

**SAFETY CODES COUNCIL**

Underground Tank Remediation Program Tel: 780/415-8659
16th Floor, Commerce Place Fax: 1-866-833-1100
10155 - 102 Street
Edmonton, Alberta T5J 4L4

FILE #00123-5102

February 3, 2004

ASR Enterprises Ltd.
P.O. Box 267
Irma, AB T0B 2H0

Dear Smith Read:

Re: Risk Management Plan, Site5102, Plan 2605X Block 6 Lots 28-35

Thank you for the Risk Management Plan (RMP) dated October 30, 2003. Alberta Environment (AENV) has completed its review of the RMP proposal and we received a copy of their review dated January 22, 2004. This new proposal has been disregarded, and the RMP of November 20, 2002, which had previously been accepted (see letter dated November 29, 2002) has been amended as per AENV's letter.

Based on Alberta Environment's review, the Proposed Risk Management Plan is acceptable. **Acceptance is conditional upon:**

1. Your consultant advises that there are no costs involved in the implementation of this RMP, and you may proceed. Your consultant should provide you with an estimate of costs for risk management that will extend past the close of the administration of the Program (October 31, 2004) and will therefore be your responsibility. A copy of the estimate should be submitted to the Program by **February 24, 2004.**
2. The remediation will be fully completed to meet a level compatible with the existing zoning and site sensitivity to comply with Alberta Environment's "Risk Management Guidelines for Petroleum Storage Tank Sites (October 2001)" including both on and offsite soil and groundwater. However, because the Program is scheduled to end October 31, 2004, a risk management plan may be incomplete by that date. The owner will not be viewed as being in breach of the CGA, if
 - i. (s)he is still working toward achieving the generic levels acceptable to Alberta Environment
 - ii. (s)he is adhering to the requirements of the approved plan.
3. Your Accredited Consulting Engineer on your behalf, as per Schedule B of the Conditional Grant Agreement, "Certify that the site has been remediated to a level compatible with the existing zoning and site sensitivity to comply with

File #00123-5102

Page 2

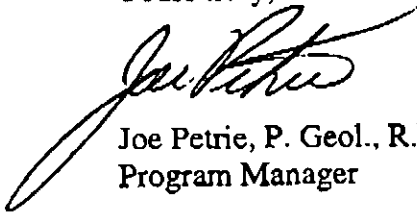
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Alberta Environment's "Risk Management Guidelines for Petroleum Storage Tank Sites (October 2001)".

4. The owner obtains all necessary permits and approvals required.

The reviews are based on technical information submitted to the program by your Consultant. Acceptance or non-acceptance of this proposal does not absolve the Grant recipient from the responsibility for remediating his site in accordance with the aforementioned Guidelines or from future liability for remediating his site in situations where either the land use may change or additional concerns arise from the contaminants remaining on or off-site.

Yours truly,



Joe Petrie, P. Geol., R.E.T.
Program Manager

Cc: Mark Hasegawa, Hasegawa Engineering
Myndy Machan, Alberta Environment



F A X

Underground Tank Remediation Program
16th Floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L4

Tel: (780) 415-8666 1-866-833-3300 Fax: (780) 415-8664 1-866-833-1100

To: Marie Read **From:** Karen Clarke

Fax: 403 754 2718 **Pages:** 3 (including cover sheet)

Phone: **Date:** February 4, 2004

Re: Site #5102 **cc:** Myndy Hachon 403 382-4428
Mark Hawegawa 403 328 2728

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MESSAGE:

If you do not receive all the pages, please call Jouhayna @780 415 8666

Regional Services
Southern Division

2nd Floor, Provincial Building
200 - 5th Avenue South
Lethbridge, Alberta T1J 4L1

Telephone: (403) 381-5470
Fax: (403) 382-4428

AENV File No. 79853

January 22, 2004

Smith Read
c/o ASR Enterprises Ltd.
3813 - 23rd Avenue South
Lethbridge, Alberta
T1K 3T5

Dear Mr. Read;

**Re: Amended Remediation/Risk Management Plan
Barons Hardware/Service Station
214 Main Street Barons, Alberta (SCC File #5102)**

As per telephone conversations on January 21 and 22, 2004 with yourself and Mark Hasegawa of Hasegawa Engineering, I am amending the current Risk Management Plan for your site, which was approved by Alberta Environment (AENV) on November 29, 2002 (copy attached). As discussed, we will disregard the *Site Specific Risk Assessment and Risk Management Plan* dated October 30, 2003, which was prepared by your consultant, as it did not expose any new information that could be used to rule out any further site-specific potential contamination pathways.

I have reviewed the current risk management plan proposed for implementation at this site as part of the remediation of petroleum hydrocarbon contaminated soil and groundwater to appropriate risk management criteria, residential/commercial (where applicable) guidelines for fine-grained soil, and have the following comments:

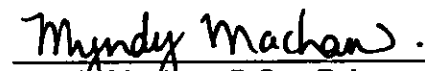
1. Petroleum contamination requiring risk management is located on-site beneath the east side of the building and off-site in Main Street, located south of the subject property.
2. Excavation of the majority of contaminated soil and groundwater from the site has taken place and likely diminished the areas of higher contamination levels. The amended remediation/risk management plan involves monitored natural attenuation (MNA), which will include ongoing groundwater monitoring and sampling of wells MW1, MW3, MW4 and MW9, two times per year. The groundwater samples will be submitted for laboratory analysis of BTEX, F1 and F2 concentrations. Monitoring is estimated to be ongoing for three years and submission of samples for laboratory analysis will occur twice per year (March and October). A letter report updating the status of the site is expected once per year.
3. A vapour extraction system (VES) is currently located on-site and connected to MW1 to remove volatile organic compounds (VOCs) from beneath the building. If during any monitoring/sampling event benzene or Fraction 1 concentrations are found above applicable criteria, the VES system will be restarted to aid in removal of VOCs. If the VES system must

be restarted, the system will run continuously until monitoring shows that concentrations of VOCs are reduced to consistently low concentrations.

4. Once the monitoring program has been completed a Phase II ESA will be conducted to confirm that the site meets the applicable remediation objectives. A minimum of four soil and four groundwater samples submitted for laboratory analysis as per Alberta Environment's 2001 *"Risk Management Guidelines for Petroleum Storage Tank Sites"*. If this information shows that remediation is not complete, this remediation/risk management plan will be re-examined and amended to include a longer period for monitoring and evaluation of the site. The borehole and monitoring well locations proposed for the future Phase II ESA will correlate to current remaining areas of on-site and off-site contamination as well as the whole of the site.
5. I think this remedial approach is likely to be successful and amend the current remediation/risk management plan accepted on November 29, 2002 to include the above information as discussed in our January 21 and 22, 2004 telephone conversations.

If you have any questions or concerns, please do not hesitate to contact myself directly at (403) 381-5470.

Sincerely,
DEPARTMENT OF ENVIRONMENT


Myndy Machan, B.Sc., P.Ag.
Contaminated Sites/Approvals Assurance Coordinator

cc: Mark Hasegawa – Hasegawa Engineering
Joe Petrie/Karen Clarke – Safety Codes Council

Attachment



Site Specific Risk Assessment and Risk Management Plan

214 Main Street
Site 5102, Plan 2605X, Block 6, Lot 28 to 35
Barons, Alberta



PREPARED FOR:
ASR Enterprises
Box 267
Irma, Alberta
T0B 2H0

PREPARED BY:
Hasegawa Engineering
1220 – 31 Street North
Lethbridge, AB T1H 5J8

Hasegawa Engineering
Consulting Professional Engineers



Environmental
Agricultural
Structural
Civil
Municipal

HASEGAWA ENGINEERING

Consulting Professional Engineers

A Division of 993997 Alberta Ltd

1220 31st Street North, Lethbridge, AB T1H 5J8
Bus: 328-2686 Fax: 328-2728 E-mail: hasgm@telusplanet.net

October 30, 2003

Job#: 01-109

Mrs. Marie Read
ASR Enterprises
Box 267
Irma, Alberta T0B 2H0

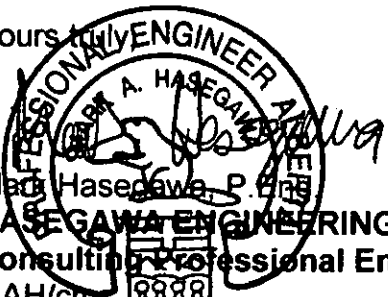
Dear Marie:

**Re: Site Specific Risk Assessment and Risk Management Plan
for Barons Hardware, Barons, Alberta**

As per your request, Hasegawa Engineering completed a site-specific risk assessment and risk management plan for the above-mentioned site.

We trust that the enclosed information meets your requirements. Please do not hesitate to contact us if you have any questions.

Yours truly,


Mark Hasegawa, P. Eng.
HASEGAWA ENGINEERING
Consulting Professional Engineers
MAH/cms

EXECUTIVE SUMMARY

Hasegawa Engineering (Hasegawa) has completed a supplementary Site Specific Risk Assessment at Barons Hardware in Barons, Alberta.

The activities involved in this phase of the work included the following:

- Submission of soil for fraction of organic carbon content analysis;
- Sampling of MW-1 and submission for BTEX, F1 and F2 analysis to determine present groundwater concentrations;
- Summarization of past monitoring results and remedial activities;
- Conduction of a receptor analysis for the site;
- Review of exposure pathways and receptors;
- Comparison of AENV remediation criteria to site specific values developed using the Risk Based Corrective Action Software, which is based on the ASTM Standard E-1739;
- Determination of the most applicable criteria for the site;
- Development of a risk management plan.

The current remedial criterion for contaminant constituents in soil and water for the site was set using onsite (commercial) and offsite (residential) criteria. Residential criteria were applied to the north 30 metres of the property following the application of multiple zoning on site.

Based on receptor analysis and assessment of onsite risk, the only exposure pathway at the site is vapour inhalation from groundwater to commercial workers. Site-specific risk analysis for the site resulted in remedial criteria that is similar to AENV commercial vapour inhalation criteria. As a result, AENV commercial criteria for vapour inhalation will be utilized as the remedial criteria for the site. Based on site-specific risk analysis, groundwater concentrations of petroleum hydrocarbons fraction F2 exceed applicable criteria.

Hasegawa Engineering recommends annual groundwater sampling to evaluate further trends. A vapour monitoring well should be installed in the slab of Barons Hardware to evaluate vapours. If the results of the vapour analysis indicate there is no impact beneath the slab, the vapour inhalation pathway may be excluded, resulting in site compliance.

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1.0 INTRODUCTION

1.1 Purpose of the Investigation and Project Background

At the request of Mrs. Marie Read of Irma, Alberta, Hasegawa Engineering (HE) initiated a Site Specific Risk Assessment (RA) and Risk Management Plan on the property at Site 5102, Plan 2605X, Block 6, Lot 28 to 35 (currently 214 Main Street), in Barons, Alberta. This property shall hereinafter be referred to as the "Subject Property" (refer to Figure 1).

The purpose of this supplementary assessment was to determine acceptable site-specific remediation criteria and set forth risk management actions at the site. This consultation provided by Hasegawa Engineering is intended to alert the client to potential environmental liabilities associated with the subject property and adjacent properties. Hasegawa Engineering does not make any recommendations regarding purchase, sale or investment in a property.

The findings of this report are subject to the statement of limitations described in the attached appendices. The users of this report are asked specifically to note these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

1.2 Scope of Work

The activities involved in this site-specific risk assessment included the following:

- Submission of soil for fraction of organic carbon content analysis;
- Sampling of MW-1 and submission for BTEX, F1 and F2 analysis to determine present groundwater concentrations;
- Summarization of past monitoring results and remedial activities;
- Conduction of a receptor analysis for the site;
- Review of exposure pathways and receptors;
- Comparison of AENV remediation criteria to site specific values developed using the Risk Based Corrective Action Software, which is based on the ASTM Standard E-1739;
- Determination of the most applicable criteria for the site;
- Development of a risk management plan.

1.3 Study Objectives

The purpose of this study was to determine the acceptable site-specific soil and groundwater remediation criteria for the site.

1.4 Summary of Past Remediation Efforts

In an attempt to remediate the site, several phased remediation efforts have been completed. Each phase of the remedial process is shown in Figure 2. In 1992 the product supply line from the Turbo station to the east was removed. In 1996 the old storage tanks were also removed. As part of that effort, the contaminated soil from the front of the building was removed and replaced with clean soil. A vapour phase extraction unit was also installed around the perimeter of the excavated area (Hasegawa Engineering, 1996). This system was operated for several years until additional remedial activities were initiated. In May of 2003 the impacted soil located east and southeast of the site building were excavated and removed from the site (Hasegawa Engineering, 2003). As a result of these activities, all accessible impacted soil was removed from the site.

It should also be noted that impacted soil existed on the Turbo site located east of the Subject Property (Seacorp, 1993). This soil was excavated and removed from that property in 1999 (Seacorp, 1999).

2.0 AENV Remediation Criteria

2.1 Current Risk Management Criteria

The current remediation levels for the site are based on criteria set forth in the Risk Management Guidelines for Petroleum Storage Tank Sites (Alberta Environment, 2001). These guidelines allow for the use of diminimus criteria, generic criteria, or the use of a site-specific risk assessment to define cleanup parameters. The purpose of this document is to re-evaluate the applicability of the diminimus levels and determine if site-specific risk management levels are appropriate.

The generic criteria are determined by inputting parameters that are used to select cleanup levels from tables within the document. Key determining criteria include:

- Land use
 - Residential
 - Commercial
 - Industrial
- Applicable exposure pathways

Classifying land uses and identifying potential exposure pathways allows the appropriate selection of cleanup criteria. The land use designations for this site and adjoining properties are shown in Table 1. When two different land use classifications are utilized, the remediation levels for the most stringent land use are always applied. However, the rule does allow for the application of multiple zoning criteria at a site. As long as the most stringent level is applied within 30 meters of the property line, depending on the size and zoning of the site, a less stringent level may be applied. As shown in Table 1 below, this site is zoned commercial but is adjacent to residential properties in the rear. As a result, the residential zoning is applied to the property that is within 30 meters of the residential property line. However, the remainder of the property has been zoned commercial.

Table 2.1: Land Use Classifications

Land Use Classification	Onsite	Offsite
Residential	No	Yes
Commercial	Yes	Yes
Industrial	No	No

The potential exposure pathways and the reasoning for inclusion or exclusion are included in Table 2.2.

Table 2.2: Exposure Pathway Analysis

Category	Exposure Pathway	Complete	Justification
Human	Soil Ingestion	No	Release below surface and source area has been removed
Human	Soil Dermal Contact	No	Release below surface and source area has been removed
Human	Inhalation Indoor	Yes	Impacted soil may be below buildings
Human	Drinking water	No	Has no potential for groundwater use
Ecological	Plant/invertebrate Soil contact	No	Impacted soil greater than 7 feet deep
Ecological	Groundwater for aquatic life	No	Not within 300 m of surface water body

The original phase II assessment revealed that the soil was classified as fine-grained with 73.6% of the soil fraction being smaller than 75 µm. Therefore, based on the information listed in Table 2.2, the soil remediation criteria onsite will be classified as fine-grained soil for commercial land use and the soil offsite will be classified as fine-grained soil for residential land use (refer to Table 2.3). The commercial classification was utilized since the soil contamination was excavated and, based on soil analysis, appears to be restricted to commercial areas. The onsite groundwater has been classified as fine-grained soil for commercial land use and offsite groundwater classified as residential for fine-grained soils. The AENV remediation levels for the site are summarized in Table 2.3.

Table 2.3: AENV Remediation Levels

Constituent	Onsite Standards (Commercial)		Offsite Standards (Residential)	
	Soil (mg/kg)	Water (mg/L)	Soil (mg/kg)	Water (mg/L)
Benzene	9	16	1.9	3.5
Toluene	450	342	300	228
Ethyl-benzene	690	NG	450	NG
Xylene	1500	NG	500	163
F1 (C6-C10)	660	24	260	9
F2 (C10-C16)	1500	18	900	11
F3 (C16-C34)	2500	NA	800	NA
F4 (>C34)	6600	NA	5600	NA
Lead	260	NA	140	NA

NG = No guidance

NA = Not Applicable

3.0 SUMMARY OF SOIL AND GROUNDWATER ANALYSIS

Results of the intrusive soil and groundwater sampling are summarized in this section. For detailed results and information obtained from the laboratory analysis, refer to Appendix B. The information included in this section was obtained from the site investigation and remediation data. For additional information refer to the Barons Hardware Soil Excavation Report, Phase III Environmental Site Assessment report and the Supplementary Phase III Investigation report.

3.1 Soil Analysis Results

The results of the soil analysis during the site investigation indicate silty clay is present to a depth of about 15 to 20 feet where it becomes underlain by a siltstone/shale. OVM readings were taken at each 5-foot interval and used to screen for volatile organics (Table 3.1). Also, organic vapour readings were taken from the Phase II excavation. These results are included in Table 3.2

Table 3.1: Soil Screening Results (ppm)

Depth	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10
5		840	640	580	700	220	500	500	520	220
10	120	9940	4000	5400	480	2040	2600	620	940	340
15	>10,000	1940	21000	2100	420	1060	3060	1540	1000	400
20	2780	1640	980	2900	340	-	-	560	940	920
25	1200	-	-	760	-	-	-	-	-	540
30	1140	-	-	-	-	-	-	-	-	580

Indicates sample was submitted for soil analysis

Table 3.2: OVM Readings During Phase II Soil Remediation

OVM Readings			Comments
Depth	Location	OVM (ppm)	
1.5 m	3N, 0.5E	150	No smell
	3N, 3E	90	No smell
2 m	2.5N, 0E	700	
	2.5N, 2E	1020	
	3N, 3E	680	
	5N, 3E	620	
	6N, 2E	300	
2.5 m	3N, 2E	1500	
	3.5N, 1E	1800	
4 m	5N, 2E	3500	
	5.5N, 2E	560	

	6N, 1E	880	
	6.2N, 1E	1360	
	6.5N, 1E	980	Lab Sample
	6N, 3E	1300	Lab Sample
	7N, 3E	1400	Lab Sample
	3N, 0E	5000	Lab Sample
	2.5N, 2E	1300	Lab Sample
4.5 m	3N, 3E	2500	
	3N, 1E	2000	
	7N, 2E	240	Lab Sample
5 m	6N, 2E	300	
	2.5N, 2E	2500	
5.4 m	3.2N, 5E	1700	
	6.0N, 5E	3000	
5.5 m	B	700	Bedrock

It should be noted that the OVM is used only as an indicator of organic contamination and relative levels, and not to quantify the contaminant levels.

The soil samples corresponding to the highest OVM reading for each well (MW-1 through MW-10) were submitted to the lab for analysis. In addition, samples were taken from the Phase II excavation and submitted for analysis. The results are shown in Table 3.3. Locations of the samples are shown in Figure 2.

Table 3.3: Soil Analytical Results

Sample Location	Depth (ft)	Date	Benzene Mg/kg	Toluene mg/kg	Ethyl-benzene mg/kg	Xylenes mg/kg	F1 mg/kg	F2 mg/kg	F3 mg/kg	F4 mg/kg	Lead
MW-1*	15	12/19/01	<0.02	<0.02	<0.02	0.04	<10	30	<10	<10	69.7
MW-2	10	12/19/01	36.8	218	36.8	280	1760	682	405	10	31.1
MW-3	10	12/19/01	2.89	16.7	6.06	49.8	228	797	503	11	11.7
MW-4	10	12/19/01	4.49	86.7	11.1	100	734	401	350	11	9.56
MW-5	10	5/31/02	<0.02	<0.02	<0.02	<0.02	<1.0	<10	35	17	42
MW-6	15	5/31/02	0.66	7.03	4.06	34.1	220	<10	25	<10	-
MW-7	15	5/31/02	0.47	5.3	3.12	28.1	134	30	<10	<10	-
MW-8	10	5/31/02	0.33	0.09	0.94	3.33	47	<10	<10	<10	-
MW-9	15	5/31/02	<0.02	<0.02	<0.02	0.02	<1	<10	<10	<10	-
MW-10		6/13/02	<0.02	<0.02	<0.02	0.05	<1	<10	23	<10	-
2.5N, 2E	4	5/22/03	14.3	235	41.2	331	1890	163	100	21	
3N, 0E	4	5/22/03	0.35	8.6	7.99	93.4	861	815	475	14	
6N, 3E	4	5/22/03	0.48	1.79	6.87	27.8	358	57	31	13	
6.5N, 1E	4	5/22/03	0.05	0.05	0.06	0.47	42	94	84	<10	
7N, 2E	4.5	5/22/03	0.02	0.06	<0.02	0.06	<1	<10	14	13	
7N, 3E	4	5/22/03	<0.02	<0.02	<0.02	0.04	<1	11	22	17	

3.2 Groundwater Sampling and Gauging

All soil borings were completed as monitoring wells and surveyed to determine the casing elevation and, prior to sampling, gauged to determine depth to water. The wells were then purged until dry or a minimum of two well bore volumes was removed. The wells were allowed to recover to 60% of their original depth. Samples were collected using a submersible sampling pump with dedicated tubing for each well. The pump was decontaminated prior to using for subsequent well sampling.

Samples were placed on ice and shipped to the laboratory for analysis of BTEX, F1 and F2. A chain of custody form was prepared and is included with the laboratory reports.

3.3 Groundwater Analysis Results

The results of the previous and current groundwater investigation are presented in this section. As can be seen from table 3.4 the only exceedances for groundwater were observed in MW-1, MW-2 and MW-7. Since that time MW-1 has been re-sampled and the results show that benzene and F1 now meet both commercial and residential standards. However, the results for the F2 fraction of the petroleum hydrocarbons did not meet residential or commercial criteria. MW-2 and MW-7 were both destroyed during the soil remediation phase of the project.

Table 3.4: Groundwater Analytical Results

Sample Location	Date	Benzene (mg/L)	Toluene (mg/L)	Ethyl-benzene (mg/L)	Xylenes (mg/L)	F1 (mg/L)	F2 (mg/L)
MW-1*	12/19/01	16.4	3.26	1.07	11.8	85.3	4.4
MW-1*	10/19/03	1.65	.016	0.031	0.605	3.78	89
MW-2	12/19/01	FP	FP	FP	FP	FP	FP
MW-3	12/19/01	2.49	1.4	0.203	2.49	8.6	0.6
MW-4	12/19/01	0.516	0.083	0.001	0.581	1.97	1.2
MW-5	12/19/01	2.17	0.051	0.009	2.81	8.1	
MW-6	14/06/02	1.85	2.19	0.005	3.33	9.85	3.0
MW-7	14/06/02	6.41	9.54	0.239	8.01	42.4	3.5
MW-8*	14/06/02	0.001	<0.001	<0.005	0.004	0.05	<0.1
MW-9*	14/06/02	<0.001	<0.001	<0.001	<0.001	<0.01	<0.1
MW-10*	14/06/02	<0.001	<0.001	<0.001	<0.001	<0.01	<0.1

indicates concentration exceeds applicable remedial criteria

*Offsite criteria applies

FP = Free Product

4.0 SITE SPECIFIC RISK ANALYSIS

4.1 Risk Assessment Methodology

The methodology used to prepare this risk analysis is set forth in this section. A major aspect of risk analysis is the development of the site conceptual exposure scenario. This includes the identification of potential receptors and determination if the exposure pathway to said receptor is complete.

In order for an exposure pathway to be complete, the following criteria should be met:

1. The receptor must be present or close enough to the site to be at risk; and
2. A pathway must exist through which the contamination can migrate and be exposed to that receptor.

Once it is determined that the pathway is complete, site-specific data is obtained from the site. In many cases, site-specific data was not available, in which case default values were obtained from the Risk Based Corrective Action Standard (ASTM). The information was then input into the Oklahoma Risk Based Correctives Action Software to model potential exposure scenarios and quantify risk. This model is also based on the RBCA standard. These results were then compared to the AENV commercial and residential remediation criteria set forth in Section 2.0.

A list of potential human exposure pathways is shown in Table 4.1 below. Since most of the accessible impacted soil has been removed from the site, much of the risk has been removed (refer to Figure 2). However, there has been impact to groundwater beneath the building, which could result in potential vapour inhalation risk. Soil samples taken from beneath the building did not exceed AENV criteria.

Table 4.1: Site Conceptual Exposure Categories

Exposure Route Category	Resident child	Resident adult	Commercial Worker
Ingestion and Dermal contact with surficial soil	no	no	no
Indoor inhalation of vapors from surficial soil	no	no	no
Indoor inhalation of vapors from subsurface soil	no	no	no
Ingestion of shallow and deep groundwater	no	no	no
Indoor inhalation of vapors from shallow groundwater (<10 feet deep)	no	no	no
Indoor inhalation from deep groundwater (>10 feet deep)	no	no	yes
Dermal contact with shallow groundwater	no	no	no

Since the groundwater at the site is approximately 5 m below the ground surface, vapour inhalation from groundwater is unlikely but could be an exposure pathway. In addition, there is no impacted soil beneath either onsite or offsite buildings. The only remaining soil contamination onsite is on the south and on the southwest wall of the phase II soil excavation (refer to Figure 2). This soil was not removed since it is on the property line between the Barons Hardware site and the adjacent phase I excavation to the west, and caving was encountered. In addition, the contaminated soil on the adjacent property to the south (former Turbo property) was removed and remediated in 1999 (Seacorp, 1999). In either case the volume of impacted soil is very small since only a small amount of soil was not accessible for removal

There were soil concentrations located in the northeast portion of the phase II remediation pit that did exceed AENV residential inhalation values, but the location of that sample is such that it is now considered to fall under commercial criteria. In addition, this sample was also taken next to the former Turbo station site which was previously remediated.

Vapour inhalation by residents has been eliminated as a potential exposure pathway due to the following reasons:

1. The houses are located cross gradient from the site;
2. All accessible impacted soil has been removed, eliminating the source for impact;
3. With the exception of TPH fraction F2, all current site groundwater results comply with current AENV commercial and residential criteria.

For comparative purposes, additional site-specific risk was assessed for commercial workers. The Oklahoma Risk Based Corrective Action Model was used for this analysis. This model is based on the ASTM Standard E 1739. The results of this analysis are comparable to the AENV commercial criteria (refer to Appendix C). Therefore, Hasegawa Engineering recommends the site remedial criteria continue to be the AENV 2001 commercial standard. However, due to the vast amount of remediation at the site and the direction of groundwater flow, it is proposed that the offset where residential criteria apply be reduced to 20 metres. Accordingly, the remediation criteria at the site will not change, with the exception of the delineating boundary between commercial and residential criteria which will be moved 10 metres northward.

5.0 Risk Management Plan

The risk management plan is set forth in this section. The purpose of this plan is to provide a long-term risk management strategy for the site. To date, remedial activities at the site include:

1. Operation of a vapour extraction unit near the site building and road;
2. Excavation of all accessible impacted soil.

Due to these remedial activities the vast majority of the contamination onsite has been removed. There is no evidence of free product remaining onsite and, with the exception of MW-1, the concentrations of hydrocarbons in the groundwater are below AENV remedial criteria. The only remaining groundwater constituent observed above AENV criteria was hydrocarbon fraction F2 in MW-1

There are residences located to the north of the site but the groundwater gradient is towards the west and this was eliminated as a complete exposure pathway.

Based on the minimal risk at the site, the risk management plan proposes the following action be followed:

1. Install one (1) vapor monitoring well in the slab of the onsite building. The purpose of this well is to monitor vapours under the slab.
2. Monitor vapours in the well, and if concentrations of BTEX or TPH are below acceptable levels and the groundwater concentration does not increase, the monitoring should no longer be required.
3. Monitor groundwater in Monitoring wells MW-1, 3, 5, 9 and 10 annually for the next 3 years.

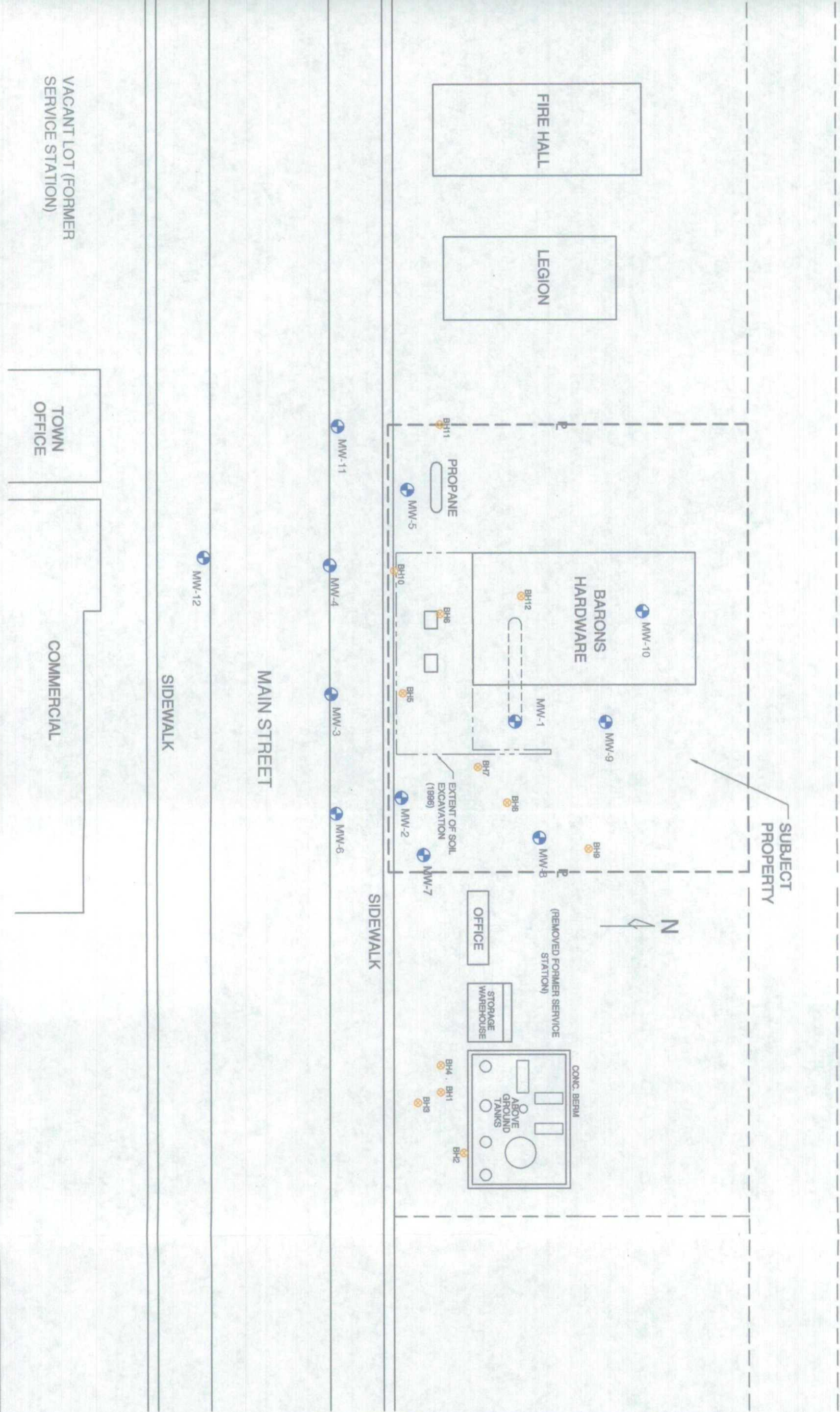
Unless vapours are detected in the vapour monitoring well located beneath the Barons Hardware building, no further remediation at the site should be warranted. The Risk Management Plan will be reviewed annually and modified if the results of the annual monitoring so indicate.

APPENDIX A

FIGURES

RESIDENTIAL
PROPERTIES

LEGEND
SOIL BORING
MONITORING WELL



Notes:

This is a copyright drawing and shall not be reproduced in any form without written permission of Engineer.

Contractor to check and verify all dimensions before construction, any errors and omissions reported to Engineer immediately.

Drawing not to be used for construction until so approved.

Do not scale Drawing.

All construction shall be in accordance with applicable codes, may it be construction, mechanical, etc. code.

No.	Revision	Date	By



LETHBRIDGE OFFICE
1220 - 31 Street North
Lethbridge Alberta T1H 5J8
Ph: 328-2686
Fax: 328-2728
email:hosgm@telusplanet.net

CALGARY OFFICE
201,2816-21 Street NE
Calgary Alberta T2E 6Z2
Ph: 250-5261

CLIENT
MARIE READ

PROJECT TITLE
BARONS
HARDWARE

DRAWING TITLE

AREA MAP

DESIGNER H.E.	PROJECT NO. 02009
DRAWN DMM	SCALE NTS
CHECKED H.E.	SHEET NO. FIG.1
APPROVED H.E.	
DRAWN OCT 29, 2003	

LEGEND
SOIL BORING
MONITORING WELL



RESIDENTIAL REMEDIATION CRITERIA
APPLIED NORTH OF THIS LINE
COMMERCIAL REMEDIATION CRITERIA
APPLIED TO SOUTH OF THIS LINE.

CONC. BERM

ABOVE
GROUND
TANKS

OFFICE

STORAGE
WAREHOUSE

TURBO PROPERTY
(FORMER SERVICE STATION)

PHASE 1
1996

PHASE 2
2003

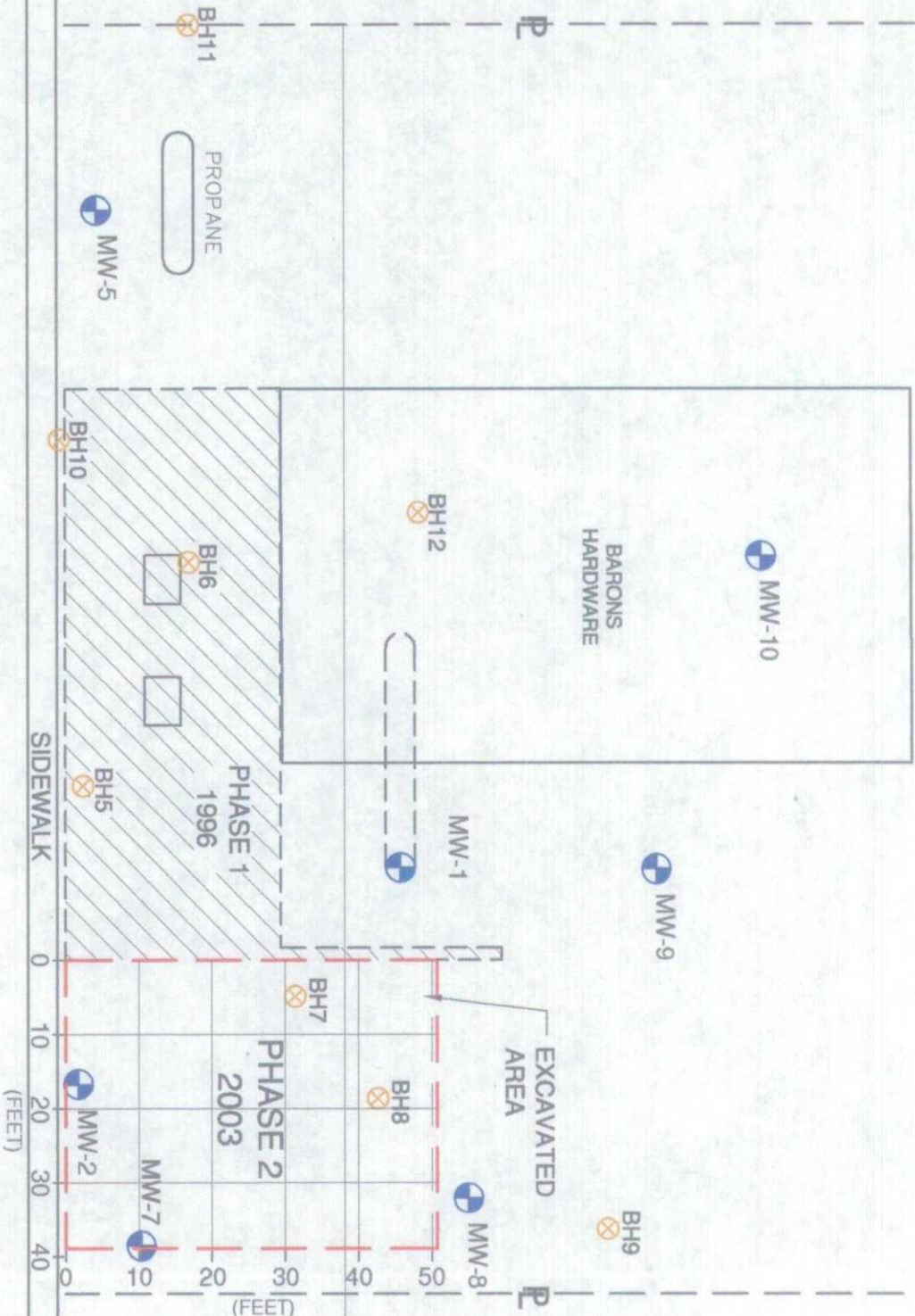
EXCAVATED
AREA

BARONS
HARDWARE

PROPANE

SIDEWALK

MAIN STREET



Notes:

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Do not scale Drawing.
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No	Revision	Date	By



LEITHBRIDGE OFFICE
1220 - 31 Street North
Lethbridge Alberta T1H 5J8
Ph: 328-2686
Fax: 328-2728
email: hasgm@telusplanet.net

CALGARY OFFICE
201,2816-21 Street NE
Calgary Alberta T2E 6Z2
Ph: 250-5261

CUSTOMER
MARIE READ

PROJECT TITLE
BARONS
HARDWARE

DRAWING TITLE

SITE MAP

DESIGNER H.E.	PROJECT NO. 02009
DRAWN DMM	SCALE NTS
CHECKED H.E.	CHECKED H.E.
DATE OCT 29, 2003	FIG. 2

APPENDIX B
ANALYTICAL REPORTS



Analytical Report

Norwest Labs
Bay 6, 2712-37 Avenue N.E.
Calgary, AB. T1Y-5L3
Phone: (403) 291-2022
Fax: (403) 291-2021

Bill to: Hasegawa Engineering Ltd.
Report to: Hasegawa Engineering Ltd.
1220 - 31 Street North
Lethbridge, AB, Canada
T1H 5J8
Attn. Mike Oler
Sampled By: Hasegawa Eng.
Company: Mike G.

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 264340
Control Number: E 124657
Date Received: Oct 17, 2003
Date Reported: Oct 23, 2003
Report Number: 470202

Page: 1 of 2

NWL Number 264340-1
Sample Date Oct 17, 2003
Sample Description MW-1 S1
Matrix Water - General

Analyte	Units	Results	Results	Results	Detection Limit
Mono-Aromatic Hydrocarbons - Water					
Benzene	mg/L	1.65			0.001
Toluene	mg/L	0.016			0.001
Ethylbenzene	mg/L	0.031			0.001
Total Xylenes (m,p,o)	mg/L	0.605			0.001
Volatile Petroleum Hydrocarbons - Water					
F1 C6-C10	mg/L	3.78			0.01
F1-BTEX	mg/L	1.48			0.01
Extractable Petroleum Hydrocarbons - Water					
F2 C10-C16	mg/L	89.0			0.1
F3 C16-C34	mg/L	27.9			0.1

Approved by:

Heather Gordon, c BST
Operations Manager

Received Time Oct.23. 1:27PM



Methodology and Notes

Norwest Labs
Bay 6, 2712-37 Avenue N.E.
Calgary, AB. T1Y-5L3
Phone: (403) 291-2022
Fax: (403) 291-2021

Bill to: Hasegawa Engineering Ltd.
Report to: Hasegawa Engineering Ltd.
1220 - 31 Street North
Lethbridge, AB, Canada
T1H 5J8
Attn: Mike Oler
Sampled By: Hasegawa Eng.
Company: Mike G.

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 264340
Control Number: E 124657
Date Received: Oct 17, 2003
Date Reported: Oct 23, 2003
Report Number: 470202

Page: 2 of 2

Method of Analysis:

MethodName	Reference	Method	Date Analysis Started	Location
BTEX-CCME - Water	Alta. Env. Method	Hydrocarbon Soil and Water Quality Guidelines, C51260500	22-Oct-03	Norwest Labs Calgary
TEH-CCME - Water	Alta. Env. Method	Hydrocarbon Soil and Water Quality Guidelines, C51260500	23-Oct-03	Norwest Labs Calgary

* Norwest method(s) is based on reference method

References:

Alta. Env. Method Alberta Environment Method

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

Received Time Oct.23. 1:27PM



NORWEST LABS

264340

fridge

Control Number **E 124657**

Environmental Sample Information Sheet

NOTE: Proper completion of this form is required in order to proceed with analysis
See reverse for your nearest Norwest location and proper sampling protocol

Billing Address:		Copy of Report To:		Copy of Invoice:	
Company: <u>Hasegawa Eng.</u>		Company:		Mail invoice to this	
Address: <u>1220 31 St N.</u>		Address: <u>Same as billing</u>		address for approval ☐	
<u>Leh. AB T1H 5J8</u>					
Attention:		Report Result:		Report Result:	
Phone: <u>328-2686</u>		Fax ☒		Fax ☐	
Fax: <u>328-2728</u>		Mail ☒		Mail ☐	
Cell:		Courier ☐		Courier ☐	
e-mail:		e-mail ☐		e-mail ☐	

Information to be Included on Report and Invoice	Project ID:	RUSH Please contact the laboratory to confirm rush dates and times before submitting samples. Upon filling out this section, client accepts that surcharges will be attached to this analysis Required on: all analyses or as indicated ☐ or ☐ Date Required: _____ Signature: _____ Norwest Authorization: _____	Sample Custody (Please Print)	
	Project Name:		Sampled by: <u>Mike Gier</u> Date <u>10/17/03</u>	
	Project Location:		Company <u>Hasegawa</u> Signature <u>[Signature]</u>	
	Legal Location:		ReInquished by:	
	PO#:		Company _____ Date _____	
Proj. Acct Code:		Waybill number:		
Agreement ID:		Received by: <u>[Signature]</u>		
		Company <u>Norwest</u> Date <u>Oct. 17/03</u>		

Special Instructions / Comments ☐ Check here if Norwest is required to report results directly to a regulatory body (Please include contact information)

Sample Identification	Location	Depth	Date / Time Sampled	Matrix	Sampling Method	Number of Containers											
						Enter tests above (✓ relevant samples below)											
1 MW-1 S1		IN CM M				✓											
2 MW-2 S2						✓											
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

NOTE: All hazardous samples must be labelled according to WHMIS guidelines.
Accredited by the Standards Council of Canada for specific tests

Page ____ of ____
##

APPENDIX C

RISK ANALYSIS RESULTS

SITE CONCEPTUAL EXPOSURE SCENARIO					
Exposure Route, Medium, and Exposure Point	RESIDENT CHILD	RESIDENT ADULT	COMMERCIAL WORKER	CONSTRUCTION WORKER	
Ingestion and Dermal contact with surficial soil	☐	☐	☐	☐	
Indoor inhalation of vapors from surficial soil	☐	☐	☐	NA	
Indoor inhalation of vapors from sub-surface soil	☐	☐	☒	NA	
Ingestion of shallow & deep groundwater	☐	☐	☐	NA	
Indoor inhalation of vapors from shallow groundwater	☐	☐	☒	NA	
Dermal contact with shallow groundwater	NA	NA	NA	☐	

* For construction workers, the first pathway includes indoor inhalation of vapor emissions from sub-surface soils

NA : Not Applicable

CHEMICAL-SPECIFIC TOXICITY PARAMETERS				
CHEMICAL	SLOPE FACTOR		REFERENCE DOSE	
	ORAL [1/(mg/kg-day)]	INHALATION [1/(mg/kg-day)]	ORAL (mg/kg-day)	INHALATION (mg/kg-day)
Benzene	0.029	0.029	NA	NA
Toluene	NA	NA	0.2	0.11
Ethylbenzene	NA	NA	0.1	0.29
Xylenes (mixed)	NA	NA	2	0.086
Naphthalene	NA	NA	0.04	0.003

Note: For dermal exposure, oral toxicity values were used.

CHEMICAL-SPECIFIC FATE AND TRANSPORT PARAMETERS						
CHEMICAL	Koc [cm ³ /g]	Kd [cm ³ /g]	H [cc-H ₂ O/cc-air]	S [mg/l]	Dair [cm ² /s]	Dwater [cm ² /s]
Benzene	38.02	0.87446	0.22	1750	0.093	0.000011
Toluene	134.9	3.1027	0.26	535	0.085	0.0000094
Ethylbenzene	1288.25	29.62975	0.32	152	0.076	0.0000085
Xylenes (mixed)	239.88	5.51724	0.29	198	0.072	0.0000085
Naphthalene	1288.25	29.62975	0.049	31	0.072	0.0000094

Definition of Symbols

Koc : Organic carbon partition coefficient

Kd : Soil-water partition coefficient

H : Normalized Henry's constant

Note: $Kd = Koc \times f_{oc}$ (from Fate and Transport Input Table)

S : Solubility

Dair : Diffusion coefficient in air

Dwater : Diffusion coefficient in water

FATE AND TRANSPORT FACTORS

	UNITS	VALUE USED	Tier 1 (Default Values)	SOURCE
Source parameters				
Depth to groundwater	cm	500	304.8	Site Specific Value
Depth to surficial soil sources	cm	30.48	30.48	Tier 1 Value
Depth to subsurface soil sources	cm	500	304.8	Site Specific Value
Building parameters				
Height of the indoor space (Building)				
On/Off-site Resident (adult and child)	cm	300	300	Tier 1 Value
On-site Commercial Worker	cm	300	300	Tier 1 Value
Construction Worker	cm	300	300	Tier 1 Value
Width of the indoor space (Building)	cm	1500	1500	Tier 1 Value
Length of the indoor space (Building)	cm	3000	1500	Site Specific Value
Fraction of area exposed by cracks	--	0.01	0.01	Site Specific Value
Enclosed space air exchange rate				
On/Off-site Resident (adult)	1/day	12	12	Tier 1 Value
On/Off-site Resident (child)	1/day	12	12	Tier 1 Value
On/Off-site Commercial Workers	1/day	18	18	Tier 1 Value
Construction Workers	1/day	12	12	Tier 1 Value
Averaging time for vapor flux				
On/Off-site Resident (adult)	sec	9.46E+08	9.46E+08	Tier 1 Value
On/Off-site Resident (child)	sec	1.89E+08	1.89E+08	Tier 1 Value
On/Off-site Commercial Workers	sec	7.88E+08	7.88E+08	Tier 1 Value
Construction Workers	sec	3.15E+07	3.15E+07	Tier 1 Value
Groundwater parameters				
Groundwater Darcy velocity	cm/year	2500	2500	Tier 1 Value
Groundwater mixing zone thickness	cm	200	200	Tier 1 Value
Soil parameters				
Total soil porosity	cc/cc	0.35	0.35	Tier 1 Value
Volumetric water content in vadose zone soils	cc/cc	0.20	0.20	Tier 1 Value
Volumetric air content in vadose zone soils	cc/cc	0.15	0.15	Tier 1 Value
Soil bulk density	g/cc	1.7	1.7	Tier 1 Value
Fraction organic carbon content in soil	g-C/g-soil	0.023	0.01	Site Specific Value
Other parameters				
Particulate emission rate	g/cm ² -s	6.90E-09	6.90E-09	Tier 1 Value
Wind speed above ground surface in ambient mixing zone	cm/s	225	225	Tier 1 Value
Width of source parallel to wind direction	cm/yr	1500	1500	Tier 1 Value
Ambient air mixing zone height	cm	200	200	Tier 1 Value

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EXPOSURE FACTORS				
	UNITS	VALUE USED	Tier 1 (Default Values)	SOURCE
Body Weight				
On/Off-site Resident (adult)	kg	70	70	Tier 1 Value
On/Off-site Resident (child)	kg	15	15	Tier 1 Value
On/Off-site Commercial Workers	kg	70	70	Tier 1 Value
Construction Worker	kg	70	70	Tier 1 Value
Exposure Duration				
On/Off-site Resident (adult)	yr	30	30	Tier 1 Value
On/Off-site Resident (child)	yr	6	6	Tier 1 Value
On/Off-site Commercial Workers	yr	25	25	Tier 1 Value
Construction Worker	yr	0.083	0.083	Tier 1 Value
Exposure Time for indoor inhalation, dermal contact, and soil ingestion				
On/Off-site Resident (adult)	hrs/day	16	16	Tier 1 Value
On/Off-site Resident (child)	hrs/day	16	16	Tier 1 Value
On/Off-site Commercial Workers	hrs/day	8	8	Tier 1 Value
Construction Worker	hrs/day	8	8	Tier 1 Value
Exposure Time for dermal contact with water				
Construction Worker	hrs/day	8	8	Tier 1 Value
Exposure Frequency				
On/Off-site Resident (adult and child)	days/yr	350	350	Tier 1 Value
On-site Commercial Worker	days/yr	250	250	Tier 1 Value
Construction Worker	days/yr	250	250	Tier 1 Value
Soil ingestion rate				
On/Off-site Resident (adult)	mg/day	100	100	Tier 1 Value
On/Off-site Resident (child)	mg/day	200	200	Tier 1 Value
On/Off-site Commercial Worker	mg/day	50	50	Tier 1 Value
Construction Worker	mg/day	50	50	Tier 1 Value
Daily Indoor Inhalation Rate				
On/Off-site Resident (child)	m ³ /hr	0.937	0.937	Tier 1 Value
On/Off-site Resident (adult)	m ³ /hr	0.937	0.937	Tier 1 Value
On/Off-site Commercial Worker	m ³ /hr	2	2	Tier 1 Value
Construction Workers	m ³ /hr	2	2	Tier 1 Value
Daily Outdoor Inhalation Rate				
Construction Workers	m ³ /hr	2	2	Tier 1 Value
Exposure Time for outdoor inhalation, dermal contact, and soil ingestion				
On/Off-site Resident (adult)	hrs/day	16	16	Tier 1 Value
On/Off-site Resident (child)	hrs/day	16	16	Tier 1 Value
On/Off-site Commercial Workers	hrs/day	8	8	Tier 1 Value
Construction Worker	hrs/day	8	8	Tier 1 Value
Daily water ingestion rate				
On/Off-site Resident (adult)	L/day	2	2	Tier 1 Value
On/Off-site Resident (child)	L/day	1	1	Tier 1 Value
On/Off-site Commercial Workers	L/day	1	1	Tier 1 Value
Construction Workers	L/day	1	1	Tier 1 Value
Skin surface area for dermal contact with soil				
On/Off-site Resident (adult)	cm ²	3160	3160	Tier 1 Value
On/Off-site Resident (child)	cm ²	3160	3160	Tier 1 Value
On/Off-site Commercial Workers	cm ²	3160	3160	Tier 1 Value
Construction Worker	cm ²	3160	3160	Tier 1 Value
Soil skin adherence factor	mg/cm ²	0.5	0.5	Tier 1 Value
Oral relative absorption factor	---	1	1	Tier 1 Value
Dermal relative absorption factor (volatiles)	---	0.5	0.5	Tier 1 Value
Dermal relative absorption factor (PAHs)	---	0.05	0.05	Tier 1 Value
Target Risk and Hazard Quotient				
Target Hazard Quotient (THQ)	---	1	THQ = 1 for both Current and Future Conditions	
Target Excess Individual Lifetime Cancer Risk (TR)	---	1.00E-06	TR = 10 ⁻⁶ for Current and 10 ⁻⁴ for Future Conditions	

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SUMMARY TABLE
TIER 1-A MODIFIED RISK-BASED SCREENING LEVELS
CURRENT CONDITIONS RECEPTOR-COMMERCIAL WORKER

CHEMICAL	Surficial Soil (<2 ft. deep)		Sub-Surface Soil (>2 ft. deep) Indoor Inhalation (mg/kg)	Shallow GW (<10 ft. bgs) Indoor Inhalation (mg/l)	Deep GW (>10 ft. bgs) Ingestion (mg/l)
	Ingestion+ Dermal (mg/kg)	Indoor Inhalation (mg/kg)			
Benzene	NC	NC	11 574	12 788	NC
Toluene	NC	NC	1735.159	535 000	NC
Ethylbenzene	NC	NC	4525.896	152.000	NC
Xylenes (Mixed)	NC	NC	1120 774	198 000	NC
Naphthalene	NC	NC	922 303	31 000	NC

NC = Incomplete Pathway

* Indicates Tier 1-A modified RBSLs exceeded saturated soil concentration and hence saturated soil concentration is listed as Tier 1-A modified RBSLs

Indicates Tier 1-A modified RBSLs exceeded pure component water solubility and hence water solubility is listed as Tier 1-A modified RBSLs