Risk Management, Remediation Plan and Cost Estimate for Barons Hardware

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

PREPARED FOR:
ASR Enterprises
Box 267
Irma, Alberta

PREPARED BY:
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Agricultural
Structural
Civil
Municipal

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November 20, 2002

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

Dear Mrs. Read,

Re: Risk Management, Remediation Plan and Cost Estimate for Barons Hardware

As per your request, Hasegawa Engineering has developed a remediation plan and cost estimate for Baron Hardware at 214 Main Street, Site 5102 Plan 2605X Block 6 Lot 28 to 35 Barons, Alberta.

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

Yours truly,

PROFESSIONAL ENGINEER ALBERTA
MARK A. HASEGAWA

Mark Hasegawa, P.Eng.
HASEGAWA ENGINEERING
Consulting Professional Engineers

Executive Summary

The following is a document comparing options for remedial actions at the Baron Hardware site. Based on site condition, two remedial criteria were applied to the site using onsite (commercial) and offsite (residential) criteria for soil and groundwater. Residential criteria was applied to the north 30 meters of the property following this application of multiple zoning on site. The area of contamination is adjacent to a former Turbo site where contamination was present and the gradient is towards the south and west. It appears the contamination on site originated from the Turbo property.

The estimated volume of soil to be excavated from the site is 1170 m^3, of which 702 m3 of that is contaminate above Alberta Environment standards (AENV). The total volume of water to be treated is estimated to be 564 m^3. The dilute or groundwater plume extends over both the onsite and offsite zones and therefore must be treated according to the respective remedial criteria.

The soil remediation options are somewhat limited as a result of the silty clay properties of the soil and the relatively small size of the soil plume impacted above AENV standards. As a result, the remedial options considered included soil excavation and either land farming onsite or disposal in a landfill.

The dilute plume treatment at this site is complex due to the presence of a building over much of the plume and the fine nature of the subsurface soils, and additional delineation has been proposed south and southwest of MW-4. Therefore, the remedial options considered included:

- Modification of the existing soil vapor extraction system to act as a dual phase extraction system;
- Design injection of an oxidant to mineralize contaminants;
- Enhanced bioremediation of contaminants; or
- Risk Assessment

Based on available site information and cost it appears remedial options for the site are to land farm the contaminated soil onsite for soil remediation, and to inject an oxidant into the subsurface for groundwater remediation. The use of oxidant will be contingent on the results of bench scale tests confirming the feasibility of the process. An alternative to groundwater remediation is the preparation for a Risk Assessment.

Table of Contents

1. Introduction

Hasegawa Engineering was retained by Mrs. Marie Read of Edmonton, Alberta to develop a remediation plan for the contaminated are on the property at Site 5102 Plan 2605X Block 6 Lot 28 to 35 (currently 214 Main Street) Barons, Alberta. The remediation plan will establish the most effective and cost efficient actions available to remediate the contaminated areas of soil and groundwater on the property.

The area of contamination is located adjacent to a former Turbo site where contamination was present. Since the gradient is towards the south and west it appears the contamination at the site originated from the Turbo property. The locations of the monitoring wells and proposed monitoring wells are shown in Figure 1 in Appendix A.

2. Extent of Impact

The remedial criteria for soil and groundwater for the site was set using onsite (commercial) and offsite (residential) criteria. Residential criteria was applied to the north 30 meters of the property following the application of multiple zoning onsite.

Soil contamination onsite covers an area of approximately 180 m^2 and extends to a depth of about 5 m, with an uncontaminated overburden in the upper 2 m. The total estimated volume of soil to be excavated is 1170 m^3, of which 702 m^3 of that is above AENV standards. A site map showing the extent of the soil contamination is on Figure 2 in Appendix A.

The contaminated groundwater covers an area of approximately 403 m^2 to a depth of about 4 m. The total estimated volume of water to be treated is 564 m^3 (assumes a porosity of 0.35). The groundwater plume extends over both the onsite and offsite zones and therefore must be treated according to respective remedial criteria. A site map showing the extent of the groundwater contamination is on Figure 3 in Appendix A.

Additional delineation has been proposed to include the area south and southwest of MW-4, which will be monitored for natural attenuation.

3. Risk Management Criteria

The Supplementary Phase III Assessment (Hasegawa 2002) determined applicable remediation levels for the site 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 scope of this document allows only for the application of generic cleanup criteria for the site. If it is determined that a site-specific risk assessment is appropriate for the site, that work will be completed under a separate scope.

Site remediation criteria have been established using the draft remediation criteria set forth in 1994. However, as new work has been completed at the site it was determined that the new criteria should be applied.

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 uses 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 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.

Table 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 Phase II investigation reported the soil was classified as fine grained, with 73.6% of the soil fraction being smaller than 75µm. Therefore, based on the information listed in Table 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. 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 proposed remediation levels for the site are summarized in Table 3.

Table 3: Proposed 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

4. Remediation and Risk Management Options

All remediation options and information has been given to the Village and is pending their acceptance.

4.1. Soil/Source Zone

Since the soil beneath the site consists of glacial till and silty clay (Hasegawa, 2002) and the size of the soil plume impacted above AENV standards is relatively small, the options for soil remediation are somewhat limited. As a result, the remedial options considered for this site are:

- Soil is excavated and land farmed onsite; or
- Soil is excavated and hauled to a landfill site for proper disposal.

Land farming (onsite treatment) involves the excavation of both the uncontaminated overburden and contaminated soil. The contaminated soil would be separated and then spread 2 m high on a liner placed at the site and treated using an Alu bucket attached to an excavator. The soil would then be sampled and analyzed to determine effectiveness. Once the soil meets criteria, the soil would be replaced in the excavation.

The disposal of the soil to a landfill site also involves the excavation of both the contaminated and uncontaminated soils. The contaminated soil is separated and then hauled to a landfill site. Disposal costs are based on tones. Removing the soil and transporting it to a regional landfill site is costly and after the soil has been submitted to the landfill it cannot be used again.

4.2. Groundwater/Dilute Plume

Due to the presence of a building over much of the groundwater plume, the plume extending into the road and the fine nature of the subsurface soils, the treatment of groundwater at this site will be complex. Therefor, in-situ remedial options considered for this site include:

- Modification of the existing soil vapor extraction system to act as a dual phase extraction system;
- Injection of an oxidant to mineralize contaminants;
- Enhanced bioremediation of contaminants; or
- Risk Assessment once all source material is removed

Technology descriptions of the oxidation and bioremediation processes are included in Appendix B. Also, additional delineation is required south and southwest of MW-4 and will be monitored for natural attenuation, which has been discussed with the Village of Barons. Once an agreement has been developed, HE expects to receive a letter from the Village accepting this option.

5. Cost Estimates of Remedial Options

Summaries of estimated costs for each remedial action are included in the following tables. These estimates are based on the assumption that the subsurface conditions at the site are as shown in the Phase III site assessment.

5.1. Soil/Source Zone

The land farming treatment (Table 4) saves on both the costs of transportation and disposal. The disposal in a landfill (Table 5) costs more than the entire land farming treatment process. The City of Lethbridge Region Landfill was chosen for the disposal, as it is the nearest facility that would accept contaminated soil.

Table 4: Soil excavation and onsite treatment

Item	Unit Cost	Amount	Total
Excavation	$4/m^3	1170 m^3	$4,680
Stage clean soil	$4/m^3	468 m^3	$1,872
Liner for treatment area	$10/m^2	351 m^2	$3,510
Soil treatment	$15/m^3	702 m^3	$10,530
Soil replacement	$4/m^3	702 m^3	$2,808
Confirmatory Sampling	$12 each	300	$3,600
Site Supervision	$5,200	1	$5,200
Project Management and Reporting	$95/hour	40	$3,800
Sidewalk replacement	$15/ft^2	100 ft^2	$1,500
Regrading	$2/m^2	200 m^2	$400
Total Cost			**$37,900**

Table 5: Soil excavation and haul to landfill

Item	Unit Cost	Amount	Total
Excavation	$4/m^3	1170 m^3	$4,680
Stage clean soil	$4/m^3	468 m^3	$1,872
Haul Contaminated soil	$7/m^3	702 m^3	$4,914
Soil Disposal	$60/m^3	702 m^3	$42,120
Soil replacement (minimal compaction)	$5/m^3	702 m^3	$3,510
Confirmatory Sampling	$300/m^3	12 m^3	$3,600
Site Supervision	$5,200	1	$5,200
Project Management and Reporting	$95/hour	40	$3,800
Sidewalk replacement	$15/ft^2	100 ft^2	$1,500
Regrading	$2/m^2	200m^2	$400
Total Cost			**$71,596**

5.2. Groundwater/Dilute Plume

Even if soil remediation is used to mitigate most of the soil plume, there is still impacted above AENV standards beneath the building and in the road. This plume could be remediated by implementing one of the following options:

- Oxygen injection (Fenton's Reaction);
- Enhanced bioremediation;
- Dual phase extraction; or
- Risk Assessment.

Use of a low chemical oxidant to degrade BTEX (benzene, toluene, ethyl-benzene and xylene) in-situ, eliminates the excavation task and reduces cost. In addition, the degradation rates of BTEX are quite rapid (within a few hours for complete decomposition) which reduces the remediation time frame compared to conventional dual phase extraction. Complete plume remediation in many cases is prevented due to some limiting factor such as lack of nutrients or bacteria, which could be added to facilitate bioremediation. There is also an existing soil vapor extraction system onsite, which could be converted to a dual phase extraction system for groundwater remediation. Finally, a risk assessment could be conducted to evaluate appropriate site-specific remediation standards at the site.

The outlines of cost estimates for groundwater remediation options are included in Table 6. For additional details on cost, please refer to Appendix C.

Table 6: Estimated costs for dilute plume remediation

Remediation Option	Estimated Cost
Oxidant injections	$38,020
Enhanced Bioremediation	$33,520
Dual Phase Extraction	$47,520
Risk Assessment	$8,500

6. Conclusions and Recommendations

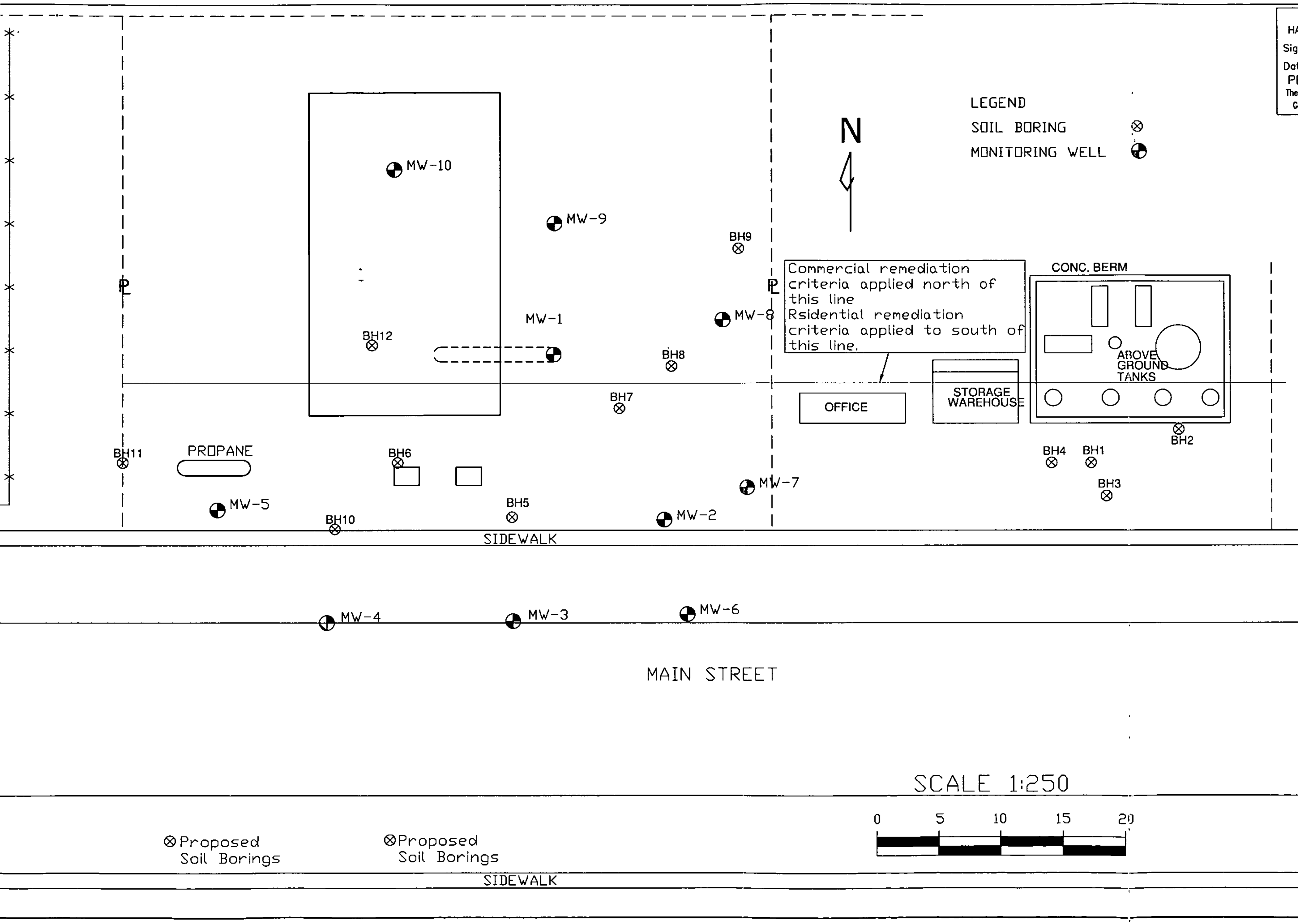
Considering costs of the methods available for the remediation of the contaminated area of soil and groundwater, it was concluded that the most effective and cost efficient remedial options are:

1. Excavate and land farm accessible soil onsite
2. Evaluate oxidation for application beneath the building at the site.
3. If feasible, apply oxidation to the remainder of the impacted soil and groundwater beneath building onsite
4. If oxidation is not feasible, conduct a risk assessment to establish site specific remediation standards at the site and perform monitored natural attenuation for a risk management strategy if needed.
5. Conduct monitored natural attenuation and monitor groundwater for impacted soil in right of way near MW-4.

The estimated cost for the proposed option is $78,920.

Appendix A

Figures



PERMIT TO PRACTICE
HASEGAWA ENGINEERING LTD.

Signature ____________

Date ____________

PERMIT NUMBER: P 582

The Association of Professional Engineers, Geologists and Geophysicist of Alberta

PROFESSIONAL ENGINEER MARK HASEGAWA ALBERTA

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No.	Revision	Date	By

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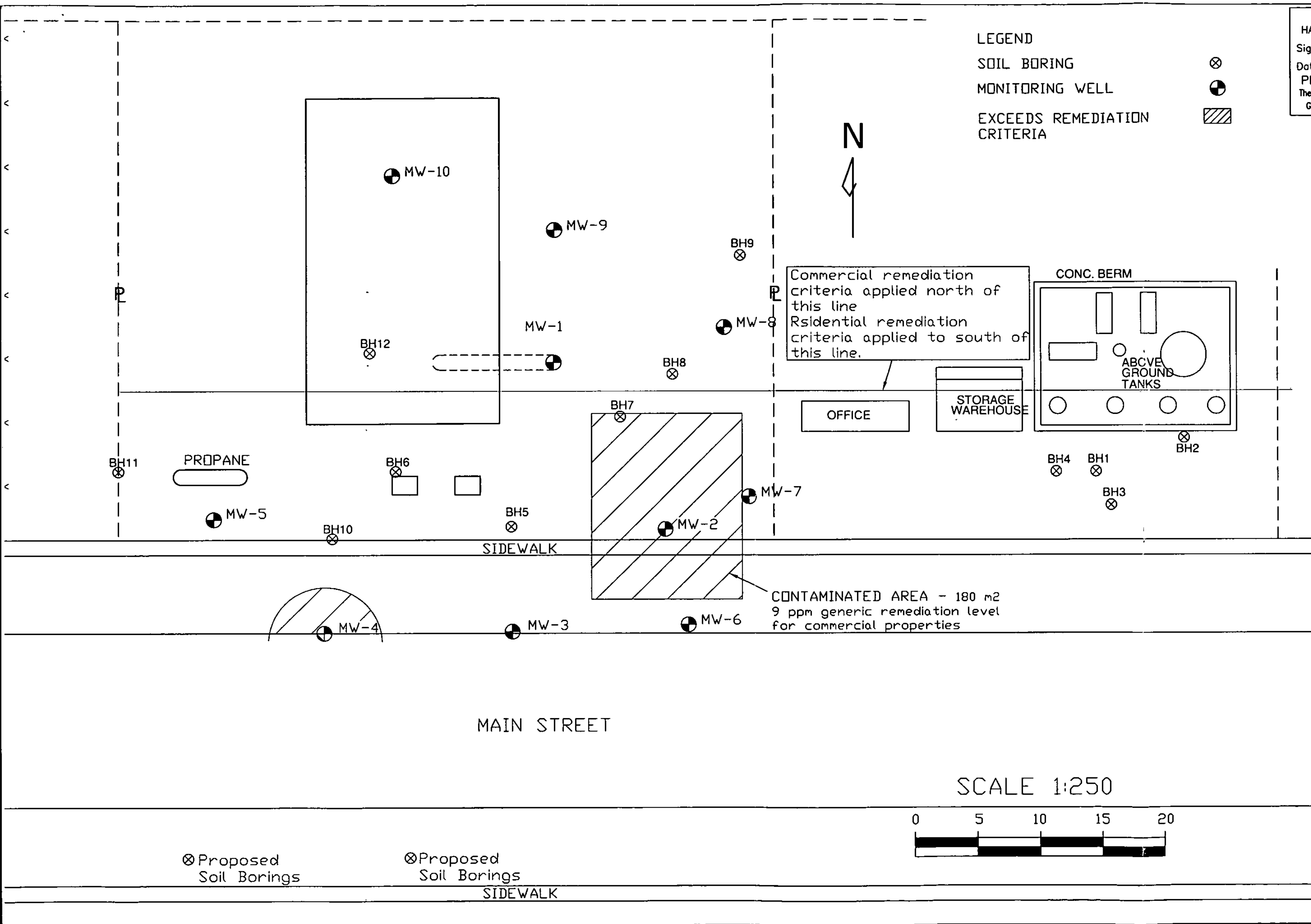
CALGARY OFFICE
201,2816-21 Street NE
Calgary Alberta T2E 6Z2
Ph: 250-5261

CLIENT: MARIE READ

PROJECT TITLE: BARONS HARDWARE

DRAWING TITLE: Well Locations

DESIGN: H.E.	PROJECT NO.: 01-009
DRAWN: CG	SCALE: AS SHOWN
CHECKED: H.E.	SHEET NO.: FIG.1
APPROVED: H.E.	
DATE DRAWN: October 10, 2002	



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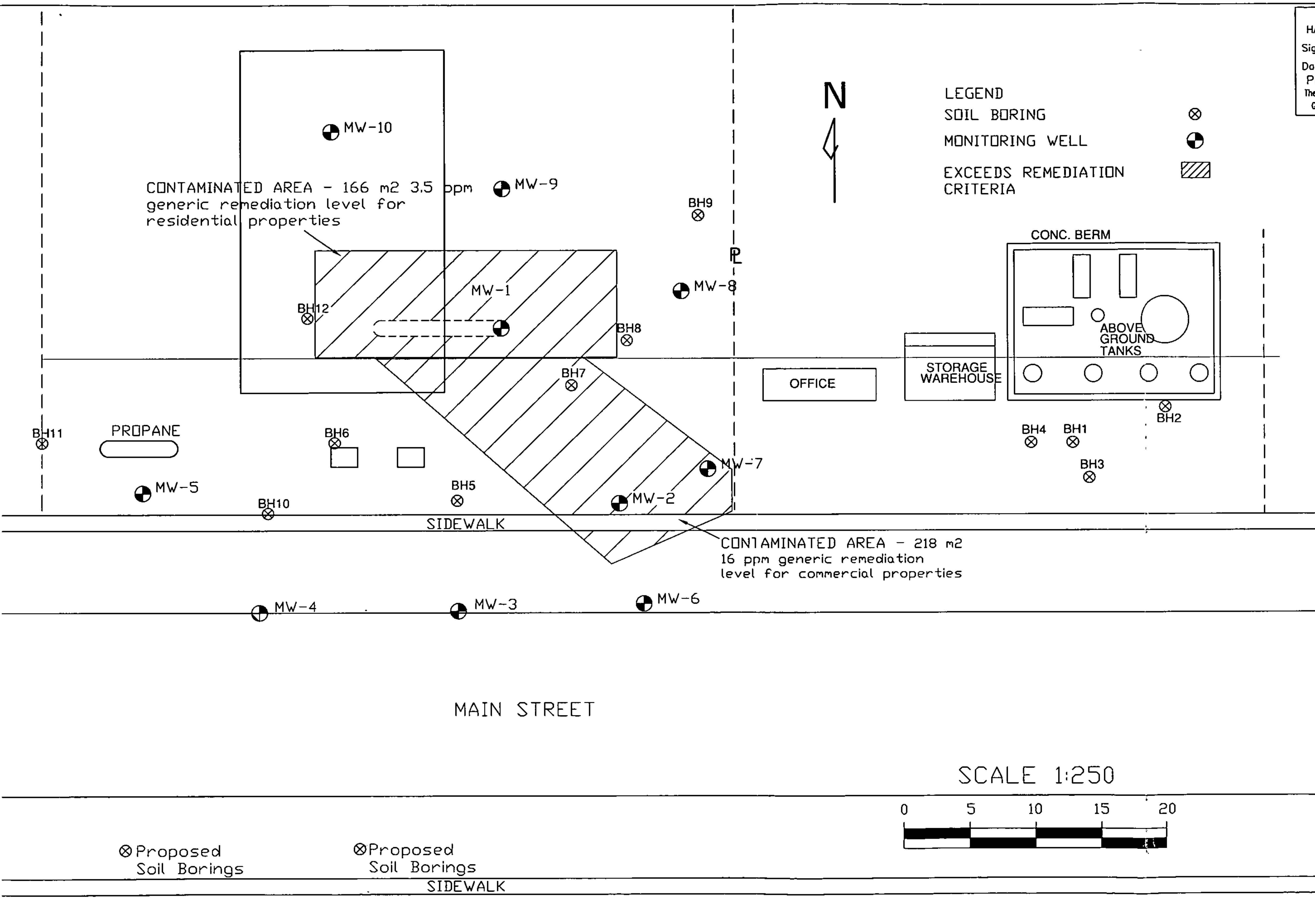
CLIENT: MARIE READ

PROJECT TITLE: BARONS HARDWARE

DRAWING TITLE: Soil Contamination Area

DESIGN: H.E.	PROJECT NO. 01-009
DRAWN: DMM	
CHECKED: H.E.	SCALE: AS SHOWN
APPROVED: H.E.	SHEET NO. FIG.2
DATE DRAWN: July 32, 2002	



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No	Revision	Date	By

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CLIENT: MARIE READ

PROJECT TITLE: BARONS HARDWARE

DRAWING TITLE: Groundwater Contamination Area

DESIGN: H.E.	PROJECT NO.: 01-009
DRAWN: DMM	
CHECKED: H.E.	SCALE: AS SHOWN
APPROVED: H.E.	SHEET NO.: FIG. 3
DATE DRAWN: Novemeber 18, 2002	

Appendix B

Technology Descriptions

Oxidation

Recently in-situ chemical oxidation has been proven as a viable remedial technology for remediation of soil and groundwater contaminated by various pollutants, including chlorinated solvents, petroleum hydrocarbons, and chlorinated aromatic pesticides. The two most common oxidizing agents used for in-situ chemical oxidation are hydrogen peroxide and potassium permanganate. Injection of hydrogen peroxide is typically combined with an iron catalyst under reduced pH conditions to generate powerful hydroxyl radicals (called Fenton's reaction). Since 1934, Fenton's Reagent has been recognized as an effective means for destroying organic compounds in wastewater and most recently as an in-situ treatment method for soil and groundwater. Fenton's Reagent is typically prepared using a solution of hydrogen peroxide, sulfuric acid, and ferrous sulfate heptahydrate. The dissolved iron acts as a catalyst for generating the hydroxyl radical, resulting in free-radical oxidation of the contaminant. In order to keep the iron in the ferrous state, a low pH needs to be maintained. The reaction can be performed successfully at a pH range between 5 and 7, but the optimal pH ranges are from 3 to 5. Obtaining the optimal subsurface pH condition is often limited by the soil buffering capacity, which is site-specific.

Potassium permanganate oxidation creates little heat or gas, therefore contaminant treatment occurs primarily through oxidation. Potassium permanganate is an oxidizing agent with a unique affinity for organic compounds containing carbon-carbon double bonds, aldehyde groups or hydroxyl groups. Under normal subsurface pH and temperature conditions, the primary oxidation reaction for chloroethenes involves spontaneous cleavage of the carbon-carbon bond. Once this double bond is broken, the highly unstable carbonyl groups are immediately converted to carbon dioxide through either hydrolysis or further oxidation by permanganate ion.

Selection of the proper oxidant is based on several factors (i.e., contaminant characteristics, site geochemical conditions, soil buffering conditions of site, etc.). Fenton's reagent is capable of oxidizing a wide range of compounds while potassium permanganate is more selective. However, potassium permanganate often provides more rapid destruction for specific compounds when compared to Fenton's reagent. The reaction process and potential by-products for both oxidants differ considerably. This treatability study will focus on the degradation of gasoline - mainly BTEX contaminants found at the targeted UST site.

With proper design, chemical oxidation would have the capability to degrade the compound completely without extracting the fluid for above-ground treatment. A strong oxidant, such as Fenton's Reagent, could be injected into a newly installed or pre-existing well to treat the targeted area. Surbec has developed a process of using a low Fenton's Reagent concentration to treat various contaminants, including chlorinated solvents and BTEX. Use of a low chemical oxidant, like Fenton's Reagent or permanganate, to degrade BTEX in-situ, will eliminate the excavation task and reduce the total project cost. In addition, the degradation rates of BTEX using these oxidants are quite rapid (within few hours for complete decomposition) which will reduce the remediation time frame compared to conventional dual phase extraction or other traditional remedial technologies

Bioremediation

Enhanced bioremediation is a technology commonly used to remediate dilute BTEX plumes. Many times complete plume bioremedaition is prevented due to some limiting factor. Once the limiting factor is identified it can be added to allow complete mineralization of the plume. Many times the limiting factor is depletion of the electron donors which could include: Oxygen, sulfate, iron or carbon dioxide. Other limiting factors could include lack of nutrients, or bacteria. In most cases the bacteria exists in the subsurface but needs the proper conditions to grow.

Appendix C

Groundwater Cost Estimates

Dual Phase Extraction System

Labour

Category	Level	Rate	Quantity	Total
	Senior Professional	$101/hr	10	$1,010
	Project Professional	$83/hr	20	$1,660
	Project Scientist	$75/hr	40	$3,000
	Staff Engineer	$53/hr	60	$3,180
	Technician	$42/hr	60	$2,520
	Administrative Assistant	$30/hr	10	$300
	Clerical Support	$23/hr	10	$230
			Subtotal 1	**$11,900**

ODC

Category	Level	Rate	Quantity	Total
Misc. Equipment		$2,000 mo	1	$2,000
Modify existing system	2 tanks/month	$2,000 tot	1	$2,000
New blower		$5,000 ea	1	$5,000
Piping		$4,000 ls	1	$4,000
Air Stripper		$10,000 ea	1	$10,000
			Subtotal 2	**$23,000**

Travel

Category	Level	Rate	Quantity	Total
Mileage	Car	$0.31 km	1000	$310
Mileage	Field vehicle	$0.31 km	1000	$310
Lodging		$85 day		$
Meals		$35 day		$
Air		$400 ea		$
Auto rental		$50 ls		$
Other		LS		$
			Subtotal 3	**$620**

Subcontracts

Category	Contractor	Rate	Quantity	Total
Wells		$2,000 ea	4	$8,000
Electrical Contractor		$4,000 ls	1	$4,000
Subtotal 4				**$12,000**
			0%	**$0**
			Total	**$47,520**

Oxidant Injection

Labour

Category	Level	Rate	Quantity	Total
	Senior Professional	$101/hr	10	$1,010
	Project Professional	$83/hr	20	$1,660
	Project Scientist	$75/hr	40	$3,000
	Staff Engineer	$53/hr	60	$3,180
	Technician	$42/hr	60	$2,520
	Administrative Assistant	$30/hr	10	$300
	Clerical Support	$23/hr	10	$230
			Subtotal 1	**$11,900**

ODC

Category	Level	Rate	Quantity	Total
Misc. Equipment		$3,000 mo	1	$3,000
Modify existing system	2 tanks/month	$4,000 tot	1	$4,000
Oxidant		$1 lb	2,500	$2,500
Piping		$4,000 ls	1	$4,000
			Subtotal 2	**$13,500**

Travel

Category	Level	Rate	Quantity	Total
Mileage	Car	$0.31 km	1000	$310
Mileage	Field vehicle	$0.31 km	1000	$310
Lodging		$85 day		$
Meals		$35 day		$
Air		$400 ea		$
Auto rental		$50 ls		$
Other		LS		$
			Subtotal 3	**$620**

Subcontracts

Category	Contractor	Rate	Quantity	Total
Wells		$2,000 ea	4	$8,000
Electrical Contractor		$4,000 ls	1	$4,000
Subtotal 4				**$12,000**
			0%	**$0**
			Total	**$38,020**

Enhanced Bioremediation

Labour

Category	Level	Rate	Quantity	Total
	Senior Professional	$101/hr	10	$1,010
	Project Professional	$83/hr	20	$1,660
	Project Scientist	$75/hr	40	$3,000
	Staff Engineer	$53/hr	60	$3,180
	Technician	$42/hr	60	$2,520
	Administrative Assistant	$30/hr	10	$300
	Clerical Support	$23/hr	10	$230
			Subtotal 1	**$11,900**

ODC

Category	Level	Rate	Quantity	Total
Misc. Equipment		$2,000 mo	1	$2,000
Mixing/injection tank	2 tanks/month	$2,000 tot	1	$2,000
Electron Donor		$1 lb	1,000	$1,000
Piping		$4,000 ls	1	$4,000
			Subtotal 2	**$9,000**

Travel

Category	Level	Rate	Quantity	Total
Mileage	Car	$0.31 km	1000	$310
Mileage	Field vehicle	$0.31 km	1000	$310
Lodging		$85 day		$
Meals		$35 day		$
Air		$400 ea		$
Auto rental		$50 ls		$
Other		LS		$
			Subtotal 3	**$620**

Subcontracts

Category	Contractor	Rate	Quantity	Total
Wells		$2,000 ea	4	$8,000
Electrical Contractor		$4,000 ls	1	$4,000
Subtotal 4				**$12,000**
			0%	**$0**
			Total	**$33,520**