



TETRA TECH EBA

REVISED RISK MANAGEMENT PLAN 124 MAIN STREET LOT 17, BLOCK 2, PLAN 2605X BARONS, ALBERTA



PRESENTED TO
Village of Barons

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EXECUTIVE SUMMARY

The Village of Barons (Barons) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to prepare a revised Risk Management Plan (RMP) for a property located at 124 Main Street in Barons, Alberta (the Site). The Site is included in the Alberta Municipal Affairs (AMA) tank site remediation program, Site No. 9558. The original RMP was prepared by Tetra Tech EBA in 2011 (Tetra Tech EBA File: L22101183.005, dated December 2011) and was developed to manage the risk associated with compounds of potential concern (COPC) identified during previous assessment activities. The RMP was submitted for review to Alberta Environment and Sustainable Resource Development (ESRD). This revised RMP has been prepared to address ESRD comments and is based on information collected during previous investigations conducted by Tetra Tech EBA at the Site. The RMP provides information relevant to the management of environmental risks at this site. Further information regarding other aspects of work to date can be found in the referenced documents.

The objectives of the RMP are:

- To characterize the COPC, potential receptors, and pathways that are present at the Site.
- To assess and identify the potential risks that COPC impacts present to the Site users and the environment.
- To provide a plan for Barons that mitigates the potential risks and provides contingency plans relating to those measures.

The proposed RMP is presented below. The RMP addresses concerns identified in the assessment of risk with a series of management measures to be implemented.

Approach

The risk characterization conducted identified the following exposure pathways at the Site that require risk management measures:

- Potable water (benzene, ethylbenzene, xylenes, and petroleum hydrocarbons (PHC) fractions F1 and F2);
- Vapour inhalation (PHC fraction F1); and
- Ecological direct soil contact (PHC fractions F1 and F2);

The risk management measures are based on the exposure control framework as outlined in the Tier 1 Guidelines to utilize site management measures designed and implemented to ensure that exposures do not result in human and ecological risks in excess of levels considered acceptable.

Tetra Tech EBA's proposed risk management approach includes:

- Maintaining current site zoning;
- Maintaining sufficient surface cover over the impacted soils;
- Implementing materials management as required for future ground disturbance activities;
- Implementing a groundwater monitoring program to assess natural attenuation; and
- Implementing a subsurface vapour monitoring program to evaluate risk to site users.

The risk management recommendations and approach are based on the following assumptions:

- The soil and groundwater concentrations measured to date are representative of the range of concentrations present at the Site.
- The source causing impacts to the soil and groundwater has been removed and conditions are not anticipated to deteriorate.

If conditions are encountered at the site that are significantly different from the source characteristics described above, additional risk management actions may be required.

Contingency Planning

A proposed contingency plan has been developed for the risk management measures and relate to the ongoing monitoring program. The contingency plan is outlined in the following Table:

Table: Proposed Contingency Plan				
Potential Occurrence	Responses			
	Precautions	Action	Timeframe	By Whom
PHC concentrations in groundwater remain above applicable guidelines.	On-going groundwater monitoring program.	Assess reason for concentrations of PHCs: Installation of three lateral and one vertical delineation monitoring wells.	Immediately	Tetra Tech EBA/Barons
PHC concentrations in groundwater increase.	On-going groundwater monitoring program.	Assess reason for increase of PHCs: Additional groundwater sampling to verify analytical results. Evaluate need for additional risk management measures and/or additional remediation.	Immediately	Tetra Tech EBA/Barons
PHCs concentrations in groundwater sampled indicate migration.	On-going groundwater monitoring program.	Assess reason for migration of PHC impacts: Additional groundwater sampling to verify analytical results. Evaluate need for additional risk management measures and/or additional monitoring wells.	Immediately	Tetra Tech EBA/Barons
Natural attenuation of PHC compounds is not occurring.	On-going groundwater monitoring program.	Evaluate data and assess reason: May require implementation of enhanced remediation techniques, i.e., chemical injection.	Two (2) years	Tetra Tech EBA/Barons

Table: Proposed Contingency Plan

Potential Occurrence	Responses			
	Precautions	Action	Timeframe	By Whom
Soil vapour concentrations exceed calculated screening levels.	Collection of soil vapour samples.	Evaluate data: May require collecting additional samples to confirm and/or the implementation of a passive or active venting/collection system.	Immediately	Tetra Tech EBA/Barons
Future re-development and/or ground disturbance.	Materials management plan.	Future re-development and/or ground disturbance	Prior to re-development and/or ground disturbance activities.	Barons

As the monitoring programs are undertaken the contingency plan will be updated as necessary.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Village of Barons and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Village of Barons, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

1.1 General

The Village of Barons (Barons) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to prepare a revised Risk Management Plan (RMP) for a property located at 124 Main Street in Barons, Alberta (the Site). The Site is included in the Alberta Municipal Affairs (AMA) tank site remediation program, Site No. 9558. The original RMP was prepared by Tetra Tech EBA in 2011 (Tetra Tech EBA File: L22101183.005, dated December 2011) and was developed to manage the risk associated with compounds of potential concern (COPC) identified during previous assessment activities. The RMP was submitted for review to Alberta Environment and Sustainable Resource Development (ESRD). This revised RMP has been prepared to address ESRD comments and is based on information collected during previous investigations conducted by Tetra Tech EBA at the Site. The RMP provides information relevant to the management of environmental risks at this site. Further information regarding other aspects of work to date can be found in the referenced documents.

1.2 Objectives

The objectives of the RMP are:

- To characterize the COPC-, potential receptors, and pathways that are present at the Site.
- To assess and identify the potential risks that COPC impacts present to the Site users and the environment.
- To provide a plan for Barons that mitigates the potential risks and provides contingency plans relating to those measures.

2.0 BACKGROUND INFORMATION

This section of the RMP provides background information, including a description of the Site, details of previous reporting, and a summary of subsurface conditions at the Site.

2.1 Site Description

The Site is a rectangular-shaped property, approximately 800 m² in area, located at 124 Main Street, in Barons, Alberta (Figure 1), and legally described as: Lot 17, Block 2, Plan 2605X. Currently, the northern portion of the Site is used as a public park and contains trees, park benches, and a gazebo, and the southern portion is vacant. Tetra Tech EBA understands that the site was the location of a service station prior to 1970 with an underground storage tank (UST) for fuel located off-site adjacent to the northern Site boundary. According to Barons, the Site is zoned commercial, however, based on current land use the property is considered to be parkland. Surrounding land use within 30 m or less of the Site is comprised of residential dwellings and commercial businesses.

2.2 Previous Reporting

Table A summarizes the previous reports available for review by Tetra Tech EBA.

Table A: Summary of Previous Reports	
Title, Author, Date, and File No.	Summary
Phase II and III Environmental Site Assessment. 124 Main Street. Lot 17, Block 2, Plan 2605X. AMA Site: 9558. EBA Engineering Consultants Ltd. October 2009. L22101183.001	Key findings of this report are as follows: - Fourteen boreholes were drilled on and off-site, eight of which were completed as groundwater monitoring wells. - During the drilling program, an underground storage tank (UST) was encountered at approximately 0.5 metres below grade (mbg) within the roadway north of the Site. - Concentrations of benzene, ethylbenzene, xylenes, and petroleum hydrocarbon (PHC) fraction F1 and F2 greater than the domestic use aquifer (DUA) guideline were detected in soil samples at 1.8 mbg and 3.6 mbg at 08MW06, north of the UST. - PHC fraction F2 was greater than the DUA guideline from a soil sample at 1.8 mbg at 08BH10, northwest of the UST. - Concentrations of benzene, ethylbenzene, and PHC fraction F2 were greater than the guideline in a groundwater sample collected from 08MW06. - Concentrations of benzene were greater than the applied guideline in a groundwater sample collected from 09MW11, southwest of the UST. - It was recommended to remove the UST.
Underground Storage Tank Removal and Monitoring. AMA Site: 9558. EBA, A Tetra Tech Company. March 2011. L22101183.004	Key findings of this report are as follows: - In 2010, the UST was removed and approximately 356 tonnes of PHC impacted material was hauled off-site to the Lethbridge Waste and Recycling Centre. - The extent of the excavation was limited due to existing urban infrastructure and the risk of damaging the rooting system of mature trees on the Site, and therefore, PHC impacted material greater than the applied guidelines was left in place along the south, east, and west walls of the excavation and the base. - Confirmatory soil samples within the excavation at a depth of 2.0 mbg were below the laboratory detection limits from all samples. - Confirmatory soil samples within the excavation at depths between 4.0 mbg and 5.0 mbg were greater than the applied guidelines for benzene, ethylbenzene, xylenes, and PHC fractions F1 and F2 from the south, east, and west walls and the base. - It was recommended to implement a RMP for the Site.

2.3 Regulatory Guidelines

Based on the surrounding land use and the desired end land use for the Site, soil and groundwater analytical results were compared to the Alberta Environment¹ (AENV) 2010 Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines) for residential land use, fine-grained soils. The Tier 1 approach is based on the assumption that all exposure pathways and receptors relevant to a particular land use are present and operative. Such receptors include the DUA, freshwater aquatic life (FAL), direct soil contact (ecological and human), off-site migration, and vapour inhalation.

2.4 Geology

The surficial geology in the Barons area is characterized as glaciolacustrine material with clay, silt, and sand forming the dominant geologic deposits (Shetson 1981). Bedrock in the Barons area consists of sandstone and shale strata from the St. Mary River Formation of the late Cretaceous age.

2.5 Soil Conditions

From the 2009 Phase II and III ESA conducted at the Site by Tetra Tech EBA, the soil encountered generally consisted of clays with intermittent silt/sand lenses from below a surficial topsoil layer (0-0.1 mbg) to a maximum depth of 4.7 mbg. Below these deposits, weathered claystone bedrock was observed to the maximum depth of investigation (13.7 mbg).

For the assessment of soil, a grain size criterion was also applied. A fine-grained soil is defined as having a median grain size (D_{50}) of 75 micrometers (μm) or less, whereas a coarse-grained soil has a D_{50} of 75 μm or greater. Particle size analysis (PSA) was conducted on selected soil samples from boreholes 08MW01, 08MW03, 08MW07, 08MW09m 08BH10, 09MW11, and 09BH14. All samples analyzed for PSA were from a sampling depth of 1.2 mbg to 6.0 mbg. The PSA indicates that the soil at the Site is fine-grained.

Borehole locations are presented on Figure 2.

2.6 Soil Quality

Soil analytical results from the Phase II and III ESA and the UST Removal conducted at the site by Tetra Tech EBA in 2009 and 2011, respectively indicate localized PHC component concentrations greater than the applied guidelines including: benzene, ethylbenzene, xylenes, and PHC fractions F1 and F2. The non-compliant soil is located at the north Site boundary in the vicinity of the former tank basin, and beneath the roadway north and northwest of the former tank basin. The depth of the identified impacts ranges from 1.8 mbg to 5.0 mbg. The vertical and lateral extent of impact appears to be reasonably well defined.

Soil analytical results from the Phase II and III ESA and UST Removal are presented in Tables 1 and 2, respectively.

2.7 Hydrogeology

There are several ephemeral wetlands located near the Village of Barons municipal boundaries; however, all identified wetlands are greater than 300 m from the site. Two water reservoirs are also located approximately 350 m southwest of the site; however, they are no longer being used. The nearest surface waterbody of significance is an irrigation canal with earthen/ gravel walls located approximately 3 km south of the Site. Keho Lake is located approximately 5 km southeast of the Site.

¹ Currently Alberta Environment and Sustainable Resource Development (ESRD).

Based on hydrogeological maps for the area, it is anticipated that shallow and regional groundwater flow would generally be southeast, towards Keho Lake (Tokarsky 1974).

2.8 Groundwater Conditions

The most recent groundwater levels available for the Site were measured by Tetra Tech EBA on March 26, 2009. Approximate groundwater elevations ranged from 2.15 mbg at 08MW07 to 2.62 mbg at 09MW11. Groundwater monitoring results indicate that the groundwater table is relatively flat with a slight hydraulic gradient to the south.

Six hydraulic conductivity tests were conducted during the ESAs in November 2009 for 08MW01 (average $K = 8.9 \times 10^{-6}$ m/s), 08MW07 (average $K = 4.5 \times 10^{-7}$ m/s), and 08MW08 (average $K = 4.3 \times 10^{-5}$ m/s) providing a geometric mean hydraulic conductivity value of 6×10^{-6} m/s.

Groundwater monitoring well locations are identified on Figure 2.

2.9 Groundwater Quality

Groundwater quality at the Site is based on analytical results from groundwater samples obtained by Tetra Tech EBA on November 28, 2008 and March 26, 2009. Monitoring wells containing one or more of benzene, ethylbenzene and/or PHC fraction F2 at concentrations in excess of the applicable groundwater quality guidelines are located north and southwest for the former tank basin, near the northern Site boundary. The lateral extent is broadly defined but remains open to the southeast and in a westerly direction. The vertical extent of Tier I impact has not been defined.

Groundwater analytical results from the Phase II and III ESA are presented in Table 3.

3.0 RISK CHARACTERIZATION

In order for there to be an environmental risk present, three elements are required – a COPC, a migratory pathway to transport the COPC, and a receptor that could be exposed to the COPC. This section provides a preliminary characterization of potential risks associated with the conditions at the Site, and is outlined according to COPCs and potential sources (Section 3.1), potential receptors and exposure pathways (Section 3.2), and potential migration pathways (Section 3.3). Section 3.4 provides a risk characterization based on the source/pathway/receptor/migration framework.

3.1 Compounds of Potential Concern and Potential Sources

Compounds of concern that have been identified in soil and groundwater which may require risk management include benzene, ethylbenzene, xylenes, and PHC fractions F1 and F2. The source of the compounds of concern is suspected to have originated from the historical storage of fuel within the former UST located adjacent to the Site. It is noted that benzene is classified as a carcinogen by Health Canada.

3.2 Potential Receptors and Exposure Pathways

This section identifies potential receptors at the Site and pathways by which receptors can be exposed to the COPCs. Receptors of COPCs can include humans, wildlife (terrestrial and aquatic), livestock, vegetation, soil, and surface and groundwater. Based on site conditions and assumptions, certain receptors and exposure pathways can be considered inoperative. For this Site, it is assumed that all exposure pathways are operative and will be discussed.

3.2.1 Human Health

Human users of the Site will include Barons personnel during regular maintenance of the Site and visitors (including adults and children). Based on the Alberta Tier 1 framework, the human health pathways for exposure to PHCs in soil and groundwater include direct soil contact, potable water/DUA, and vapour inhalation.

3.2.1.1 Direct Soil Contact

There is a potential for personnel to come into direct dermal contact with or incidentally ingest soil and groundwater during ground disturbance activities on Site. COPC in soil may also be adsorbed to particle surfaces, which may be ingested or inhaled as a result of dust generation. Given that future activities at and in the vicinity of the Site could include ground disturbance, there is the potential for inhalation or ingestion of dust particulate and this pathway cannot be excluded. Potential receptors to direct contact with impacted materials on site include Barons personnel, visitors to the site, external contractors, and maintenance staff during the normal operation or during future ground disturbance (i.e., maintenance, landscaping, etc.).

3.2.1.2 Potable Water/Domestic Use Aquifer

Shallow groundwater at the site is not used as a source of potable water. However, conductivity testing to date indicates that the shallow water bearing horizon could supply sufficient yield to be considered a potential DUA, and the presence of an aquitard providing hydraulic isolation of deeper potential DUAs has not been established. Therefore, the pathway for the protection of a domestic use aquifer cannot be excluded at this time and the DUA pathway will be considered operable and included in the risk characterization.

3.2.1.3 Vapour Inhalation

PHCs in soil and groundwater can partition to the vapour phase resulting in the potential for PHC vapours to enter a building envelope and create a risk due to inhalation of those vapours. Even though the only structure at the Site is an outdoor gazebo, the potential source area is located within 30 m of existing commercial enterprises and, under ESRD guidance, the potential for PHCs to migrate to those buildings in the vapour phase must be considered. In addition, the Site is a common public space and involuntary exposure to vapours in the outdoor environment should also be considered. The vapour inhalation pathway is therefore considered operable and is included in the risk characterization.

3.2.2 Ecological Receptors

Based on the Alberta Tier 1 framework, the ecological pathways for exposure to PHC compounds include ecological direct soil contact and protection of FAL.

3.2.2.1 Direct Soil Contact

There is the potential for plants and soil invertebrates to come into direct contact with impacted soils on-site. Exposure can occur through evapotranspiration and shallow groundwater uptake by plants, direct soil-root contact, and soil ingestion by invertebrates. There is also potential for small mammals (e.g., rabbits), birds (e.g., crows, hawks, and owls), rodents, and other animals to access the site. Small mammals may also come into direct contact with impacted soil during burrowing activities. Therefore the ecological direct contact pathway is considered operable and will be included in the risk characterization.

3.2.2.2 Protection of Freshwater Aquatic Life

Groundwater is of significance as a potential means of contaminant transport. Protection of FAL must be considered when surface waterbodies are present within 300 m of the site. Major surface waterbodies are not present near the site within this zone; and the closest surface waterbody is an irrigation canal and Kehoe Lake located approximately 3 km and 5 km south and southeast of the Site, respectively. The FAL pathway is therefore considered non-operable and will not be included in the risk characterization.

3.3 Potential Migration Pathways

This section outlines potential migration pathways for the COPC identified in Section 3.1 and the potential receptors and exposure pathways identified in Section 3.2. Migration of dissolved constituents in groundwater would typically follow the groundwater flow direction. Migration of constituents in soil is typically through leaching or dissolution to the groundwater, through generation of vapours, via windborne dust, or via tracking by humans and construction equipment.

3.3.1 Vapour Pathways

There is a potential for PHCs in the soil and groundwater to volatilize and migrate from the groundwater through soil pore space. Migration of vapours within soil pore spaces is associated primarily with pressure or concentration gradients. The transport mechanisms vary depending upon the vapour pressure, molecular weight, and specific gravity of the gases. PHC vapours can migrate into outdoor air and into buildings through cracks, construction joints, subsurface utility service openings, and other weak spots in the basement wall or building floor. Other potential pathways are underground services such as sewers and stormwater drains.

3.3.1.1 Natural Features

The dominant soil types beneath the site are clay till overlaying weathered bedrock. The groundwater table is relatively shallow; therefore, the clay till appears to be unsaturated to depths of approximately 2.2 mbg. Fractures within the clay till may act as natural migration pathways for vapours. Migration will also be influenced by the varying composition of fill material. Depending on the temperature and pressure fluctuation, vapours can migrate to the ground surface and vent to the atmosphere. Lower permeability surface soil layers and concrete will impede venting at the ground surface. Frozen soils in the winter will also act as a barrier to vertical and horizontal migration of vapours.

3.3.1.2 Man-made Features

In the shallow subsurface, there are several existing utility corridors (e.g., sewers, waterlines, and other utilities) in close proximity to the Site which may affect potential vapour migration. Generally, the coarse-grained nature of soils typically used as backfill around utilities can act as a migration pathway. There is also a potential for vapours to enter the stormwater and sewer utilities and travel within the pipe.

Potential pathways for vapour entry into structures include cracks in foundation walls and floor slabs, poorly sealed joints, penetrations in foundation walls and floor slabs, and poorly sealed underground utility connections into buildings.

3.4 Risk Characterization

Based on the COPC, receptors, and pathways identified for the Site, an assessment of potential risk for the Site identifying each potential migration pathway, potential receptors, and exposure pathways is presented in Table B and Table C below.

Human health effects associated with PHCs would depend upon the length of exposure (short term or acute, versus long term or chronic), the amount of exposure (i.e., dose), the frequency of exposure, the toxicity of the volatile chemical, and the individual's sensitivity to the chemical. For most PHCs, reference concentrations have been established by Health Canada to evaluate the relative carcinogenic and/or toxic effects of specific compounds on human health; the reference concentrations can be adjusted based on exposure scenarios.

The Tier 1 Guidelines provide guidelines for each human health and ecological exposure pathway. Table B and Table C provide an evaluation of the maximum contaminant concentration observed in relation to the guidelines established for the individual pathways, and evaluate the potential risk present for each contaminant.

Table B: Risk Characterization in Soil

Potential Receptor: Exposure Pathway						
Potential Contaminant of Concern	Human Health			Ecological	Maximum Concentration Identified (mg/kg)	Risk Characterization
	Direct Contact Guideline (mg/kg)	Potable Water Guideline (mg/kg)	Vapour Inhalation Guideline ¹ (mg/kg)	Direct Contact Guideline (mg/kg)		
Benzene	78	<u>0.046</u>	1.6	60	0.782	Potential risk identified; potable water exposure pathway is operational.
Ethylbenzene	8,500	<u>0.11</u>	930	120	12	Potential risk identified; potable water exposure pathway is operational.
Xylenes	140,000	<u>15</u>	250	65	29	Potential risk identified; potable water exposure pathway is operational.
PHC Fraction F1	12,000	<u>1,100</u>	<u>610</u>	<u>210</u>	1,220	Potential risk identified; potable water, vapour inhalation, and ecological soil contact exposure pathways are operational.
PHC Fraction F2	6,800	1,500	3,100	<u>150</u>	694	Potential risk identified; ecological soil contact exposure pathway is operational.

Note:

0.00 Maximum concentrations identified on-site exceeds exposure pathway guideline.

¹ Vapour inhalation guideline used is most stringent for fine-grained soils (surface and sub-surface).

Table C: Risk Characterization Groundwater

Potential Receptor: Exposure Pathway					
Potential Contaminant of Concern	Human Health		Ecological	Maximum Concentration Identified (mg/kg)	Risk Characterization
	Potable Water Guideline (mg/L)	Vapour Inhalation Guideline ¹ (mg/kg)	Direct Contact Guideline (mg/kg)		
Benzene	<u>0.005</u>	2.8	100	0.068	Potential risk identified; potable water exposure pathway is operational.
Ethylbenzene	<u>0.0024</u>	NG	42	0.036	Potential risk identified; potable water exposure pathway is operational.
PHC fraction F2	<u>1.1</u>	NG	1.8	1.7	Potential risk identified; potable water exposure pathway is operational.

Note:

0.00 Maximum concentrations identified on-site exceeds exposure pathway guideline.

NG – no guideline established.

The potential risks outlined in Tables B and C exist from historical off-site land use. The Tier 1 Guidelines for protection of the DUA, vapour inhalation, and ecological direct soil contact pathways are considered appropriate for evaluating the analytical results of the collected soil and groundwater samples. The assessment of risk outlined above is such that management measures may be necessary for some concerns identified. These measures are outlined in the RMP in Section 4.0.

4.0 PROPOSED RISK MANAGEMENT PLAN [RMP]

The proposed RMP is presented in this section. The RMP addresses concerns identified in the assessment of risk with a series of management measures to be implemented.

4.1 Approach

The risk characterization conducted in Section 3.0 identified the following exposure pathways at the Site that require risk management measures:

- Potable water (benzene, ethylbenzene, xylenes, and PHC fractions F1 and F2);
- Vapour inhalation (PHC fraction F1); and
- Ecological direct soil contact (PHC fractions F1 and F2);

The risk management measures are based on the exposure control framework as outlined in the Tier 1 Guidelines to utilize site management measures designed and implemented to ensure that exposures do not result in human and ecological risks in excess of levels considered acceptable.

Tetra Tech EBA's proposed risk management approach includes:

- Maintaining current site zoning;
- Maintaining sufficient surface cover over the impacted soils;
- Implementing materials management as required for future ground disturbance activities;
- Implementing a groundwater monitoring program to assess natural attenuation; and
- Implementing a subsurface vapour monitoring program to evaluate risk to site users.

The risk management recommendations and approach are based on the following assumptions:

- The soil and groundwater concentrations measured to date are representative of the range of concentrations present at the Site.
- The source causing impacts to the soil and groundwater has been removed and conditions are not anticipated to deteriorate.

If conditions are encountered at the site that are significantly different from the source characteristics described above, additional risk management actions may be required.

4.2 RMP Implementation

The first step in implementing the RMP will involve a written commitment by Barons to maintain the RMP until the applicable Tier 1 objectives have been achieved. Additionally, written commitments by potentially affected landowners on adjacent properties may be required. Additional actions of the RMP are discussed in the following sections.

4.2.1 Site Zoning

The risk characterization, risk assessment, and the proposed RMP measures included in this document are based on the Alberta Tier 1 Residential/Parkland Land Use criteria. Subsequently, the site zoning must remain under residential/parkland land use, and the land use must be maintained in order for the RMP to apply.

4.2.2 Surface Cover

The surface cover approach will include maintaining the existing layer of asphalt surface cover on the roadway. The cover will discourage burrowing activity and thereby reduce the potential for small mammals to come into direct contact with impacted soil, as well as prevent access by human receptors to the impacted soil. The cover offers the additional advantage that it will also reduce the potential for surface erosion and thereby reduce the risks associated with potential off-site migration of PHCs.

4.2.3 Materials Management Plan for Future Ground Disturbance

If future redevelopment and/or ground disturbance is to be conducted at the Site, contractors should be made aware of the potential impacts associated with the Site. Subsequently, appropriate safety requirements and materials management practices should be implemented and documented. Further, prior to re-use or disposal, the material should be appropriately characterized. Tetra Tech EBA can assist with the development of the soil management plan and can advise on the necessary personal protective equipment that should be employed by contractors carrying out ground disturbance.

4.2.4 Groundwater Monitoring Program

A groundwater monitoring program should be implemented at four (4) of the existing monitoring wells located on and off-site. Specifically, monitoring wells where concentrations of PHCs have historically been greater than the applied guidelines (08MW06 and 09MW11). Additionally, monitoring well 09MW09 (northeast of the former UST) and 08MW03 (south of the former UST) should be included. The purpose of the groundwater monitoring program is to confirm if PHC concentrations are stable and/or decreasing, and to assess whether natural attenuation and/or migration of PHC impacted groundwater is occurring.

Tetra Tech EBA recommends that the monitoring and sampling program be conducted as follows:

- The program should be implemented semi-annually for two years. Following two years, the monitoring scope and frequency can be re-evaluated.
- Monitoring activities will include monitoring of groundwater levels, well headspace vapour concentrations, and collecting groundwater samples for analyses of benzene, toluene, ethylbenzene, and xylenes (BTEX), and PHC fractions F1 and F2. Additionally analysis should include routine groundwater chemistry, dissolved manganese, and dissolved iron to evaluate the continued potential for natural attenuation.
- If concentrations of PHCs in groundwater are found to be increasing, the proposed contingency plan(s) (Section 5.0) should be implemented.

4.2.5 Subsurface Vapour Monitoring Program

A subsurface vapour monitoring program should be implemented in the vicinity of the former UST location where a soil sample was collected with a concentration of PHC fraction F1 greater than the Tier 1 vapour inhalation guideline (southeast corner of UST excavation). The purpose of the surface vapour monitoring program is to assess the possibility for PHC vapours to partition from the soil and to determine whether there is a potential risk to site users.

Tetra Tech EBA recommends that the monitoring and sampling program be conducted as follows:

- Activities should include the installation of four soil vapour probes and the collection of soil vapour using Summa™ canisters for analysis of BTEX and PHC fractions F1 and F2. Two sampling events are recommended so that potential seasonal variations can be assessed.
- Soil vapour concentrations should be compared to the soil vapour screening levels calculated following protocols presented in the Alberta Tier 2 Guidelines, the British Columbia Contaminated Sites Regulations, and the Health Canada Guidance on Human Health Preliminary Quantitative Risk Assessment.
- If the calculated screening levels are exceeded, the proposed contingency plan(s) (Section 5.0) should be implemented.

5.0 CONTINGENCY PLANNING

A proposed contingency plan has been developed for the risk management measures and relate to the ongoing monitoring program. The contingency plan is outlined in Table D.

Table D: Proposed Contingency Plan

Potential Occurrence	Responses			
	Precautions	Action	Time Frame	By Whom
PHC concentrations in groundwater remain above applicable guidelines.	On-going groundwater monitoring program.	Assess reason for concentrations of PHCs: Installation of three lateral and one vertical delineation monitoring wells.	Immediately	Tetra Tech EBA/Barons
PHC concentrations in groundwater increase.	On-going groundwater monitoring program.	Assess reason for increase of PHCs: Additional groundwater sampling to verify analytical results. Evaluate need for additional risk management measures and/or additional remediation.	Immediately	Tetra Tech EBA/Barons
PHCs concentrations in groundwater sampled indicate migration.	On-going groundwater monitoring program.	Assess reason for migration of PHC impacts: Additional groundwater sampling to verify analytical results. Evaluate need for additional risk management measures and/or additional monitoring wells.	Immediately	Tetra Tech EBA/Barons
Natural attenuation of PHC compounds is not occurring.	On-going groundwater monitoring program.	Evaluate data and assess reason: May require implementation of enhanced remediation techniques, i.e., chemical injection.	Two (2) years	Tetra Tech EBA/Barons
Soil vapour concentrations exceed calculated screening levels.	Collection of soil vapour samples.	Evaluate data: May require collecting additional samples to confirm and/or the implementation of a passive or active venting/collection system.	Immediately	Tetra Tech EBA/Barons
Future re-development and/or ground disturbance.	Materials management plan.	Future re-development and/or ground disturbance	Prior to re-development and/or ground disturbance activities.	Barons

As the monitoring programs are undertaken the contingency plan will be updated as necessary.

A Record of Site Condition is provided in Appendix B.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

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/dlm

PERMIT TO PRACTICE TETRA TECH EBA INC.	
Signature	<u>Gray</u>
Date	<u>May 14 / 2014</u>
PERMIT NUMBER: P245 The Association of Professional Engineers and Geoscientists of Alberta	

c: Mr. Stephen Hoare, Project Coordinator - Tank Site Remediation Program

REFERENCES

- Alberta Environment. 2010. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Environmental Policy Branch. Edmonton, Alberta.
- EBA Engineering Consultants Ltd. 2009. Phase II and III Environmental Site Assessment. 124 Main Street. Lot 17, Block 2, Plan 2605X. AMA Site 9558, Barons, Alberta. Report dated October 2009. EBA File: L22101183.001.
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- Shetson, I. 1981. Surficial Geology Lethbridge, Alberta. Alberta Research Council, Edmonton, Alberta.
- Tokarsky, O. 1973. Hydrogeological Map – Lethbridge-Fernie Alberta (NTS 82G-H). Alberta Research Council, Edmonton, Alberta.

TABLES

Table 1	Soil Analytical Results – Phase II and III ESA
Table 2	Soil Analytical Results – UST Removal
Table 3	Groundwater Analytical Results – Phase II and III ESA

Table 1: Soil Analytical Results - Phase II and III ESA

Parameters	Detection Limits	Units	Protection of Domestic Use		Ecological Direct Soil Contact		17-Nov-08															
							08MW01			08BH02		08MW03			08MW06				08MW07			
			< 3.0 m	> 3.0 m	< 3.0 m	> 3.0 m	1.2 m	4.2 m	5.4 m	1.8 m	3.6 m	1.8 m	3.6 m	4.8 m	0.6 m	1.8 m	3.6 m	4.5 m	0.6 m	2.4 m	4.2 m	4.8 m
Petroleum Hydrocarbons																						
Benzene	0.02	mg/kg	0.046	0.046	60	120	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.076	0.011	nd	nd	--	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	110	220	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.15	nd	nd	nd	--	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	120	240	nd	nd	nd	nd	nd	nd	nd	nd	nd	12	0.12	nd	nd	--	nd	nd
Xylenes	0.04	mg/kg	15	15	65	130	nd	nd	nd	nd	nd	nd	nd	nd	nd	29	0.32	nd	nd	--	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	1,100	1,100	210	420	nd	nd	nd	nd	nd	nd	nd	nd	nd	570	36	nd	nd	--	nd	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	1,500	1,500	150	300	nd	nd	nd	nd	nd	nd	nd	nd	nd	370	nd	nd	nd	--	nd	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	1,300	2,600	nd	nd	nd	nd	nd	nd	nd	nd	nd	<10	nd	nd	nd	--	nd	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	6,600	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd	<10	nd	nd	nd	--	nd	nd
Metals																						
Lead (Pb)	1	mg/kg	ng	ng	140*		7	8	17	11	9	11	8	14	62	32	9	8	7	--	12	11
Physical Properties																						
Soil Moisture Content	0.3	%	ng	ng	ng	ng	16	15	12	24	14	24	11	13	12	19	17	7.1	12	23	14	9.5
<75 um Sieve	0.2	%	ng	ng	ng	ng	92	nt	nt	nt	nt	nt	nt	87	nt	nt	nt	nt	nt	90	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	ng	8	nt	nt	nt	nt	t	nt	13	nt	nt	nt	nt	nt	10	nt	nt
CCME Class	0.2		ng	ng	ng	ng	FINE	nt	nt	nt	nt	nt	nt	FINE	nt	nt	nt	nt	nt	FINE	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use		Ecological Direct Soil Contact		11-Mar-09											
			< 3.0 m	> 3.0 m	< 3.0 m	> 3.0 m	09MW09			09BH10			09MW11			09MW13	09BH14	
							4.2 m	4.8 m	6.0 m	1.8 m	3.0 m	4.8 m	3.6 m	4.8 m	6.0 m	4.8 m	3.0 m	4.8 m
Petroleum Hydrocarbons																		
Benzene	0.02	mg/kg	0.046	0.046	60	120	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	110	220	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	120	240	nd	nd	nd	0.02	nd	nd	nd	nd	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	65	130	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	210	420	nd	nd	nd	160	nd	nd	nd	nd	nd	nd	nd	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	150	300	nd	nd	nd	420	nd	nd	nd	nd	nd	nd	nd	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	1,300	2,600	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	6,600	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metals																		
Lead (Pb)	1	mg/kg	ng	ng		140*	8	9	7	14	14	16	10	16	15	8	10	15
Physical Properties																		
Soil Moisture Content	0.3	%	ng	ng		ng	13	11	13	19	26	21	20	15	13	14	15	12
<75 um Sieve	0.2	%	ng	ng		ng	63	75	nt	81	nt	nt	nt	nt	91	nt	67	nt
>75 um Sieve	0.2	%	ng	ng		ng	37	25	nt	19	nt	nt	nt	nt	9.2	nt	33	nt
CCME Class	0.2		ng	ng		ng	FINE	FINE	nt	FINE	nt	nt	nt	nt	FINE	nt	FINE	nt

Notes:¹ Alberta Environment. December 2010. Alberta Tier 1 Soil Remediation Guideline Values for Soil and Groundwater for Residential Land Use for Fine-grained Soils.

nt - Parameter not analyzed.

nd - Less than analytical detection limits.

ng - No guidelines established.

Bold and Underlined - Greater than the referenced guideline.

* Guideline is for human direct soil contact.

Table 2: Soil Analytical Results - UST Removal

Parameter	Units	Tier 1 ¹	Tier 1 ²	N4	W5	W6	W7	N3	N5	N6	N7	N8	W2	W3	W3B	W4
		Residential	Residential	2.0 m	2.0 m	2.0 m	2.0 m	4.5 m	4.5 m	2.0 m	4.0 m	4.0 m	4.0 m	4.0 m	4.0 m	4.0 m
PHCs and Other Organics				Soil (<3 mbg)				Subsoil (>3 mbg)								
Benzene	mg/kg	0.046	0.046	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.015	0.059	0.041	0.013
Toluene	mg/kg	0.52	0.52	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	mg/kg	0.11	0.11	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	4.09	3.66	<0.010
Total Xylenes	mg/kg	15	15	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.24	0.15	0.02
F1 (C6-C10)	mg/kg	--	--	<4	<4	<4	<4	5	<4	<4	5	<4	7	251	238	32
F1 -BTEX	mg/kg	210	420	<4	<4	<4	<4	5	<4	<4	5	<4	7	247	234	32
F2 (C10-C16)	mg/kg	150	300	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	174	147	12
F3 (C16-C34)	mg/kg	1300	2600	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
F4 (C34-C50)	mg/kg	5600	10,000	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
F4HTGCc C34-C50+	mg/kg	--	--	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
% C50+	%	--	--	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Routine Parameters																
Moisture	%	--	--	26.1	22	23.4	24.3	26.6	23.8	22.7	18.4	24.7	28.2	22.6	23.2	25.7

Parameter	Units	Tier 1 ¹ Residential	Tier 1 ² Residential	E4	E6	E6B	S4	S5	B4	B5	B6	B7	B8	B9	E3	S3	S3B	E5
				2.0 m	2.0 m	2.0 m	2.0 m	2.0 m	5.0 m	5.0 m	5.0 m	4.4 m	4.4 m	4.4 m	4.5 m	4.0 m	4.0 m	4.5 m
PHCs and Other Organics				Soil (<3 mbg)					Subsoil (>3 mbg)									
Benzene	mg/kg	0.046	0.046	<0.004	<0.004	<0.004	<0.004	<0.004	<u>0.216</u>	<u>0.161</u>	<u>0.782</u>	<u>0.030</u>	<u>0.085</u>	<u>0.134</u>	<0.004	<u>0.062</u>	<u>0.086</u>	<0.004
Toluene	mg/kg	0.52	0.52	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	mg/kg	0.11	0.11	<0.010	<0.010	<0.010	<0.010	<0.010	0.089	<u>0.228</u>	<u>0.794</u>	0.047	<u>1.17</u>	<u>8.66</u>	<0.010	<u>4.02</u>	<u>6.58</u>	<u>0.524</u>
Total Xylenes	mg/kg	15	15	<0.010	<0.010	<0.010	<0.010	<0.010	0.28	0.52	5.05	0.02	1.65	6.65	<0.010	0.13	0.3	<0.010
F1 C6-C10	mg/kg	--	--	<4	<4	<4	<4	<4	48	51	180	34	179	1240	<4	239	876	158
F1 -BTEX	mg/kg	210	420	<4	<4	<4	<4	<4	47	50	173	34	176	<u>1220</u>	<4	235	<u>869</u>	157
F2 (C10-C16)	mg/kg	150	300	<10	<10	<10	<10	<10	52	46	165	<10	178	<u>694</u>	<10	246	246	60
F3 (C16-C34)	mg/kg	1300	2600	<30	<30	<30	<30	<30	<30	36	38	<30	<30	119	<30	37	<30	<30
F4 (C34-C50)	mg/kg	5600	10,000	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
F4HTGCc C34-C50+	mg/kg	--	--	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
% C50+	%	--	--	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Routine Parameters																		
Moisture	%	--	--	21.1	21.2	23.7	24	22	18.7	22.3	15.5	14.2	14.5	13.4	28.5	25.6	22.9	28.2

Notes:

1. Alberta Environment's, December 2010, Soil and Groundwater Remediation Guidelines.
 2. Alberta Environment's, December 2010, Subsoil Remediation Guidelines.
 3. mbg = metres below grade
 4. -- = no guideline
 5. **Bold** = concentration is greater than the applied guideline.
- *Samples collected between November 2 and November 4, 2010.

Table 3: Groundwater Analytical Results - Phase II and III ESA

Parameter	Detection Limits	Units	AENV Tier 1 ¹	28-Nov-08					26-Mar-09			
				08MW01	08MW03	08MW06	08MW07	08MW08	09MW09	09MW11	09MW13	09DUP01*
Petroleum Hydrocarbons												
Benzene	0.0009	mg/L	0.005	nd	nd	<u>0.068</u>	nd	nd	0.0017	<u>0.0057</u>	nd	nd
Toluene	0.0009	mg/L	0.024	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.0009	mg/L	0.0024	nd	nd	<u>0.036</u>	nd	nd	nd	nd	nd	nd
Xylenes	0.002	mg/L	0.3	nd	nd	0.072	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	0.2	mg/L	2.2	nd	nd	1.6	nd	nd	nd	0.1	nd	nd
F2 (C ₁₀ to C ₁₆)	0.1	mg/L	1.1	nd	nd	<u>1.7</u>	nd	nd	0.1	nd	nd	nd
Metals												
Lead (Pb)	1	mg/L	0.01	nd	nd	0.0031	0.0003	nd	nd	nd	nd	nd

Notes:

¹ Alberta Environment. December 2010. Alberta Tier 1 Soil and Groundwater Remediation Guideline Values for Residential Lands with Fine-grained Soils.

nt - Parameter not analyzed.

nd - Below analytical detection limits.

ng - No guidelines established.

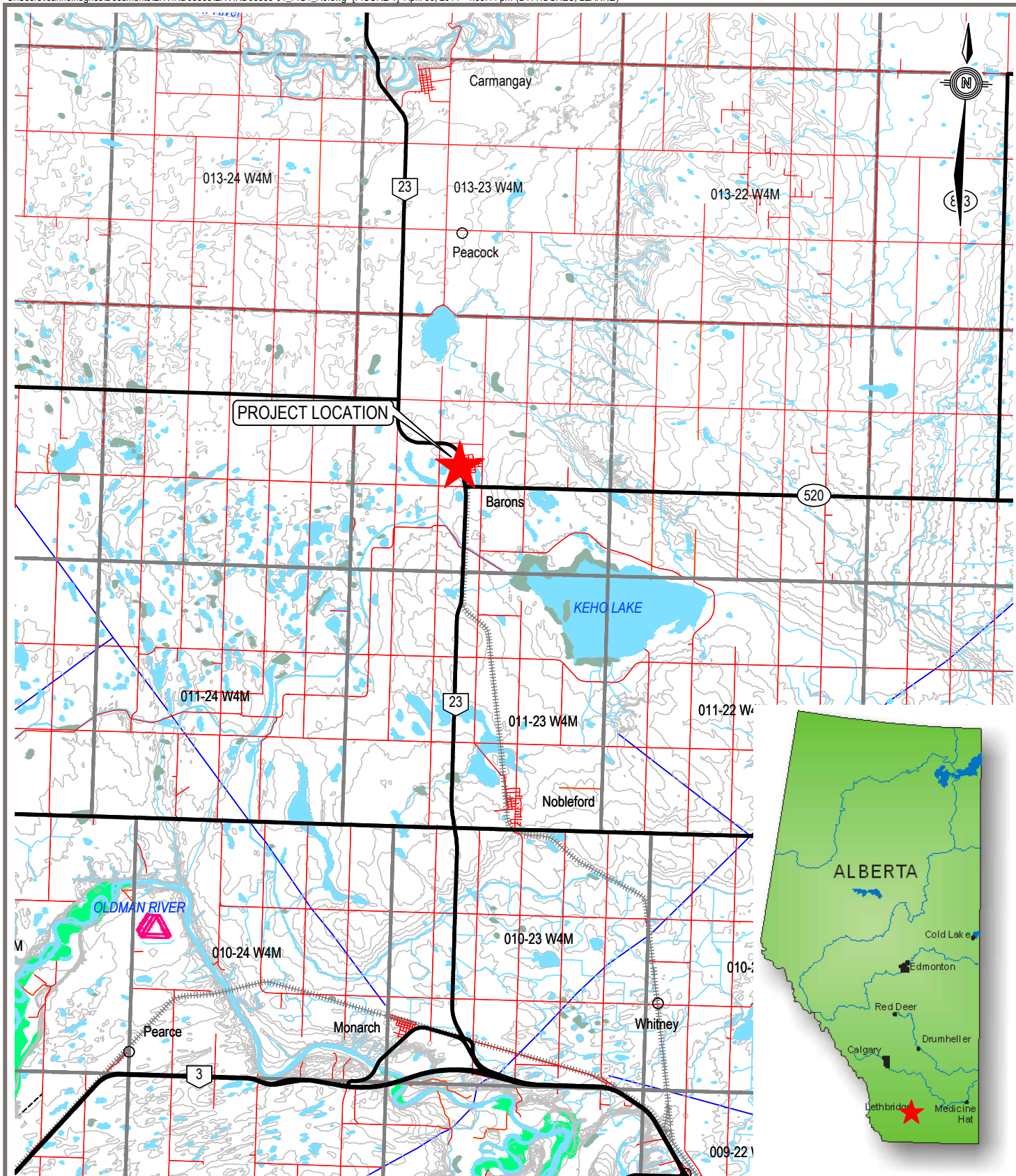
Bold and Underlined - Greater than the referenced guideline.

* 09DUP01 - Duplicates sample of 09MW13

FIGURES

Figure 1 Site Location Plan

Figure 2 Site Plan Showing Boreholes, Monitoring Wells and Approximate UST Excavation



NOTES
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CLIENT

**VILLAGE OF BARONS
(AMA SITE 9558)**

**RISK MANAGEMENT PLAN
AMA SITE 9558
124 MAIN STREET, BARONS, ALBERTA**

SITE LOCATION PLAN

0 10,000m
Scale: 1:200,000 @ 8.5"x11"

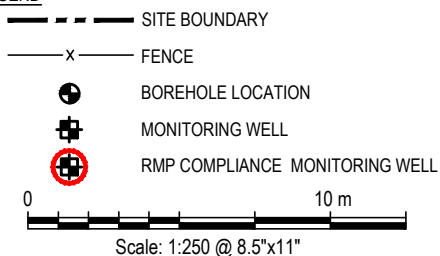


PROJECT NO. ENVIND03335-01	DWN LCH	CKD JG	REV 0
OFFICE EBA-RIV	DATE May 2014		

Figure 1



LEGEND



CLIENT

VILLAGE OF BARONS
(AMA SITE 9558)



TETRA TECH EBA

RISK MANAGEMENT PLAN

AMA SITE 9558

124 MAIN STREET, BARONS, ALBERTA

SITE PLAN SHOWING BOREHOLES, MONITORING WELLS AND APPROXIMATE UST EXCAVATION

PROJECT NO. ENVIND03335-01	DWN LCH	CKD JG	REV 0
OFFICE EBA-RIV	DATE MAY 2014		

Figure 2

APPENDIX A

TETRA TECH EBA'S GEOENVIRONMENTAL REPORT - GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA's client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

RECORD OF SITE CONDITION

RECORD OF SITE CONDITION

1 REPORT AND FORM INFORMATION			
Title of report	Revised Risk Management Plan		
Report date (dd-mon-yyyy)	May 2014	Record of Site Condition (RSC) ID No. ^ψ	

2 SITE IDENTIFICATION AND PHYSICAL LOCATION								
2.1 Site name		AMA Site #9558						
2.2 Address of site		124 Main Street						
		Municipality	Barons					Alberta
2.3 Legal land description of site (if multiple, list all.)								
Plan, Block, Lot (PBL)			Alberta Township System (ATS)					
Plan	Block	Lot	LSD	Quarter	Section	Township	Range	Meridian
2605X	2	17						

3 STAKEHOLDERS			
3.1 Operator			
Company	Village of Barons	Contact person	Laurie Beck
Mailing address	PO Box 129 Barons AB T0L 0G0	Position held	Administrator
		Business phone No.	403.757.3633
		Business fax No.	403.757.2599
		Business e-mail	barons@figment.ca
3.2 Consultant ☐ Not applicable			
Company	Tetra Tech EBA Inc.	Contact person	Jaymes Going
Mailing address	442-10 Street North Lethbridge, AB T1H 2C7	Position held	Project Manager
		Business phone No.	403.329.9009
		Business fax No.	403.328.8817
		Business e-mail	Jaymes.Going@tetrattech.com
3.3 Landowner(s)			
Land type	☐ Private ☐ Special Areas ☐ Parks and protected area ☒ Public (if not private, provide Disposition No.: _____)		
Landowner(s)	☒ Same as operator ☐ Other		

^ψ: Do not fill in. Reserved for internal administrative purposes only.

RECORD OF SITE CONDITION

3.4 Occupant(s)			
Are there occupants at the site?	☐ Yes	☒ No	☐ To be determined (TBD)
Occupant(s)	☒ Same as operator	☐ Same as landowner	☐ Other
What is the type of occupancy?	☐ Apartment building	☐ Town house	☐ Single detached house
	☐ Agricultural	☐ Industrial	☐ Commercial
	☐ Other (specify) _____		

4 OPERATING STATUS	
☐ Operating ☐ Suspended ☒ Abandoned ☐ Decommissioning in progress ☐ Closed ☐ Reclaimed (provide Reclamation Certificate No.(s): _____) ☐ Not applicable	

5 TYPE OF ACTIVITY AND SITE					
5.1 Petroleum Storage Tank Site				☒ Yes	
5.1.1 AENV file No.(s)		PTMAA site No.		Unknown	
5.1.2 Types of activity					
☒	Retail gas station	☐	Aviation fuelling station	☐	Bulk fuel
		☐ Other (specify): _____			
5.2 Upstream Oil and Gas Facility				☐ Yes	
5.2.1 AENV file No.(s)		ERCB authorization No.(s)			
5.2.2 ERCB authorization type		☐ Approval ☐ License ☐ Permit ☐ Order ☐ Other (specify)_____			
5.2.3 Types of activity					
☐	Wellsite and associated facility	☐	Satellite	☐	Battery
☐	Compressor and pumping station	☐ Other (specify): _____			
5.3 Approved Facility Under Environmental Protection and Enhancement Act (EPEA)					☐ Yes
5.3.1 AENV approval No.(s)					
5.3.2 Types of approved activity					
☐	Chemical manufacturing plant	☐	Enhanced recovery in-situ oil sands or heavy oil processing plant	☐	Fertilizer manufacturing plant
☐	Metal manufacturing plant	☐	Oil refinery	☐	Oilsands processing plant
☐	Pesticide manufacturing plant	☐	Petrochemical manufacturing plant	☐	Pipeline
☐	Pulp and paper processing plant	☐	Sour gas processing plant	☐	Sulphur manufacturing or processing plant
☐	Wood treatment plant	☐	Other (specify): _____		
☐		☐		☐	Landfill
☐		☐		☐	Oil production site
☐		☐		☐	Power plant
☐		☐		☐	Waste management facility

RECORD OF SITE CONDITION

5.4 Facility Under EPEA Code of Practice				☐ Yes	
5.4.1 AENV registration No.(s)					
5.4.2 Type of Code of Practice					
☐	Asphalt paving plant	☐	Compressor and pumping station	☐	Concrete producing plant
☐	Pesticides	☐	Pipeline	☐	Land treatment of soils containing hydrocarbons
☐	Small incinerator	☐	Sweet gas processing plant	☐	Other (specify): _____
5.5 Other Activity				☐ Yes	
5.5.1 AENV file No.(s)		Other site ID No.(s)		Authorized by	
5.5.2 Types of activity					
☐	Dry cleaning operation	☐	Highway maintenance yard	☐	Transportation
☐	Other (specify): _____				

6 SITE CHARACTERIZATION					
6.1 What Environmental Site Assessments (ESA) Have Been Conducted and Completed to Date?					
☒ Phase I ESA ☒ Phase II ESA (check all that apply.) ☒ Initial intrusive sampling ☐ delineation completed ☐ post-remediation monitoring ☐ final confirmatory sampling					
6.2 Contaminants of Potential Concern (COPC)					
6.2.1 Does the site have any of the conditions that require the mandatory use of Alberta Tier 2 Soil and Groundwater Remediation Guidelines (2008), as amended? (check all that apply in Section 6.2.1.1.)					
☒ Yes ☐ No (→ proceed to Section 6.2.2.)					
6.2.1.1 Identify any conditions that require the approaches of the Alberta Tier 2 guidelines. (see Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2008), as amended, for details.)					
☐	Contamination within 30 cm of building foundation	☐	Unusual building feature (eg. earthen floor)	☐	Contamination within 10 m distance of surface water body
☒	Fractured bedrock	☐	Potentially high hydraulic conductivity ($> 10^{-5}$ m/sec.)	☐	Other (see Alberta Tier 1 guidelines and specify): _____
6.2.1.2 Did the Alberta Tier 2 approach lead to a soil or groundwater guideline that was lower than the corresponding Tier 1 guideline for the same contaminant(s)?					
☐ Yes ☐ TBD ☒ No (→ proceed to Section 6.2.2.)					
6.2.1.3 If you answered 'yes' or 'TBD' to Section 6.2.1.2, identify the group of contaminants for each COPC with a mandatory Tier 2 guideline that is lower than the corresponding Tier 1 guideline (check all that apply, see Alberta Tier 1 guidelines, Tables 1-4 for detailed listing).					
☐	General and inorganic parameters	☐	Metals		
☐	Hydrocarbons	☐	Halogenated aliphatics		
☐	Chlorinated aromatics	☐	Pesticides		
☐	Other organics	☐	Radionuclides		
☐	Salt	☐	Other (specify): _____		

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6.2.1.4 Did any past or current ESA relevant to this investigation identify an exceedance of the mandatory Tier 2 guidelines referred to in Section 6.2.1.3 (e.g. Tier 2 guidelines that are lower than the corresponding Tier 1 guidelines)? ☐ Yes ☐ No ☐ TBD	
6.2.1.5 If you answered 'yes' in Section 6.2.1.4, have all relevant COPC been remediated to meet the mandatory Tier 2 guidelines? ☐ Yes ☐ No	
6.2.2. Did any past or current ESA relevant to this investigation identify a drilling waste disposal area? ☐ Yes ☒ No (→ proceed to Section 6.2.3.)	
6.2.2.1 If a drilling waste disposal area was identified, did any past or current ESA identify non-compliance with the compliance options outlined in <i>Assessing Drilling Waste Disposal Areas: Compliance Options for Reclamation Certification</i> (AENV, 2007), as amended? ☐ Yes ☐ No	
6.2.2.2 If you answered 'yes' in Section 6.2.2.1, have all COPC been remediated to meet the compliance options outlined in <i>Assessing Drilling Waste Disposal Areas: Compliance Options for Reclamation Certification</i> (AENV, 2007), as amended? ☐ Yes ☐ No	
6.2.2.3 For any COPC that did not meet the compliance options in <i>Assessing Drilling Waste Disposal Areas</i>, identify the group of contaminants (check of all that apply, see the Alberta Tier 1 guidelines, Tables 1-4 for detailed listing).	
☐ General and inorganic parameters	☐ Metals
☐ Hydrocarbons	☐ Halogenated aliphatics
☐ Chlorinated aromatics	☐ Pesticides
☐ Other organics	☐ Radionuclides
☐ Salt	☐ Other (specify): _____
6.2.3 For all areas and COPCs not assessed under Sections 6.2.1 or 6.2.2, did any ESA relevant to this investigation identify an exceedance over the Alberta Tier 1 guidelines? ☒ Yes ☐ No (→ proceed to Section 6.3.)	
6.2.3.1 If you answered 'yes' in Section 6.2.3, have all COPC been remediated to meet the Alberta Tier 1 guidelines? ☐ Yes ☒ No ☐ TBD	
6.2.3.2 For any COPC that exceeded Alberta Tier 1 guidelines in Section 6.2.3.1, identify the group of contaminants. (check all that apply, see the Alberta Tier 1 guidelines, Tables 1-4 for detailed listing.)	
☐ General and inorganic parameters	☐ Metals
☒ Hydrocarbons	☐ Halogenated aliphatics
☐ Chlorinated aromatics	☐ Pesticides
☐ Other organics	☐ Radionuclides
☐ Salt	☐ Other (specify): _____

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6.3 Status of Investigation

6.3.1 Identify soil and groundwater guidelines used to assess the COPCs that are the subject of this investigation (check all that apply).

- ☒ Alberta Tier 1 Soil and Groundwater Remediation Guidelines – 2008, as amended
☐ Coarse grained ☒ Fine grained
☒ Alberta Tier 2 Soil and Groundwater Remediation Guidelines – 2008, as amended
☒ Pathway exclusion ☐ Guideline adjustment ☐ Site specific remediation objectives
☐ Assessing Drilling Waste Disposal Areas: Compliance Options for Reclamation Certification (AENV, 2007), as amended
☐ Other (specify): _____

6.3.2 What land use classification(s) is used?

- ☐ Natural ☐ Agricultural ☒ Residential ☐ Commercial ☐ Industrial ☐ Other (specify: _____)

6.3.3 What is the outcome of the investigation? (check one only.)

- ☐ For all COPCs on-site and off-site, no exceedance has been found above any applicable soil and groundwater guidelines in any prior and current assessments.
☐ All contamination on-site and off-site has been completely remediated and meets the applicable soil and groundwater guidelines.
☒ One or more COPC still exceeds the applicable soil or groundwater guidelines.

6.3.4 How many contaminated areas are there currently at the site?

- one ☐ None ☐ TBD

6.3.5 Are all contaminated areas and potential contaminated areas assessed during this investigation?

- ☒ Yes ☐ No

6.3.6 For all areas of potential environmental concern, list the dates when the contamination was discovered (specify dd-mon-yyyy): November 2008; March 2009

6.3.7 For all areas that have been identified in Section 6.3.4, have all substance releases been reported to AENV?

- ☐ Yes ☒ No ☐ Not applicable

6.3.8 If the answer to Section 6.3.7 is 'yes', list all Incident No.(s) (attach separate sheet if necessary):

- _____; _____ ☐ Not assigned

6.3.9 What is the approximate, cumulative amount of land area remaining exceeding applicable remediation guidelines? _____ (m²) ☐ None ☒ TBD

6.3.10 Is there non-aqueous phase liquid (NAPL) product remaining on site? ☐ Yes ☒ No ☐ TBD

6.3.11 Is there non-aqueous phase liquid (NAPL) product remaining off site? ☐ Yes ☒ No ☐ TBD

6.3.12 What is the remediation status of the contaminated areas at site?

- | | |
|---|---|
| ☐ No remediation required | ☐ Site has exceedance but no remediation plan |
| ☐ Remediation plan developed | ☐ Active remediation |
| ☐ Remediation completed | ☐ Post remediation assessment completed |
| ☒ Ongoing risk management plan – on-site | ☒ Ongoing risk management plan – off-site |
| ☐ Remediation Certificate issued for some area(s) (provide Remediation Certificate No.(s): _____) | |
| ☐ Remediation Certificate cancelled for some area(s) (provide Remediation Certificate No.(s): _____) | |

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Direction for Completing the Remainder of the Form

Attach the analytical summary tables of the COPCs that are the subject of this investigation and still present at this site. A detailed listing of COPCs can be found with Tables 1-4 in *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AENV, 2008), as amended. Refer to the *RSC User's Guide* for detailed information on format and other requirements regarding the summary table.

For the remainder of the form, follow the directions below:

- If the COPCs on-site and off-site have never exceeded any applicable soil and groundwater guidelines in any prior and current assessments, → proceed to Section 8, or
- If the COPCs on-site and off-site have been completely remediated and meet the applicable soil and groundwater guidelines, → proceed to Section 8, or
- For all other circumstances, continue with Section 6.4.

6.4 Key Transport Factors for Existing COPCs

6.4.1 What is the horizontal distance to the nearest water well from the edge of the nearest contaminated area?

☐ 0-50 m ☐ 50-100 m ☒ 100-300 m ☐ 300-1000 m ☐ > 1000 m

6.4.2 What is the horizontal distance to the nearest surface water body from the edge of the contaminated area?

☐ ≤10 m ☐ 10-50 m ☐ 50-100 m ☐ 100-300 m ☒ 300-1000 m ☐ > 1000 m

6.4.3 Does delineation achieve closure above the groundwater water table that is nearest to the ground surface?

☐ Yes (→ go to Section 6.5.) ☒ No ☐ TBD

6.4.4 Is the groundwater that is nearest the ground surface a domestic use aquifer (DUA) as defined in Alberta Tier 2 guidelines?

☐ Yes ☐ No ☒ TBD ☐ Not required (NR)

6.4.5 Is there a hydraulic barrier, as defined in Alberta Tier 2 guidelines, between the base of the contaminated area and the DUA?

☐ Yes ☒ No ☐ TBD ☐ NR

6.4.6 If you answered 'yes' to Section 6.4.5, provide the measured largest value of the hydraulic conductivity (as value $\times 10^{-7}$ m/sec.) for the 5.0 m vertical layer from the bottom of the contaminated zone.

_____ ($\times 10^{-7}$ m/sec.) ☐ TBD ☐ NR

6.5 On-site Characterization

6.5.1 What is the dominant soil texture that governs substance transport at the site?

☐ Coarse grained ☒ Fine grained ☐ TBD ☐ Not applicable (must identify reason in Section 6.2.1.1.)

6.5.2 What are the shallowest and deepest measured depths (meters below ground surface) of the water table at site?

Shallowest: 2.15 (m) Deepest: 2.62 (m) ☐ TBD ☐ NR (specify max. depth assessed: _____ (m))

6.5.3 What is the dominant horizontal direction of groundwater flow for the near surface water table?

(N, NW, etc.: SE) ☐ TBD ☐ NR

6.5.4 What is the existing land use classification?

☐ Natural ☐ Agricultural ☒ Residential ☐ Commercial ☐ Industrial ☐ Other (specify) _____

6.5.5 What is the end land use classification?

☐ Natural ☐ Agricultural ☒ Residential ☐ Commercial ☐ Industrial ☐ Other (specify) _____

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6.5.6 Identify exposure pathways for which the applicable guidelines are exceeded on-site (check all that apply).

☒	Vapour inhalation	☐	Soil ingestion
☒	Ingestion of potable water	☐	Soil dermal (skin) contact
☐	Fresh water aquatic life	☒	Soil contact for plants and invertebrates
☐	TBD	☒	Other (specify): <u>Management Limits</u>

6.6 Off-site Characterization

6.6.1 Are there COPCs off-site exceeding applicable soil or groundwater guidelines?

- ☐ No (→ if on-site contamination was reported, proceed to Section 7, otherwise, proceed to Section 8.)
☒ Yes ☐ TBD

6.6.2 What is the current land use classification for any off-site area(s) identified in Section 6.6.1?

- ☐ Natural ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial ☒ Other (specify) Road

6.6.3 What is the end land use classification for any off-site area(s) identified in Section 6.6.1?

- ☐ Natural ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial ☒ Other (specify) Road

6.6.4 Is there any substance concentration under a road allowance exceeding the applicable soil or groundwater guidelines?

- ☒ Yes ☐ No (→ proceed to Section 6.6.6.) ☐ TBD

6.6.5 What is the most sensitive land use classification adjacent to the road allowance?

- ☐ Natural ☐ Agricultural ☒ Residential ☐ Commercial ☐ Industrial ☐ Other (specify) _____

6.6.6 Identify exposure pathways for which the applicable guidelines are exceeded off-site (check all that apply).

☒	Vapour inhalation	☐	Soil ingestion
☒	Ingestion of potable water	☐	Soil dermal (skin) contact
☐	Fresh water aquatic life	☒	Soil contact for plants and invertebrates
☐	TBD	☐	Other (specify): _____

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7 RISK MANAGEMENT PLAN (RMP)

7.1 What is the Plan for Contaminated Areas Still Remaining on and off the Site? (check one only.)

- ☐ Complete remediation (→ proceed to Section 8).
- ☐ Partial remediation with risk management for some residual contamination.
- ☒ Risk management for all remaining contamination.

7.2 Key Progress of RMP

7.2.1 If the site needs an on-going RMP, answer all the following questions that apply to the RMP.

☐ Yes	☒ No	Are contaminated areas completely delineated horizontally and vertically in soil?
☐ Yes	☒ No	Are contaminated areas completely delineated horizontally and vertically in groundwater?
☒ Yes	☐ No	Is source identified and completely delineated?
☒ Yes	☐ No	Is source migrating or has migrated off-site?
☐ Yes	☒ No	Is source left as is?
☒ Yes	☐ No	Is source partially removed and residual source being managed?
☐ Yes	☒ No	Is source controlled with physical or administrative methods?
☒ Yes	☐ No	Are all pathways of concern identified?
☐ Yes	☒ No	Have all relevant receptors been identified and protected?
☐ Yes	☒ No	Is there a monitoring program in place to verify RMP success?
☐ Yes	☒ No	Are there third parties related to this RMP? (if the answer is 'no', skip the next question.)
☐ Yes	☐ No	If there are third parties, have all of them accepted the RMP?
☒ Yes	☐ No	Is there a commitment from person(s) responsible to implement and monitor the RMP until final remediation guidelines are achieved?
☒ Yes	☐ No	Is there a contingency plan in place should the RMP fail?
☐ Yes	☒ No	Is the RMP implemented for the site?

Public Disclosure and Privacy Notification

The *Record of Site Condition* form is a public record that is disclosed in accordance with section 35 of the *Environmental Protection and Enhancement Act*, *Disclosure of Information Regulation*, and *Ministerial Order 23/2004*. Reasonable efforts have been made to minimize collection of personal information where possible. Personal information on the form is collected under the authority of section 12(c) and other provisions of the *Environmental Protection and Enhancement Act* and is in compliance with section 33(a) and 33(c) of the *Freedom of Information and Protection of Privacy Act* (FOIP). Personal information collected on this form will be used by Alberta Environment for the purposes of administering its programs.

Accuracy of Information

The information in this document has been submitted by persons other than Alberta Environment. The Department and the Government of Alberta cannot and do not warrant that the information in this document is current, accurate, complete, or free of errors. Persons accessing the information provided should not rely on it, and any reliance on the information provided is taken at the sole risk of the user. Users of this information are advised to conduct their own due diligence to satisfy themselves of the environmental condition of the property of interest.

RECORD OF SITE CONDITION

8 DECLARATION

This *Record of Site Condition* form was prepared for the purpose of reporting on the state of environmental site conditions and, where applicable, for the purpose of remediation or reclamation, for:

AMA Site #9558 (site name) (the "Site").

I, as the licensed operator or authorized representative, have reviewed all information that was used in preparation of this form and I am satisfied that it was prepared in a manner consistent with the Applicable Standard¹ together with any relevant additional guidance that is available from Alberta Environment as of this date for conducting environmental site assessments.

Having conducted reasonable inquiries to obtain all relevant information, to my knowledge, the statements made in this form are true as of this date. I have disclosed all pertinent information of which I am aware concerning the historical and current environmental condition of the Site to the Director.

Any use which a third party, other than the Crown in right of Alberta, makes of this form, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. The undersigned accepts no responsibility for damages, if any, suffered by any third party, other than the Crown in right of Alberta, as a result of decisions made or actions based on this form. Any exclusions or disclaimers to the contrary contained in any attachment to this form are of no force or effect as against the Crown in right of Alberta.

Footnote ¹:

"Applicable Standard" means

a) for the purposes of upstream oil and gas sites,

i) *Alberta Environment Phase I Environmental Site Assessment Guideline for Upstream Oil and Gas Sites* (AENV 2001),

ii) *CSA Standard Z769, Phase II Environmental Site Assessment*, as amended, for any Phase II site assessment information used in preparation of this form on all upstream oil and gas sites not included in a) i);

b) for the purposes of all other sites, *CSA Standard Z768, Phase I Environmental Site Assessment*, as amended, for any Phase I site assessment information and with *CSA Standard Z769, Phase II Environmental Site Assessment*, as amended, for any Phase II site assessment information used in preparation of this form.

By signing below, I as the licensed operator or authorized representative, confirm the information provided herein is correct and complete, to the best of my knowledge and belief.

	LAURIE BECK	ADMINISTRATOR	COB	13/05/2014
Name of operator	Name of authorized representative	Title of authorized representative (e.g. officer, director)	Signature	Date (dd-mon-yyyy)