vapor				
4					
5					
6					
7					
8					
9					
10					
11					
12					

**ANALYSIS REQUESTED**  
 Fibra Hydrocarbons  
 Metals Extended  
 Asbestos  
 Routine Volatiles  
 Total Ammonia Nitrogen  
 pH  
 Conductivity  
 Temperature  
 7.7.7

Received: 19/09/07  
 15:40  
 Signature: [Signature]  
 Date/Time: \_\_\_\_\_  
 Temperature: 7.7.7  
 Co/C# 136815

Relinquished By: [Signature]  
 Signature: [Signature]  
 COMMENTS/SPECIAL INSTRUCTIONS: \_\_\_\_\_  
 KEROJET/CAH-0063

**EXTENDED GAS ANALYSIS**

Oxygen included

<p><b>Laboratory Number :</b> A744639-H06226</p> <p><b>Container Identity :</b> TEDLAR BAG</p> <p><b>Operator Name :</b> MMM GROUP</p> <p><b>Plant/Well Name :</b> MMM GROUP MAYERTHORPE</p> <p><b>Sample Point :</b> MW2</p> <p><b>Sampled By :</b> MMM GROUP</p> <p><b>Date Sampled :</b> 09/18/2007</p> <p><b>Date Received :</b> 09/21/2007</p> <p><b>Date Reported :</b> 09/24/2007</p> <p><b>Analyst :</b> TW/MW</p>	<p><b>Gauge Pressures kPa</b></p> <p>Source : N/A</p> <p>As Received : N/A</p> <hr/> <p><b>Temperatures °C</b></p> <p>Source : N/A</p> <p>As Received : 21</p>
--	--

Component	Boiling Point (C)	Composition
		Mole Percent As Received
Hydrogen	-253	<0.01
Helium	-269	<0.01
Oxygen	-183	21.09
Nitrogen	-196	78.81
Carbon Dioxide	-79	0.09
Hydrogen Sulphide	-60	<0.01
Methane	-162	0.011
Ethane	-89	<0.001
Propane	-42	<0.001
Iso-Butane	-12	<0.001
N-Butane	0	<0.001
Iso-Pentane	28	<0.001
N-Pentane	36	<0.001
Hexanes	69	<0.001
Heptanes	98	<0.001
Octanes	126	<0.001
Nonanes	151	<0.001
Decanes	174	<0.001
Undecanes	196	<0.001
Dodecanes	216	<0.001
Tridecanes	236	<0.001
Tetradecanes	253	<0.001
Pentadecanes +	271+	<0.001
Neo-Hexane	50	<0.001
Methyl Cyclopentane	72	<0.001
Benzene	80	<0.001
Cyclohexane	81	<0.001
Methyl Cyclohexane	101	<0.001
Toluene	111	<0.001
Ethyl Benzene	136	<0.001
m+p Xylene	139	<0.001
o-Xylene	144	<0.001
1,2,4 Trimethyl Benzene	169	<0.001
Totals		100.00