

**2024 Groundwater and Soil Vapour Monitoring Report  
Riverside Light Industrial Park  
NW 21-038-27 W4M  
Red Deer, Alberta**



PRESENTED TO  
**City of Red Deer**

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## EXECUTIVE SUMMARY

The City of Red Deer (the City) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct the 2024 groundwater and soil vapour monitoring program related to potential buried waste materials at the Riverside Light Industrial Park (RSLIP or the Site). The Site is located within the northwest quarter of 21-038-27 W4M in Red Deer, Alberta.

The objectives of the monitoring program are to assess the environmental conditions at the Site and potential impacts on the environment and adjacent receptors related to potential buried waste materials and to provide recommendations related to risk management activities at the Site. These objectives include assessing whether existing groundwater conditions at the Site meet the 2024 Alberta Environment and Protected Areas (AEPA) Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines) and whether soil vapour conditions meet site-specific soil vapour screening levels.

The scope of work for 2024 included the installation of three soil vapour monitoring wells (24VW-06, 24VW-07, and 24VW-08) in September, in addition to groundwater and soil vapour monitoring and sampling. The new soil vapour wells were installed to further assess the spatial distribution of subsurface methane and carbon dioxide previously found to be widespread at the Site. The wells were positioned beyond the existing lateral extent of the monitoring well network, to the northeast (24VW-06; approximately 180 m away), northwest (24VW-07 approximately 230 m away) and southwest (24VW-08 approximately 220 m away) of the potential buried waste with the intent of delineating the extent of soil vapour exceedances for methane previously detected via field monitoring and laboratory measurement of samples.

Based upon the results of the groundwater and vapour monitoring and sampling in 2024 and previous years, Tetra Tech has developed the following conclusions:

- The inferred groundwater flow direction is to the northeast on the northern portion of the Site under an estimated horizontal gradient of 0.005 m/m, with more easterly flow on the southern portion of the Site under an estimated horizontal gradient of 0.002 m/m. These results are in alignment with the proximity and flow direction of the Red Deer River.
- The 2024 groundwater sampling results indicate little evidence of impact to groundwater from potential buried onsite wastes, although the inferred redox conditions at MW-03 remain deeply anoxic. The results are similar to previous results and show the following:
  - Groundwater quality parameters that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2024 included total dissolved solids (TDS), chloride, and the dissolved metals arsenic, iron, manganese and zinc. The routine water chemistry and dissolved metals parameter concentrations were consistent overall with previous results. The results for down-gradient wells suggest that the environmental risk related to the discharge of groundwater passing through the Site to the Red Deer River is low. Comparing the 2023 ammonia concentrations at MW-03 to MW-03 (Lot 4), which is closer to the Red Deer River and hydraulically cross gradient, indicates that concentrations of ammonia decrease significantly as groundwater moves towards the Red Deer River. The inferred decrease in ammonia concentrations is such that the ammonia entering the Red Deer River from RSLIP is minimal.
  - Ammonia concentrations have been persistently above the Tier 1 Guideline at MW-03, ranging from 19.1 mg/L in 2019 to 51.3 mg/L in 2023. A miscommunication led to ammonia not being analyzed as part of the 2024 analytical suite of water quality parameters. However, given the minimal overall changes in water chemistry observed in the other parameters between the 2021 and 2023 sampling events, and the 2024 sampling event, it is likely that the ammonia concentrations have also remained relatively unchanged.
- Methane extends beyond the identified waste footprint of the Site, similar to previous results, as outlined below:
  - Elevated methane gas concentrations were measured in December 2024 at 22VW-01 (21.7%), VW-02 (18.3%), and at the newly installed 24VW-06 (10.8%), north of the interpreted waste footprint.

The two other new soil vapour wells to the west, 24VW-07 and 24VW-08, exhibited negligible methane concentrations in December 2024. For 22VW-01 and VW-02 the results were similar to the 2023 measurement (22VW-01) and 2021 to 2023 (VW-02). The measured concentrations at 22VW-01, VW-02, and 24VW-06 were greater than values referenced in the Standards for Landfills in Alberta (Standards) for on-site buildings or enclosed structures or in the area immediately outside the foundation of a building or structure. The Standards are not directly applicable to the Site but were used as a relative indicator of impact. Thus, the extent of elevated methane gas concentrations is not delineated north of the former gravel pit and/or interpreted waste footprint.

- Concentrations of the BTEX compounds, PHCs, and VOCs in the soil vapour samples collected from VW-02, 24VW-06, 24VW-07, and 24VW-08 were less than the soil vapour screening criteria. The estimated cumulative risks and hazards associated with the soil vapour samples collected in December 2024 did not exceed the corresponding target risk and hazard levels and only dichlorodifluoromethane in VW-02, exceeded the individual hazard level.

The results of the groundwater and vapour monitoring program in 2024 and early 2025, in combination with results from previous years, indicate there are impacts to groundwater and soil vapours from the buried waste in place at the Site. Ongoing risk management is required, including ongoing monitoring and administrative actions.

The following recommendations are made according to these risk management elements.

**Ongoing Monitoring:**

- The groundwater flow direction and groundwater quality has been reasonably well defined, with a known presence of persistently elevated ammonia at MW-03, based on previous years of monitoring. Therefore, periodic groundwater monitoring and sampling events are recommended, albeit not necessarily on an annual basis. A proposed schedule for the upcoming years is presented below.
- Continue quarterly monitoring of soil vapour concentrations and pressures at all new and existing vapour monitoring wells. Based on the analytical results to date, ongoing collection of soil vapour samples for analytical testing is not considered warranted unless monitoring results yield significant methane concentrations. Sample any new soil vapour wells installed in 2025 to confirm concentrations.
- Use of the ASTM (2023) Guide for evaluating the methane hazard should be considered to support the risk management approach for the Site.
- Based on the above, the following monitoring program is proposed. If results remain consistent, reducing the monitoring and sampling frequency over time may be warranted.

**Table 1-1: Proposed Site Condition, Surface Water, Groundwater and Vapour Monitoring Program**

Activity	2025	2026	2027	2028	2029
Groundwater monitoring (summer) at five wells (MW-01, MW-03, and 22MW-04 within the industrial park and MW-01 and MW-03 on Lot 4, Block 8, to the east of the industrial park)		X			X
Groundwater sampling (summer) at two wells (MW-03 and 22MW-04)		X			X
Tri-annual (3 times per year) vapour monitoring of eight locations (22VW-01, VW-02, 22VW-03, 22VW-04, 22VW-05, 24VW-06, 24VW-07 and 24VW-08). Sample as needed if monitoring yields significant methane concentrations.	X	X	X	X	X
Install soil vapour monitoring wells northwest (25VW-09) and northeast (25VW-10) of 24VW-06 to delineate elevated subsurface methane concentrations and add to the monitoring program. Monitor and sample in 2025.	X				

### **Further Assessment:**

- Tetra Tech recommends the installation of additional soil vapour monitoring wells to the northwest and northeast of 24VW-06 to delineate the elevated methane concentrations.

### **Administrative Actions:**

- Ensure that the site is clearly identified within the City's Zoning Bylaw and appropriate administrative requirements are met for site development in accordance with City policies and provincial regulations.
- Ensure that the site is clearly identified within the City's Utility mapping system. Elevated subsurface methane concentrations are present in areas of the site and future activities in the vicinity (e.g. utility work, repairs, paving) should consider the potential presence of sub-surface gas and site-specific safety plans should be developed for work undertaken to limit the potential for exposure to site workers
- Further to the above recommendations, as noted, the Site has buried waste materials and elevated subsurface methane concentrations. As the Site is fully developed with roadways and commercial buildings, the City should review the Site's status on an ongoing basis with respect to the elevated methane concentrations and the possibility of the accumulation of methane gas in underground utility corridors, trenches/excavations, and potentially within or beneath the footprint of buildings.

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## LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of The City of Red Deer and their agents. Tetra Tech Canada Inc. (Tetra Tech) 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 City of Red Deer, 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 document is subject to the Limitations on the Use of this Document attached in Appendix A or Contractual Terms and Conditions executed by both parties.

## 1.0 INTRODUCTION

The City of Red Deer (the City) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct the 2024 groundwater and soil vapour monitoring program related to potential buried waste materials at the Riverside Light Industrial Park (RSLIP or the Site). The Site is located within the northwest quarter of 21-038-27 W4M in Red Deer, Alberta.

The objectives of the monitoring program are to assess the environmental condition of the Site and potential impacts on the environment and adjacent receptors related to potential buried waste materials, and to provide recommendations related to risk management activities at the Site.

Tetra Tech's scope of work for the 2024 monitoring and sampling program at the Site was based on the results presented in the 2023 Groundwater and Soil Vapour Monitoring Report – Riverside Light Industrial Park (Tetra Tech 2024). The 2024 scope of work also included the installation of three soil vapour monitoring wells in September 2024, in addition to groundwater and soil vapour monitoring and sampling. The field components of the monitoring program were completed using Tetra Tech's detailed work plans encompassing the scope of work outlined in Section 1.1.

This report was completed under Tetra Tech's Limitations on the Use of this Document for conducting environmental work. A copy of these conditions is provided in Appendix A.

### 1.1 Scope of Work

Based on the 2023 findings and recommendations, the work conducted in 2024 included the following:

- Installation of three new soil vapour wells (24VW-06 to 24VW-08) to the north, northwest, and southwest, respectively, beyond the existing lateral extent of the monitoring well network and the identified potential buried waste area (Figure 2).
- An annual groundwater monitoring event at five wells in September 2024 (MW-01, MW-03, 22MW-04, MW-01 [Lot 4], and MW-03 [Lot 4]), including measuring methane concentrations in headspace vapours and groundwater levels within each groundwater monitoring well and observing monitoring well integrity.
- Annual groundwater sampling at two wells in September 2024 (MW-03 and 22MW-04):
  - Purged monitoring wells until practically dry or until a minimum of three well volumes had been removed and allowed the water levels in the wells to recover;
  - Measured field parameters (pH, electrical conductivity [EC], and water temperature) at the time of sampling; and
  - Collected groundwater samples from each well and submitted the samples for laboratory chemical analyses to ALS Laboratory Group (ALS) in Calgary, Alberta.
- Soil vapour well monitoring at the five existing (22VW-01, VW-02, 22VW-03, 22VW-04, and 22VW-05) soil vapour wells in September 2024 and December 2024 and three new (24VW-06 to 22VW-08) soil vapour well locations in December 2024.
- One soil vapour sampling event at VW-02, and 24VW-06 to 22VW-08 in December 2024 using Summa canisters.
- Submission of the soil vapour samples to ALS for analyses.
- Monitoring well repairs, as required.

- Preparation of an annual report summarizing the field activities, interpreting the groundwater and soil vapour analytical results and providing recommendations for future monitoring activities at the Site.

## 2.0 BACKGROUND INFORMATION

### 2.1 General Information

The Site is located within NW 21-038-27 W4M. The site is zoned I1—Industrial District—and is in a business area used for commercial and light industrial business activities. The Site is located on the west side of the Red Deer River, south of Alberta Highway 11, and east of Gaetz Avenue. Figure 1 shows the general site location plan.

Based on Phase I and II Environmental Site Assessments (ESAs) conducted in 2013 and 2014 by Tiamat Environmental Consultants Ltd. (Tiamat 2013 and 2014a), there is a historical waste disposal area within the industrial area. The waste is located southeast of 62 Street, northwest of 61 Street, and southwest of 46A Avenue in Red Deer, and appeared to be mostly construction waste materials.

The industrial area is surrounded by an environmental preservation land use to the north and west, and parkland to the south and east. The Red Deer River is approximately 200 m from the southern site boundary and flows in a northeasterly direction.

Municipal waste was not expected, but in the Phase I ESA Tiamat mentioned that it may be present in lesser quantities. During the subsequent Phase II ESA (Tiamat 2014a), the area where wastes were suspected was further assessed, and its footprint was estimated to be approximately 5,500 m<sup>2</sup>. The outline of the waste disposal area in Tiamat’s Phase II ESA was roughly in between vapour probes VW-01 and VW-02 and is shown on Figure 2.

An aerial photograph from 1962 that was included in the Phase I ESA showed a gravel pit larger than the interpreted waste disposal area, extending further east towards the CN Rail right-of-way (ROW). On a second aerial photograph from 1966 in the Phase I ESA, the gravel pit appeared to have been filled in. Tetra Tech obtained a slightly older aerial photograph from 1959 (Figure 1), which also shows the gravel pit. The approximate extent of the gravel pit is also presented on Figure 2.



**Figure 1: Screen shot from the 1959 aerial photograph showing gravel mining operations**

Discussions with the City in 2021 and 2022 confirmed that the gravel mining operations took place and that, anecdotally, the pit was filled in and leveled with topsoil, overburden stockpiles, excavation soil from other sites as well as concrete, metal, and wood. The surface was reclaimed with imported topsoil and manure. While this information cannot be verified, it is known that backfilling excavations with materials containing organics often leads to methane generation in the subsurface as the organic wastes break down. Neither the ultimate extent of the gravel mining operations nor the nature of the material used for backfill are fully characterized. Additional information on the site history, historical groundwater monitoring investigations, geology, and hydrogeology can be found in Appendix B.

Monitoring wells and vapour wells were installed across several city blocks during previous assessments and are located within the industrial area (MW-01 to MW-03, and VW-01 and VW-02) and near the adjacent Lions Campground and Red Deer Native Friendship Society Building, Asooahum Crossing (MW-01 to MW-03 [Lot 4]), along Riverside Drive.

In December 2022, Tetra Tech installed a groundwater monitoring well (22MW-04) north of 46A Avenue and east of a rail line ROW, two soil vapour wells (22VW-03 and 22VW-05) at the northeast corner of 62 Street and 46A Avenue and adjacent to MW-03, respectively, and replaced two soil vapour wells; 22VW-01 (replacement for VW-01) and 22VW-04 (replacement for VP-01 [Lot 4]).

In September 2024, Tetra Tech installed three new soil vapour wells (24VW-06, 24VW-07, and 24VW-08), to the north of 22VW-03 near the intersection of 62 Street and 46 Avenue; to the south of VW-02 along 61 Street; and to

the west along 62 Street. The wells were installed to further assess the lateral distribution of elevated methane concentrations reported in 2021.

Cross-sections that were prepared based on borehole information from the wells previously installed at the Site in 2013 are included in Appendix C (Tiamat 2014a).

## 2.2 Conceptual Site Model Summary

The selection of comparative guidelines is based on the conceptual site model (CSM), first described in the 2021 groundwater and soil vapour monitoring report (Tetra Tech 2022a) and updated in the 2023 groundwater and soil vapour monitoring report (Tetra Tech 2024a). The CSM outlines the rationale for the selection of applicable exposure pathways and receptors at the Site. This evaluation is based on guidance presented in the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines Alberta Environment and Parks [AEP] 2022 as amended in 2024 by Alberta Environment and Protected Areas [AEPA]). The CSM included the following items:

- Description of any identified environmental issues including a description of processes or activities undertaken at or near the Site and a listing of chemicals of potential concern (COPCs) identified in earlier investigations.
- Description of known and reported historical releases, including locations and status of any subsequent ESAs and remediation.
- Identification of applicable exposure pathways and receptors.

The following table presents a summary of the relevant receptors and exposure pathways identified in the CSM.

**Table 2-1: Summary of Exposure Pathways and Receptors for Soil and Groundwater**

Release Mechanism	COPC	Migration Pathway	Potential Receptor
Impacted groundwater migration.	Inorganic parameters and nutrients, metals, benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbon (PHC) fractions, and volatile organic compounds (VOCs) and other indicator parameters (i.e., biological oxygen demand [BOD] and chemical oxygen demand [COD]).	Direct soil contact.	Human users of the area; ecological plants and soil invertebrates.
		Migration to groundwater users via water wells; migration to Red Deer River via groundwater or surface seeps.	Domestic use aquifer (DUA) drinking water; freshwater aquatic life (FAL) in the Red Deer River.
		Nutrient and energy cycling.	Microbial functioning of the soil.
Hazardous ground gas emissions.	VOCs, methane, BTEX, and PHC fractions.	Vapour inhalation (ambient and indoors); preferential pathway migration via utility corridors and coarse-grained stratigraphies (sand/gravel layers).	Building occupants and users in onsite/adjacent commercial/industrial buildings and residential buildings to the southeast (Lot 4); workers in excavations/trenches.

## 2.2.1 Data Evaluation

To establish the appropriate guidelines for the Site, residential land use criteria were used due to the most sensitive receptor being residences in the adjacent lots to the southeast. The receptors were determined by a combination of the degree of potential exposure, the exposure pathway, and the contaminants of concern. Human receptor exposures applicable to the Site include the DUA, direct soil contact, and inhalation pathways. The ecological receptor exposures applicable to the Site include direct soil contact, FAL, and nutrient and energy cycling. Previous investigations at the Site have determined that the dominant soil stratigraphy governing transport at the Site is coarse-grained.

As recommended by AEP, the soil vapour results obtained during investigation were compared to the Canadian Council of Minister of the Environment's (CCME's) document A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures Via Inhalation of Vapours (CCME 2014). To determine the appropriate guidelines to compare the vapour sampling results to, indoor air risk calculations were undertaken, and methane explosive risks were evaluated.

Based on the CSM, the most applicable guidelines for groundwater and vapour results for the Site were as follows:

- Groundwater concentrations at the Site were compared to the Tier 1 Guidelines (AEPA 2024a) under residential land use for coarse-grained soils (AEP 2022a).
- Soil vapour analytical results were compared to soil vapour screening criteria for both slab-on-grade and basement for coarse-grained soils (CCME 2014). Soil vapour screening criteria have been updated using current toxicity reference values (TRVs) from Health Canada and the United States Environmental Protection Agency (USEPA).
- Cumulative target risk and hazard levels for the hazard quotient evaluation were determined in accordance with Alberta Tier 2 Guidelines (Tier 2 AEPA 2024b). For carcinogens, the target risk level is  $1 \times 10^{-5}$ , as this value is considered by Health Canada to represent a negligible risk. This risk level applies to both individual compounds and a summation (i.e., cumulative) of individual compounds risks. For non-carcinogens a cumulative target hazard level of 1.0 is used as potential exposures that result in cumulative hazard indices equal to or less than 1.0 signify negligible potential for adverse health effects. For individual compounds, a hazard index of 0.2 was used. Each sampling location was screened individually for every chemical detected, and the results evaluated relative to both individual and cumulative risks and hazard levels. For some compounds, both carcinogenic and non-carcinogenic effects required calculation.

There are not currently AEPA standards to evaluate methane for a historical site with buried wastes such as this. The Standards for Landfills in Alberta (Standards; AENV 2010) provide concentrations to evaluate methane concentrations at a landfill and at the landfill perimeter. While not directly applicable to this Site, they have been used as a qualifier of potential impact to aid in results interpretation.

## 2.3 Monitoring Well Network

The original groundwater monitoring network at the Site consisted of six monitoring wells (MW-01 to MW-03 within the industrial park, and MW-01 to MW-03 on Lot 4, Block 8, to the east of the industrial park).

Monitoring wells MW-01, MW-01 (Lot 4), MW-02 (Lot 4) and MW-03 (Lot 4) were screened across native sand and gravel and into mudstone or shale bedrock. MW-02 was screened in native sand and gravel layer and into a clay layer, and MW-03 was screened in the native sand and gravel. Monitoring wells MW-02 and MW-02 (Lot 4) have not been located since 2013 and are suspected to be destroyed. An additional hydraulically down-gradient groundwater monitoring well (22MW-04) was installed in December 2022. It is screened across in the native sand and clay. In summary, at the time of sampling in September 2024 the groundwater monitoring well network

consisted of six wells: MW-01, MW-03, 22MW-04, MW-01 (Lot 4), MW-02 (Lot 4), and MW-03 (Lot 4). Monitoring well completion details are summarized in Table 1.

The original soil vapour well monitoring network consisted of three wells (VW-01, VW-02, and VP-01 [Lot 4]). In 2021, VW-01 and VP-01 (Lot 4) were found to be compromised; these vapour wells were replaced in December 2022, as 22VW-01 and 22VW-04 along with an additional two soil vapour monitoring wells (22VW-03 and 22VW-05).

Three new soil vapour wells were installed in September 2024 (24VW-06, 24VW-07, and 24VW-08) to further assess the spatial distribution of subsurface methane and carbon dioxide previously found to be widespread at the Site. The wells were positioned beyond the existing lateral extent of the network of monitoring wells, to the northeast (24VW-06; approximately 180 m away), northwest (24VW-07; approximately 230 m away) and southwest (24VW-08; approximately 220 m away) of the potential buried waste. In summary, at the time of sampling in December 2024, the soil vapour monitoring network consisted of eight probes: 22VW-01, VW-02, VW-03, 22VW-04, 22V-05, 24VW-06, 24VW-07, and 24VW-08.

Groundwater and vapour monitoring well locations are shown on Figure 2. Borehole logs for both groundwater and soil vapour monitoring wells are presented in Appendix F.

## 3.0 FIELD MONITORING AND SAMPLING METHODOLOGY

A discussion of the methods used for the soil vapour well installation, fieldwork and laboratory testing is presented in the following sections.

### 3.1 Soil Vapour Well Installation

On September 3 and September 4, 2024, Tetra Tech contracted Ernco Environmental Drilling & Coring Inc to install three soil vapour wells using a track-mounted drilling rig with solid stem augers. The soil vapour wells were installed with the aim of delineating the extent of soil vapour, in particular methane related to the breakdown of organic matter.

Tetra Tech described soil at the borehole location according to the modified Unified Soil Classification System (USCS) with additional comments on soil staining, odours, and/or debris (if present). The soil vapour wells were installed with 19 mm diameter solid polyvinyl chloride (PVC) pipe and screened with 19 mm slotted PVC pipe. The installation details were as follows:

- 24VW-06: Installed to a total depth of 4.5 mbg with a 1.0 m screen from 3.5 mbg to 4.5 mbg. No waste encountered.
- 24VW-07: Installed to a total depth of 4.4 mbg with a 1.0 m screen from 3.4 mbg to 4.4 mbg. No waste encountered.
- 24VW-08: Installed to a total depth of 4.5 mbg with a 1.0 m screen from 3.5 mbg to 4.5 mbg. No waste encountered.

Silica sand was placed from the base of the borehole to approximately 0.15 m above the slotted interval of the standpipe within the borehole annulus, followed by bentonite clay to ground level. Flush mount gatic covers were installed over the wells for protection and pea gravel was placed at the top 0.25 m to seal the monument in place.

The soil vapour well locations are shown on Figure 2, and the installation details are provided on the borehole logs in Appendix F.

## 3.2 Groundwater Monitoring and Sampling

Tetra Tech conducted groundwater monitoring and well development on September 5, 2024, and groundwater sampling on September 6, 2024.

Groundwater monitoring consisted of measuring static groundwater levels in each monitoring well using an interface meter.

The methodology for groundwater monitoring and sampling included the following:

- Observing the integrity of each well and noting drainage and site conditions near the well that may have an effect on monitoring results or groundwater quality.
- Measuring liquid levels in each monitoring well with an interface probe and recording total depths confirming the absence of non-aqueous phase liquids (NAPL) and evaluating the water level relative to the screen to confirm the screen was not blinded.
- Recording of field data on standardized forms as documented in Tetra Tech standard operating practices.
- Purging each monitoring well requiring sampling using dedicated polyethylene bailers or Waterra tubing with inertial pump foot valves of at least three well volumes of water, or until the well was practically dry.

Following the completion of groundwater monitoring and purging, groundwater samples were collected from the selected wells using the procedures identified below:

- Groundwater samples were collected from two monitoring wells (MW-03 and 22MW-04) and placed into appropriate laboratory-supplied, sterile glass, and plastic vials and bottles for the required analytical package. If required, samples were filtered and/or preserved in the field.
- Field measurements were taken for pH, EC, and temperature at the time of sampling.
- Samples were submitted in coolers with ice to ALS in Calgary, Alberta for laboratory analysis of routine water chemistry, and dissolved metals. Groundwater samples were submitted under chain-of-custody (COC) documentation.

The groundwater monitoring well locations are shown on Figure 2.

### 3.2.1 Groundwater Analytical Program

The analytical program for the groundwater monitoring wells was developed based on the recommendations in Section 1.1 and is summarized below:

- Routine water chemistry, which includes the parameters pH, EC, total dissolved solids (TDS), calcium, magnesium, potassium, sodium, chloride, fluoride, sulphate, nitrate, and nitrite.
- Total Ammonia as nitrogen (N);
- Dissolved metals;
- BTEX and PHC fractions F1 and F2; and
- VOCs.

A miscommunication led to ammonia not being analyzed as part of the 2024 analytical suite.

### 3.3 Vapour Field Program

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Tetra Tech conducted soil vapour headspace monitoring at five groundwater monitoring wells on September 5, 2024, and soil vapour monitoring at eight soil vapour well locations December 4, 2024.

Measurements were taken of the methane headspace concentrations in each groundwater monitoring well using a LandGEM 5000 landfill gas analyzer calibrated to methane.

Each soil vapour probe was inspected for visible signs of damage and the position of the sampling labcock was noted. Soil gas pressure was recorded using a digital manometer. Once the soil gas pressure measurement was recorded, the soil gas probe was purged of three well volumes of air, or until readings stabilized.

Gas composition measurements were subsequently recorded for methane, carbon dioxide, oxygen, balance gas, and hydrogen sulphide were recorded on a percent volumetric basis using a GEM analyzer. Then, the soil vapour well depths and depth to groundwater (if present) were measured and recorded to confirm that any water within the well was beneath the screen (i.e., the well was not blinded).

After connecting the Summa vacuum canister sample to the soil vapour well, at each location, a leak detection test was completed to ensure the vapour well was sealed properly. The test was completed using a helium gas tracer to inspect the wells and apparatus for any leaks. If there was a leak beyond the acceptable range (2% of helium concentration), the connections were tightened, and the leak test was conducted again.

Sampling of the soil vapour monitoring wells was based on the methodology of the CCME sampling guidelines (CCME 2016a; 2016b), and is summarized as follows:

- Prior to collecting the soil vapour well samples, the well was purged of three well volumes, or until headspace readings stabilized.
- A 1.4 L Summa vacuum canister was used for sample collection.
- Sample data was recorded on the provided sample tag for each canister.
- Sample tubing that was used to connect the canister to the soil vapour probe was low in VOCs, and only used once to prevent sample cross-contamination.
- When beginning sample collection, the end cap was removed, and a 60-minute flow controller was attached to the canister. The start time and starting pressure were recorded on the sample tag.
- When sampling was complete, the valve was closed, and the flow controller was removed. The end time and final pressure were recorded on the sample tag.
- The protective end cap was replaced back on the canister.
- Canisters, flow controllers, and pressure gauges were placed in the original shipping container and returned to the laboratory under COC.
- The soil vapour well sampling port was returned to the closed position and the well was securely locked.

The vapour samples were submitted to ALS for chemical analyses of VOCs, BTEX, PHCs, and matrix gases including oxygen, carbon dioxide, methane, and nitrogen.

### 3.3.1 Vapour Well Analytical Program

The analytical program for the vapour monitoring probe is summarized below:

- VOCs.
- Matrix gases including oxygen, carbon dioxide, methane, and nitrogen.
- BTEX and PHCs.
- Naphthalene.

## 4.0 RESULTS AND DISCUSSION

This section presents the results of the fieldwork conducted in 2024 at the Site and discussions of these results.

### 4.1 Groundwater Well Headspace Monitoring

Tetra Tech conducted headspace monitoring at groundwater monitoring wells MW-01, MW-03, 22MW-04, MW-01 (Lot 4), and MW-03 (Lot 4). The groundwater level was below the top of the monitoring well screen at all five monitoring wells during the monitoring event meaning the wells were not blinded and so, the results were deemed representative of ground vapour conditions.

The LandGEM landfill gas analyzer detection limit ranges from 5 parts per million (ppm) to 100% of the lower explosive limit (LEL). For methane, the LEL is 5% by volume in air, or 50,000 ppm. Thus, 500 ppm is equivalent to 1% LEL and 20% LEL is equivalent to 1% gas.

During the September 2024 monitoring event, groundwater monitoring well headspace methane concentrations were non-detect at all monitoring wells.

The methane headspace concentrations are presented in Table 1.

### 4.2 Groundwater Elevations

Groundwater levels were measured in all five monitoring wells in September 2024. The recorded levels as well as calculated groundwater elevations are presented in Table 1. Figure 3 presents the groundwater elevation trends (hydrographs) for the monitoring wells for the years 2013 to 2024. The 2024 calculated groundwater elevations and the groundwater elevation contours are presented on Figure 4.

The average depth to groundwater in the monitoring wells in September 2024 was 3.70 mbg, which is similar to historical depths to groundwater. The groundwater elevations in 2024 were similar to the elevations measured historically.

The elevation contours indicate a northeasterly groundwater flow direction with an easterly component to the flow direction on the southern portion of the Site. The hydraulic gradient is steeper in the northeastern portion of the Site.

An estimated horizontal hydraulic gradient of 0.005 m/m was calculated for this northeastern portion of the Site and an estimated horizontal hydraulic gradient of 0.002 m/m was calculated for the southern portion of the Site.

### 4.3 Groundwater Field Parameters

Field measurements for temperature, pH, and EC in September 2024 were obtained at wells MW-03 and 22MW-04 and are provided in Table 2. A discussion of the results of the field measurements is summarized in this section.

Groundwater temperatures were 11.0°C at MW-03 and 15.6°C at 22MW-04.

Field pH values were 6.74 at MW-03 and 6.77 at 22MW-04. The field pH values were less than the laboratory pH values. The difference between field-recorded and laboratory pH values may be due to limitations of the field equipment, differences in sample temperature, and the loss of carbon dioxide from the sample.

Field EC measurements were 2,380 µS/cm at MW-03 and 1,705 µS/cm at 22MW-04. Field EC results were similar to the laboratory measured EC results.

### 4.4 Groundwater Analytical Results

The groundwater analytical data for 2024 and previous years is summarized in Table 2. The 2024 laboratory analytical reports are included in Appendix D and historical analytical tables reproduced from the Tiamat *Phase II Environmental Site Assessment* (2014) are presented in Appendix E.

#### 4.4.1 Routine Water Chemistry Parameters

The 2024 TDS concentrations ranged from 1,020 mg/L at 22MW-04 to 1,250 mg/L at MW-03. TDS concentrations were similar to the concentrations measured previously and both monitoring wells exceeded the Tier 1 Guideline of 500 mg/L. Elevated TDS concentrations often occur in groundwater as a result of the dissolution of naturally occurring salts and minerals in Alberta, and do not necessarily indicate groundwater quality impact related to buried wastes.

Chloride is often considered a useful parameter to assess groundwater quality impacts associated with sites with buried wastes, as chloride is usually present in elevated concentrations, and due to the mobile and conservative (non-reactive) nature of the ion. However, in urban settings the use of road salt also typically contributes to chloride concentrations in groundwater. Chloride concentrations were greater than the Tier 1 Guideline of 120 mg/L at MW-03 (160 mg/L) and the concentration appears stable and similar to the concentrations measured in 2019 (168 mg/L), 2021 (171 mg/L), and 2023 (172 mg/L) results. The chloride concentration at 22MW-04 was 104 mg/L; this is less than the Tier 1 Guideline.

High concentrations of nitrate and nitrite are typically indicative of other anthropogenic impacts and are often an indication of oxic groundwater conditions. The nitrate and nitrite concentrations at MW-03 and 22MW-04 were less than their respective Tier 1 Guidelines of 3 mg/L and 0.2 mg/L in 2024. Nitrate was detected at 22MW-04 at 0.703 mg/L and was below the analytical detection limit at MW-03 at <0.100 mg/L. Wells MW-03 and 22MW-04 are both hydraulically downgradient from the buried waste, with MW-03 intercepting groundwater that has passed through the Site before reaching 22MW-04. Considering the relative positions of the wells to the buried waste, it is possible that the nitrate concentration in 22MW-04 may be from sources other than potential on-site buried wastes. It is worth noting that monitoring wells MW-01 and MW-01 (Lot 4), which are up-gradient and cross-gradient respectively, had 2019 and 2021 nitrate concentrations well above the Tier 1 Guideline, ranging from 8.05 mg/L (MW-01 [Lot 4], 2019) to 29.6 mg/L (MW-01, 2019). These wells were not sampled in 2023 or 2024. Wells MW-01 and MW-01 (Lot 4) are positioned approximately 140 m southwest, and 210 m southeast of the identified buried waste area.

The term “total ammonia” is used to describe the sum of ammonia ( $\text{NH}_3$ ) and ammonium ( $\text{NH}_4^+$ ) concentrations. Natural sources of ammonia include the decomposition or breakdown of organic waste matter. Ammonia is a non-persistent and non-cumulative toxicant to aquatic life. Its toxicity is dependent on pH, temperature, the dissolved ionic composition of the water, and whether exposure is chronic or intermittent, with pH in particular having the greatest influence on toxicity to freshwater aquatic life (CCME 2010; Water Quality Australia, 2000). Consequently, the guideline for total ammonia in surface water is dependent upon the pH and temperature of the water, the guideline decreasing as pH and temperature increase, with the highest guidelines occurring at pH values below 6.5 (AEP 2018).

Ammonia concentrations at MW-03 have persistently exceeded the Tier 1 Guideline of 5.2 mg/L by a large margin, ranging from 19.1 mg/L in 2019 to 51.3 mg/L in 2023. A miscommunication led to ammonia not being analyzed as part of the 2024 analytical suite of routine water quality parameters. However, given the minimal overall changes in water chemistry observed in the other parameters between the 2021 and 2023 sampling events and the 2024 monitoring event, it is likely that the ammonia concentrations have also remained relatively unchanged. A comparison of 2023 ammonia concentrations at MW-03, approximately 146 m from the Red Deer River, and MW-03 (Lot 4), approximately 135 m from the Red Deer River, indicate that concentrations of ammonia decrease significantly as groundwater moves towards the Red Deer River (51.3 mg/L at MW-03 to 1.73 mg/L at MW-03 [Lot 4]). Similarly, concentrations the mobile constituent chloride decreased from 160 mg/L at MW-03 to 118 mg/L at MW-03 (Lot 4) in 2024. The inferred decrease in ammonia concentrations is such that the ammonia entering the Red Deer River from RSLIP is likely minimal.

Ammonia concentrations in Alberta natural surface waters range between non-detectable and 10.2 mg/L, averaging 0.183 mg/L (CCME 2010). As pH has the greatest effect on the toxicity of ammonia, it should be noted that pH values in the Red Deer River are stable, ranging from 8.02 to 8.19 over the year, and are thus unlikely to change and affect how ammonia affects freshwater aquatic life (City of Red Deer 2024d). The toxicity of ammonia can also be affected by the volume of water available, with periods of low flow and high ambient temperatures being the times of greatest risk for freshwater aquatic life. In the case of the Red Deer River in the City, the highest water temperatures of 19.0°C to 23.3°C occur from July to September (AEPA 2025). However, this period is also a time of moderate flow, 46.1 m<sup>3</sup>/sec to 96.3 m<sup>3</sup>/sec, mitigating the effects of higher temperatures (Government of Canada 2025). The lowest flows of 11.8 m<sup>3</sup>/sec to 12.9 m<sup>3</sup>/sec occur from December to February, coinciding with water temperatures of 0°C (AEPA 2025 Government of Canada 2025). The stability of the river’s pH means there is little variation in the calculated guidelines for ammonia, ranging from 0.24 mg/L at peak temperature to 1.83 mg/L at the lowest temperature (AEP 2018).

#### 4.4.2 Dissolved Metals

Dissolved iron and manganese are redox-sensitive parameters that naturally occur in groundwater under anoxic conditions and can help determine whether the groundwater quality is affected by biodegradation reactions, such as those related to groundwater impacted by buried waste. Dissolved iron concentrations exceeded the Tier 1 Guideline of 0.3 mg/L at MW-03 (14.9 mg/L) and exceeded the Tier 1 Guideline in 2021 and 2023, ranging from 13.8 mg/L to 19.9 mg/L, indicating anoxic conditions. Conversely, iron concentrations at 22MW-04 were below the Guideline in 2024 (0.012 mg/L) and 2023 (0.023 mg/L). Dissolved manganese exceeded the Tier 1 Guideline of 0.02 mg/L at MW-03 (0.447 mg/L) and 22MW-04 (0.414 mg/L). The inferred redox conditions at MW-03 remain deeply anoxic as of 2024, whereas conditions at 22MW-04 appear to be oxic.

Similar to previous results, dissolved arsenic exceeded the Tier 1 Guideline of 0.005 mg/L at MW-03 (0.0154 mg/L) and was below the Guideline at 22MW-04 (0.00068 mg/L). The elevated dissolved arsenic concentration at MW-03 may be related to the presence of dissolved iron. Arsenic is strongly adsorbed onto iron(hydro)oxides, and when these oxides dissolve due to anaerobic groundwater conditions, arsenic is mobilized.

Dissolved zinc concentrations exceeded the Tier 1 Guideline of 0.03 mg/L at MW-03 (0.0342 mg/L) for the first time in 2024 and were below the Tier 1 Guideline at 22MW-04 (0.0014 mg/L). The zinc concentrations measured at MW-03 since 2019 have been greater than at the other monitoring well locations and may be influenced by the degradation of buried wastes.

Overall, the 2024 dissolved metals concentrations were consistent with historical results.

## 4.5 Soil Vapour Monitoring Results

The soil vapour monitoring results are presented in Table 4.

Pressures at all vapour wells were negligible during the December 2024 and February 2025 monitoring events.

Elevated methane gas concentrations were measured in December 2024 at 22VW-01 (21.7%), VW-02 (18.3% field-measured; 15.3% laboratory-measured) and 24VW-06 (10.8%). Oxygen was reported at 0.0% at 22VW-01 and VW-02, and 0.6% at 24VW-06. Methane concentrations at 22VW-03, 22VW-04, 22VW-05, 24VW-07, and 24VW-08 were all below 0.2%.

Carbon dioxide was also elevated at most soil vapour wells, indicating a widespread distribution of elevated carbon dioxide. The lowest carbon dioxide reading was 2.7% at 22VW-04, then concentrations ranged from 7.9% at 22VW-03 to 20.8% at 22VW-01. Carbon monoxide was not detected.

## 4.6 Soil Vapour Analytical Results

Table 5 summarizes the 2024 soil vapour analytical results for VW-02, 24VW-06, 24VW-07, and 24VW-08 together with results from across the vapour well network, dating back to 2019.

The results have been compared against soil vapour screening criteria protective of vapour intrusion into indoor air. The laboratory analytical report is included in Appendix D. Vapour well 22VW-01 was not sampled in 2024 based on the previous results at this location where BTEX, PHC compounds, and VOCs were less than the soil vapour screening criteria. However, it should be noted that vapour sampling of this well in 2023 measured methane concentrations of 7.36%, above the LEL of 5% for methane.

The parameters BTEX and PHC fractions F1 and F2 (parameters with a TRV for inhalation) were compared against the screening criteria for residential land use for coarse-grained soil. The aliphatic and aromatic PHC fractions that comprise F1 and F2 were detected in all four samples. However, soil vapour concentrations were between one and three orders of magnitude less than the soil vapour screening criteria.

The VOC (parameters with a TRV for inhalation) results were compared against the screening criteria for residential land use, coarse-grained soil. Several VOC analytes were detected in each sample; however, the VOC concentrations were up to six orders of magnitude less than the soil vapour screening criteria.

The methane concentrations in the soil vapour samples at VW-02 (15.3%) and 24VW-06 (7.58%) were above the methane LEL of 5%.

The measured methane concentrations at 22VW-01 (field-measured), VW-02 and 24VW-06 were greater than the value of 20% LEL referenced in the Standards for on-site buildings or enclosed structures or in the area immediately outside the foundation of a building or structure. While the Standards are not directly applicable to the Site, they are used as a relative indicator of impact.

Based on the results from the existing and newly installed soil vapour wells, the lateral distribution of elevated methane gas concentrations is not delineated to the north of the former gravel pit and/or interpreted waste footprint.

## 4.7 Quality Assurance/Quality Control

### 4.7.1 Methods

Tetra Tech's quality assurance/quality control (QA/QC) procedures include reviewing the data collected for precision and accuracy and following the appropriate field protocols.

The field procedures for QA/QC involved:

- Changing nitrile gloves between sample collections;
- Using sample containers provided by the laboratory;
- Cleaning monitoring and sampling tools between sample locations;
- Conducting leak testing at vapour wells prior to the collection of vapour samples;
- Collecting a duplicate groundwater and vapour sample during the vapour sampling event; and
- Documenting field procedures and sampling activities.

### 4.7.2 Results

The groundwater and soil vapour QA/QC results are included in Table 3 and Table 11. The duplicate sample for groundwater was taken at monitoring well 22MW-04 and the duplicate sample for soil gas was taken at vapour well VW-02. The duplicate samples were submitted for analysis of the same parameters as the primary sample.

The duplicate results are compared by relative percent difference (RPD). The RPD is calculated using the following equation:

$$RPD = \frac{(V_1 - V_2)}{\frac{(V_1 + V_2)}{2}} * 100\%$$

Where:

$V_1$  = Parent Sample.

$V_2$  = Duplicate Sample.

Chemical parameters were considered as having passed the QA/QC reproducibility procedure if the RPD was less than or equal to 20%, indicating a close correlation between the sample-duplicate pair.

RPD values were not calculated if one or both of the sample-duplicate concentrations were between the reportable detection limit (RDL) and five times the RDL. In these cases, chemical parameters were still considered as having passed the QA/QC reproducibility procedure if the sample duplicate concentration difference was less than one RDL value.

All RPDs for groundwater were less than 20% for the duplicate and parent samples at 22MW-04 in September 2024, and VW-02 in December 2024. Based on the QA/QC results, the sample methods and results are considered acceptable.

Nearly all RPDs for the parent and duplicate soil vapour samples from VW-02 in December 2024 were below the RPD of 50%, except for 1,2-Dichlorotetrafluoroethane. However, the concentrations, which are both less than  $10 \mu\text{g}/\text{m}^3$ , are 6 orders of magnitude below the criterion and thus do not affect interpretation. The results are considered acceptable.

## 5.0 UPDATED HAZARD QUOTIENT RESULTS

Using the soil vapour screening levels and calculations described in the 2023 groundwater and soil vapour monitoring report (Tetra Tech 2024), the soil vapour sampling results, estimated cancer risks (for carcinogens), and estimated hazard quotients (for non-carcinogens) were calculated for the Site.

Cumulative target risk and hazard levels were determined in accordance with 2024 A EPA Alberta Tier 2 Soil and Groundwater Remediation Guidelines (Tier 2 Guidelines). For carcinogens, the target risk level is  $1 \times 10^{-5}$ , as this value is considered by Health Canada to represent a negligible risk. This risk level applies to both individual compounds and a summation (i.e., cumulative) of individual compound risks. For non-carcinogens a cumulative target hazard level of 1.0 is used as potential exposures that result in cumulative hazard indices equal to or less than 1.0 signify negligible potential for adverse health effects. For individual compounds, a hazard index of 0.2 was used. Each sampling location was screened individually for every chemical detected, and the results evaluated relative to both individual and cumulative risks and hazard levels.

As shown in Table 10, the estimated cumulative risks and hazards associated with the soil vapour samples collected in December 2024 did not exceed the corresponding target risk and hazard levels. The cumulative risk level for carcinogens in samples VW-02, 24VW-06, 24VW-07, and 24VW-08 were less than  $1 \times 10^{-5}$  by one to two orders of magnitude. The cumulative hazard level identified in the four soil vapour samples for the non-carcinogens were less than the target hazard level of 1.00. Only the individual hazard level for dichlorodifluoromethane in the July 2021 and December 2024 samples at VW-02 exceeded the individual target hazard level of 0.2. No other exceedances were identified.

Table 6 summarizes the properties of the compounds being assessed. Table 7 summarizes the soil properties used for the calculations. Table 8 summarizes the building properties used for the calculations, and Table 9 presents the generic soil vapour criteria calculated. Table 10 presents the estimated risk and hazard for the volatile compounds that were detected in soil vapour.

## 6.0 EVALUATION OF SITE CONDITIONS

### 6.1 Summary of Site Conditions

The Site has buried waste and fill material within an industrial area, approximately 200 m west of a surface water receptor, namely the Red Deer River.

Based on findings from the 2024 groundwater and soil vapour monitoring and sampling events and historical data for the Site, there are concerns related to soil vapours generated from the potential buried wastes.

The groundwater concentrations reported in 2024 at the down-gradient wells MW-03 and 22MW-04 were consistent with previous results. Parameters that are typical of groundwater impacted by buried wastes, including chloride and VOCs, have been reported at higher concentrations at these wells than at up-gradient and cross-gradient wells.

Groundwater analytical results confirmed that the groundwater is deeply anoxic, based on elevated concentrations of redox sensitive parameters (e.g., dissolved iron and manganese) at MW-03, while sulphate is reduced. These conditions are consistent with the presence of methane at vapour wells and are likely related to the decomposition of buried organic materials.

Monitoring well 22MW-04 did not have any obvious groundwater quality effects that would be typical of buried organic materials or wastes. Along with historical data from other monitoring wells between MW-03 and the Red Deer River, the environmental risk related to Tier 1 Guideline exceedances measured at the various monitoring wells is interpreted to be low.

Soil vapour sample results from wells VW-02, 24VW-06, 24VW-07, and 24VW-08 did not exceed the cumulative target risks and hazard levels for the parameters tested and only dichlorodifluoromethane in VW-02, exceeded the individual hazard level. However, methane and carbon dioxide were measured at elevated concentrations across the monitoring network, indicating a widespread issue. The methane concentrations in the soil vapour samples at VW-02 (15.3%) and 24VW-06 (7.58%) were above the methane LEL (5%) and carbon dioxide was field-measured at above 7.9% (22VW-03) at all wells but 22VW-04 (2.7%), with a maximum carbon dioxide concentration measured of 20.8% at 22VW-01. The widespread, elevated methane and carbon dioxide concentrations may pose a health risk to receptors.

## 6.2 Summary of Hazard Quotient Results

A summary of the 2014 hazard quotients from the 2014 risk management plan (RMP) for the Site that was completed by Tiamat is attached in Appendix B.

For consistency with XCG Consulting Limited's (XCG's) approach from 2017, Tetra Tech compared individual hazard quotients with the individual target hazard level (0.2). Based on the 2019, 2021, 2023, and 2024 programs, the greatest individual hazard quotient calculated for the Site was 0.6 (vs a target individual hazard level of 0.2) for dichlorodifluoromethane at VW-02 in 2021 and the greatest individual estimated cancer risk was  $1.1 \times 10^{-6}$  (vs a target risk of  $1.0 \times 10^{-5}$ ) for benzene at 24VW-06 in 2024. The greatest cumulative hazard quotient calculated for the Site was 0.6 (vs target cumulative hazard level of 1.0) at VW-02 in 2021, and the greatest cumulative estimated cancer risk was  $1.1 \times 10^{-6}$  at 24VW-06 (2024) and  $4.5 \times 10^{-6}$  at VW-02 (2024).

While further development at the Site is not currently proposed, for illustrative purposes and based on the hazard quotients and cancer risk levels calculated from the 2019, 2021, 2023, and 2024 vapour data, the Site was upgraded from no passive or active measures required for development within the setback area to Passive Level A measures (compacted clay liner with a minimum thickness of 1 m and confirmed maximum hydraulic conductivity of  $10^{-6}$  cm/sec) using the prior RMP approach.

These measures relate to compounds with hazard quotients and cancer risks and were not specifically developed for methane. Risk management for methane should consider concentrations as well as other factors such as volume of methane-generating material, generation rates, and soil gas movement. Common concentrations and soil gas pressures are used to assess response requirements. Based on the measured methane concentrations at the Site, Passive Level A measures may not be sufficient in certain areas of the setback.

Future applications for development within the setback are subject to review by the City. The developer's team would be responsible for reviewing and verifying the available data relative to their proposed development. The mitigative measures presented above are generic and can be used as a general guide for expectations by the City, but it is recommended that future applications for development within the setback review this report and the historical methane concentration data to determine if the generic measures would be sufficient with respect to methane for their specific development and location. Ultimately, the developer's design engineer would be

responsible for developing measures specific to the intended development based on the above or an appropriate equivalent. Protection of workers (e.g., construction and utility) should form part of any development plan.

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the groundwater and vapour monitoring and sampling in 2024 and previous years, Tetra Tech has developed the following conclusions:

- The inferred groundwater flow direction is to the northeast on the northern portion of the Site under an estimated horizontal gradient of 0.005 m/m, and an easterly flow on the southern portion of the Site under an estimated horizontal gradient of 0.002 m/m. These results are in alignment with the proximity and flow direction of the Red Deer River.
- The 2024 groundwater sampling results indicate little evidence of impact to groundwater from potential buried onsite wastes, although the inferred redox conditions at MW-03 remain deeply anoxic. The results are similar to previous results and show the following:
  - Groundwater quality parameters that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2024 included TDS, chloride, and the dissolved metals arsenic, iron, manganese, and zinc. The routine water chemistry parameter concentrations were consistent with previous results. The results for down-gradient wells suggest that the environmental risk related to the discharge of groundwater passing through the Site to the Red Deer River is low.
  - Ammonia concentrations have been persistently above the Tier 1 Guideline at MW-03, ranging from 19.1 mg/L in 2019 to 51.3 mg/L in 2023. A miscommunication led to ammonia not being analyzed as part of the 2024 analytical suite of water quality parameters. However, given the minimal overall changes in water chemistry observed in the other parameters between the 2021 and 2023 sampling events and the 2024 sampling event, it is likely that the ammonia concentrations have also remained relatively unchanged. Comparing the 2023 ammonia concentrations at MW-03 to MW-03 (Lot 4), which is closer to the Red Deer River and hydraulically cross gradient, indicates that concentrations of ammonia decrease significantly as groundwater moves towards the Red Deer River. The inferred decrease in ammonia concentrations is such that the ammonia entering the Red Deer River from RSLIP is minimal.
- Methane extends beyond the identified waste footprint of the Site, similar to previous results, as outlined below:
  - Elevated methane gas concentrations were measured in December 2024 at 22VW-01 (21.7%), VW-02 (18.3%), and at the newly installed 24VW-06 (10.8%), north of the interpreted waste footprint. The two other new soil vapour wells to the west, 24VW-07 and 24VW-08, exhibited negligible methane concentrations in December 2024. For 22VW-01 and VW-02 the results were similar to the 2023 measurement (22VW-01) and 2021 to 2023 (VW-02). The measured concentrations at 22VW-01, VW-02, and 24VW-06 were greater than values referenced in the Standards for on-site buildings or enclosed structures or in the area immediately outside the foundation of a building or structure. The Standards were not directly applicable to the Site but were used as a relative indicator of impact. Thus, the extent of elevated methane gas concentrations is not delineated north of the former gravel pit and/or interpreted waste footprint.
  - Concentrations of the BTEX compounds, PHCs, and VOCs in the soil vapour samples collected from VW-02, 24VW-06, 24VW-07, and 24VW-08 were less than the soil vapour screening criteria. The estimated cumulative risks and hazards associated with the soil vapour samples collected in December 2024 did not exceed the corresponding target risk and hazard levels and only dichlorodifluoromethane in VW-02, exceeded the individual hazard level.

The results of the groundwater and vapour monitoring program in 2024 and early 2025, in combination with results from previous years, indicate there are impacts to groundwater and soil vapours from the buried waste in place at the Site. Ongoing risk management is required, including ongoing monitoring and administrative actions.

The following recommendations are made according to these risk management elements.

**Ongoing Monitoring:**

- The groundwater flow direction and groundwater quality has been reasonably well defined, with a known presence of persistently elevated ammonia at MW-03, based on previous years of monitoring. Therefore, periodic groundwater monitoring and sampling events are recommended, albeit not necessarily on an annual basis. A proposed schedule for the upcoming years is presented below.
- Continue quarterly monitoring of soil vapour concentrations and pressures at all new and existing vapour monitoring wells. Based on the analytical results to date, ongoing collection of soil vapour samples for analytical testing is not considered warranted unless monitoring results yield significant methane concentrations. Sample any new soil vapour wells installed in 2025 to confirm concentrations.
- Use of the American Society for Testing and Materials ([ ASTM] 2023) Guide for evaluating the methane hazard should be considered to support the risk management approach for the Site.
- Based on the above, the following monitoring program is proposed. If results remain consistent, reducing the monitoring and sampling frequency over time may be warranted.

**Table 7-1: Proposed Site Condition, Groundwater, and Vapour Monitoring Program**

Activity	2025	2026	2027	2028	2029
Groundwater monitoring (summer) at five wells (MW-01, MW-03, and 22MW-04 within the industrial park and MW-01 and MW-03 on Lot 4, Block 8, to the east of the industrial park)		X			X
Groundwater sampling (summer) at two wells (MW-03 and 22MW-04)		X			X
Tri-annual (3 times per year) vapour monitoring of eight locations (22VW-01, VW-02, 22VW-03, 22VW-04, 22VW-05, 24VW-06, 24VW-07 and 24VW-08). Sample as needed if monitoring yields significant methane concentrations.	X	X	X	X	X
Install soil vapour monitoring wells northwest (25VW-09) and northeast (25VW-10) of 24VW-06 to delineate elevated subsurface methane concentrations and add to the monitoring program. Monitor and sample in 2025.	X				

**Further Assessment:**

- Tetra Tech recommends the installation of additional soil vapour monitoring wells to the northwest and northeast of 24VW-06 to delineate the elevated methane concentrations.

**Administrative Actions:**

- Ensure that the site is clearly identified within the City's Zoning Bylaw and appropriate administrative requirements are met for site development in accordance with City policies and provincial regulations.
- Ensure that the site is clearly identified within the City's Utility mapping system. Elevated subsurface methane concentrations are present in areas of the site and future activities in the vicinity (e.g. utility work, repairs, paving) should consider the potential presence of sub-surface gas and site-specific safety plans should be developed for work undertaken to limit the potential for exposure to site workers
- Further to the above recommendations, as noted, the Site has buried waste materials and elevated subsurface methane concentrations. As the Site is fully developed with roadways and commercial buildings, the City should review the Site's status on an ongoing basis with respect to the elevated methane concentrations and the

possibility of the accumulation of methane gas in underground utility corridors, trenches/excavations, and potentially within or beneath the footprint of buildings.

## 8.0 CLOSURE

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

Respectfully submitted,  
Tetra Tech Canada Inc.

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**Table 1: Groundwater Monitoring Results**

Monitoring Well		MW-01	MW-02	MW-03	22MW-04	MW-01 (Lot 4)	MW-02 (Lot 4)	MW-03 (Lot 4)
Total Drilled Depth (m)		7.6	8.4	7.6	6.0	7.0	5.8	6.9
Top of Screened Interval (mbg)		3.0	3.0	3.0	3.0	3.0	2.8	3.9
Bottom of Screened Interval (mbg)		7.6	8.4	7.6	6.0	7.0	5.8	6.9
Stick up (m)		-0.13	-0.16	-0.09	0.97	0.76	-	0.93
Ground Elevation (m)		854.67	855.26	854.55	851.35	853.62	-	853.12
TPC Elevation (m)		854.54	855.10	854.46	852.32	854.38	-	854.05
Depth to Groundwater (mBTPC)	Mar-13	-	-	-	-	5.20	4.79	4.84
	Apr-13	-	-	-	-	5.19	4.78	4.82
	Aug-13	4.92	5.25	5.13	-	-	-	-
	Jun-19	5.14	CNL	5.29	-	5.17	CNL	4.81
	Dec-19	5.32	CNL	5.15	-	5.20	CNL	4.83
	Apr-21	4.90	Destroyed	5.18	-	5.07	Destroyed	4.69
	Jul-21	4.86	Destroyed	5.16	-	5.06	Destroyed	4.68
	Nov-21	4.98	Destroyed	5.25	-	5.18	Destroyed	4.79
	May-23	5.04	Destroyed	5.26	4.41	5.18	Destroyed	4.80
Sep-24	5.00	Destroyed	5.25	4.40	5.18	Destroyed	4.79	
Groundwater Elevation (m)	Mar-13	-	-	-	-	849.18	-	849.21
	Apr-13	-	-	-	-	849.19	-	849.23
	Aug-13	849.62	849.84	849.33	-	-	-	-
	Jun-19	849.40	CNL	849.17	-	849.21	CNL	849.24
	Dec-19	849.22	CNL	849.32	-	849.18	CNL	849.22
	Apr-21	849.64	Destroyed	849.29	-	849.31	Destroyed	849.36
	Jul-21	849.68	Destroyed	849.30	-	849.32	Destroyed	849.37
	Nov-21	849.56	Destroyed	849.22	-	849.20	Destroyed	849.27
	May-23	849.50	Destroyed	849.20	847.91	849.20	Destroyed	849.25
Sep-24	849.54	Destroyed	849.21	847.92	849.20	Destroyed	849.26	
Volatile Organic Compounds* (VOCs) (ppm)	Aug-13	ND	ND	ND	-	-	-	-
	Jun-19	1	CNL	ND	-	ND	CNL	ND
	Dec-19	ND	CNL	1	-	ND	CNL	ND
Combustible Vapour Concentrations* (CVCs) (ppm)	Aug-13	510	155	460	-	-	-	-
	Jun-19	770	CNL	150	-	430	CNL	40
	Dec-19	5	CNL	10	-	ND	CNL	ND
Methane Concentrations** (ppm)	Apr-21	75	-	500	-	100	-	10
	Jul-21	5	-	280	-	ND	-	10
	Nov-21	640	-	110	-	100	-	65
	May-23	230	-	130	45	30	-	40
	Sep-24	ND	-	ND	ND	ND	-	ND

**Notes:**

mbg - Metres below grade.

mBTPC - Metres below top of plastic pipe casing.

N/A - Not applicable; prior to well installation.

CNL - Could not locate.

ND - Non-detect.

ppm - Parts per million.

\*- Measured using an RKI Eagle II calibrated to hexane and isobutylene and operated in methane elimination mode.

\*\* - Measured using an RKI Eagle II calibrated to methane.

- Not measured/information unavailable.

**Table 2: Groundwater Analytical Results**

Parameter	Unit	Tier 1 Guidelines <sup>1,2</sup>	MW-01		MW-01 (Lot 4)		MW-03				22MW-04		MW-03 (Lot 4)	
			05 Dec 2019	23 Nov 2021	05 Dec 2019	23 Nov 2021	05 Dec 2019	23 Nov 2021	31 May 2023	06 Sep 2024	31 May 2023	06 Sep 2024	05 Dec 2019	23 Nov 2021
<b>Field Parameters</b>														
Field pH	pH Units	6.5 to 8.5	7.50	6.90	7.79	7.45	8.35	6.92	6.88	6.74	7.08	6.77	7.78	6.98
Field Electrical Conductivity	µS/cm	-	1,201	1,166	1,066	1,129	1,367	1,604	2,480	2,380	1,763	1,705	1,409	900
Field Temperature	°C	-	6.5	8.2	7.2	7.4	5.8	7.2	9.0	11.0	9.3	15.6	7.4	8.3
<b>Routine</b>														
pH	pH Units	6.5 to 8.5	7.32	7.51	7.59	7.41	7.42	7.06	7.36	7.36	7.59	7.89	7.61	7.47
Electrical Conductivity (EC)	µS/cm	-	1,820	1,630	1,460	1,640	2,100	2,320	2,320	2,240	1,670	1,660	1,370	1,300
Total Dissolved Solids (TDS)	mg/L	500	<b>1,190</b>	<b>1,080</b>	<b>963</b>	<b>1,060</b>	<b>654</b>	<b>1,440</b>	<b>1,470</b>	<b>1,250</b>	<b>1,070</b>	<b>1,020</b>	<b>820</b>	<b>826</b>
Hardness	mg/L	-	881	759	874	788	831	807	851	715	600	574	658	626
Alkalinity	mg/L	-	692	633	559	688	1,040	1,170	1,110	1,040	781	762	591	584
Bicarbonate	mg/L	-	844	772	681	840	1,270	1,430	1,360	1,270	952	930	721	712
Carbonate	mg/L	-	<5	<1	<5	<1	<5	<1	<1.0	<1.0	<1.0	<1.0	<5	<1
Hydroxide	mg/L	-	<5	<1	<5	<1	<5	<1	<1.0	<1.0	<1.0	<1.0	<5	<1
Calcium	mg/L	-	229	197	220	195	190	179	182	151	156	147	157	152
Magnesium	mg/L	-	75.2	64.8	78.8	73.1	86.5	87.4	96.3	82.1	51.1	50.2	64.7	59.9
Potassium	mg/L	-	8.78	8.04	8.55	8.03	32.2	55.8	68.1	62.1	10.1	11.6	10.1	9.59
Sodium	mg/L	200	69.7	72.4	65	69.6	154	143	157	129	<b>211</b>	166	57.5	59.3
Chloride	mg/L	120	<b>125</b>	<b>127</b>	113	118	<b>168</b>	<b>171</b>	<b>172</b>	<b>160</b>	101	104	106	89.6
Fluoride	mg/L	1.5	<0.1	<0.1	<0.1	<0.1	<0.1	0.218	<0.100	0.110	0.402	0.368	<0.1	0.116
Sulphate	mg/L	429 <sup>#1</sup>	135	126	107	118	21.7	8.86	4.53	2.25	51.3	57.6	70.1	83.7
Anions Total (filtered)	meq/L	-	-	20.2	-	20.3	-	28.4	27.1	25.3	19.6	19.4	-	16
Cations Total (filtered)	meq/L	-	-	18.5	-	19	-	27.2	30	22.0	21.5	19.0	-	15.5
Ionic Balance	%	-	93.7	4.39	120	3.31	97.9	2.16	-5.08	87.0	-4.62	97.9	98.8	1.59
<b>Nutrients</b>														
Ammonia as N	mg/L	5.2 <sup>#2</sup>	<0.05	0.0167	<0.05	0.0213	<b>19.1</b>	<b>40.8</b>	<b>51.3</b>	-	0.253	-	2.06	1.73
Nitrate (as NO <sub>3</sub> -N)	mg/L	3	<b>29.6</b>	<b>18.6</b>	<b>8.05</b>	<b>10.7</b>	0.44	0.142	0.063	<0.100	0.422	0.703	<0.1	0.124
Nitrite (as NO <sub>2</sub> -N)	mg/L	0.2 <sup>#3</sup>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.019	<0.050	<0.010	<0.050	<0.05	<0.05
Nitrate and Nitrite (as N)	mg/L	-	-	-	-	-	-	-	-	<0.112	-	0.703	-	-
Total Kjeldahl Nitrogen (TKN)	mg/L	-	<0.2	-	3.6	-	22.7	-	-	-	-	-	2.3	-
<b>Hydrocarbons</b>														
Benzene	mg/L	0.005	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Toluene	mg/L	0.021	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Ethylbenzene	mg/L	0.0016	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Xylene (o)	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Xylenes (m & p)	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Xylenes Total	mg/L	0.02	<0.00071	-	<0.00071	-	<0.00071	-	-	-	-	-	<0.00071	-
Styrene	mg/L	0.072	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
F1 (C6-C10)	mg/L	0.81	<0.1	-	<0.1	-	<0.1	-	-	-	-	-	<0.1	-
F1 (C6-C10) - BTEX	mg/L	0.81	<0.1	-	<0.1	-	<0.1	-	-	-	-	-	<0.1	-
F2 (C10-C16 Hydrocarbons)	mg/L	1.1	<0.1	-	<0.1	-	<0.1	-	-	-	-	-	<0.1	-
<b>Dissolved Metals</b>														
Aluminum	mg/L	0.05 <sup>#4</sup>	<b>0.305</b>	<0.005	0.0187	<0.005	<0.005	<0.005	0.0014	<0.0020	0.002	0.0014	0.004	0.0059
Antimony	mg/L	0.006	<0.0005	<0.0005	0.00014	<0.0005	<0.0005	<0.0005	0.0001	<0.00020	0.0002	0.00024	<0.0001	<0.0005
Arsenic	mg/L	0.005	0.00053	<0.0005	0.0003	<0.0005	0.00123	<b>0.00675</b>	<b>0.0213</b>	<b>0.0154</b>	0.0009	0.00068	0.00046	<0.0005
Barium	mg/L	2	0.168	0.135	0.187	0.165	0.599	1.26	1.82	1.48	0.276	0.250	0.272	0.246
Beryllium	mg/L	-	-	<0.0001	-	<0.0001	-	<0.0001	-	-	-	-	-	<0.0001
Boron	mg/L	1.5	0.114	0.109	0.078	0.09	0.176	0.157	0.153	0.157	0.186	0.193	0.07	0.086
Cadmium	mg/L	0.00037 <sup>#1</sup>	<b>0.000407</b>	0.000234	0.000155	0.000149	0.000033	0.000243	<b>0.00082</b>	0.000225	0.0000308	0.0000273	0.0000707	0.000045
Chromium	mg/L	0.05	<0.0005	<0.0025	<0.0001	<0.0025	<0.0005	<0.0025	<0.00050	<0.00100	<0.00050	<0.00050	<0.0001	<0.0025
Cobalt	mg/L	-	-	<0.0005	-	<0.0005	-	0.00678	-	-	-	-	-	0.0026
Copper	mg/L	0.007	0.0021	<0.001	0.00139	0.00201	<0.001	0.00124	0.0004	<0.00040	0.00117	0.00201	0.00055	0.00125
Iron	mg/L	0.3	<b>0.379</b>	<0.05	0.023	<0.05	<0.05	<b>13.8</b>	<b>19.9</b>	<b>14.8</b>	0.023	0.012	0.106	0.126
Lead	mg/L	0.007 <sup>#1</sup>	0.00062	<0.00025	<0.00005	<0.00025	<0.00025	<0.00025	<0.000050	<0.000100	<0.000050	<0.000050	<0.00005	<0.00025
Lithium	mg/L	-	-	0.036	-	0.042	-	0.0386	-	-	-	-	-	0.0372
Manganese	mg/L	0.02	<b>0.095</b>	<b>0.0395</b>	<b>1.22</b>	<b>1.2</b>	<b>0.727</b>	<b>0.639</b>	<b>0.438</b>	<b>0.447</b>	<b>0.998</b>	<b>0.414</b>	<b>1.03</b>	<b>1.01</b>
Mercury	mg/L	0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.0000050	<0.0000050	<0.0000050	0.0000050	<0.000005	<0.000005
Molybdenum	mg/L	-	-	0.000966	-	0.00238	-	0.00453	-	-	-	-	-	0.00132
Nickel	mg/L	0.17 <sup>#1</sup>	0.0061	0.00513	0.0102	0.0104	0.0108	0.013	0.0114	0.0122	0.00615	0.00626	0.00519	0.0051
Phosphorus	mg/L	-	0.0997	<0.25	2.4	<0.25	0.129	<0.25	-	-	-	-	0.399	<0.25
Selenium	mg/L	0.002	0.00056	0.000459	0.000106	<0.00025	<0.00025	0.00026	0.000353	0.000243	0.000316	0.000285	0.000088	<0.00025
Silicon	mg/L	-	-	6.59	-	6.24	-	10.3	-	<0.000020	-	<0.000010	-	6.48
Silver	mg/L	0.0001	<0.00005	<0.00005	<0.00001	<0.00005	<0.00005	<0.000010	-	<0.000010	-	<0.000010	<0.00001	<0.00005
Strontium	mg/L	-	-	0.919	-	1.12	-	2.1	-	-	-	-	-	0.988
Thallium	mg/L	-	-	0.000056	-	0.0001	-	<0.00005	-	-	-	-	-	0.000066
Tin	mg/L	-	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005
Titanium	mg/L	-	-	<0.0015	-	<0.0015	-	<0.0015	-	-	-	-	-	<0.0015
Uranium	mg/L	0.015	0.00766	0.00798	0.00967	0.00912	0.00539	0.00381	0.0019	0.00220	0.00293	0.00341	0.00551	0.00563
Vanadium	mg/L	-	-	<0.0025	-	<0.0025	-	<0.0025	-	-	-	-	-	<0.0025
Zinc	mg/L	0.03	0.0266	0.007	0.0019	<0.005	0.0125	0.0264	0.0139	<b>0.0342</b>	0.0012	0.0014	0.0015	<0.005
<b>Volatile Organic Compounds (VOCs)</b>														
Acetic Acid	mg/L	-	<10	-	<10	-	<10	-	-	-	-	-	<10	-
Butyric Acid	mg/L	-	<1	-	<1	-	<1	-	-	-	-	-	<1	-
Formic Acid	mg/L	-	<50	-	<50	-	<50	-	-	-	-	-	<50	-
Hexanoic Acid	mg/L	-	<1	-	<1	-	<1	-	-	-	-	-	<1	-
Valeric Acid	mg/L	-	<1	-	<1	-	<1	-	-	-	-	-	<1	-
Bromobenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	<0.001	-
Bromochloromethane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	<0.001	-
Bromodichloromethane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Bromoform	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	<0.0005	-
Bromomethane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	<0.001	-
n-Butylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	<0.001	-
sec-Butylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	<0.001	-
tert-Butylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-			

**Table 2: Groundwater Analytical Results**

Parameter	Unit	Tier 1 Guidelines <sup>1,2</sup>	MW-01		MW-01 (Lot 4)		MW-03				22MW-04		MW-03 (Lot 4)		
			05 Dec 2019	23 Nov 2021	05 Dec 2019	23 Nov 2021	05 Dec 2019	23 Nov 2021	31 May 2023	06 Sep 2024	31 May 2023	06 Sep 2024	05 Dec 2019	23 Nov 2021	
<b>Volatile Organic Compounds (VOCs)</b>															
1,2-Dichloroethene (cis)	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,2-Dichloroethene (trans)	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
Dichlorodifluoromethane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,2-Dichloropropane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,3-Dichloropropane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
2,2-Dichloropropane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,1-Dichloropropene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,3-Dichloropropene [cis]	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,3-Dichloropropene [trans]	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
Hexachlorobutadiene	mg/L	0.0013	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
p-Isopropyltoluene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
Methylene Chloride	mg/L	0.05	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
iso-Propylbenzene (cumene)	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
iso-Butyric Acid	mg/L	-	<1	-	<1	-	<1	-	-	-	-	-	-	<1	-
Isovaleric acid	mg/L	-	<1	-	<1	-	<1	-	-	-	-	-	-	<1	-
Proponic Acid	mg/L	-	<5	-	<5	-	<5	-	-	-	-	-	-	<5	-
n-Propylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,1,1,2-Tetrachloroethane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,1,1,2,2-Tetrachloroethane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
Tetrachloroethene	mg/L	0.01	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,2,3-Trichlorobenzene	mg/L	0.008	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,2,4-Trichlorobenzene	mg/L	0.015	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,1,1-Trichloroethane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,1,2-Trichloroethane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
Trichloroethene	mg/L	0.005	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
Trichlorofluoromethane	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,2,3-Trichloropropane	mg/L	-	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-
1,2,4-Trimethylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
1,3,5-Trimethylbenzene	mg/L	-	<0.001	-	<0.001	-	<0.001	-	-	-	-	-	-	<0.001	-
Vinyl chloride	mg/L	0.0011	<0.0005	-	<0.0005	-	<0.0005	-	-	-	-	-	-	<0.0005	-

**Notes:**  
<sup>1</sup> Alberta Environment and Parks (AEP). 2024. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Policy and Planning Division. Referenced guidelines are for coarse-textured soils under Residential/Parkland land use.  
<sup>2</sup> Alberta Environment and Parks (AEP). Environmental Quality Guidelines for Alberta Surface Waters. March 2018. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (FAL). Most conservative values applied (chronic or acute).  
 #1 Guideline varies with hardness. Values shown based on site hardness range of 574 mg/L to 881 mg/L.  
 #2 Guideline varies with pH and temperature. Values shown based on pH range of 7.06 to 7.89 and temperature range of 5.8°C to 15.6°C.  
 #3 Guideline varies with chloride. Values shown based on site chloride range of 89.6 mg/L to 172 mg/L.  
 #4 Guideline varies with pH. Values shown based on site pH range of 7.06 to 7.89.  
 "-" No applicable guideline.  
**BOLD** - Greater than Tier 1 Guideline.

**Table 3: Groundwater Quality Assurance/Quality Control Analytical Results**

Parameter	Unit	RDL	22MW-04	DUPLICATE	RPD (%)	22MW-04	DUPLICATE	RPD (%)
			31 May 2023	31 May 2023		06 Sep 2024	06 Sep 2024	
<b>Routine</b>								
pH	pH Units	0.1	7.59	7.51	1	7.89	7.72	2
Electrical Conductivity (EC)	µS/cm	1	1,670	1,660	0.6	1,660	1,640	1
Total Dissolved Solids (TDS)	mg/L	1	1,070	1,060	0.9	1,020	1,040	2
Hardness	mg/L	0.5	600	597	0.5	574	588	2
Alkalinity	mg/L	1.0	781	756	3	762	787	3
Bicarbonate	mg/L	1	952	922	3	930	960	3
Carbonate	mg/L	1	<1.0	<1.0	-	<1.0	<1.0	-
Hydroxide	mg/L	1	<1.0	<1.0	-	<1.0	<1.0	-
Calcium	mg/L	0.05	156	155	0.6	147	150	2
Magnesium	mg/L	0.005	51.1	50.9	0.4	50.2	51.8	3
Potassium	mg/L	0.05	10.1	10.2	1	11.6	11.6	0
Sodium	mg/L	0.05	211	215	2	166	175	5
Chloride	mg/L	0.5	101	100	1	104	104	0
Fluoride	mg/L	0.02	0.402	0.413	3	0.368	0.375	2
Sulphate	mg/L	0.3	51.3	51.2	0.2	57.6	58.8	2
<b>Nutrients</b>								
Ammonia as N	mg/L	0.005	0.253	0.241	5	0.703	0.717	2
Nitrate (as NO3-N)	mg/L	0.02	0.422	0.417	1	<0.050	<0.050	-
Nitrite (as NO2-N)	mg/L	0.01	<0.010	<0.010	-	0.703	0.717	2
Nitrate and Nitrite (as N)	mg/L	0.112	-	-	-	-	-	-
<b>Dissolved Metals</b>								
Aluminum	mg/L	0.001	0.002	0.002	-	0.0014	0.0014	-
Antimony	mg/L	0.0001	0.0002	0.0002	-	0.00024	0.00024	-
Arsenic	mg/L	0.0001	0.0009	0.0009	0	0.00068	0.00064	6
Barium	mg/L	0.0001	0.276	0.283	3	0.25	0.252	0.8
Boron	mg/L	0.01	0.186	0.192	3	0.193	0.2	4
Cadmium	mg/L	0.000005	0.0000308	0.0000291	6	0.0000273	0.0000282	3
Chromium	mg/L	0.0001	<0.00050	<0.00050	-	<0.00050	<0.00050	-
Copper	mg/L	0.0002	0.00117	0.00116	0.9	0.00201	0.00216	7
Iron	mg/L	0.01	0.023	0.022	-	0.012	0.021	-
Lead	mg/L	0.00005	<0.000050	<0.000050	-	<0.000050	<0.000050	-
Manganese	mg/L	0.0001	0.998	0.996	0.2	0.414	0.417	0.7
Mercury	mg/L	0.000005	<0.0000050	<0.0000050	-	0.000005	<0.0000050	-
Nickel	mg/L	0.0005	0.00615	0.00608	1	0.00626	0.00631	0.8
Selenium	mg/L	0.00005	0.000316	0.000315	0.3	0.000285	0.000233	-
Silver	mg/L	0.00001	<0.000010	<0.000010	-	<0.000010	<0.000010	-
Uranium	mg/L	0.00001	0.00293	0.00287	2	0.00341	0.00333	2
Zinc	mg/L	0.001	0.0012	0.0012	0	0.0014	0.0025	-

**Notes:**

RDL - Reportable detection limit.

RPD - Relative Percentage Difference calculated as  $RPD(\%) = \frac{|V1 - V2|}{[(V1 + V2) / 2]} * 100$  where V1, V2 = concentrations of parent and duplicate sample,

"-" Indicates RPD not calculated. RPDs have only been considered where both concentrations are greater than 5 times the RDL.

N/A - Not applicable.

**BOLD** - RPD value greater than 20%.

**Table 4: Soil Vapour Monitoring Results**

Parameter	Vapour Well																						
	VW-01							22VW-01					VW-02										
	Aug-13	Jun-19	Dec-19	Apr-21	May-21	Jul-21	Nov-21	Jan-23	Apr-23	May-23	Nov-23	Dec-24	Aug-13	Jun-19	Dec-19	Apr-21	May-21	Jul-21	Nov-21	Jan-23	May-23	Nov-23	Dec-24
Total Drilled Depth (m)	4.6							4.5					5.0										
Top of Screen Interval (mbg)	4.3							3.5					4.7										
Bottom of Screened Interval (mbg)	4.6							4.5					5.0										4.9
Stick up (m)	-0.12							-0.01				-0.12	-0.02										-0.08
Pressure (kPa) <sup>1</sup>		0.01	0.0	0.0	*	0.0	0.0	0.0	-0.1	0.0	0.0	-0.002		0.02	0.0	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0
CH <sub>4</sub> (%)	27.4	11.3	0.0	0.0	0.0	0.0	0.9	1.9	7.2	12.2	20.0	21.7	17.6	17.1	1.4	12.1	14.6	15.9	18.2	17.5	17.1	16.9	18.3
CO (ppm) <sup>2</sup>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.0	1.0	0.0
CO <sub>2</sub> (%)	19.8	9.9	0.2	0.5	0.2	0.1	1.4	9.3	15.9	17.3	24.3	20.8	10.4	10.4	1.7	8.8	10.2	10.2	14.5	13.1	9.7	15.3	14.9
O <sub>2</sub> (%)	2.0	9.4	20.3	19.9	20.9	20.1	20.4	12.0	0.2	0.3	0.2	0.0	5.0	0.4	17.9	2.3	0.4	0.1	0.0	0.0	0.4	0.2	0.0
Balance (% v/v)	50.9	69.5	79.5	79.4	78.9	79.9	77.2	76.9	76.8	70.1	55.5	57.6	67.0	72.0	78.8	76.8	74.7	73.8	67.3	69.4	72.9	67.6	66.8
Static Water Level (mbtoc) <sup>3</sup>		Dry	Dry	Dry	NM	Dry	Dry	Dry	Dry	Dry	Dry	Dry		Dry	Dry	Dry	NM	Dry	Dry	Dry	Dry	Dry	Dry

**Notes:**

<sup>1</sup> Kpa - Kilopascal.

<sup>2</sup> ppm - Parts per million.

<sup>3</sup> mbtoc - Metres below top of casing.

\* Vapour well headspace pressures were not measured.

N/A - Not applicable - well can not be accessed to obtain measurement or has a submerged screen (blinded).

NM - Not measured.

VW-01 and 22VW-01 (Lot 4) were decommissioned in December 2022.

**Bold** - exceeds the applicable criterion.

CNO - Could not open probe enough to obtain water level and well depth.

**Table 4: Soil Vapour Monitoring Results**

Parameter	Vapour Well																	
	22VW-03				VP-01 (Lot 4)			22VW-04				22VW-05				24VW-06	24VW-07	24VW-08
	Jan-23	May-23	Nov-23	Dec-24	May-21	Jul-21	Nov-21	Jan-23	May-23	Nov-23	Dec-24	Jan-23	May-23	Nov-23	Dec-24	Dec-24	Dec-24	Dec-24
Total Drilled Depth (m)	3.0				3.2			3.0				3.0				4.5	4.2	4.5
Top of Screen Interval (mbg)	2.0				2.9			2.0				2.0				3.5	3.42	3.5
Bottom of Screened Interval (mbg)	3.0			2.6	3.2			3.0		3.8		3.0			2.732	4.3	4.1	4.1
Stick up (m)	0.04			-0.14	0.91			0.88		0.79		-0.03			-0.18	-0.38	-0.30	-0.32
Pressure (kPa) <sup>1</sup>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH <sub>4</sub> (%)	0.0	5.7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	10.8	0	0.1
CO (ppm) <sup>2</sup>	0.0	1.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	2.0	0.0	0.0	0	0	0	0
CO <sub>2</sub> (%)	4.2	10.8	7.8	7.9	2.5	2.9	4.2	1.8	2.3	3.9	2.7	3.8	7.7	7.5	9.0	13.9	4.5	17.8
O <sub>2</sub> (%)	19.9	9.3	16.0	15.7	18.9	17.6	17.7	19.5	17.1	19.3	19.6	19.6	13.0	14.8	12.6	0.6	17.7	0.5
Balance (% v/v)	76.0	74.4	76.2	76.7	78.6	79.5	78.1	78.7	80.6	76.8	77.6	76.6	79.3	77.7	78.3	74.7	77.7	81.5
Static Water Level (mbtoc) <sup>3</sup>	Dry	Dry	Dry	Dry	Blocked	Blocked	Blocked	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry

**Notes:**

<sup>1</sup> Kpa - Kilopascal.

<sup>2</sup> ppm - Parts per million.

<sup>3</sup> mbtoc - Metres below top of casing.

\* Vapour well headspace pressures were not measured.

N/A - Not applicable - well can not be accessed to obtain measurement or has a submerged screen (blinded).

NM - Not measured.

VW-01 and VW-01 (Lot 4) were decommissioned in December 2022.

**Bold** - exceeds the applicable criterion.

CNO - Could not open probe enough to obtain water level and well depth.

**Table 5: Soil Vapour Analytical Results**

Location Field ID Sample Date Laboratory Report Number Laboratory Sample ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m <sup>3</sup> ) <sup>1</sup>	VW-01			22VW-01	VW-02						24VW-06	24VW-07	24VW-08	
		VW-01	VW-01	19DUP01	22VW-01	VW-02	VW-02	VW-02/1229	VW-02/9880	VW-02	DUPLICATE	24VW-06	24VW-07	24VW-08	
		5-Dec-2019	5-Dec-2019	5-Dec-2019	5-Apr-2023	5-Dec-2019	5-Dec-2019	4-May-2021	12-Jul-2021	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	
		L2393570	L2393570	L2393570	CG2304075	L2393570	L2393570	C1C2833	C1J4824	CG2418081	CG2418081	CG2418081	CG2418081	CG2418081	
Parameter	Unit	µg/m <sup>3</sup>													
<b>Field Parameters</b>															
Pressure on receipt	Inches Hg	NG	0	-	-10.2	-8.99	-6.7	-	-4.3	-4.6	-10.8	-11.0	-7.56	-7.15	-6.54
<b>C1-C5 Hydrocarbon Gases (%)</b>															
Methane	%	NG	0.00029	-	0.00116	-	-	-	-	-	-	-	-	-	-
Ethane	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
Ethene	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
Propane	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
Propene	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
Butane	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
Pentane	%	NG	<0.00020	-	<0.00020	-	-	-	-	-	-	-	-	-	-
<b>Gas (ppm)</b>															
n-Butane	ppm	NG	-	-	-	-	-	-	<0.27	0.36	-	-	-	-	-
n-Pentane	ppm	NG	-	-	-	-	-	-	<0.27	<0.24	-	-	-	-	-
Ethane	ppm	NG	-	-	-	-	-	-	<0.27	1.1	-	-	-	-	-
Ethene	ppm	NG	-	-	-	-	-	-	<0.27	<0.24	-	-	-	-	-
Acetylene	ppm	NG	-	-	-	-	-	-	<0.27	<0.24	-	-	-	-	-
Methane	ppm	NG	-	-	-	-	-	-	1,600	-	-	-	-	-	-
Propane	ppm	NG	-	-	-	-	-	-	<0.27	0.40	-	-	-	-	-
Propene	ppm	NG	-	-	-	-	-	-	<0.27	<0.24	-	-	-	-	-
Propyne	ppm	NG	-	-	-	-	-	-	<0.27	<0.24	-	-	-	-	-
<b>Fixed Gases</b>															
Oxygen	% v/v	NG	21.8	-	21.6	1.27	21.7	-	22.6	1.6	1.76	1.73	4.94	16.60	2.55
Nitrogen	% v/v	NG	80.3	-	80.2	68.9	80.7	-	76.8	67.2	62.3	61.8	68.2	74.6	75.0
Carbon Monoxide	% v/v	NG	<0.05	-	<0.05	<0.050	<0.05	-	<0.3	<0.2	<0.050	<0.050	<0.050	<0.050	<0.050
Methane	% v/v	NG	<0.05	-	<0.05	7.36	0.234	-	<0.3	18.5	15.30	15.30	7.58	0.07	<0.050
Carbon Dioxide	% v/v	NG	0.15	-	0.205	14.0	0.246	-	0.4	12.7	11.90	11.80	10.60	3.99	14.70
<b>Aliphatics</b>															
Aliphatic (>C5-C6)	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	16.1	2,950	-	-	-	-	-
Aliphatics (C6-C8)	µg/m <sup>3</sup>	740,737	56	-	31	2,580	59	-	13.3	1,470	1,560	1,570	743	42	134
Aliphatics (>C8-C10)	µg/m <sup>3</sup>	40,257	83	-	152	1,590	50	-	6.4	87	172	195	802	29	83
Aliphatics (>C10-C12)	µg/m <sup>3</sup>	40,257	70	-	145	212	32	-	16.6	23	<15	<15	686	<15	23
Aliphatics (>C12-C16)	µg/m <sup>3</sup>	40,257	<30	-	<30	31	<30	-	5.3	<10	<30	<30	48	<30	<30
<b>Aromatics</b>															
Aromatics (C6-C8)	µg/m <sup>3</sup>	NG	-	-	-	<15	-	-	<5.0	<10	33	34	<15	<15	<15
Aromatics (>C8-C10)	µg/m <sup>3</sup>	805	<15	-	<15	39	<15	-	<5.0	<10	19	21	23	<15	<15
Aromatics (>C10-C12)	µg/m <sup>3</sup>	8,051	<15	-	<15	677	<15	-	<5.0	<10	<15	<15	22	<15	<15
Aromatics (>C12-C16)	µg/m <sup>3</sup>	8,051	<30	-	<30	1,210	<30	-	<5.0	<10	<30	<30	<30	<30	<30

**Notes:**

<sup>1</sup> Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of

NG - No applicable criteria.

**BOLD** - Greater than criteria.

"-" Not analyzed.

**Table 5: Soil Vapour Analytical Results**

Location Field ID Sample Date Laboratory Report Number Laboratory Sample ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m <sup>3</sup> ) <sup>1</sup>	VW-01			22VW-01	VW-02				24VW-06	24VW-07	24VW-08			
		VW-01	VW-01	19DUP01	22VW-01	VW-02	VW-02	VW-02/1229	VW-02/9880	VW-02	DUPLICATE	24VW-06	24VW-07	24VW-08	
		5-Dec-2019	5-Dec-2019	5-Dec-2019	5-Apr-2023	5-Dec-2019	5-Dec-2019	4-May-2021	12-Jul-2021	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	
		L2393570	L2393570	L2393570	CG2304075	L2393570	L2393570	C1C2833	C1J4824	CG2418081	CG2418081	CG2418081	CG2418081	CG2418081	
Parameter	Unit	µg/m <sup>3</sup>	L2393570-1	L2393570-4	L2393570-3	CG2304075-001	L2393570-2	L2393570-5	PMX241	QBY851	CG2418081-001	CG2418081-005	CG2418081-002	CG2418081-003	CG2418081-004
<b>CWS TVOC</b>															
CWS TVOC (C6-C8)	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	-	-	1,590	1,600	743	42	134
CWS TVOC (>C8-C10)	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	-	-	191	216	825	29	83
CWS TVOC (>C10-C12)	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	-	-	<15	<15	708	<15	23
CWS TVOC (>C12-C16)	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	-	-	<30	<30	48	<30	<30
<b>BTEXS F1-F2</b>															
Benzene	µg/m <sup>3</sup>	41	1.54	-	2.55	0.83	2.11	-	2.82	<0.64	18.4	16.9	4.38	2.14	0.67
Toluene	µg/m <sup>3</sup>	75,190	17.7	-	4.24	1.47	4.75	-	1.09	<0.75	21.0	21.6	6.29	3.39	8.59
Ethylbenzene	µg/m <sup>3</sup>	68,650	<0.87	-	<0.87	1.26	<0.87	-	<0.43	<0.87	3.08	3.26	1.39	0.61	0.82
Xylene (o)	µg/m <sup>3</sup>	NG	<0.87	-	1.31	2.6	0.92	-	<0.43	<0.87	3.00	3.13	2.26	0.74	1.17
Xylenes (m & p)	µg/m <sup>3</sup>	NG	2.0	-	3.2	2.43	2.4	-	1.35	<1.7	9.25	9.90	5.12	2.30	3.00
Xylenes Total	µg/m <sup>3</sup>	3,520	2.0	-	4.5	5.00	3.3	-	1.30	<2.6	12.2	13.0	7.40	3.00	4.20
Styrene	µg/m <sup>3</sup>	3,220	<0.85	-	<0.85	<0.85	<0.85	-	<0.43	<0.85	<0.89	<0.94	<0.85	<0.85	<0.85
Total BTEX	mg/m <sup>3</sup>	NG	-	-	-	8.6	-	-	-	-	54.7	54.8	19.4	9.2	14.2
F1 (C <sub>6</sub> -C <sub>10</sub> )	µg/m <sup>3</sup>	867,383	146	-	199	2,660	76	-	-	-	1,600	1,630	1,490	66	201
F1 (C <sub>6</sub> -C <sub>10</sub> ) - BTEX	µg/m <sup>3</sup>	867,383	-	-	-	2,650	-	-	54.3	1,880	1,540	1,580	1,470	57	187
F2 (C <sub>10</sub> -C <sub>16</sub> )	µg/m <sup>3</sup>	52,495	88	-	201	3,830	50	-	68.8	118	18	20	939	<15	46
F2-NAPHTHALENE	µg/m <sup>3</sup>	NG	-	-	-	2,790	-	-	-	-	18	20	939	<15	46
<b>Alcohols</b>															
Ethanol	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	17.8	6.5	-	-	-	-	-
2-propanol	µg/m <sup>3</sup>	6,219	2.8	-	<2.5	-	<2.5	-	<2.5	<4.9	-	-	-	-	-
<b>Linear &amp; Cyclic Methyl Siloxanes</b>															
D3(CVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
D4(CVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
D5(CVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
D6(CVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
MM(LVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
MDM(LVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
MD2M(LVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
MD3M(LVMS)	µg/m <sup>3</sup>	NG	-	<170	-	-	-	<170	-	-	-	-	-	-	-
<b>Volatile Organic Compounds (VOCs)</b>															
1,1,1,2-Tetrachloroethane	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	<0.69	<1.4	-	-	-	-	-
1,1,1-Trichloroethane	µg/m <sup>3</sup>	1,693,510	<1.1	-	<1.1	<1.1	<1.1	-	<0.55	<1.1	<1.1	<1.2	<1.1	<1.1	188
1,1,2,2-Tetrachloroethane	µg/m <sup>3</sup>	11	<1.4	-	<1.4	<1.4	<1.4	-	<0.69	<1.4	<1.4	<1.5	<1.4	<1.4	<1.4
1,1,2-Trichloroethane	µg/m <sup>3</sup>	7	<1.1	-	<1.1	<1.1	<1.1	-	<0.55	<1.1	<1.1	<1.2	<1.1	<1.1	<1.1
1,1-Dichloroethane	µg/m <sup>3</sup>	430	<0.81	-	<0.81	<0.81	<0.81	-	<0.4	<0.81	<0.85	<0.89	<0.81	<0.81	6.11
1,1-Dichloroethene	µg/m <sup>3</sup>	6,470	<0.79	-	<0.79	<0.79	<0.79	-	<0.4	<0.79	<0.83	<0.87	<0.79	<0.79	<0.79

**Notes:**

<sup>1</sup> Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of  
 NG - No applicable criteria.

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"-" Not analyzed.

**Table 5: Soil Vapour Analytical Results**

Location Field ID Sample Date Laboratory Report Number Laboratory Sample ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m <sup>3</sup> ) <sup>1</sup>	VW-01			22VW-01	VW-02				24VW-06	24VW-07	24VW-08			
		VW-01	VW-01	19DUP01	22VW-01	VW-02	VW-02	VW-02/1229	VW-02/9880	VW-02	DUPLICATE	24VW-06	24VW-07	24VW-08	
		5-Dec-2019	5-Dec-2019	5-Dec-2019	5-Apr-2023	5-Dec-2019	5-Dec-2019	4-May-2021	12-Jul-2021	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	
		L2393570	L2393570	L2393570	CG2304075	L2393570	L2393570	C1C2833	C1J4824	CG2418081	CG2418081	CG2418081	CG2418081	CG2418081	
Parameter	Unit	µg/m <sup>3</sup>	L2393570-1	L2393570-4	L2393570-3	CG2304075-001	L2393570-2	L2393570-5	PMX241	QBY851	CG2418081-001	CG2418081-005	CG2418081-002	CG2418081-003	CG2418081-004
<b>Volatile Organic Compounds (VOCs)</b>															
1,2,4-Trichlorobenzene	µg/m <sup>3</sup>	365	<1.5	-	<1.5	<1.5	<1.5	-	<3.7	<7.4	<1.6	<1.6	<1.5	<1.5	<1.5
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	2,235	<0.98	-	<0.98	4.9	<0.98	-	<2.5	<4.9	3.0	3.0	2.0	<1.0	1.70
1,2-Dibromoethane	µg/m <sup>3</sup>	2.2	<1.5	-	<1.5	<1.5	<1.5	-	<0.77	<1.5	<1.6	<1.7	<1.5	<1.5	<1.5
1,2-Dichlorobenzene	µg/m <sup>3</sup>	7,072	<1.2	-	<1.2	<1.2	<1.2	-	<0.6	<1.2	<1.3	<1.3	<1.2	<1.2	<1.2
1,2-Dichloroethane	µg/m <sup>3</sup>	24	<0.81	-	<0.81	<0.81	<0.81	-	<0.4	<0.81	<0.85	<0.89	<0.81	<0.81	<0.81
1,2-Dichloroethene [cis]	µg/m <sup>3</sup>	242	<0.79	-	<0.79	<0.79	<0.79	-	<0.4	<0.79	<0.83	<0.87	<0.79	<0.79	<0.79
1,2-Dichloroethene [trans]	µg/m <sup>3</sup>	1,400	<0.79	-	<0.79	<0.79	<0.79	-	<0.4	<0.79	<0.83	<0.87	<0.79	<0.79	<0.79
1,2-Dichloropropane	µg/m <sup>3</sup>	135	<0.92	-	<0.92	<0.9	<0.92	-	<0.46	<0.92	<1.0	<1.0	<0.9	<0.9	<0.9
1,2-Dichlorotetrafluoroethane	µg/m <sup>3</sup>	566,335	<1.4	-	<1.4	<1.4	<1.4	-	<1.2	<2.4	2.9	8.4	<1.4	<1.4	<1.4
1,3,5-Trimethylbenzene	µg/m <sup>3</sup>	2,235	<0.98	-	<0.98	6.8	<0.98	-	<2.5	<4.9	<1.0	<1.1	1.0	<1.0	<1.0
1,3-Butadiene	µg/m <sup>3</sup>	17	<0.44	-	<0.44	<2.88	<0.44	-	<1.1	<2.2	<0.46	<0.49	<1.11	<0.44	<0.44
1,3-Dichlorobenzene	µg/m <sup>3</sup>	64	<1.2	-	<1.2	<1.2	<1.2	-	<2.4	<4.8	<1.3	<1.3	<1.2	<1.2	<1.2
1,3-Dichloropropene, [cis+trans]	µg/m <sup>3</sup>	NG	-	-	-	<1.8	-	-	-	-	<1.9	<2.0	<1.8	<1.8	<1.8
1,3-Dichloropropene [cis]	µg/m <sup>3</sup>	163	<0.91	-	<0.91	<0.9	<0.91	-	<0.45	<0.91	<1.0	<1.0	<0.9	<0.9	<0.9
1,3-Dichloropropene [trans]	µg/m <sup>3</sup>	149	<0.91	-	<0.91	<0.9	<0.91	-	<0.45	<0.91	<1.0	<1.0	<0.9	<0.9	<0.9
1,4-Dichlorobenzene	µg/m <sup>3</sup>	64	<1.2	-	<1.2	<1.2	<1.2	-	<0.6	<1.2	<1.3	<1.3	<1.2	<1.2	<1.2
1,4-Dioxane	µg/m <sup>3</sup>	105	<0.72	-	<0.72	<0.72	<0.72	-	<3.6	<7.2	<0.76	<0.79	<0.72	<0.72	<0.72
1-Methyl-4 ethyl benzene	µg/m <sup>3</sup>	14,461	<0.98	-	<0.98	1.9	<0.98	-	<2.5	<4.9	<1.0	<1.1	<1.0	<1.0	<1.0
2,2,4-Trimethylpentane	µg/m <sup>3</sup>	NG	-	-	-	-	-	-	<0.93	40.9	28.40	28.40	17.90	<0.9	<0.9
2-Butanone (MEK)	µg/m <sup>3</sup>	167,364	1.12	-	1.23	1.68	1.15	-	1.38	<1.2	4.98	5.37	<0.59	<0.59	1.62
2-Hexanone (MBK)	µg/m <sup>3</sup>	1,053	<4.1	-	<4.1	<12.3	<4.1	-	<4.1	<8.2	<4.51	<4.51	5.33	<4.10	<4.10
4-Methyl-2-pentanone (MIBK)	µg/m <sup>3</sup>	102,977	<0.82	-	<0.82	<9.75	<0.82	-	<0.82	<1.6	<0.86	<0.90	<0.82	<0.82	<0.82
Acetone	µg/m <sup>3</sup>	918,788	16.3	-	12.6	15.7	13.1	-	8.7	<2.9	3.3	4.0	3.1	3.3	37.0
Allyl chloride	µg/m <sup>3</sup>	32	<0.63	-	<0.63	<0.63	<0.63	-	-	-	<0.66	<0.69	<0.63	<0.63	<0.63
Benzyl chloride	µg/m <sup>3</sup>	34	<1	-	<1	<1.2	<1	-	<2.6	<5.2	<1.1	<1.1	<1.0	<1.0	<1.0
Bromodichloromethane	µg/m <sup>3</sup>	28	<1.3	-	<1.3	<1.3	<1.3	-	<1.3	<2.7	<1.4	<1.5	<1.3	<1.3	<1.3
Bromoform	µg/m <sup>3</sup>	1,494	<2.1	-	<2.1	<2.1	<2.1	-	<2.1	<4.1	<2.2	<2.3	<2.1	<2.1	<2.1
Bromomethane	µg/m <sup>3</sup>	173	<0.78	-	<0.78	<0.78	<0.78	-	<0.39	<0.78	<0.82	<0.85	<0.78	<0.78	<0.78
Carbon disulfide	µg/m <sup>3</sup>	21,713	<0.62	-	<0.62	<1.6	11.7	-	<1.6	<3.1	<1.6	<1.7	<1.6	1.6	48.9
Carbon tetrachloride	µg/m <sup>3</sup>	113	<1.3	-	<1.3	<1.26	<1.3	-	<0.63	<1.3	<1.32	<1.38	<1.26	<1.26	<1.26

**Notes:**

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Location Field ID Sample Date Laboratory Report Number Laboratory Sample ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m <sup>3</sup> ) <sup>1</sup>	VW-01			22VW-01	VW-02				24VW-06	24VW-07	24VW-08			
		VW-01	VW-01	19DUP01	22VW-01	VW-02	VW-02	VW-02/1229	VW-02/9880	VW-02	DUPLICATE	24VW-06	24VW-07	24VW-08	
		5-Dec-2019	5-Dec-2019	5-Dec-2019	5-Apr-2023	5-Dec-2019	5-Dec-2019	4-May-2021	12-Jul-2021	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	4-Dec-2024	
		L2393570	L2393570	L2393570	CG2304075	L2393570	L2393570	C1C2833	C1J4824	CG2418081	CG2418081	CG2418081	CG2418081	CG2418081	
Parameter	Unit	µg/m <sup>3</sup>	L2393570-1	L2393570-4	L2393570-3	CG2304075-001	L2393570-2	L2393570-5	PMX241	QBY851	CG2418081-001	CG2418081-005	CG2418081-002	CG2418081-003	CG2418081-004
<b>Volatile Organic Compounds (VOCs)</b>															
Chlorobenzene	µg/m <sup>3</sup>	347	<0.92	-	<0.92	<0.92	<0.92	-	<0.46	<0.92	<0.97	<1.01	<0.92	<0.92	<0.92
Chloroethane	µg/m <sup>3</sup>	124,080	<0.53	-	<0.53	<0.53	<0.53	-	<0.79	<1.6	<0.55	0.61	<0.53	<0.53	<0.53
Chloroform	µg/m <sup>3</sup>	27	<0.98	-	<0.98	<0.98	<0.98	-	<0.49	<0.98	<1.02	<1.07	<0.98	<0.98	<0.98
Chloromethane	µg/m <sup>3</sup>	2,657	1.05	-	1.04	0.6	1.7	-	1.11	<1.2	9.64	10.1	0.54	<0.41	<0.41
Cyclohexane	µg/m <sup>3</sup>	201,510	<0.69	-	<0.69	67.1	1.2	-	0.78	<12	14.5	13.7	43.7	2.48	2.17
Dibromochloromethane	µg/m <sup>3</sup>	6,070	<1.7	-	<1.7	<1.7	<1.7	-	<1.7	<3.4	<1.8	<1.9	<1.7	<1.7	<1.7
Dichlorodifluoromethane	µg/m <sup>3</sup>	3,584	2.76	-	2.75	11.2	23.8	-	13.9	2,110	1670	1740	3.40	37.5	1.80
Ethyl acetate	µg/m <sup>3</sup>	2,509	11.9	-	0.76	1.76	<0.72	-	<3.6	<7.2	<0.76	<0.79	<0.72	<0.72	<0.72
Freon 113	µg/m <sup>3</sup>	230,627	<1.5	-	<1.5	<1.5	<1.5	-	<1.2	<2.3	<1.6	<1.7	<1.5	<1.5	<1.5
Heptane	µg/m <sup>3</sup>	14,461	<0.82	-	0.99	13	1.35	-	3	3.1	7.42	6.84	6.93	3.12	<0.82
Hexachlorobutadiene	µg/m <sup>3</sup>	51	<2.1	-	<2.1	<2.1	<2.1	-	<5.3	<11	<2.2	<2.3	<2.1	<2.1	<2.1
Hexane	µg/m <sup>3</sup>	18,839	20.1	-	2.25	21.4	2.42	-	<0.7	6	11.0	9.38	22.2	4.44	0.81
Isooctane	µg/m <sup>3</sup>	14,917	<0.93	-	1.05	<14.0	1.92	-	-	-	28.4	28.4	17.9	<0.9	<0.9
iso-Propylbenzene (cumene)	µg/m <sup>3</sup>	14,461	<0.98	-	<0.98	<1.0	<0.98	-	-	-	<1.0	<1.1	<1.0	<1.0	<1.0
Methyl t-Butyl Ether (MTBE)	µg/m <sup>3</sup>	1,153	18.9	-	<0.72	7.36	<0.72	-	<0.72	<1.4	<0.76	<0.79	<0.72	<0.72	<0.72
Methylene Chloride	µg/m <sup>3</sup>	18,764	4	-	<0.69	<0.72	<0.69	-	<2.1	<4.2	<0.73	<0.76	<0.69	<0.69	<0.69
Naphthalene	µg/m <sup>3</sup>	380	<2.6	-	<2.6	<0.69	<2.6	-	1.2	<2.1	<0.58	<0.58	<0.52	<0.52	<0.52
Propene	µg/m <sup>3</sup>	91,723	<0.34	-	<0.34	<112	<0.34	-	-	<260	<177	<184	484	<0.69	<8.09
Tetrachloroethene	µg/m <sup>3</sup>	1,390	<1.4	-	<1.4	<1.4	<1.4	-	<0.68	<1.4	<1.4	<1.5	<1.4	<1.4	<1.4
Tetrahydrofuran	µg/m <sup>3</sup>	62,828	0.8	-	0.6	2.39	<0.59	-	<1.2	<2.4	<0.62	<0.65	<0.59	<0.59	<0.59
Trichloroethene	µg/m <sup>3</sup>	70	<1.1	-	1.4	<1.1	<1.1	-	<0.54	<1.1	10.7	10.5	3.8	1.9	2.7
Trichlorofluoromethane	µg/m <sup>3</sup>	34,325	1.3	-	1.3	<1.1	1.6	-	<1.1	<2.2	<1.2	<1.2	<1.1	1.7	<1.1
Vinyl acetate	µg/m <sup>3</sup>	6,586	<1.8	-	<1.8	<12.7	<1.8	-	<0.7	<1.4	<1,150	<1,160	<19.7	<1.8	<2.3
Vinyl bromide (bromoethene)	µg/m <sup>3</sup>	40	<0.87	-	<0.87	<0.9	<0.87	-	<0.87	<1.8	<0.9	<1.0	<0.9	<0.9	<0.9
Vinyl chloride	µg/m <sup>3</sup>	70	<0.51	-	<0.51	<0.51	<0.51	-	<0.26	<0.51	<0.54	<0.56	<0.51	<0.51	<0.51

**Notes:**

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**Table 6: Chemical, Physical, and Toxicological Properties**

Parameter	TC	RsC	H'	D <sub>air</sub>	D <sub>water</sub>	BAF	MF			
	Tolerable Concentration	Risk-Specific Concentration	Unitless Henry's Law Constant	Pure Component Molecular Diffusivity in Air	Pure Component Molecular Diffusivity in Water	Bioattenuation Factor	Mass Fraction in Soil (Coarse and Fine)	Mass Fraction in Soil Vapour - Coarse Soil	Mass Fraction in Soil Vapour - Fine Soil	
Units	mg/m <sup>3</sup>	mg/m <sup>3</sup>	unitless	cm <sup>2</sup> /s	cm <sup>2</sup> /s	unitless	unitless	unitless	unitless	
Benzene	--	0.003	0.225	0.088	1.00E-05	10	--	--	--	
Toluene	3.8	--	0.274	0.087	9.20E-06	10	--	--	--	
Ethylbenzene	1	--	0.358	0.075	8.50E-06	10	--	--	--	
Xylenes	0.18	--	0.252	0.078	9.90E-06	10	--	--	--	
Naphthalene	0.003	--	0.017	0.059	7.50E-06	10	--	--	--	
F1	Aliphatic C>6-C8	18.4	--	50	0.05	0.00001	10	0.55	0.854	0.842
	Aliphatic C>8-C10	1	--	80	0.05	0.00001	10	0.36	0.141	0.153
	Aromatic C>8-C10	0.2	--	0.48	0.05	0.00001	10	0.09	0.005	0.005
F2	Aliphatic C>10-C12	1	--	120	0.05	0.00001	10	0.36	0.767	0.766
	Aliphatic C>12-C16	1	--	520	0.05	0.00001	10	0.44	0.205	0.206
	Aromatic C>10-C12	0.2	--	0.14	0.05	0.00001	10	0.09	0.023	0.023
	Aromatic C>12-C16	0.2	--	0.053	0.05	0.00001	10	0.11	0.005	0.005
1,1,1-Trichloroethane	5	--	0.688	0.078	0.000009	10	--	--	--	
1,1,2,2-Tetrachloroethane	--	0.000172	0.019	0.071	0.000008	10	--	--	--	
1,1,2-Trichloroethane	0.0002	0.000625	0.038	0.078	0.000009	10	--	--	--	
1,1-Dichloroethane	--	0.006250	0.240	0.074	0.000011	10	--	--	--	
1,1-Dichloroethene	0.2	--	0.942	0.090	0.000010	10	--	--	--	
1,2,4-Trichlorobenzene	0.007	--	0.112	0.030	0.000008	10	--	--	--	
1,2,4-Trimethylbenzene	0.06	--	0.230	0.061	0.000008	10	--	--	--	
1,2-Dibromoethane	0.0093	0.016700	0.027	0.022	0.000012	10	--	--	--	
1,2-Dichlorobenzene	0.2	--	0.072	0.069	0.000008	10	--	--	--	
1,2-Dichloroethane	0.007	0.000385	0.049	0.104	0.000010	10	--	--	--	
1,2-Dichloropropane	0.004	0.002703	0.110	0.078	0.000009	10	--	--	--	
1,3,5-Trimethylbenzene	0.06	--	0.359	0.060	0.000008	10	--	--	--	
1,3-Butadiene	0.002	0.000333	3.009	0.249	0.000011	10	--	--	--	
1,3-Dichlorobenzene	0.095	0.000909	0.128	0.069	0.000008	10	--	--	--	
1,4-Dichlorobenzene	0.095	0.000909	0.098	0.069	0.000008	10	--	--	--	
1,4-Dioxane	0.03	0.002000	0.000	0.229	0.000010	10	--	--	--	
2-Hexanone	0.03	--	0.004	0.070	0.000008	10	--	--	--	
Acetone	31	--	0.002	0.124	0.000011	10	--	--	--	
Allyl chloride	0.001	--	0.450	0.094	0.000011	10	--	--	--	
Benzyl chloride	0.001	--	0.017	0.075	0.000008	10	--	--	--	
Bromodichloromethane	--	0.000270	0.098	0.030	0.000011	10	--	--	--	
Bromoform	--	0.009091	0.024	0.015	0.000010	10	--	--	--	
Bromomethane	0.005	--	0.255	0.073	0.000012	10	--	--	--	
Carbon Disulfide	0.7	--	0.705	0.104	0.000010	10	--	--	--	
Carbon Tetrachloride	0.1	0.001667	1.183	0.078	0.000009	10	--	--	--	
Chlorobenzene	0.01	--	0.148	0.073	0.000009	10	--	--	--	
Chloroethane	1	--	0.073	0.271	0.000012	10	--	--	--	
Chloroform	0.098	0.000435	0.154	0.104	0.000010	10	--	--	--	
Chloromethane	0.09	--	0.388	0.126	0.000007	10	--	--	--	
cis-1,2-Dichloroethene	0.007	--	0.302	0.074	0.000011	10	--	--	--	
cis-1,3-Dichloropropene	0.02	0.002500	0.053	0.087	0.000010	10	--	--	--	
Cyclohexane	6	--	7.618	0.080	0.000009	10	--	--	--	
Dibromochloromethane	0.07	--	0.040	0.020	0.000011	10	--	--	--	
Dichlorodifluoromethane	0.1	--	16.475	0.067	0.000010	10	--	--	--	
4-Ethyltoluene	0.40	--	0.205	0.065	0.000007	10	--	--	--	
Ethyl acetate	0.07	--	0.006	0.067	0.000010	10	--	--	--	
Freon 113	5	--	21.500	0.038	0.000009	10	--	--	--	
Freon 114	17	--	115.000	0.082	0.000009	10	--	--	--	
Heptane	0.4	--	83.709	0.065	0.000007	10	--	--	--	
Hexachlorobutadiene	--	0.000455	0.421	0.027	0.000007	10	--	--	--	
Isooctane	0.4	--	30.500	0.060	0.000007	10	--	--	--	
Isopropyl alcohol	0.2	--	0.000331	0.103	0.000011	10	--	--	--	
Isopropylbenzene	0.4	--	0.591	0.065	0.000007	10	--	--	--	
Methyl ethyl ketone	5	--	0.001	0.081	0.000010	10	--	--	--	
Methyl isobutyl ketone	0.003	--	0.006	0.075	0.000008	10	--	--	--	
Methylene chloride	0.6	1	0.151	0.101	0.000012	10	--	--	--	
MTBE	0.037	--	0.028	0.102	0.000011	10	--	--	--	
n-Hexane	0.7	--	73.916	0.200	0.000008	10	--	--	--	
Propylene	3	--	8.013	0.110	0.000011	10	--	--	--	
Styrene	0.092	--	0.130	0.071	0.000008	10	--	--	--	
Tetrachloroethylene	0.36	0.038462	1.077	0.072	0.000008	10	--	--	--	
Tetrahydrofuran	2	--	0.003	0.099	0.000011	10	--	--	--	
trans-1,2-Dichloroethene	--	--	0.277	0.071	0.000012	10	--	--	--	
trans-1,3-Dichloropropene	0.02	0.002500	0.053	0.087	0.000010	10	--	--	--	
Trichloroethylene	0.04	0.002439	0.477	0.079	0.000009	10	--	--	--	
Trichlorofluoromethane	1.05	--	5.200	0.087	0.000010	10	--	--	--	
Vinyl acetate	0.2	--	0.024	0.085	0.000009	10	--	--	--	
Vinyl bromide	0.003	--	0.260	0.100	0.000012	10	--	--	--	
Vinyl chloride	0.1	0.002273	3.236	0.106	0.000012	10	--	--	--	
Hydrogen Sulfide	0.002	--	0.350	0.188	0.000022	10	--	--	--	

**Notes:**

- cm<sup>2</sup>/s Square centimetres per second.
- F1 Fraction 1 (C6-C10).
- F2 Fraction 2 (C>10-C16).
- mg/m<sup>3</sup> Milligrams per cubic metre.
- PHC Petroleum hydrocarbon.
- Not applicable.

References: Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours.  
 Alberta Environment and Protected Areas (EPA). 2024. Alberta Tier 1 Soil and Groundwater Remediation Guidelines.  
 Health Canada. 2021. Federal contaminated site risk assessment in Canada: Toxicological reference values (TRVs), Version 3.0.  
 United States Environmental Protection Agency (US EPA). 2024. Regional Screening Levels for Chemical Contaminants at Superfund Sites.

**Table 7: Soil Properties for Evaluation of Vapour Transport**

Parameter		Units	Coarse-Grained Soil	Fine-Grained Soil
$\theta_a$	Vapour-filled porosity	unitless	0.31	0.303
$\rho_b$	Dry bulk density	$\text{g/cm}^3$	1.7	1.4
$n$	Total soil porosity	unitless	0.36	0.47
$\theta_w$	Moisture-filled porosity	unitless	0.05	0.167
$Q_{\text{soil}}$	Soil gas flow rate	$\text{cm}^3/\text{s}$	167	16.7

**Notes:**

Values from CCME (2014).

cm Centimetre.

$\text{cm}^2$  Square centimetre.

$\text{g/cm}^3$  Grams per cubic centimetre.

PHC Petroleum hydrocarbon.

References: Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours.

Alberta Environment and Protected Areas (EPA). 2024. Alberta Tier 1 Soil and Groundwater Remediation Guidelines.

**Table 8: Building Properties for Evaluation of Vapour Transport**

Parameter		Units	Residential/Parkland Land Use
$L_B$	Building length	cm	1,225
$W_B$	Building width	cm	1,225
$A_B$	Building area exposed to soil, including basement wall area	$cm^2$	2.70E+06
$H_B$	Building height	cm	360
$L_{crack}$	Thickness of the foundation	cm	11.25
$A_{crack}$	Area of cracks through which contaminant vapours enter the building	$cm^2$	994.5
ACH	Air exchanges per hour	$h^{-1}$	0.5

**Notes:**

Values taken from CCME (2014).

cm Centimetre.

$cm^2$  Square centimetre.

$h^{-1}$  Per hour.

References: Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours.  
 Alberta Environment and Protected Areas (EPA). 2024. Alberta Tier 1 Soil and Groundwater Remediation Guidelines.

**Table 9: Generic Soil Vapour Criteria**

Parameter	Residential/Parkland			
	Units	Coarse-Grained	Units	Coarse-Grained
Benzene		0.041		41.0
Toluene		75.2		75,190
Ethylbenzene		68.7		68,650
Xylenes		3.52		3,520
PHC F1		867		867,380
PHC F2		52.5		52,500
Naphthalene		0.38		1,694,000
1,1,1-Trichloroethane		1,694		1,693,510
1,1,2,2-Tetrachloroethane		0.011		11.2
1,1,2-Trichloroethane		0.0070		7.00
1,1-Dichloroethane		0.43		430
1,1-Dichloroethene		6.47		6,470
1,2,4-Trichlorobenzene		0.36		365
1,2,4-Trimethylbenzene		2.23		2,235
1,2-Dibromoethane		0.0022		2.16
1,2-Dichlorobenzene		7.07		7,072
1,2-Dichloroethane		0.020		23.9
1,2-Dichloroethene (cis)		0.24		242
1,2-Dichloroethene (trans)		1.40		1,400
1,2-Dichloropropane		0.14		135
1,3,5-Trimethylbenzene		2.23		2,235
1,3-Butadiene		0.020		17.3
1,3-Dichlorobenzene		0.060		64.3
1,3-Dichloropropene [cis]		0.16		163
1,3-Dichloropropene [trans]		0.15		149
1,4-Dichlorobenzene		0.064		64.0
1,4-Dioxane		0.11		105
1-Methyl-4 ethyl benzene		14.5		14,461
2-Butanone (MEK)		167		167,364
2-Hexanone (MBK)		1.05		1,053
4-Methyl-2-pentanone (MIBK)		103		102,977
Acetone		919		918,788
Allyl chloride	mg/m <sup>3</sup>	0.030	µg/m <sup>3</sup>	32.0
Benzyl chloride		0.030		34.3
Bromodichloromethane		0.030		28.3
Bromoform		1.49		1,494
Bromomethane		0.17		173
Carbon disulfide		21.7		21,713
Carbon tetrachloride		0.11		113
Chlorobenzene		0.35		347
Chloroethane		124		124,080
Chloroform		0.030		27.0
Chloromethane		2.66		2,657
Cyclohexane		202		201,510
Dibromochloromethane		6.07		6,070
Dichlorodifluoromethane		3.58		3,584
Ethyl acetate		2.51		2,509
Freon 113		231		230,627
Freon 114		566		566,335
Heptane		14.5		14,461
Hexachlorobutadiene		0.050		50.7
Hexane		18.8		18,839
Isooctane		14.9		14,917
iso-Propylbenzene (cumene)		14.5		14,461
Isopropanol		6.22		6,219
Methyl t-Butyl Ether (MTBE)		1.15		1,153
Methylene Chloride		18.8		18,764
Propylene		91.7		91,723
Styrene		3.22		3,220
Tetrachloroethene		1.39		1,390
Tetrahydrofuran		62.8		62,828
Trichloroethene	0.070	70.0		
Trichlorofluoromethane	34.3	34,325		
Vinyl acetate	6.59	6,586		
Vinyl bromide (bromoethene)	0.040	40.0		
Vinyl chloride	0.070	70.0		

**Notes:**

mg/m<sup>3</sup> Milligrams per cubic metre.  
 µg/m<sup>3</sup> Micrograms per cubic metre.

**References:**

- <sup>1</sup> Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours.
- <sup>2</sup> Alberta Environment and Protected Areas (EPA). 2024. Alberta Tier 1 Soil and Groundwater Remediation Guidelines.
- <sup>3</sup> Health Canada. 2021. Federal contaminated site risk assessment in Canada: Toxicological reference values (TRVs), Version 3.0.
- <sup>4</sup> United States Environmental Protection Agency (US EPA). 2024. Regional Screening Levels for Chemical Contaminants at Superfund Sites.

**Table 10: Soil Vapour Risk Evaluation**

Parameter	Unit	Soil Vapour Screening Criteria <sup>a</sup>	Soil Vapour Results (µg/m <sup>3</sup> )									Comparisons of Soil Vapour Measurements to Soil Vapour Criteria																	
												Estimated Cancer Risk <sup>b</sup>						Estimated Hazard Quotients <sup>c</sup>											
			VW-01	22VW-01	VW-02	VW-02	VW-02	VW-02	24VW-06	24VW-07	24VW-08	VW-01	22VW-01	VW-02	VW-02	VW-02	VW-02	24VW-06	24VW-07	24VW-08	VW-01	22VW-01	VW-02	VW-02	VW-02	VW-02	24VW-06	24VW-07	24VW-08
5-Dec-19	5-Apr-23	5-Dec-19	4-May-21	12-Jul-21	4-Dec-24	4-Dec-24	4-Dec-24	4-Dec-24	5-Dec-19	5-Apr-23	5-Dec-19	4-May-21	12-Jul-21	4-Dec-24	4-Dec-24	4-Dec-24	4-Dec-24	5-Dec-19	5-Apr-23	5-Dec-19	4-May-21	12-Jul-21	4-Dec-24	4-Dec-24	4-Dec-24	4-Dec-24			
Benzene	µg/m <sup>3</sup>	41	2.55	0.83	2.11	2.82	<0.64	18.4	4.38	2.14	0.67	6.2E-07	2.0E-07	5.1E-07	6.9E-07	ND	4.5E-06	1.1E-06	5.2E-07	1.6E-07	-	-	-	-	-	-	-	-	
Toluene	µg/m <sup>3</sup>	75,190	17.7	1.47	4.75	1.09	<0.75	21.6	6.29	3.39	8.59	-	-	-	-	-	-	-	-	-	2.4E-04	2.0E-05	6.3E-05	1.4E-05	ND	2.9E-04	8.4E-05	4.5E-05	1.1E-04
Ethylbenzene	µg/m <sup>3</sup>	68,650	<0.87	1.26	<0.87	<0.43	<0.87	3.26	1.39	0.61	0.82	-	-	-	-	-	-	-	-	-	ND	1.8E-05	ND	ND	ND	4.7E-05	2.0E-05	8.9E-06	1.2E-05
Xylenes Total	µg/m <sup>3</sup>	3,520	4.5	5	3.3	1.3	<2.6	13	7.4	3	4.2	-	-	-	-	-	-	-	-	-	1.3E-03	1.4E-03	9.4E-04	3.7E-04	ND	3.7E-03	2.1E-03	8.5E-04	1.2E-03
F1 (C <sub>6</sub> -C <sub>10</sub> )	µg/m <sup>3</sup>	867,383	199	2,660	76	54.3	1880	1630	1490	66	201	-	-	-	-	-	-	-	-	-	2.3E-04	3.1E-03	8.8E-05	6.3E-05	2.2E-03	1.9E-03	1.7E-03	7.6E-05	2.3E-04
F2 (C <sub>10</sub> -C <sub>16</sub> )	µg/m <sup>3</sup>	52,495	201	3,830	50	68.8	118	20	939	<15	46	-	-	-	-	-	-	-	-	-	3.8E-03	7.3E-02	9.5E-04	1.3E-03	2.2E-03	3.8E-04	1.8E-02	ND	8.8E-04
Aliphatics (C <sub>6</sub> -C <sub>8</sub> )	µg/m <sup>3</sup>	740,737	56	2,580	59	13.3	1470	1570	743	42	134	-	-	-	-	-	-	-	-	-	7.6E-05	3.5E-03	8.0E-05	1.8E-05	2.0E-03	2.1E-03	1.0E-03	5.7E-05	1.8E-04
Aliphatics (>C <sub>8</sub> -C <sub>10</sub> )	µg/m <sup>3</sup>	40,257	152	1,590	50	6.4	87	195	802	29	83	-	-	-	-	-	-	-	-	-	3.8E-03	3.9E-02	1.2E-03	1.6E-04	2.2E-03	4.8E-03	2.0E-02	7.2E-04	2.1E-03
Aliphatics (>C <sub>10</sub> -C <sub>12</sub> )	µg/m <sup>3</sup>	40,257	145	212	32	16.6	23	<15	686	<15	23	-	-	-	-	-	-	-	-	-	3.6E-03	5.3E-03	7.9E-04	4.1E-04	5.7E-04	ND	1.7E-02	ND	5.7E-04
Aliphatics (>C <sub>12</sub> -C <sub>16</sub> )	µg/m <sup>3</sup>	40,257	<30	31	<30	5.3	<10	<30	48	<30	<30	-	-	-	-	-	-	-	-	-	ND	7.7E-04	ND	1.3E-04	ND	ND	1.2E-03	ND	ND
Aromatics (>C <sub>8</sub> -C <sub>10</sub> )	µg/m <sup>3</sup>	805	<15	39	<15	<5.0	<10	21	23	<15	<15	-	-	-	-	-	-	-	-	-	ND	4.8E-02	ND	ND	ND	2.6E-02	2.9E-02	ND	ND
Aromatics (>C <sub>10</sub> -C <sub>12</sub> )	µg/m <sup>3</sup>	8,051	<15	677	<15	<5.0	<10	<15	22	<15	<15	-	-	-	-	-	-	-	-	-	ND	8.4E-02	ND	ND	ND	ND	2.7E-03	ND	ND
Aromatics (>C <sub>12</sub> -C <sub>16</sub> )	µg/m <sup>3</sup>	8,051	<30	1,210	<30	<5.0	<10	<30	<30	<30	<30	-	-	-	-	-	-	-	-	-	ND	0.15	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	µg/m <sup>3</sup>	1,693,510	<1.1	<1.1	<1.1	<0.55	<1.1	<1.2	<1.1	<1.1	188	-	-	-	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	1.1E-04
1,1-Dichloroethane	µg/m <sup>3</sup>	430	<0.81	<0.81	<0.81	<0.4	<0.81	<0.89	<0.81	<0.81	6.11	ND	ND	ND	ND	ND	ND	ND	1.4E-07	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4E-02
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	2,235	<0.98	4.9	<0.98	<2.5	<4.9	3	2	<1.0	1.7	-	-	-	-	-	-	-	-	-	ND	2.2E-03	ND	ND	ND	1.3E-03	8.9E-04	ND	7.6E-04
1,2-Dichlorotetrafluoroethane	µg/m <sup>3</sup>	566,335	<1.4	<1.4	<1.4	<1.2	<2.4	8.4	<1.4	<1.4	<1.4	-	-	-	-	-	-	-	-	-	ND	ND	ND	ND	ND	1.5E-05	ND	ND	ND
1,3,5-Trimethylbenzene	µg/m <sup>3</sup>	2,235	<0.98	6.8	<0.98	<2.5	<4.9	<1.1	1	<1.0	<1.0	-	-	-	-	-	-	-	-	-	ND	3.0E-03	ND	ND	ND	ND	4.5E-04	ND	ND
1-Methyl-4 ethyl benzene	µg/m <sup>3</sup>	14,461	<0.98	1.9	<0.98	<2.5	<4.9	<1.1	<1.0	<1.0	<1.0	-	-	-	-	-	-	-	-	-	ND	1.3E-04	ND	ND	ND	ND	ND	ND	ND
Isopropanol (2-Propanol)	µg/m <sup>3</sup>	6,219	2.8	--	<2.5	<2.5	<4.9	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5E-04	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	µg/m <sup>3</sup>	167,364	1.23	1.68	1.15	1.38	<1.2	5.37	<0.59	<0.59	1.62	-	-	-	-	-	-	-	-	-	7.3E-06	1.0E-05	6.9E-06	8.2E-06	ND	3.2E-05	ND	ND	9.7E-06
2-Hexanone (MBK)	µg/m <sup>3</sup>	1,053	<4.1	<12.3	<4.1	<4.1	<8.2	<4.51	5.33	<4.10	<4.10	-	-	-	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	5.1E-03	ND	ND
Acetone	µg/m <sup>3</sup>	918,788	16.3	15.7	13.1	8.7	<2.9	4	3.1	3.3	37	-	-	-	-	-	-	-	-	-	1.8E-05	1.7E-05	1.4E-05	9.5E-06	ND	4.4E-06	3.4E-06	3.6E-06	4.0E-05
Carbon disulfide	µg/m <sup>3</sup>	21,713	<0.62	<1.6	11.7	<1.6	<3.1	<1.7	<1.6	1.6	48.9	-	-	-	-	-	-	-	-	-	ND	ND	5.4E-04	ND	ND	ND	ND	7.4E-05	2.3E-03
Chloroethane	µg/m <sup>3</sup>	124,080	<0.53	<0.53	<0.53	<0.79	<1.6	0.61	<0.53	<0.53	<0.53	-	-	-	-	-	-	-	-	-	ND	ND	ND	ND	ND	4.9E-06	ND	ND	ND
Chloromethane	µg/m <sup>3</sup>	2,657	1.05	0.6	1.7	1.11	<1.2	10.1	0.54	<0.41	<0.41	-	-	-	-	-	-	-	-	-	4.0E-04	2.3E-04	6.4E-04	4.2E-04	ND	3.8E-03	2.0E-04	ND	ND
Cyclohexane	µg/m <sup>3</sup>	201,510	<0.69	67.1	1.2	0.78	<12	14.5	43.7	2.48	2.17	-	-	-	-	-	-	-	-	-	ND	3.3E-04	6.0E-06	3.9E-06	ND	7.2E-05	2.2E-04	1.2E-05	1.1E-05
Dichlorodifluoromethane	µg/m <sup>3</sup>	3,584	2.76	11.2	23.8	13.9	2110	1740	3.4	37.5	1.8	-	-	-	-	-	-	-	-	-	7.7E-04	3.1E-03	6.6E-03	3.9E-03	<b>0.59</b>	<b>0.49</b>	9.5E-04	1.0E-02	5.0E-04
Ethyl acetate	µg/m <sup>3</sup>	2,509	11.9	1.76	<0.72	<3.6	<7.2	<0.79	<0.72	<0.72	<0.72	-	-	-	-	-	-	-	-	-	4.7E-03	7.0E-04	ND	ND	ND	ND	ND	ND	ND
Heptane	µg/m <sup>3</sup>	14,461	0.99	13	1.35	3	3.1	7.42	6.93	3.12	<0.82	-	-	-	-	-	-	-	-	-	6.8E-05	9.0E-04	9.3E-05	2.1E-04	2.1E-04	5.1E-04	4.8E-04	2.2E-04	ND
Hexane	µg/m <sup>3</sup>	18,839	20.1	21.4	2.42	<0.7	6	11	22.2	4.44	0.81	-	-	-	-	-	-	-	-	-	1.1E-03	1.1E-03	1.3E-04	ND	3.2E-04	5.8E-04	1.2E-03	2.4E-04	4.3E-05
Isooctane	µg/m <sup>3</sup>	14,917	1.05	<14.0	1.92	-	--	28.40	17.90	<0.9	<0.9	-	-	-	-	-	-	-	-	-	7.0E-05	ND	1.3E-04	ND	ND	1.9E-03	1.2E-03	ND	ND
Methyl t-Butyl Ether (MTBE)	µg/m <sup>3</sup>	1,153	18.9	7.36	<0.72	<0.72	<1.4	<0.79	<0.72	<0.72	<0.72	-	-	-	-	-	-	-	-	-	1.6E-02	6.4E-03	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	µg/m <sup>3</sup>	18,764 / 62,546 <sup>e</sup>	4.00	<0.72	<0.69	<2.1	<4.2	<0.76	<0.69	<0.69	<0.69	6.4E-10	ND	ND	ND	ND	ND	ND	ND	ND	2.1E-04	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	µg/m <sup>3</sup>	380	<2.6	<0.69	<2.6	1.2	<2.1	<0.58	<0.52	<0.52	<0.52	-	-	-	-	-	-	-	-	-	ND	ND	ND	3.2E-03	ND	ND	ND	ND	ND
Propene	µg/m <sup>3</sup>	91,723	<0.34	<112	<0.34	-	<260	<184	484	<0.69	<8.09	-	-	-	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	5.3E-03	ND	ND
Tetrahydrofuran	µg/m <sup>3</sup>	62,828	0.80	2.39	<0.59	<1.2	<2.4	<0.65	<0.59	<0.59	<0.59	-	-	-	-	-	-	-	-	-	1.3E-05	3.8E-05	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	µg/m <sup>3</sup>	1,392 / 2,679 <sup>e</sup>	1.4	<1.1	<1.1	<0.54	<1.1	10.7	3.8	1.9	2.7	5.2E-09	ND	ND	ND	ND	4.0E-08	1.4E-08	7.1E-09	1.0E-08	1.0E-03	ND	ND	ND	ND	7.7E-03	2.7E-03	1.4E-03	1.9E-03
Trichlorofluoromethane	µg/m <sup>3</sup>	6,586	1.3	<1.1	1.6	<1.1	<2.2	<1.1	1.7	<1.1	<1.1	-	-	-	-	-	-	-	-	-	2.0E-04	ND	2.4E-04	ND	ND	ND	ND	2.6E-04	ND
<b>Cumulative Risk and Hazard Index<sup>d</sup></b>												6.3E-07	2.0E-07	5.1E-07	6.9E-07	ND	4.5E-06	1.1E-06	5.3E-07	3.2E-07	<b>3.8E-02</b>	<b>0.43</b>	<b>1.3E-02</b>	<b>1.0E-02</b>	<b>0.60</b>	<b>0.54</b>	<b>0.11</b>	<b>1.4E-02</b>	<b>2.5E-02</b>
<b>Target Risk and Hazard Levels</b>												<b>1.0 x 10<sup>-5</sup></b>								<b>1.00</b>									

**Notes:**

- < – not detected. Listed value is the corresponding detection limit.
- = screening criteria not calculated as appropriate toxicity data not available.
- Bold** = identifies estimated risks and hazards that exceed the target risk level of 1 x 10<sup>-5</sup> or target hazard level of 1.
- <sup>a</sup> Listed soil vapour screening criteria derived in accordance with CCME, 2014.
- <sup>b</sup> Estimated cancer risk = (soil vapour concentration/cancer soil vapour screening level) x 10<sup>-5</sup>.
- <sup>c</sup> Estimated hazard quotient = (soil vapour concentration/non-cancer soil vapour screening level).
- <sup>d</sup> Cumulative risk and hazard index represent the sum of chemical-specific cancer risks and hazard quotients.
- <sup>e</sup> Soil vapour screening criteria shows both the threshold criteria and non-threshold criteria. Target risk and hazard levels are calculated with the appropriate criteria.

**Table 11: Soil Vapour Quality Assurance/Quality Control Analytical Results**

		Location		RPD
		Field ID		
		Sample Date		
		Laboratory Report Number	Laboratory Sample ID	
		VW-02		
		VW-02	DUPLICATE	
		04 Dec 2024	04 Dec 2024	
		CG2418081	CG2418081	
		CG2418081-001	CG2418081-005	
Parameter	Unit			
<b>Field Parameters</b>				
Pressure on receipt	Inches Hg	-10.8	-11.0	2
<b>Fixed Gases</b>				
Oxygen	% v/v	1.76	1.73	2
Nitrogen	% v/v	62.3	61.8	1
Carbon Monoxide	% v/v	<0.050	<0.050	-
Methane	% v/v	15.3	15.3	-
Carbon Dioxide	% v/v	11.9	11.8	1
<b>Aliphatics</b>				
Aliphatics (C6-C8)	µg/m <sup>3</sup>	1,560	1,570	1
Aliphatics (>C8-C10)	µg/m <sup>3</sup>	172	195	13
Aliphatics (>C10-C12)	µg/m <sup>3</sup>	<15	<15	-
Aliphatics (>C12-C16)	µg/m <sup>3</sup>	<30	<30	-
<b>Aromatics</b>				
Aromatics (C6-C8)	µg/m <sup>3</sup>	33	34	3
Aromatics (>C8-C10)	µg/m <sup>3</sup>	19	21	10
Aromatics (>C10-C12)	µg/m <sup>3</sup>	<15	<15	-
Aromatics (>C12-C16)	µg/m <sup>3</sup>	<30	<30	-
<b>CWS TVOC</b>				
CWS TVOC (C6-C8)	µg/m <sup>3</sup>	1,590	1,600	1
CWS TVOC (>C8-C10)	µg/m <sup>3</sup>	191	216	12
CWS TVOC (>C10-C12)	µg/m <sup>3</sup>	<15	<15	-
CWS TVOC (>C12-C16)	µg/m <sup>3</sup>	<30	<30	-
<b>BTEX F1-F2</b>				
Benzene	µg/m <sup>3</sup>	18.4	16.9	8
Toluene	µg/m <sup>3</sup>	21	21.6	3
Ethylbenzene	µg/m <sup>3</sup>	3.08	3.26	6
Xylene (o)	µg/m <sup>3</sup>	3	3.13	4
Xylenes (m & p)	µg/m <sup>3</sup>	9.25	9.9	7
Xylenes Total	µg/m <sup>3</sup>	12.2	13	6
Styrene	µg/m <sup>3</sup>	<0.89	<0.94	-
Total BTEX	mg/m <sup>3</sup>	54.7	54.8	-
F1 (C <sub>6</sub> -C <sub>10</sub> )	µg/m <sup>3</sup>	1,600	1,630	2
F1 (C <sub>6</sub> -C <sub>10</sub> ) - BTEX	µg/m <sup>3</sup>	1,540	1,580	3
F2 (C <sub>10</sub> -C <sub>16</sub> )	µg/m <sup>3</sup>	18	20	11
F2-NAPHTHALENE	µg/m <sup>3</sup>	18	20	11
<b>Volatile Organic Compounds (VOCs)</b>				
1,1,1-Trichloroethane	µg/m <sup>3</sup>	<1.1	<1.2	-
1,1,2,2-Tetrachloroethane	µg/m <sup>3</sup>	<1.4	<1.5	-
1,1,2-Trichloroethane	µg/m <sup>3</sup>	<1.1	<1.2	-
1,1-Dichloroethane	µg/m <sup>3</sup>	<0.85	<0.89	-
1,1-Dichloroethene	µg/m <sup>3</sup>	<0.83	<0.87	-
1,2,4-Trichlorobenzene	µg/m <sup>3</sup>	<1.6	<1.6	-
1,2,4-Trimethylbenzene	µg/m <sup>3</sup>	3	3	-
1,2-Dibromoethane	µg/m <sup>3</sup>	<1.6	<1.7	-
1,2-Dichlorobenzene	µg/m <sup>3</sup>	<1.3	<1.3	-
1,2-Dichloroethane	µg/m <sup>3</sup>	<0.85	<0.89	-
1,2-Dichloroethene [cis]	µg/m <sup>3</sup>	<0.83	<0.87	-
1,2-Dichloroethene [trans]	µg/m <sup>3</sup>	<0.83	<0.87	-
1,2-Dichloropropane	µg/m <sup>3</sup>	<1.0	<1.0	-
1,2-Dichlorotetrafluoroethane	µg/m <sup>3</sup>	2.9	8.4	<b>97</b>
1,3,5-Trimethylbenzene	µg/m <sup>3</sup>	<1.0	<1.1	-
1,3-Butadiene	µg/m <sup>3</sup>	<0.46	<0.49	-
1,3-Dichlorobenzene	µg/m <sup>3</sup>	<1.3	<1.3	-
1,3-Dichloropropene, [cis+trans]	µg/m <sup>3</sup>	<1.9	<2.0	-
1,3-Dichloropropene [cis]	µg/m <sup>3</sup>	<1.0	<1.0	-
1,3-Dichloropropene [trans]	µg/m <sup>3</sup>	<1.0	<1.0	-
1,4-Dichlorobenzene	µg/m <sup>3</sup>	<1.3	<1.3	-
1,4-Dioxane	µg/m <sup>3</sup>	<0.76	<0.79	-
1-Methyl-4 ethyl benzene	µg/m <sup>3</sup>	<1.0	<1.1	-
2,2,4-Trimethylpentane	µg/m <sup>3</sup>	28.4	28.4	-
2-Butanone (MEK)	µg/m <sup>3</sup>	4.98	5.37	8
2-Hexanone (MBK)	µg/m <sup>3</sup>	<4.51	<4.51	-
4-Methyl-2-pentanone (MIBK)	µg/m <sup>3</sup>	<0.86	<0.90	-

**Notes:**

RDL - Reportable detection limit.

RPD - RPD is Relative Percentage Difference calculated as  $RPD(\%) = \frac{|V1-V2|}{(V1+V2)/2} * 100$

where V1, V2 = concentrations of parent and duplicate sample, respectively.

"-" Indicates RPD not calculated. RPDs have only been considered where both concentrations are greater than 5 times the RDL.

N/A - Not applicable.

**BOLD** - RPD value greater than 50%.

**Table 11: Soil Vapour Quality Assurance/Quality Control Analytical Results**

		Location		RPD
		VW-02		
		Field ID	DUPLICATE	
		Sample Date	04 Dec 2024	
Laboratory Report Number		CG2418081	CG2418081	
Laboratory Sample ID		CG2418081-001	CG2418081-005	
Parameter	Unit			
<b>Volatile Organic Compounds (VOCs)</b>				
Acetone	µg/m3	3.3	4	19
Allyl chloride	µg/m3	<0.66	<0.69	-
Benzyl chloride	µg/m3	<1.1	<1.1	-
Bromodichloromethane	µg/m3	<1.4	<1.5	-
Bromoform	µg/m3	<2.2	<2.3	-
Bromomethane	µg/m3	<0.82	<0.85	-
Carbon disulfide	µg/m3	<1.6	<1.7	-
Carbon tetrachloride	µg/m3	<1.32	<1.38	-
Chlorobenzene	µg/m3	<0.97	<1.01	-
Chloroethane	µg/m3	<0.55	0.61	10
Chloroform	µg/m3	<1.02	<1.07	-
Chloromethane	µg/m3	9.64	10.1	5
Cyclohexane	µg/m3	14.5	13.7	6
Dibromochloromethane	µg/m3	<1.8	<1.9	-
Dichlorodifluoromethane	µg/m3	1,670	1,740	4
Ethyl acetate	µg/m3	<0.76	<0.79	-
Freon 113	µg/m3	<1.6	<1.7	-
Heptane	µg/m3	7.42	6.84	8
Hexachlorobutadiene	µg/m3	<2.2	<2.3	-
Hexane	µg/m3	11	9.38	16
Isooctane	µg/m3	28.4	28.4	-
iso-Propylbenzene (cumene)	µg/m3	<1.0	<1.1	-
Methyl t-Butyl Ether (MTBE)	µg/m3	<0.76	<0.79	-
Methylene Chloride	µg/m3	<0.73	<0.76	-
Naphthalene	µg/m3	<0.58	<0.58	-
Propene	µg/m3	<177	<184	-
Tetrachloroethene	µg/m3	<1.4	<1.5	-
Tetrahydrofuran	µg/m3	<0.62	<0.65	-
Trichloroethene	µg/m3	10.7	10.5	2
Trichlorofluoromethane	µg/m3	<1.2	<1.2	-
Vinyl acetate	µg/m3	<1,150	<1,160	-
Vinyl bromide (bromoethene)	µg/m3	<0.9	<1.0	-
Vinyl chloride	µg/m3	<0.54	<0.56	-

**Notes:**

RDL - Reportable detection limit.

RPD - RPD is Relative Percentage Difference calculated as  $RPD(\%) = \frac{|V1-V2|}{[(V1+V2)/2]} * 100$

where V1, V2 = concentrations of parent and duplicate sample, respectively.

"-" Indicates RPD not calculated. RPDs have only been considered where both concentrations are greater than 5 times the RDL.

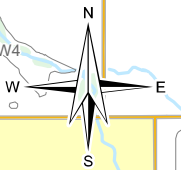
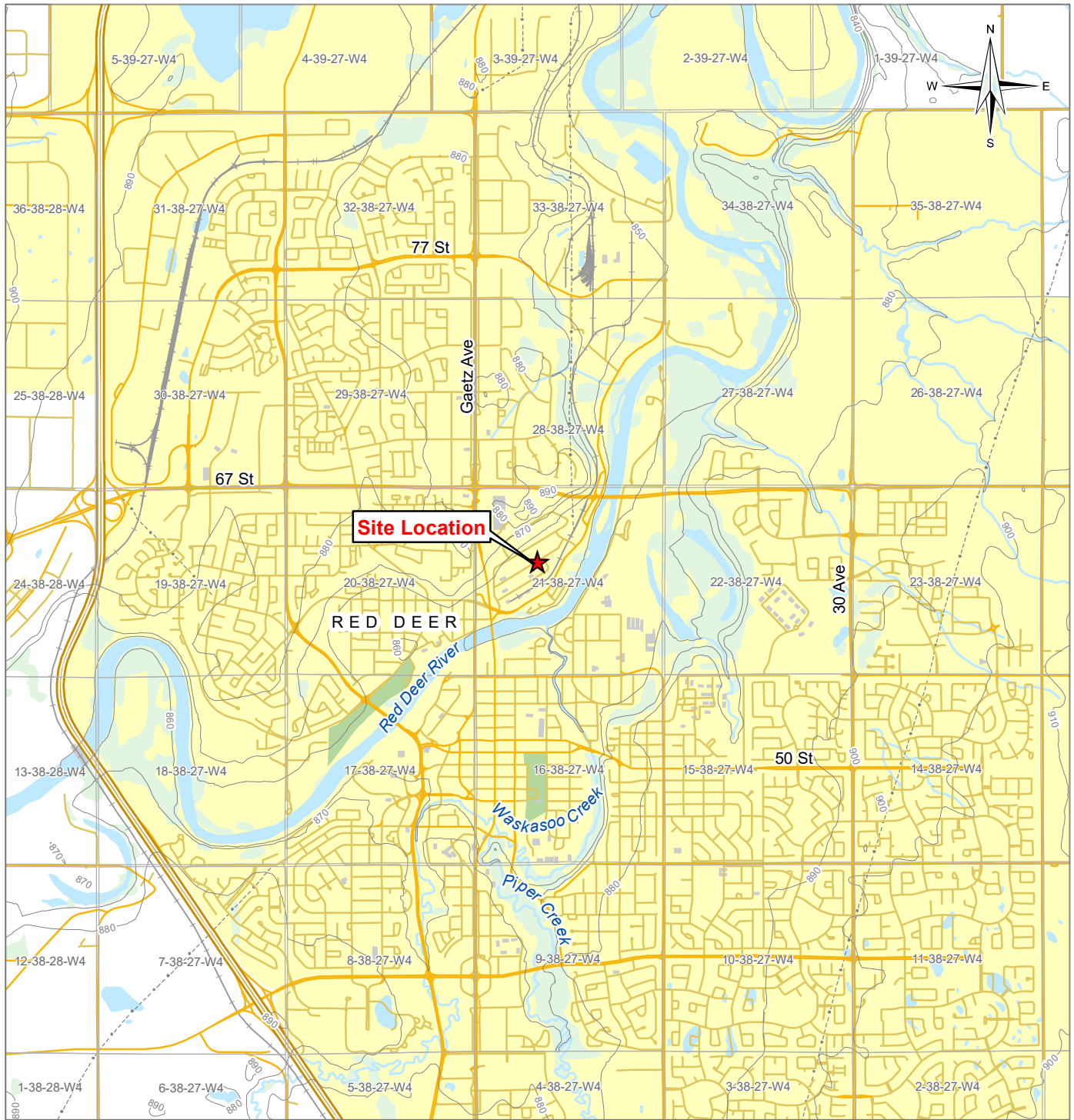
N/A - Not applicable.

**BOLD** - RPD value greater than 50%.

## FIGURES

- Figure 1 Site Location Plan
- Figure 2 Site Plan and Surrounding Land Use
- Figure 3 Historical Groundwater Elevations (Groundwater Monitoring Wells)
- Figure 4 Groundwater Elevation Contours May 2023

G:\SOLID\_WASTE\SWOP\SWOP04071-04\GIS\SWOP04071-04\_Figure1\_SiteLocation.mxd modified 4/23/2025 by Stephanie Leusink



**LEGEND**

- ★ Site Location
- Highway
- Main Road
- Local Road
- Resource/Recreational Road
- Railway
- Power Line
- Building
- Park
- Residential Area
- Contour (10 m)
- Watercourse
- Waterbody
- Wooded Area
- Urban Area

**NOTES**  
Base data source: CanVec 1:50,000.

**STATUS**  
ISSUED FOR USE

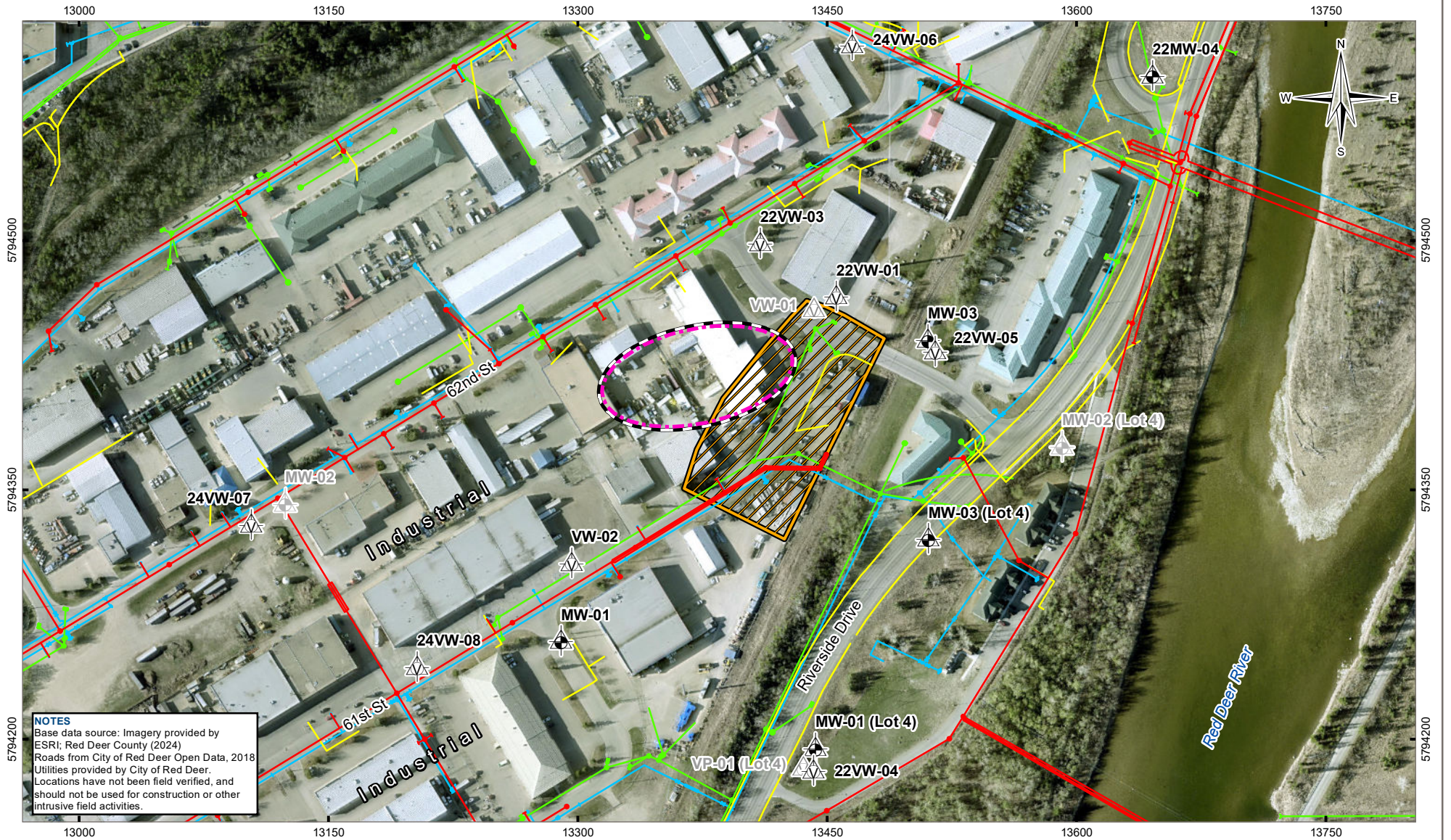
**2024 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT  
RIVERSIDE LIGHT INDUSTRIAL PARK**

**Site Location Plan**

<b>PROJECTION</b> 3TM 114		<b>DATUM</b> NAD83	
Scale: 1:50,000			
<b>FILE NO.</b> SWOP04071-04_Figure1_SiteLocation.mxd			
<b>OFFICE</b> Tt-EDM	<b>DWN</b> SL	<b>CKD</b> BB	<b>APVD</b> WC
<b>DATE</b> April 23, 2025	<b>PROJECT NO.</b> SWM.SWOP04071-04.006		



**Figure 1**



**NOTES**  
 Base data source: Imagery provided by ESRI; Red Deer County (2024)  
 Roads from City of Red Deer Open Data, 2018  
 Utilities provided by City of Red Deer.  
 Locations have not been field verified, and should not be used for construction or other intrusive field activities.

**LEGEND**

- Monitoring Well
- Destroyed Monitoring Well
- Vapour Well
- Vapour Well Decommissioned
- Site Boundary
- Approximate Area of Former Gravel Pit
- Historic Waste Disposal (Provided by Tiamat, 2014)
- Utilities**
- Electrical
- Sanitary
- Storm
- Water

**STATUS**  
 ISSUED FOR USE

Scale: 1:3,300

Metres

<b>PROJECTION</b> 3TM 114	<b>DATUM</b> NAD83
<b>FILE NO.</b> SWOP04071-04_Figure2_LandUse.mxd	
<b>CLIENT</b>	
Red Deer	TETRA TECH

**2024 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RIVERSIDE LIGHT INDUSTRIAL PARK**

**Site Plan and Surrounding Land Use**

<b>OFFICE</b> TL-EDM	<b>DWN</b> SL	<b>CKD</b> BB	<b>APVD</b> WC	<b>REV</b> 0
<b>DATE</b> May 7, 2025	<b>PROJECT NO.</b> SWM.SWOP04071-04.006			

**Figure 2**

**FIGURE 3**  
**HISTORICAL GROUNDWATER ELEVATIONS**  
**(GROUNDWATER MONITORING WELLS)**

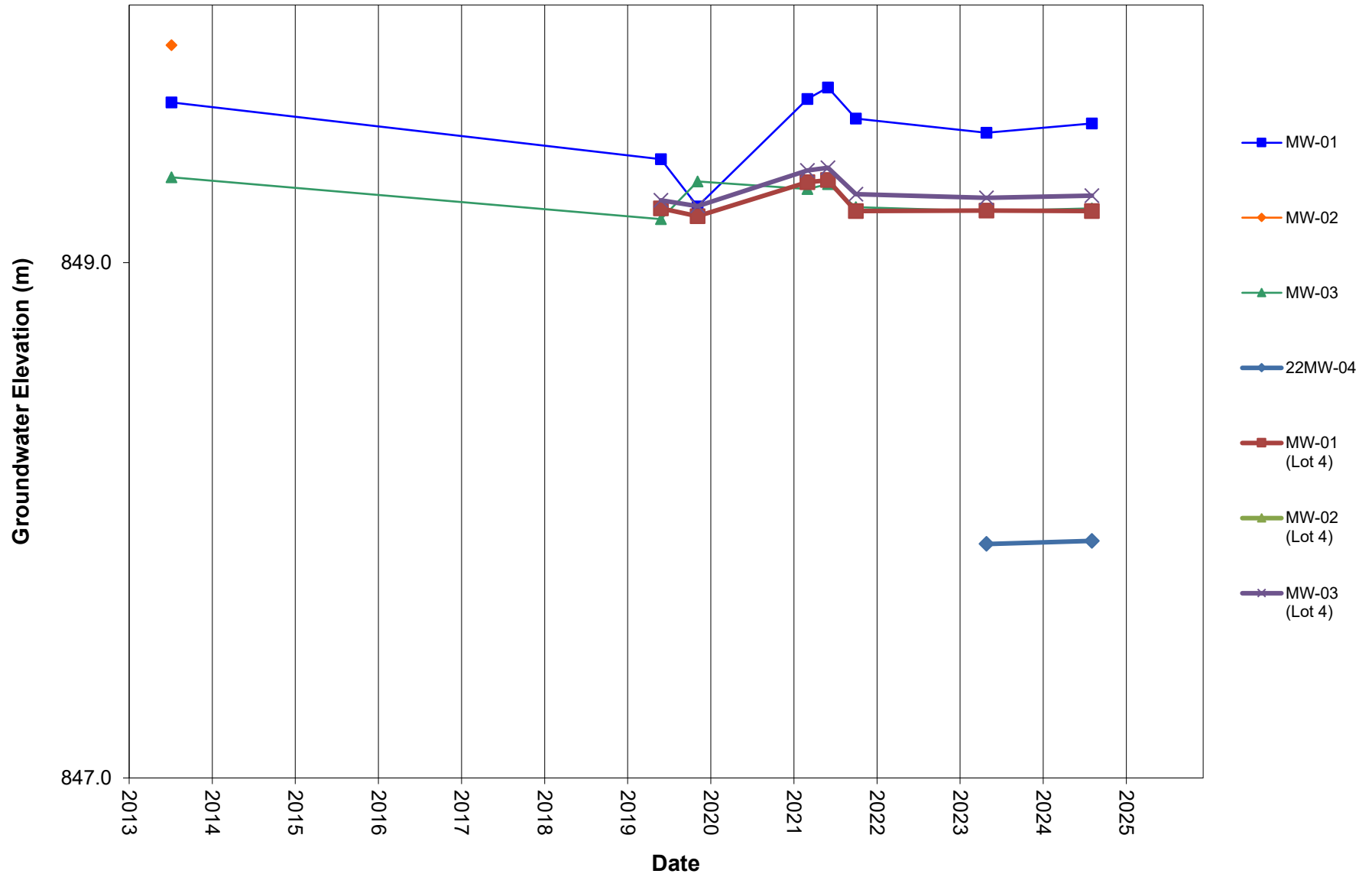
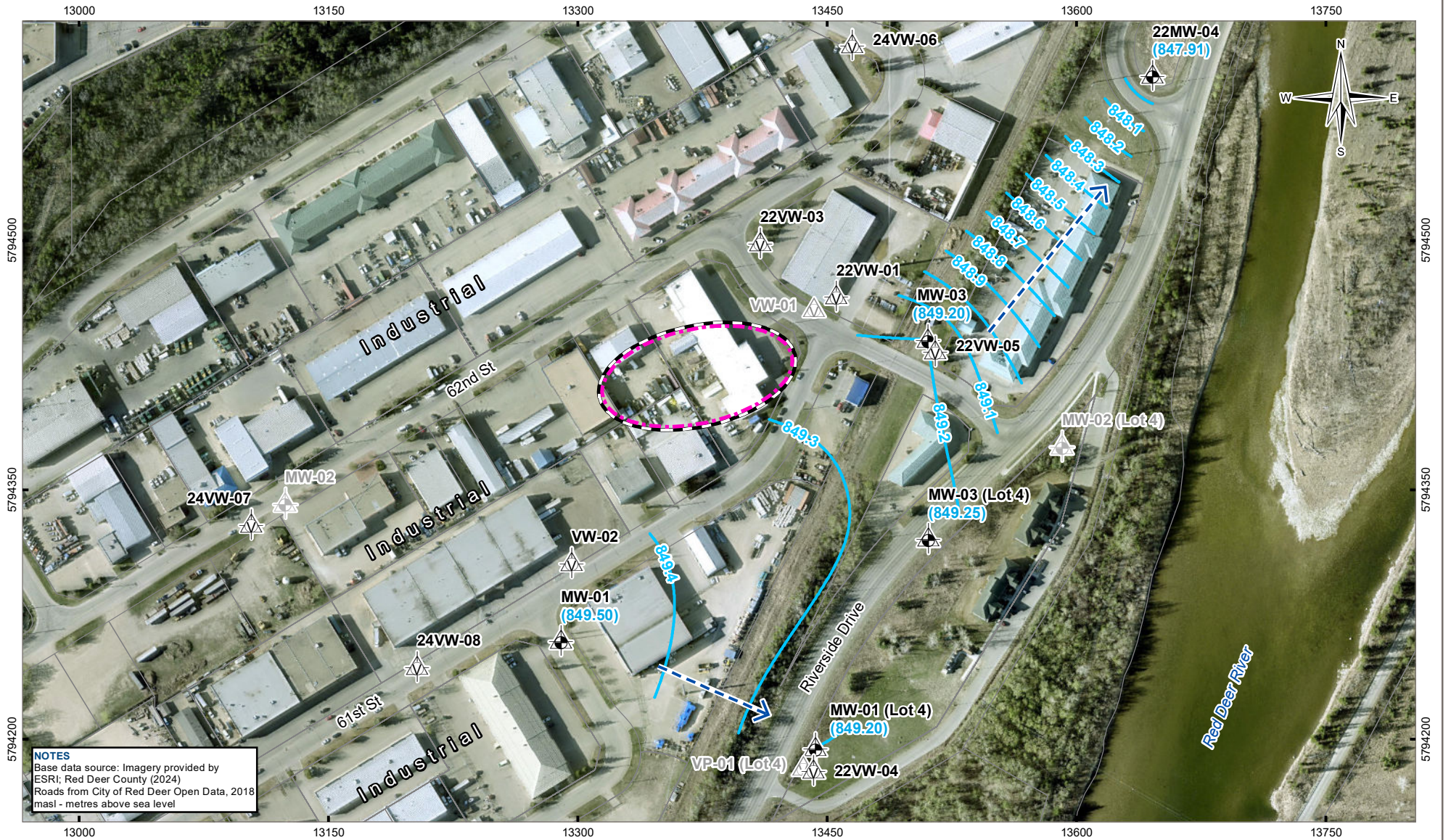












Figure 3 - MW Hydrographs

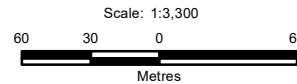


**NOTES**  
 Base data source: Imagery provided by ESRI; Red Deer County (2024)  
 Roads from City of Red Deer Open Data, 2018  
 masl - metres above sea level

**LEGEND**

-  Monitoring Well
-  Destroyed Monitoring Well
-  Vapour Well
-  Vapour Well Decommissioned
-  Groundwater Elevation Contour (masl)
-  Groundwater Elevation (masl)
-  Inferred Groundwater Flow Direction
-  Site Boundary
-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Lot Boundary

**STATUS**  
ISSUED FOR USE



**PROJECTION**  
3TM 114

**DATUM**  
NAD83

**FILE NO.**  
SWOP04071-04\_Figure4\_GW\_2024.mxd

**CLIENT**




**2024 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RIVERSIDE LIGHT INDUSTRIAL PARK**

**Groundwater Elevation Contours 2024**

<b>OFFICE</b> TI-EDM	<b>DWN</b> SL	<b>CKD</b> BB	<b>APVD</b> WC	<b>REV</b> 0
<b>DATE</b> May 7, 2025	<b>PROJECT NO.</b> SWM.SWOP04071-04.006			

**Figure 4**

## APPENDIX A

### TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

# LIMITATIONS ON USE OF THIS DOCUMENT

## GEOENVIRONMENTAL

### 1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

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Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

### 1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

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

### 1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner

consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

### 1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

### 1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

### 1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document 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 conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

### 1.7 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 in its reasonably exercised discretion.

## APPENDIX B

### SITE HISTORY, SITE SETTING, AND 2014 RISK MANAGEMENT PLAN REVIEW

## 1.0 SITE HISTORY

The following section summarizes the history of the Red Deer Riverside Light Industrial Park (RSLIP) site and was developed for the 2019 groundwater and soil vapour monitoring report<sup>1</sup>.

Municipal records do not indicate a timeline for waste disposal at the site. Based on the Phase I environmental site assessment<sup>2</sup> (ESA), aerial photographs were reviewed, and ground disturbance was observed from 1962 to 1976. Large pits and trenches were visible in the photographs prior to the commercial development. Historical information indicates the waste consisted of construction waste possibly mixed with municipal solid waste (MSW).

Historical waste disposal areas identified during the 2014 Phase II ESA<sup>3</sup> were beneath commercial buildings, roadways, and other infrastructure in the industrial park. The historical waste disposal area is estimated to be within the central and northeast parts of the industrial park, and the nature of how buildings above the waste footprint were constructed, or if any immediate waste removal was conducted, is not known. The estimated waste area is identified on Figure 2. The Red Deer River is located east of the site within 200 m. The status of the former landfill is listed as closed and inactive.

Results of the Phase II ESA<sup>3</sup> indicated that surface material consisted of sod, loam, and asphalt with varying amounts of clay fill. This material was overlying sand and clay fill. In the southwest to northeast, the fill was overlying native gravel. TH-01 encountered shale bedrock. In the north area the fill was overlying native silt and in various other areas native sand and gravel was present beneath fill.

## 2.0 HISTORICAL GROUNDWATER MONITORING AND INVESTIGATION SUMMARY

Monitoring wells were installed in 2013, including three groundwater monitoring wells (MW-01 to MW-03) within and beside the waste material boundary and two soil vapour wells (VW-01 and VW-02). An additional five testholes were advanced to monitor the material and determine the extent of the waste. Monitoring wells MW-01 to MW-03 on Lot 4 to the east were installed in 2013 as part of a site investigation in response to development interest. Development on the Lot 4 site was subsequently approved by the Subdivision and Development Appeal Board.

Previous reports conducted by Tiamat include:

- Environmental Site Assessment Landfill Variance Request, 4615 Riverside Drive, Red Deer, Alberta. May 10, 2013<sup>4</sup>.
- Phase I Environmental Site Assessment, Historic Waste Disposal Site, Riverside Light Site, The City of Red Deer. October 10, 2013<sup>2</sup>.
- Phase II Environmental Site Assessment, Historic Waste Disposal Site, Riverside Light Industrial Park, The City of Red Deer. February 7, 2014<sup>3</sup>.

<sup>1</sup> Tetra Tech Canada Inc. 2019 Groundwater and Soil Vapour Monitoring Report – Riverside Light Industrial Park. Prepared for The City of Red Deer. October 2020. Project Number: 704-SWM.SWOP04071-01.008.

<sup>2</sup> Tiamat Environmental Consultants Ltd. 2013. Phase I Environmental Site Assessment, Historic Waste Disposal Site, Riverside Light Industrial Park, The City of Red Deer. October 10, 2013.

<sup>3</sup> Tiamat Environmental Consultants Ltd. 2014. Phase II Environmental Site Assessment, Historic Waste Disposal Site, Riverside Light Industrial Park, The City of Red Deer. February 7, 2014.

<sup>4</sup> Tiamat Environmental Consultants Ltd. 2013. Environmental Site Assessment Landfill Variance Request, 4615 Riverside Drive. The City of Red Deer. May 10, 2013.

- Environmental Risk Management Plan, Historic Waste Disposal Sites, Riverside Light Industrial Park, The City of Red Deer. November 24, 2014<sup>5</sup>.

The results of the site assessment at 4615 Riverside Drive (Lot 4) identified the presence of the adjacent historical waste disposal site, and included the following:

- Five boreholes were advanced and did not identify unusual conditions (odours or discolouration).
- Groundwater sampling did not identify obvious concerns; however, soil vapour samples identified detectable volatile organic compounds (VOCs) in subsurface vapour. The levels were considered to be limited and manageable, and specific potential/proposed developments and associated infrastructure were recommended to be reviewed to determine whether mitigative measures may be required to limit exposure to soil vapours.

The results of the Phase II ESA conducted by Tiamat in 2014 indicated the following:

- The historical waste disposal area extends to under a public roadway and private land. Residential properties are located west of Gaetz Avenue at more than 500 m from the previous Riverside Light disposal area and are situated approximately 20 m higher than the industrial park.
- Commercial/industrial guidelines have been established for the area.

The recommendations of the program were as follows:

- Monitor groundwater elevations and soil vapour data semi-annually for at least one hydrogeological cycle.
- Collect an additional set of soil vapour and groundwater analytical data, groundwater elevations, and volatile headspace measurement during the winter months to determine seasonal changes in soil vapour concentrations.
- Create a risk management plan (RMP) that outlines the environmental issues of the site and future land use.
- Review any available data to update the RMP.

The results of the RMP<sup>5</sup> indicated the following:

- Information in the preliminary quantitative risk assessment (PQRA) should be updated as new site information is obtained.
- A review of the RMP should be completed when the PQRA information is updated, if there are changes to the chemicals of potential concern (COPCs).
- The RMP should be reviewed and updated at five-year intervals.

## 3.0 SITE SETTING

The following section presents an overview of the regional and local setting for the site.

<sup>5</sup> Tiamat Environmental Consultants Ltd. 2014. Environmental Risk Management Plan, Historic Waste Disposal Sites, Riverside Light Industrial Park, The City of Red Deer. November 24, 2014.

## 3.1 Geology

---

The following sections summarize the regional and local geology.

### 3.1.1 Geological Setting and Stratigraphy

The City of Red Deer (the City) and site are located within the Red Deer River drainage basin with principal drainage via the Red Deer River located east of the site. The Red Deer River has incised the uplands with gentle slopes to the east and west of the river in the vicinity of the site.

The geology in the river valley is characterized by fluvial surficial sediments deposited by the Red Deer River, overlying shale and sandstone bedrock of the Paskapoo Formation.

Key elements of the geological setting are presented below from Tiamat's 2013 Phase I Report<sup>2</sup>:

*"The fertile black soil in the region (Penhold Loam) is of alluvial lacustrine origin. The Penhold Loam is a well-drained fine sandy loam classified as Chernozemic. It is generally stone free and in natural areas, is typically 1.5 m thick, more or less.*

*The Quaternary deposits consist of drift deposits of clay, silt, gravel and sand. Published information indicates the banks of the Red Deer River comprise of dirty gravel with thickness ranging from 6 to 12 m, more or less.*

*Terrace gravels hydraulically connected to the Red Deer River are a known resource of groundwater. Surficial soils comprise largely of poorly to moderately sorted sand, silt and gravel with a varying amount of clay. The fluvial sediments generally have obscure bedding planes. Medium to coarse sized gravel with cross-bedded sand have been documented.*

*The Tertiary bedrock consists of sequences of alternating shales and sandstones of the Paskapoo Formation. The Paskapoo Formation underlies the gravel sediments. This non-marine bedrock is composed of mudstone, siltstone and sandstone. The formation of the Rocky Mountains subjected the Paskapoo Formation to a regional stress-induced fracture pattern."*

### 3.1.2 Local Geology

Based on the 2014 Phase II ESA, the RSLIP consisted of 10 cm to 20 cm of sod and loam overlying the waste. The MSW included a mix of construction debris, wood, and glass. Where no MSW was observed, under the fill material was a mixture of sand and gravel to depths of 6.1 m. Native gravel and sand were under the fill material and overlying a shale bedrock.

## 3.2 Hydrogeology

---

The following sections summarize the regional and local hydrogeology.

### 3.2.1 Regional Hydrogeology

The regional hydrogeology is most influenced by the presence of the river sediments situated within the valley along the Red Deer River and a bedrock valley trending north-northeast in the vicinity of the site.

Key elements of the hydrogeological setting are presented below from Tiamat's 2013 Phase I report<sup>2</sup>:

*“A significant buried valley and aquifer resource trending northeastward through the city has been partially mapped and lies in the SE 28-38-27 W4M (McKenzie Trail and Riverside). This buried valley extends to a depth of 21 m, more or less and may extend to the south into north portions of 21-28-27 W4M.” Mapping by the Alberta Geological Survey<sup>6</sup> indicates that the valley is east of the site, however the width of the valley is not defined.*

*“The dominant type of near-surface groundwater in the Paskapoo Formation in the area of assessment is sodium bicarbonate. Notable concentrations of sodium sulphate type groundwater have also been reported. The quality of groundwater for potable use is generally suitable to depths of 300 m on the west side of Red Deer and decreases to 90 m, more or less in the east.*

*Areas of recharge (downward flow) in unsaturated heterogeneous sediments include most areas above the river and creek valleys, whereas; the river valleys will generally exhibit discharge. The distribution of groundwater in the area can also be influenced by the local geology, topographic relief, areas of artesian flow, springs and reasonable yielding water source wells.*

*Numerous permanent surface water features within The City of Red Deer and vicinity include Red Deer River, Waskasoo Creek, Gaetz Lakes, Hazlett Lake, Bower Ponds (result of formerly mining gravel resources), various sloughs in the fringe areas of the city and an assortment of other smaller creeks and springs.*

*The regional groundwater flow is expected to follow the bedrock topography and will be influenced by the varying distribution of sediments in the river valley, which will have been deposited in various historical channels since filled in under varying depositional environments. Further, the river is in hydrologic connection with the adjacent sediments, and therefore seasonal changes in river stage will affect the local groundwater flow patterns (magnitude and direction). In seasons of higher river flow, bank storage will occur whereas in seasons of lower flow (such as late summer/fall), the storage will be released.”*

### 3.2.2 Local Hydrogeology

The RSLIP area is relatively level with a gentle slope to the southeast. Areas to the west near Gaetz Avenue and north of Highway 11 are considerably higher in elevation. Groundwater flow direction is interpreted to be to the east or southeast towards the Red Deer River. The Red Deer River flows north. No other surface waterbodies were identified within 500 m of the site.

## 3.3 Groundwater Resource Usage

A search of the Alberta Water Well Database conducted in January 2020 for groundwater users within a 1 km radius of the RSLIP identified 22 groundwater wells; seven of the wells are listed as domestic use, four are listed as domestic and industrial use, four are listed as industrial use, six as investigation use, and one is unknown use<sup>7</sup>.

The nearest water well to site is located approximately 370 m southeast of the site, near the Red Deer River. The proposed well use was listed as for investigation purposes. The water wells within a 1 km radius of the site range from 4.5 m to 235 m deep. The status and use of the surrounding groundwater wells were not confirmed and they were not field verified.

<sup>6</sup> Andriashek, L. comp. 2018. Thalwegs of Bedrock Valleys, Alberta (GIS data, line features); Alberta Energy Regulator, AER/AGS Digital Data 2018-0001.

<sup>7</sup> Alberta Environment and Parks. 2019. Water Well Database. Information obtained included in the 2019 monitoring report. [http://www.telusgeomatics.com/tgpub/ag\\_water/](http://www.telusgeomatics.com/tgpub/ag_water/).

## 4.0 HAZARD QUOTIENTS

### 4.1 Review of the 2014 Hazard Quotients from the Risk Management Plan

The following section is a review of the 2014 RMP for the site that was completed by Tiamat<sup>5</sup>. The review of the 2014 RMP was completed for the 2019 groundwater and soil vapour monitoring report<sup>1</sup>.

The 2014 RMP presented a proposed site-specific environmental RMP as a tool to assist with the review of future subdivision applications on lands lying within the regulated setback distance from the site (300 m). The focus was on potential ingress of soil gas for COPCs with a hazard quotient (HQ) greater than 1.0. Residential land use was considered most sensitive, and exposure ratings for other land uses (e.g., school, public institutions, commercial complexes) were considered to not be greater than residential; however, unique exceptions would have to be reviewed and addressed on a site-specific basis<sup>8</sup>. Further, underground utility workers and subsurface utility infrastructure were considered relevant to potential exposure.

The RMP applied a 10x factor of safety to the hazard quotients to address uncertainties. Hazard quotients from the RMP ranged up to 1,406 (including the 10x factor of safety). Based on these, the RMP then provided recommended generic mitigative measures based on the calculated hazard quotients, ranging from passive to active measures, recognizing that the ultimate approach would require a design professional for the proposed development.

Following the 2014 RMP, the Canadian Council of Ministers of the Environment (CCME) released the document “A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures Via Inhalation of Vapours”<sup>9</sup>, designed to provide guidance for developing site-appropriate soil vapour quality guidelines. The guidelines developed using the methods outlined in the CCME document were used for this current study and are included with the vapour sampling results in Table 4. Hazard quotients were calculated using estimated dose (based on concentrations measured at the site) and divided by tolerable daily intake. Soil vapour concentrations from the Phase II ESA conducted in 2013 were not compared to soil vapour quality guidelines; however, spot checks of five target compounds with the highest hazard quotients in the 2013 work (vinyl chloride, tetrachloroethylene, chloromethane, trichloroethylene, and chloroform) identified that none of the 2013 concentrations would have unacceptable HQs using the updated CCME methodology.

The 2014 RMP was prepared concurrent to RMPs at several other former City landfills, and a common set of mitigative measures was applied based on the HQs. Subsequent to the 2014 RMP and to the release of the CCME Protocol document, The City undertook additional assessment at another former City Landfill (Montfort); as part of that work, their consultant XCG Consulting Limited (XCG) revised the 2014 RMP criteria ranges for each generic mitigative measure category to include a Cancer Risk range to allow comparison of the 2014 RMP ranges with the HQ and Cancer Risks calculated by XCG<sup>8</sup>. From that work, XCG identified the following generic mitigative measures for developments within a 300 m setback of these landfills (based on Tiamat 2014), and these have been adopted for this site.

<sup>8</sup> XCG Consulting Limited. 2018. Vapour Intrusion Assessment and Environmental Monitoring Report, prepared for the City of Red Deer's Montfort Landfill.

<sup>9</sup> Canadian Council of Ministers of the Environment. 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Exposure Protection of Human Exposures via Inhalation of Vapours. Available online: <http://cegg-rcqe.ccme.ca/en/index.html>.

### Passive Measures

1. Passive Measures – Level A: for Cancer Risk of  $> 1E^{-5}$  and  $< 5E^{-5}$  and/or HQ  $>0.2$  and  $<1$ .  
Compacted clay liner with a minimum thickness of 1m and confirmed maximum hydraulic conductivity of  $10^{-6}$  cm/sec.
2. Passive Measures – Level B: for Cancer Risk of  $> 5E^{-5}$  and  $< 5E^{-4}$  and/or HQ  $>1$  and  $<5$ .  
Synthetic liner with type of material, thickness and installation details dependent on the design professional.
3. Passive Measures – Level C: for Cancer Risk of  $> 5E^{-4}$  and  $< 1E^{-3}$  and/or HQ  $>5$  and  $<50$ .  
Passive sub-slab depressurization (SSD) system with a minimum depressurization of 4 Pa to 10 Pa. In some instances (such as a pervious subgrade), the actual depressurization necessary may require an active SSD or alternative active ventilation system.

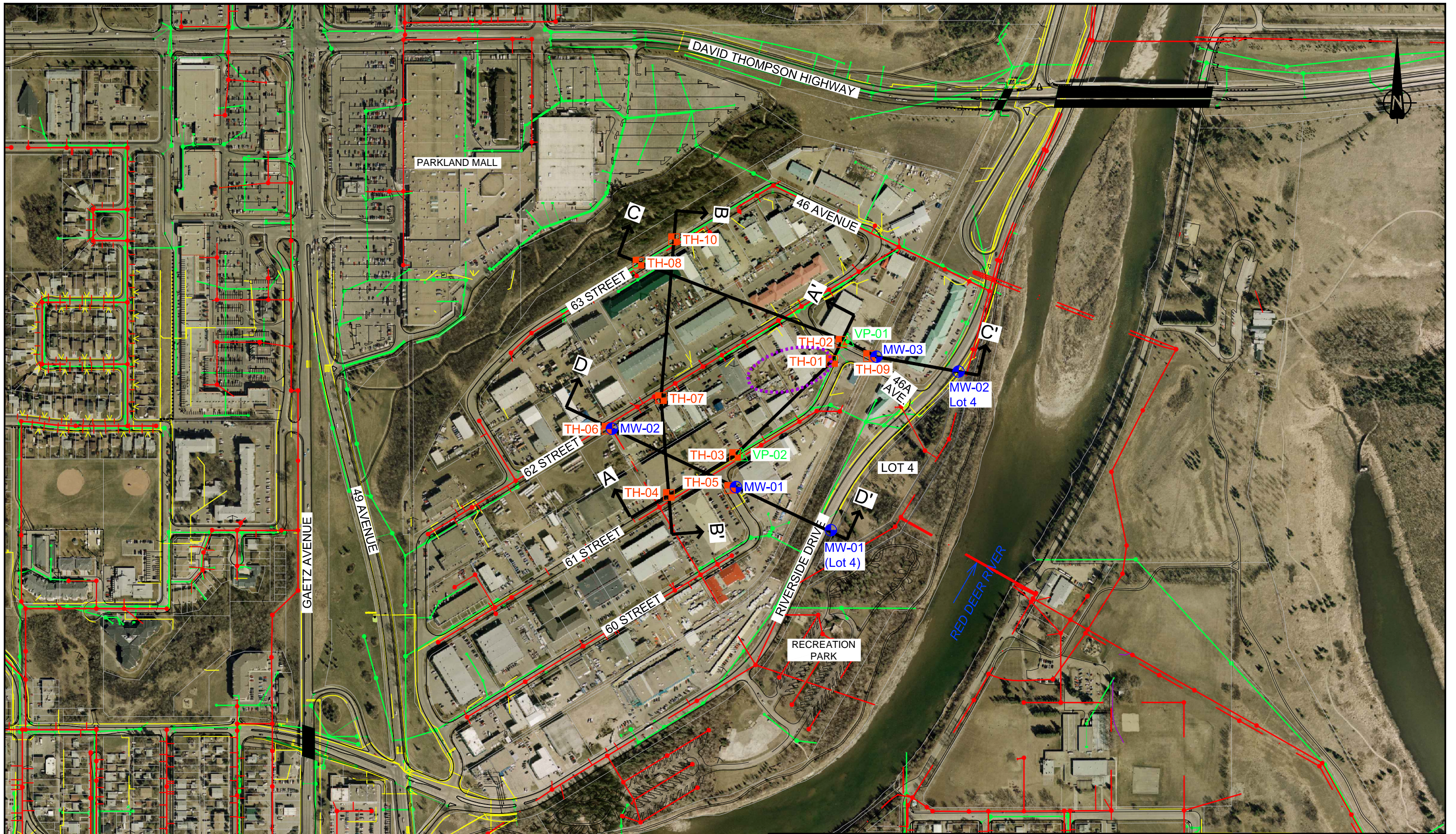
### Active Measures

Field verify the presence of the identified chemicals of concern and other potential chemicals in the soil gas state at the development site. If confirmed, determine the most appropriate manner to prevent soil vapour intrusion.

1. Active Measures – Level D: for Cancer Risk of  $> 1E^{-3}$  and  $< 2E^{-3}$  and/or HQ values  $>50$  and  $<100$ .  
Active SSD must be configured to compensate for depressurization of the building and have adequate negative pressure gradients across the entire footprint of the foundation.
2. Active Measures - Level E: for Cancer Risk of  $>2E^{-3}$  and/or HQ values  $>100$ .  
Installation of geomembrane and active soil vapour extraction with system fault notification alarm.

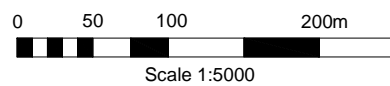
## APPENDIX C

### CROSS-SECTIONS (TIAMAT 2014)



SOURCE  
2010 ORTHOGRAPHIC IMAGE © COPYRIGHT WITH  
PERMISSION FROM THE CITY OF RED DEER.

NOTE:  
LOCATION OF BURIED UTILITIES ARE APPROXIMATE.  
ACTUAL LOCATIONS OF THE SHALLOW UTILITIES  
AND ANY OTHER UTILITIES SHOULD BE VERIFIED  
PRIOR TO ANY GROUND DISTURBANCE ACTIVITY.



PHASE II TEST LOCATIONS  
 MW-## GROUNDWATER MONITORING WELL (3)  
 TH-## TESTHOLE (10)  
 VW-## SOIL VAPOUR MONITORING WELL (2)

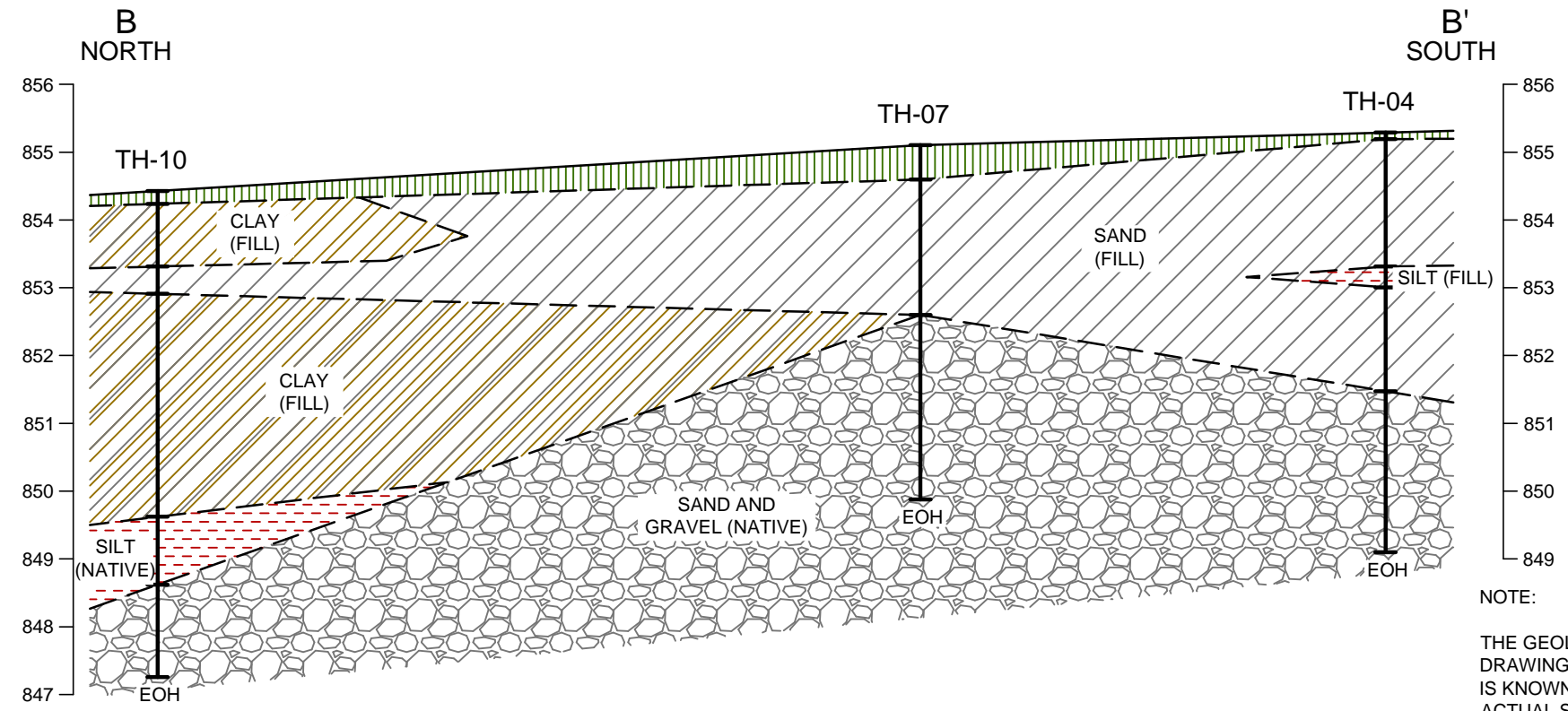
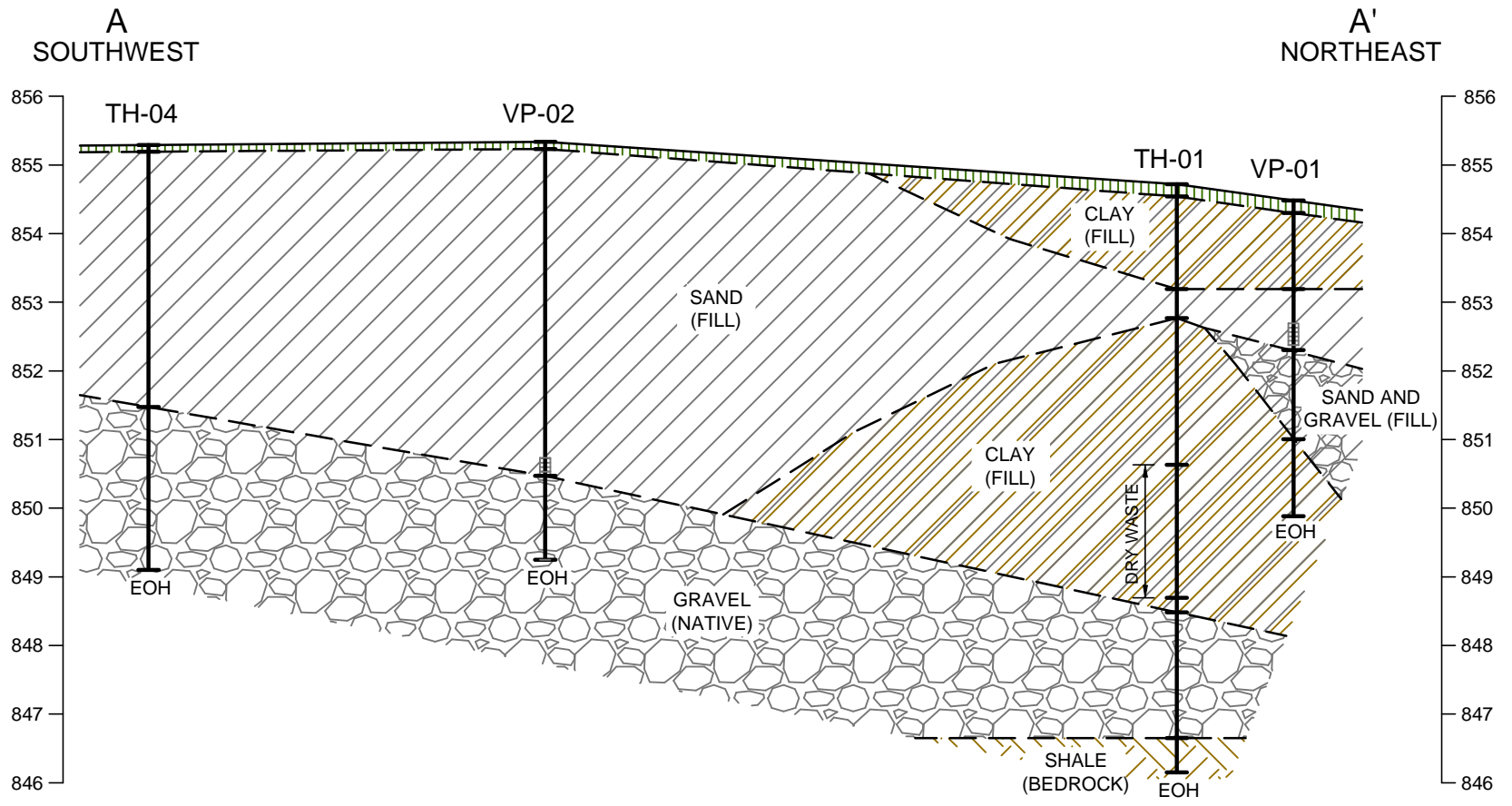
LEGEND  
 HISTORIC WASTE DISPOSAL  
 LOT BOUNDARY  
 CROSS SECTION LOCATION

ELECTRICAL  
 SANITARY  
 STORM  
 WATER

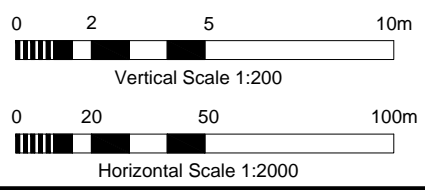
CLIENT: THE CITY OF RED DEER  
 PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN  
 HISTORIC WASTE DISPOSAL SITE  
 RIVERSIDE LIGHT INDUSTRIAL PARK  
 TITLE: SITE PLAN SHOWING INTERPRETED EXTENT OF WASTE

Tiamat Environmental Consultants Ltd.

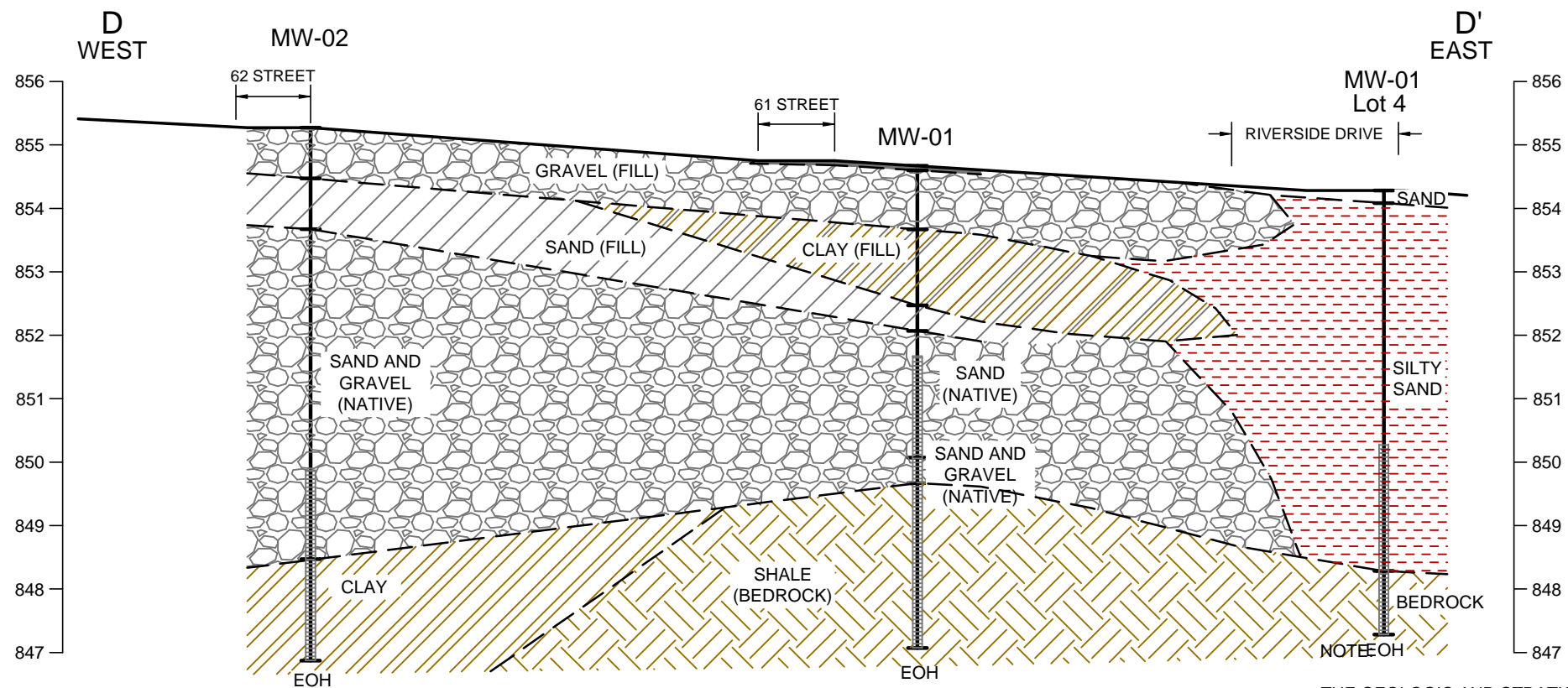
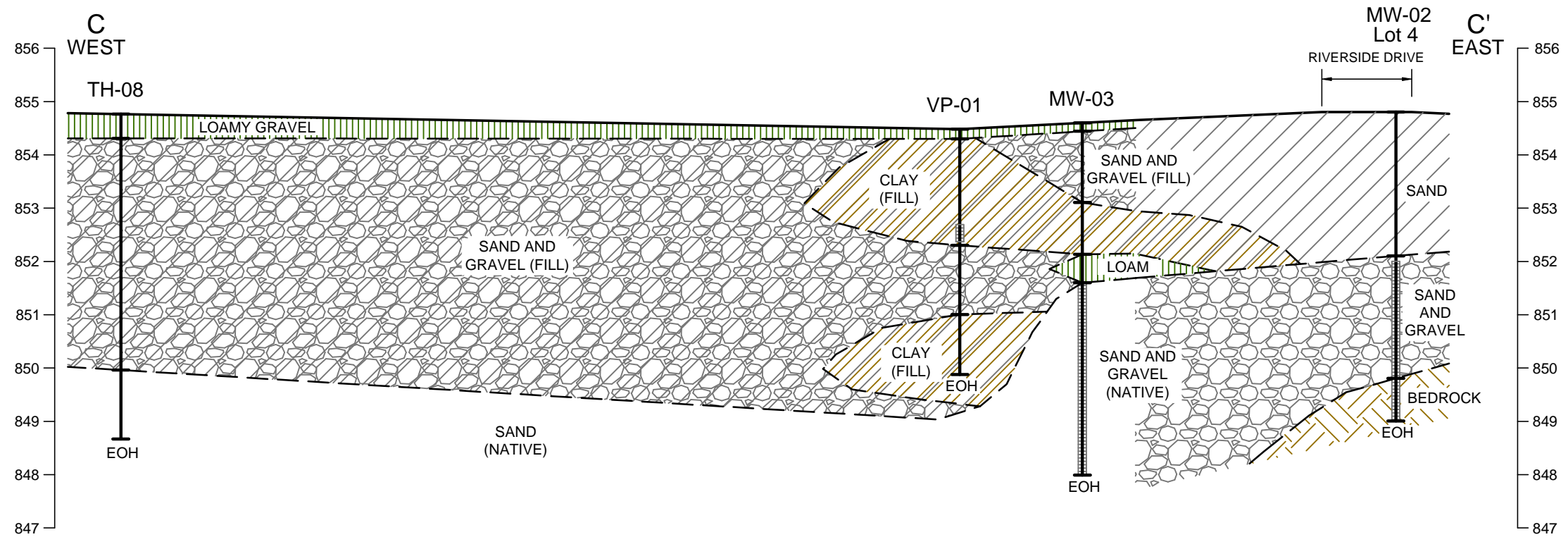
SCALE: 1 : 5000	DATE: June 1/14	PROJECT NO.: 12-435	FIGURE NO.: FIGURE 2
DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP v1.02.dwg	



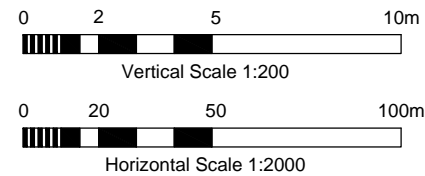
NOTE:  
THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.



CLIENT:	THE CITY OF RED DEER			
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE RIVERSIDE LIGHT INDUSTRIAL PARK			
TITLE:	CROSS SECTION A - A' AND B - B'			SCALE: AS SHOWN
		DATE: June 1/14	PROJECT NO.: 12-435	FIGURE NO.:
	DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERP Sections v1.02	<b>FIGURE 3A</b>



THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.



CLIENT:	THE CITY OF RED DEER			
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE RIVERSIDE LIGHT INDUSTRIAL PARK			
TITLE:	CROSS SECTIONS C - C' AND D - D'			
SCALE:	AS SHOWN	DATE:	Feb. 5/15	PROJECT NO.:
DRAWN BY:	LCH	CHECKED BY:	LTM	12-435
				CAD FILE NO.:
				ERMP Sections v1.04
				FIGURE NO.:
				FIGURE 3B

**Tiamat Environmental Consultants Ltd.**

## APPENDIX D

### LABORATORY ANALYTICAL REPORTS



## CERTIFICATE OF ANALYSIS

<p><b>Work Order</b> : <b>CG2412813</b></p> <p><b>Client</b> : <b>Tetra Tech Canada Inc.</b></p> <p><b>Contact</b> : Darby Madalena</p> <p><b>Address</b> : 110, 140 Quarry Park Blvd SE Calgary AB Canada T2C 3G3</p> <p><b>Telephone</b> : 403 203 3355</p> <p><b>Project</b> : SWOPO4071-04.006</p> <p><b>PO</b> : SWOPO4071-04.006</p> <p><b>C-O-C number</b> : CORD RIVERSIDE LIGHT</p> <p><b>Sampler</b> : W.V.</p> <p><b>Site</b> :</p> <p><b>Quote number</b> : Calgary Tetra Tech General 2024</p> <p><b>No. of samples received</b> : 3</p> <p><b>No. of samples analysed</b> : 3</p>	<p><b>Page</b> : 1 of 4</p> <p><b>Laboratory</b> : ALS Environmental - Calgary</p> <p><b>Account Manager</b> : Patryk Wojciak</p> <p><b>Address</b> : 2559 29th Street NE Calgary AB Canada T1Y 7B5</p> <p><b>Telephone</b> : +1 403 407 1800</p> <p><b>Date Samples Received</b> : 06-Sep-2024 15:00</p> <p><b>Date Analysis Commenced</b> : 08-Sep-2024</p> <p><b>Issue Date</b> : 12-Sep-2024 22:41</p>
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Anthony Calero	Supervisor - Inorganic	Inorganics, Calgary, Alberta
Gurvinder Kour	Lab Assistant	Metals, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Metals, Calgary, Alberta
Katarzyna Glinka	Analyst	Inorganics, Calgary, Alberta
Kevin Baxter	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Kevin Baxter	Team Leader - Inorganics	Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Metals, Calgary, Alberta
Shirley Li	Team Leader - Inorganics	Inorganics, Calgary, Alberta



## General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances  
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
-	no units
%	percent
µS/cm	microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

## Qualifiers

<i>Qualifier</i>	<i>Description</i>
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
RRV	Reported result verified by repeat analysis.



## Analytical Results

Sub-Matrix: Water					Client sample ID	MW-03	22MW-04	DUPLICATE	----	----
(Matrix: Water)					Client sampling date / time	06-Sep-2024 08:50	06-Sep-2024 09:05	06-Sep-2024 00:00	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2412813-001	CG2412813-002	CG2412813-003	-----	-----	
					Result	Result	Result	----	----	
<b>Physical Tests</b>										
Alkalinity, bicarbonate (as HCO3)	71-52-3	E290/CG	1.0	mg/L	1270	930	960	----	----	
Alkalinity, carbonate (as CO3)	3812-32-6	E290/CG	1.0	mg/L	<1.0	<1.0	<1.0	----	----	
Alkalinity, hydroxide (as OH)	14280-30-9	E290/CG	1.0	mg/L	<1.0	<1.0	<1.0	----	----	
Alkalinity, total (as CaCO3)	----	E290/CG	1.0	mg/L	1040	762	787	----	----	
Conductivity	----	E100/CG	1.0	µS/cm	2240	1660	1640	----	----	
Hardness (as CaCO3), dissolved	----	EC100/CG	0.50	mg/L	715	574	588	----	----	
pH	----	E108/CG	0.10	pH units	7.36	7.89	7.72	----	----	
Solids, total dissolved [TDS], calculated	----	EC103/CG	1.0	mg/L	1250	1020	1040	----	----	
<b>Anions and Nutrients</b>										
Chloride	16887-00-6	E235.Cl/CG	0.50	mg/L	160	104	104	----	----	
Fluoride	16984-48-8	E235.F/CG	0.020	mg/L	0.110	0.368	0.375	----	----	
Nitrate (as N)	14797-55-8	E235.NO3/CG	0.020	mg/L	<0.100 <sup>DLDS</sup>	0.703	0.717	----	----	
Nitrate + Nitrite (as N)	----	EC235.N+N/C G	0.0032	mg/L	<0.112	0.703	0.717	----	----	
Nitrite (as N)	14797-65-0	E235.NO2/CG	0.010	mg/L	<0.050 <sup>DLDS</sup>	<0.050 <sup>DLDS</sup>	<0.050 <sup>DLDS</sup>	----	----	
Sulfate (as SO4)	14808-79-8	E235.SO4/CG	0.30	mg/L	2.25	57.6	58.8	----	----	
<b>Ion Balance</b>										
Anion sum	----	EC101/CG	0.10	meq/L	25.3	19.4	20.0	----	----	
Cation sum	----	EC101/CG	0.10	meq/L	22.0	19.0	19.7	----	----	
Ion balance (APHA)	----	EC101/CG	0.01	%	-6.98	-1.04	-0.76	----	----	
Ion balance (cations/anions)	----	EC101/CG	0.010	%	87.0	97.9	98.5	----	----	
<b>Dissolved Metals</b>										
Aluminum, dissolved	7429-90-5	E421/CG	0.0010	mg/L	<0.0020 <sup>DLDS</sup>	0.0014	0.0014	----	----	
Antimony, dissolved	7440-36-0	E421/CG	0.00010	mg/L	<0.00020 <sup>DLDS</sup>	0.00024	0.00024	----	----	
Arsenic, dissolved	7440-38-2	E421/CG	0.00010	mg/L	0.0154	0.00068	0.00064	----	----	
Barium, dissolved	7440-39-3	E421/CG	0.00010	mg/L	1.48	0.250	0.252	----	----	
Boron, dissolved	7440-42-8	E421/CG	0.010	mg/L	0.157	0.193	0.200	----	----	
Cadmium, dissolved	7440-43-9	E421/CG	0.0000050	mg/L	0.000225	0.0000273	0.0000282	----	----	
Calcium, dissolved	7440-70-2	E421/CG	0.050	mg/L	151	147	150	----	----	



## Analytical Results

Sub-Matrix: Water					Client sample ID	MW-03	22MW-04	DUPLICATE	----	----
(Matrix: Water)					Client sampling date / time	06-Sep-2024 08:50	06-Sep-2024 09:05	06-Sep-2024 00:00	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2412813-001	CG2412813-002	CG2412813-003	-----	-----	
					Result	Result	Result	----	----	
<b>Dissolved Metals</b>										
Chromium, dissolved	7440-47-3	E421/CG	0.00050	mg/L	<0.00100 <sup>DLDS</sup>	<0.00050	<0.00050	----	----	
Copper, dissolved	7440-50-8	E421/CG	0.00020	mg/L	<0.00040 <sup>DLDS</sup>	0.00201	0.00216	----	----	
Iron, dissolved	7439-89-6	E421/CG	0.010	mg/L	14.8	0.012	0.021	----	----	
Lead, dissolved	7439-92-1	E421/CG	0.000050	mg/L	<0.000100 <sup>DLDS</sup>	<0.000050	<0.000050	----	----	
Magnesium, dissolved	7439-95-4	E421/CG	0.0050	mg/L	82.1	50.2	51.8	----	----	
Manganese, dissolved	7439-96-5	E421/CG	0.00010	mg/L	0.447	0.414	0.417	----	----	
Mercury, dissolved	7439-97-6	E509/CG	0.0000050	mg/L	<0.0000050	0.0000050 <sup>RRV</sup>	<0.0000050	----	----	
Nickel, dissolved	7440-02-0	E421/CG	0.00050	mg/L	0.0122	0.00626	0.00631	----	----	
Potassium, dissolved	7440-09-7	E421/CG	0.050	mg/L	62.1	11.6	11.6	----	----	
Selenium, dissolved	7782-49-2	E421/CG	0.000050	mg/L	0.000243	0.000285	0.000233	----	----	
Silver, dissolved	7440-22-4	E421/CG	0.000010	mg/L	<0.000020 <sup>DLDS</sup>	<0.000010	<0.000010	----	----	
Sodium, dissolved	7440-23-5	E421/CG	0.050	mg/L	129	166	175	----	----	
Uranium, dissolved	7440-61-1	E421/CG	0.000010	mg/L	0.00220	0.00341	0.00333	----	----	
Zinc, dissolved	7440-66-6	E421/CG	0.0010	mg/L	0.0342	0.0014	0.0025	----	----	
Dissolved mercury filtration location	----	EP509/CG	-	-	Field	Field	Field	----	----	
Dissolved metals filtration location	----	EP421/CG	-	-	Field	Field	Field	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.




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## QUALITY CONTROL INTERPRETIVE REPORT

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<p><b>Work Order</b> : <b>CG2412813</b></p> <p><b>Client</b> : <b>Tetra Tech Canada Inc.</b></p> <p><b>Contact</b> : Darby Madalena</p> <p><b>Address</b> : 110, 140 Quarry Park Blvd SE Calgary AB Canada T2C 3G3</p> <p><b>Telephone</b> : 403 203 3355</p> <p><b>Project</b> : SWOPO4071-04.006</p> <p><b>PO</b> : SWOPO4071-04.006</p> <p><b>C-O-C number</b> : CORD RIVERSIDE LIGHT</p> <p><b>Sampler</b> : W.V.</p> <p><b>Site</b> :</p> <p><b>Quote number</b> : Calgary Tetra Tech General 2024</p> <p><b>No. of samples received</b> : 3</p> <p><b>No. of samples analysed</b> : 3</p>	<p><b>Page</b> : 1 of 10</p> <p><b>Laboratory</b> : ALS Environmental - Calgary</p> <p><b>Account Manager</b> : Patryk Wojciak</p> <p><b>Address</b> : 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5</p> <p><b>Telephone</b> : +1 403 407 1800</p> <p><b>Date Samples Received</b> : 06-Sep-2024 15:00</p> <p><b>Issue Date</b> : 12-Sep-2024 22:41</p>
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This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

**Key**

- Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO: Data Quality Objective.
- LOR: Limit of Reporting (detection limit).
- RPD: Relative Percent Difference.

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### ***Workorder Comments***

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

### ***Summary of Outliers***

#### ***Outliers : Quality Control Samples***

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

#### ***Outliers: Reference Material (RM) Samples***

- No Reference Material (RM) Sample outliers occur.

***Outliers : Analysis Holding Time Compliance (Breaches)***

- Analysis Holding Time Outliers exist - please see following pages for full details.

***Outliers : Frequency of Quality Control Samples***

- No Quality Control Sample Frequency Outliers occur.



## Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
<b>Anions and Nutrients : Chloride in Water by IC</b>											
HDPE 22MW-04	E235.Cl	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Chloride in Water by IC</b>											
HDPE DUPLICATE	E235.Cl	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Chloride in Water by IC</b>											
HDPE MW-03	E235.Cl	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Fluoride in Water by IC</b>											
HDPE 22MW-04	E235.F	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Fluoride in Water by IC</b>											
HDPE DUPLICATE	E235.F	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Fluoride in Water by IC</b>											
HDPE MW-03	E235.F	06-Sep-2024	08-Sep-2024	28 days	2 days	✔	08-Sep-2024	28 days	2 days	✔	
<b>Anions and Nutrients : Nitrate in Water by IC</b>											
HDPE 22MW-04	E235.NO3	06-Sep-2024	08-Sep-2024	3 days	2 days	✔	08-Sep-2024	3 days	2 days	✔	



Matrix: **Water** Evaluation: \* = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
<b>Anions and Nutrients : Nitrate in Water by IC</b>											
HDPE DUPLICATE	E235.NO3	06-Sep-2024	08-Sep-2024	3 days	2 days	✓	08-Sep-2024	3 days	2 days	✓	
<b>Anions and Nutrients : Nitrate in Water by IC</b>											
HDPE MW-03	E235.NO3	06-Sep-2024	08-Sep-2024	3 days	2 days	✓	08-Sep-2024	3 days	2 days	✓	
<b>Anions and Nutrients : Nitrite in Water by IC</b>											
HDPE 22MW-04	E235.NO2	06-Sep-2024	08-Sep-2024	3 days	2 days	✓	08-Sep-2024	3 days	2 days	✓	
<b>Anions and Nutrients : Nitrite in Water by IC</b>											
HDPE DUPLICATE	E235.NO2	06-Sep-2024	08-Sep-2024	3 days	2 days	✓	08-Sep-2024	3 days	2 days	✓	
<b>Anions and Nutrients : Nitrite in Water by IC</b>											
HDPE MW-03	E235.NO2	06-Sep-2024	08-Sep-2024	3 days	2 days	✓	08-Sep-2024	3 days	2 days	✓	
<b>Anions and Nutrients : Sulfate in Water by IC</b>											
HDPE 22MW-04	E235.SO4	06-Sep-2024	08-Sep-2024	28 days	2 days	✓	08-Sep-2024	28 days	2 days	✓	
<b>Anions and Nutrients : Sulfate in Water by IC</b>											
HDPE DUPLICATE	E235.SO4	06-Sep-2024	08-Sep-2024	28 days	2 days	✓	08-Sep-2024	28 days	2 days	✓	
<b>Anions and Nutrients : Sulfate in Water by IC</b>											
HDPE MW-03	E235.SO4	06-Sep-2024	08-Sep-2024	28 days	2 days	✓	08-Sep-2024	28 days	2 days	✓	
<b>Dissolved Metals : Dissolved Mercury in Water by CVAAS</b>											
Glass vial dissolved (hydrochloric acid) 22MW-04	E509	06-Sep-2024	10-Sep-2024	28 days	4 days	✓	10-Sep-2024	28 days	4 days	✓	



Matrix: **Water** Evaluation: \* = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
<b>Dissolved Metals : Dissolved Mercury in Water by CVAAS</b>										
Glass vial dissolved (hydrochloric acid) DUPLICATE	E509	06-Sep-2024	10-Sep-2024	28 days	4 days	✓	10-Sep-2024	28 days	4 days	✓
<b>Dissolved Metals : Dissolved Mercury in Water by CVAAS</b>										
Glass vial dissolved (hydrochloric acid) MW-03	E509	06-Sep-2024	10-Sep-2024	28 days	4 days	✓	10-Sep-2024	28 days	4 days	✓
<b>Dissolved Metals : Dissolved Metals in Water by CRC ICPMS</b>										
HDPE dissolved (nitric acid) 22MW-04	E421	06-Sep-2024	10-Sep-2024	180 days	4 days	✓	11-Sep-2024	180 days	5 days	✓
<b>Dissolved Metals : Dissolved Metals in Water by CRC ICPMS</b>										
HDPE dissolved (nitric acid) DUPLICATE	E421	06-Sep-2024	10-Sep-2024	180 days	4 days	✓	11-Sep-2024	180 days	5 days	✓
<b>Dissolved Metals : Dissolved Metals in Water by CRC ICPMS</b>										
HDPE dissolved (nitric acid) MW-03	E421	06-Sep-2024	10-Sep-2024	180 days	4 days	✓	11-Sep-2024	180 days	5 days	✓
<b>Physical Tests : Alkalinity Species by Titration</b>										
HDPE 22MW-04	E290	06-Sep-2024	09-Sep-2024	14 days	3 days	✓	09-Sep-2024	14 days	3 days	✓
<b>Physical Tests : Alkalinity Species by Titration</b>										
HDPE DUPLICATE	E290	06-Sep-2024	09-Sep-2024	14 days	3 days	✓	09-Sep-2024	14 days	3 days	✓
<b>Physical Tests : Alkalinity Species by Titration</b>										
HDPE MW-03	E290	06-Sep-2024	09-Sep-2024	14 days	3 days	✓	09-Sep-2024	14 days	3 days	✓
<b>Physical Tests : Conductivity in Water</b>										
HDPE 22MW-04	E100	06-Sep-2024	09-Sep-2024	28 days	3 days	✓	09-Sep-2024	28 days	3 days	✓



Matrix: **Water** Evaluation: \* = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
<b>Physical Tests : Conductivity in Water</b>										
HDPE DUPLICATE	E100	06-Sep-2024	09-Sep-2024	28 days	3 days	✓	09-Sep-2024	28 days	3 days	✓
<b>Physical Tests : Conductivity in Water</b>										
HDPE MW-03	E100	06-Sep-2024	09-Sep-2024	28 days	3 days	✓	09-Sep-2024	28 days	3 days	✓
<b>Physical Tests : pH by Meter</b>										
HDPE 22MW-04	E108	06-Sep-2024	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM
<b>Physical Tests : pH by Meter</b>										
HDPE DUPLICATE	E108	06-Sep-2024	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM
<b>Physical Tests : pH by Meter</b>										
HDPE MW-03	E108	06-Sep-2024	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM	09-Sep-2024	0.25 hrs	73 hrs	* EHTR-FM

**Legend & Qualifier Definitions**

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended  
 Rec. HT: ALS recommended hold time (see units).



## Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water** Evaluation: \* = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
<b>Analytical Methods</b>							
<b>Laboratory Duplicates (DUP)</b>							
Alkalinity Species by Titration	E290	1640302	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1639149	2	23	8.7	5.0	✓
Conductivity in Water	E100	1640301	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	1642122	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	1643008	1	5	20.0	5.0	✓
Fluoride in Water by IC	E235.F	1639142	2	23	8.7	5.0	✓
Nitrate in Water by IC	E235.NO3	1639145	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	1639146	1	5	20.0	5.0	✓
pH by Meter	E108	1640300	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1639147	2	23	8.7	5.0	✓
<b>Laboratory Control Samples (LCS)</b>							
Alkalinity Species by Titration	E290	1640302	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1639149	2	23	8.7	5.0	✓
Conductivity in Water	E100	1640301	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	1642122	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	1643008	1	5	20.0	5.0	✓
Fluoride in Water by IC	E235.F	1639142	2	23	8.7	5.0	✓
Nitrate in Water by IC	E235.NO3	1639145	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	1639146	1	5	20.0	5.0	✓
pH by Meter	E108	1640300	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1639147	2	23	8.7	5.0	✓
<b>Method Blanks (MB)</b>							
Alkalinity Species by Titration	E290	1640302	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1639149	2	23	8.7	5.0	✓
Conductivity in Water	E100	1640301	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	1642122	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	1643008	1	5	20.0	5.0	✓
Fluoride in Water by IC	E235.F	1639142	2	23	8.7	5.0	✓
Nitrate in Water by IC	E235.NO3	1639145	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	1639146	1	5	20.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1639147	2	23	8.7	5.0	✓
<b>Matrix Spikes (MS)</b>							
Chloride in Water by IC	E235.Cl	1639149	2	23	8.7	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	1642122	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	1643008	1	5	20.0	5.0	✓



Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
<i>Analytical Methods</i>							
<b>Matrix Spikes (MS) - Continued</b>							
Fluoride in Water by IC	E235.F	1639142	2	23	8.7	5.0	✔
Nitrate in Water by IC	E235.NO3	1639145	1	5	20.0	5.0	✔
Nitrite in Water by IC	E235.NO2	1639146	1	5	20.0	5.0	✔
Sulfate in Water by IC	E235.SO4	1639147	2	23	8.7	5.0	✔



## Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 ALS Environmental - Calgary	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 ALS Environmental - Calgary	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Chloride in Water by IC	E235.Cl ALS Environmental - Calgary	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Calgary	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC	E235.NO2 ALS Environmental - Calgary	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 ALS Environmental - Calgary	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Calgary	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 ALS Environmental - Calgary	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Calgary	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS.  Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Mercury in Water by CVAAS	E509 ALS Environmental - Calgary	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Calgary	Water	APHA 2340B	"Hardness (as CaCO <sub>3</sub> , dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO <sub>3</sub> equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Ion Balance using Dissolved Metals	EC101 ALS Environmental - Calgary	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 ALS Environmental - Calgary	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N ALS Environmental - Calgary	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 ALS Environmental - Calgary	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO <sub>3</sub> .
Dissolved Mercury Water Filtration	EP509 ALS Environmental - Calgary	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

## QUALITY CONTROL REPORT

<p><b>Work Order</b> : <b>CG2412813</b></p> <p>Client : Tetra Tech Canada Inc.</p> <p>Contact : Darby Madalena</p> <p>Address : 110, 140 Quarry Park Blvd SE Calgary AB Canada T2C 3G3</p> <p>Telephone : 403 203 3355</p> <p>Project : SWOPO4071-04.006</p> <p>PO : SWOPO4071-04.006</p> <p>C-O-C number : CORD RIVERSIDE LIGHT</p> <p>Sampler : W.V.</p> <p>Site :</p> <p>Quote number : Calgary Tetra Tech General 2024</p> <p>No. of samples received : 3</p> <p>No. of samples analysed : 3</p>	<p>Page : 1 of 10</p> <p>Laboratory : ALS Environmental - Calgary</p> <p>Account Manager : Patryk Wojciak</p> <p>Address : 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5</p> <p>Telephone : +1 403 407 1800</p> <p>Date Samples Received : 06-Sep-2024 15:00</p> <p>Date Analysis Commenced : 08-Sep-2024</p> <p>Issue Date : 12-Sep-2024 22:41</p>
--	---

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Anthony Calero	Supervisor - Inorganic	Calgary Inorganics, Calgary, Alberta
Gurvinder Kour	Lab Assistant	Calgary Metals, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Metals, Calgary, Alberta
Katarzyna Glinka	Analyst	Calgary Inorganics, Calgary, Alberta
Kevin Baxter	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Kevin Baxter	Team Leader - Inorganics	Calgary Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Calgary Metals, Calgary, Alberta
Shirley Li	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta

Page : 2 of 10  
Work Order : CG2412813  
Client : Tetra Tech Canada Inc.  
Project : SWOPO4071-04.006



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## General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

# = Indicates a QC result that did not meet the ALS DQO.

## Workorder Comments

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Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

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### Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: <b>Water</b>					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
<b>Physical Tests (QC Lot: 1640300)</b>											
CG2412804-001	Anonymous	pH	----	E108	0.10	pH units	7.85	7.97	1.52%	4%	----
<b>Physical Tests (QC Lot: 1640301)</b>											
CG2412804-001	Anonymous	Conductivity	----	E100	1.0	µS/cm	1180	1190	1.18%	10%	----
<b>Physical Tests (QC Lot: 1640302)</b>											
CG2412804-001	Anonymous	Alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	550	556	1.14%	20%	----
<b>Anions and Nutrients (QC Lot: 1639142)</b>											
CG2412803-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.068	0.069	0.001	Diff <2x LOR	----
<b>Anions and Nutrients (QC Lot: 1639143)</b>											
CG2412803-001	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	16.1	16.2	0.351%	20%	----
<b>Anions and Nutrients (QC Lot: 1639144)</b>											
CG2412803-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	14.2	14.3	0.473%	20%	----
<b>Anions and Nutrients (QC Lot: 1639145)</b>											
CG2412813-002	22MW-04	Nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	0.703	0.701	0.002	Diff <2x LOR	----
<b>Anions and Nutrients (QC Lot: 1639146)</b>											
CG2412813-002	22MW-04	Nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
<b>Anions and Nutrients (QC Lot: 1639147)</b>											
CG2412813-002	22MW-04	Sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	57.6	57.8	0.277%	20%	----
<b>Anions and Nutrients (QC Lot: 1639148)</b>											
CG2412813-002	22MW-04	Fluoride	16984-48-8	E235.F	0.100	mg/L	0.368	0.384	0.016	Diff <2x LOR	----
<b>Anions and Nutrients (QC Lot: 1639149)</b>											
CG2412813-002	22MW-04	Chloride	16887-00-6	E235.Cl	2.50	mg/L	104	104	0.222%	20%	----
<b>Dissolved Metals (QC Lot: 1642122)</b>											
CG2412803-007	Anonymous	Mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
<b>Dissolved Metals (QC Lot: 1643008)</b>											
CG2412809-003	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0010	<0.0010	0.00003	Diff <2x LOR	----
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00015	0.00014	0.000007	Diff <2x LOR	----
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.0161	0.0158	1.67%	20%	----
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.270	0.262	3.29%	20%	----
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	0.534	0.528	1.07%	20%	----
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----



Sub-Matrix: **Water**

*Laboratory Duplicate (DUP) Report*

<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Analyte</i>	<i>CAS Number</i>	<i>Method</i>	<i>LOR</i>	<i>Unit</i>	<i>Original Result</i>	<i>Duplicate Result</i>	<i>RPD(%) or Difference</i>	<i>Duplicate Limits</i>	<i>Qualifier</i>
<b>Dissolved Metals (QC Lot: 1643008) - continued</b>											
CG2412809-003	Anonymous	Calcium, dissolved	7440-70-2	E421	0.050	mg/L	95.3	94.7	0.566%	20%	----
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00024	0.00023	0.000008	Diff <2x LOR	----
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	3.33	3.38	1.57%	20%	----
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	31.0	31.1	0.294%	20%	----
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.279	0.276	1.18%	20%	----
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00164	0.00160	0.00004	Diff <2x LOR	----
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	11.6	11.6	0.471%	20%	----
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	54.1	54.4	0.443%	20%	----
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000696	0.000684	1.77%	20%	----
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0030	0.0029	0.00008	Diff <2x LOR	----



## Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
<b>Physical Tests (QCLot: 1640301)</b>						
Conductivity	---	E100	1	µS/cm	<1.0	---
<b>Physical Tests (QCLot: 1640302)</b>						
Alkalinity, total (as CaCO3)	---	E290	1	mg/L	<1.0	---
<b>Anions and Nutrients (QCLot: 1639142)</b>						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	---
<b>Anions and Nutrients (QCLot: 1639143)</b>						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	---
<b>Anions and Nutrients (QCLot: 1639144)</b>						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	---
<b>Anions and Nutrients (QCLot: 1639145)</b>						
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	---
<b>Anions and Nutrients (QCLot: 1639146)</b>						
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	---
<b>Anions and Nutrients (QCLot: 1639147)</b>						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	---
<b>Anions and Nutrients (QCLot: 1639148)</b>						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	---
<b>Anions and Nutrients (QCLot: 1639149)</b>						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	---
<b>Dissolved Metals (QCLot: 1642122)</b>						
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	---
<b>Dissolved Metals (QCLot: 1643008)</b>						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	---
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	---
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	---
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	---
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	---
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	---
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	---
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	---
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	---
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	---



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
<b>Dissolved Metals (QCLot: 1643008) - continued</b>						
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----



## Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
<b>Physical Tests (QCLot: 1640300)</b>									
pH	----	E108	----	pH units	7 pH units	101	98.0	102	----
<b>Physical Tests (QCLot: 1640301)</b>									
Conductivity	----	E100	1	µS/cm	147 µS/cm	99.2	90.0	110	----
<b>Physical Tests (QCLot: 1640302)</b>									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	95.3	85.0	115	----
<b>Anions and Nutrients (QCLot: 1639142)</b>									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	97.2	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639143)</b>									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	98.2	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639144)</b>									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	99.9	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639145)</b>									
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	98.2	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639146)</b>									
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	99.0	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639147)</b>									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	97.9	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639148)</b>									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	97.4	90.0	110	----
<b>Anions and Nutrients (QCLot: 1639149)</b>									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	97.9	90.0	110	----
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0 mg/L	107	80.0	120	----
<b>Dissolved Metals (QCLot: 1643008)</b>									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	101	80.0	120	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	96.3	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	102	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	97.0	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	96.0	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	96.7	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	92.9	80.0	120	----



Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
<b>Dissolved Metals (QCLot: 1643008) - continued</b>									
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	99.5	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	96.0	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	98.0	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	97.4	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	93.9	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	99.3	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	97.8	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	97.9	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	91.6	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	89.8	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	94.0	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	98.3	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	98.0	80.0	120	----



### Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
<b>Anions and Nutrients (QCLot: 1639142)</b>										
CG2412803-002	Anonymous	Fluoride	16984-48-8	E235.F	0.981 mg/L	1 mg/L	98.1	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639143)</b>										
CG2412803-002	Anonymous	Chloride	16887-00-6	E235.Cl	98.8 mg/L	100 mg/L	98.8	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639144)</b>										
CG2412803-002	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	98.2 mg/L	100 mg/L	98.2	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639145)</b>										
CG2412813-003	DUPLICATE	Nitrate (as N)	14797-55-8	E235.NO3	2.49 mg/L	2.5 mg/L	99.5	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639146)</b>										
CG2412813-003	DUPLICATE	Nitrite (as N)	14797-65-0	E235.NO2	0.502 mg/L	0.5 mg/L	100	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639147)</b>										
CG2412813-003	DUPLICATE	Sulfate (as SO4)	14808-79-8	E235.SO4	100 mg/L	100 mg/L	100	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639148)</b>										
CG2412813-003	DUPLICATE	Fluoride	16984-48-8	E235.F	0.947 mg/L	1 mg/L	94.7	75.0	125	----
<b>Anions and Nutrients (QCLot: 1639149)</b>										
CG2412813-003	DUPLICATE	Chloride	16887-00-6	E235.Cl	ND mg/L	----	ND	75.0	125	----
<b>Dissolved Metals (QCLot: 1642122)</b>										
CG2412803-008	Anonymous	Mercury, dissolved	7439-97-6	E509	0.000116 mg/L	0 mg/L	116	70.0	130	----
<b>Dissolved Metals (QCLot: 1643008)</b>										
CG2412809-004	Anonymous	Aluminum, dissolved	7429-90-5	E421	1.94 mg/L	2 mg/L	97.1	70.0	130	----
		Antimony, dissolved	7440-36-0	E421	0.194 mg/L	0.2 mg/L	96.8	70.0	130	----
		Arsenic, dissolved	7440-38-2	E421	0.192 mg/L	0.2 mg/L	96.2	70.0	130	----
		Barium, dissolved	7440-39-3	E421	ND mg/L	----	ND	70.0	130	----
		Boron, dissolved	7440-42-8	E421	ND mg/L	----	ND	70.0	130	----
		Cadmium, dissolved	7440-43-9	E421	0.0378 mg/L	0.04 mg/L	94.4	70.0	130	----
		Calcium, dissolved	7440-70-2	E421	ND mg/L	----	ND	70.0	130	----
		Chromium, dissolved	7440-47-3	E421	0.385 mg/L	0.4 mg/L	96.3	70.0	130	----
		Copper, dissolved	7440-50-8	E421	0.188 mg/L	0.2 mg/L	94.1	70.0	130	----
		Iron, dissolved	7439-89-6	E421	18.5 mg/L	20 mg/L	92.4	70.0	130	----
		Lead, dissolved	7439-92-1	E421	0.187 mg/L	0.2 mg/L	93.7	70.0	130	----
		Magnesium, dissolved	7439-95-4	E421	ND mg/L	----	ND	70.0	130	----
		Manganese, dissolved	7439-96-5	E421	ND mg/L	----	ND	70.0	130	----
		Nickel, dissolved	7440-02-0	E421	0.382 mg/L	0.4 mg/L	95.5	70.0	130	----
		Potassium, dissolved	7440-09-7	E421	37.2 mg/L	40 mg/L	93.1	70.0	130	----
		Selenium, dissolved	7782-49-2	E421	0.371 mg/L	0.4 mg/L	92.7	70.0	130	----



Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
<b>Dissolved Metals (QCLot: 1643008) - continued</b>										
CG2412809-004	Anonymous	Silver, dissolved	7440-22-4	E421	0.0366 mg/L	0.04 mg/L	91.6	70.0	130	----
		Sodium, dissolved	7440-23-5	E421	ND mg/L	----	ND	70.0	130	----
		Uranium, dissolved	7440-61-1	E421	0.0378 mg/L	0.04 mg/L	94.4	70.0	130	----
		Zinc, dissolved	7440-66-6	E421	3.83 mg/L	4 mg/L	95.7	70.0	130	----





**CERTIFICATE OF ANALYSIS**

<b>Work Order</b>	: <b>CG2418081</b>	<b>Laboratory</b>	: ALS Environmental - Waterloo
<b>Client</b>	: <b>Tetra Tech Canada Inc.</b>	<b>Account Manager</b>	: Patryk Wojciak
<b>Contact</b>	: Darby Madalena	<b>Address</b>	: 60 Northland Road, Unit 1
<b>Address</b>	: 110, 140 Quarry Park Blvd SE Calgary Alberta Canada T2C 3G3		: Waterloo ON Canada N2V 2B8
<b>Telephone</b>	: 403 203 3355	<b>Telephone</b>	: +1 519 886 6910
<b>Project</b>	: SWM.SWOP04071-04.006	<b>Date Samples Received</b>	: 06-Dec-2024 14:30
<b>PO</b>	: SWM.SWOP04071-04.006	<b>Date Analysis Commenced</b>	: 12-Dec-2024
<b>C-O-C number</b>	: CORD SLIP VWs	<b>Issue Date</b>	: 20-Dec-2024 08:56
<b>Sampler</b>	: Willem Verduyn		
<b>Site</b>	: ----		
<b>Quote number</b>	: CG22-EBAE100-0021 City of Red Deer (CORD) Pre-1972 Landfill Sites		
<b>No. of samples received</b>	: 5		
<b>No. of samples analysed</b>	: 5		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

**Signatories**

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
David Tremblett	VOC Section Supervisor	Air Quality, Waterloo, Ontario



## General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.  
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
-	no units
%	percent
inches Hg	inches of mercury
ppbv	parts per billion (volume/volume)
µg/m <sup>3</sup>	micrograms per cubic metre

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

## Workorder Comments

RRR - Result may be biased low due to possible contamination.



## Qualifiers

<u>Qualifier</u>	<u>Description</u>
AI	Analytical interferences may be present. Result may be biased high.
DLQ	Detection Limit raised due to co-eluting interference. Mass Spectrometry qualifier ion ratio did not meet acceptance criteria.
RRR	Refer to report comments for issues regarding this analysis.



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Field Tests</b>										
ID, batch proof	----	EF001/WT	-	-	241111.116	241111.130	241108.101	241111.108	241111.114	
ID, canister	----	EF001/WT	-	-	01400-0432	01400-0544	01400-0333	01400-0255	01400-0479	
ID, regulator	----	EF001/WT	-	-	G44	G105	G299	G333	G44	
Pressure on receipt	----	EF001/WT	0.10	inches Hg	-10.8	-7.56	-7.15	-6.54	-11.0	
<b>Permanent Gases</b>										
Carbon dioxide	124-38-9	E629B-H/WT	0.050	%	11.9	10.6	3.99	14.7	11.8	
Carbon monoxide	630-08-0	E629B-H/WT	0.050	%	<0.050	<0.050	<0.050	<0.050	<0.050	
Methane	74-82-8	E629B-H/WT	0.050	%	15.3	7.58	0.066	<0.050	15.3	
Nitrogen	7727-37-9	E629B-H/WT	1.0	%	62.3	68.2	74.6	75.0	61.8	
Oxygen	7782-44-7	E629B-H/WT	0.10	%	1.76	4.94	16.6	2.55	1.73	
<b>Volatile Organic Compounds</b>										
Acetone	67-64-1	EC621B/WT	2.4	µg/m <sup>3</sup>	3.3	3.1	3.3	37.0	4.0	
Acetone	67-64-1	E621B/WT	1.0	ppbv	1.4	1.3	1.4	15.6	1.7	
Allyl chloride	107-05-1	EC621B/WT	0.63	µg/m <sup>3</sup>	<0.66	<0.63	<0.63	<0.63	<0.69	
Allyl chloride	107-05-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Benzene	71-43-2	EC621B/WT	0.32	µg/m <sup>3</sup>	18.4	4.38	2.14	0.67	16.9	
Benzene	71-43-2	E621B/WT	0.10	ppbv	5.77 <sup>RRR</sup>	1.37	0.67	0.21	5.30 <sup>RRR</sup>	
Benzyl chloride	100-44-7	EC621B/WT	1.0	µg/m <sup>3</sup>	<1.1	<1.0	<1.0	<1.0	<1.1	
Benzyl chloride	100-44-7	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Bromodichloromethane	75-27-4	EC621B/WT	1.3	µg/m <sup>3</sup>	<1.4	<1.3	<1.3	<1.3	<1.5	
Bromodichloromethane	75-27-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Bromoform	75-25-2	EC621B/WT	2.1	µg/m <sup>3</sup>	<2.2	<2.1	<2.1	<2.1	<2.3	
Bromoform	75-25-2	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Bromomethane	74-83-9	EC621B/WT	0.78	µg/m <sup>3</sup>	<0.82	<0.78	<0.78	<0.78	<0.85	
Bromomethane	74-83-9	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Butadiene, 1,3-	106-99-0	EC621B/WT	0.44	µg/m <sup>3</sup>	<0.46	<1.11	<0.44	<0.44	<0.49	
Butadiene, 1,3-	106-99-0	E621B/WT	0.20	ppbv	<0.21	<0.50 <sup>DLO</sup>	<0.20	<0.20	<0.22	
Carbon disulfide	75-15-0	EC621B/WT	1.6	µg/m <sup>3</sup>	<1.6	<1.6	1.6	48.9	<1.7	
Carbon disulfide	75-15-0	E621B/WT	0.50	ppbv	<0.53	<0.50	0.51	15.7 <sup>AI</sup>	<0.54	
Carbon tetrachloride	56-23-5	EC621B/WT	1.30	µg/m <sup>3</sup>	<1.32	<1.26	<1.26	<1.26	<1.38	
Carbon tetrachloride	56-23-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Chlorobenzene	108-90-7	EC621B/WT	0.92	µg/m <sup>3</sup>	<0.97	<0.92	<0.92	<0.92	<1.01	
Chlorobenzene	108-90-7	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Chloroethane	75-00-3	EC621B/WT	0.53	µg/m <sup>3</sup>	<0.55	<0.53	<0.53	<0.53	0.61	
Chloroethane	75-00-3	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	0.23	
Chloroform	67-66-3	EC621B/WT	0.98	µg/m <sup>3</sup>	<1.02	<0.98	<0.98	<0.98	<1.07	
Chloroform	67-66-3	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Chloromethane	74-87-3	EC621B/WT	0.41	µg/m <sup>3</sup>	9.64	0.54	<0.41	<0.41	10.1	
Chloromethane	74-87-3	E621B/WT	0.20	ppbv	4.67 <sup>AI</sup>	0.26	<0.20	<0.20	4.90 <sup>AI</sup>	
Cyclohexane	110-82-7	EC621B/WT	0.69	µg/m <sup>3</sup>	14.5	43.7	2.48	2.17	13.7	
Cyclohexane	110-82-7	E621B/WT	0.20	ppbv	4.22	12.7	0.72	0.63	3.99	
Dibromochloromethane	124-48-1	EC621B/WT	1.7	µg/m <sup>3</sup>	<1.8	<1.7	<1.7	<1.7	<1.9	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Dibromochloromethane	124-48-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dibromoethane, 1,2-	106-93-4	EC621B/WT	1.5	µg/m³	<1.6	<1.5	<1.5	<1.5	<1.7	
Dibromoethane, 1,2-	106-93-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichlorobenzene, 1,2-	95-50-1	EC621B/WT	1.2	µg/m³	<1.3	<1.2	<1.2	<1.2	<1.3	
Dichlorobenzene, 1,2-	95-50-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichlorobenzene, 1,3-	541-73-1	EC621B/WT	1.2	µg/m³	<1.3	<1.2	<1.2	<1.2	<1.3	
Dichlorobenzene, 1,3-	541-73-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichlorobenzene, 1,4-	106-46-7	EC621B/WT	1.2	µg/m³	<1.3	<1.2	<1.2	<1.2	<1.3	
Dichlorobenzene, 1,4-	106-46-7	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichlorodifluoromethane	75-71-8	EC621B/WT	1.0	µg/m³	1670	3.4	37.5	1.8	1740	
Dichlorodifluoromethane	75-71-8	E621B/WT	0.20	ppbv	337	0.69	7.58	0.37	351	
Dichloroethane, 1,1-	75-34-3	EC621B/WT	0.81	µg/m³	<0.85	<0.81	<0.81	6.11	<0.89	
Dichloroethane, 1,1-	75-34-3	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	1.51	<0.22	
Dichloroethane, 1,2-	107-06-2	EC621B/WT	0.81	µg/m³	<0.85	<0.81	<0.81	<0.81	<0.89	
Dichloroethane, 1,2-	107-06-2	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloroethylene, 1,1-	75-35-4	EC621B/WT	0.79	µg/m³	<0.83	<0.79	<0.79	<0.79	<0.87	
Dichloroethylene, 1,1-	75-35-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloroethylene, cis-1,2-	156-59-2	EC621B/WT	0.79	µg/m³	<0.83	<0.79	<0.79	<0.79	<0.87	
Dichloroethylene, cis-1,2-	156-59-2	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloroethylene, trans-1,2-	156-60-5	EC621B/WT	0.79	µg/m³	<0.83	<0.79	<0.79	<0.79	<0.87	
Dichloroethylene, trans-1,2-	156-60-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Dichloromethane	75-09-2	EC621B/WT	0.69	µg/m³	<0.73	<0.69	<0.69	<0.69	<0.76	
Dichloromethane	75-09-2	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloropropane, 1,2-	78-87-5	EC621B/WT	0.9	µg/m³	<1.0	<0.9	<0.9	<0.9	<1.0	
Dichloropropane, 1,2-	78-87-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloropropylene, cis-1,3-	10061-01-5	EC621B/WT	0.9	µg/m³	<1.0	<0.9	<0.9	<0.9	<1.0	
Dichloropropylene, cis-1,3-	10061-01-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichloropropylene, cis+trans-1,3-	542-75-6	EC621B/WT	1.3	µg/m³	<1.9	<1.8	<1.8	<1.8	<2.0	
Dichloropropylene, cis+trans-1,3-	542-75-6	E621B/WT	0.30	ppbv	<0.30	<0.30	<0.30	<0.30	<0.31	
Dichloropropylene, trans-1,3-	10061-02-6	EC621B/WT	0.9	µg/m³	<1.0	<0.9	<0.9	<0.9	<1.0	
Dichloropropylene, trans-1,3-	10061-02-6	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Dichlorotetrafluoroethane, 1,2- [Freon 114]	76-14-2	EC621B/WT	1.4	µg/m³	2.9	<1.4	<1.4	<1.4	8.4	
Dichlorotetrafluoroethane, 1,2- [Freon 114]	76-14-2	E621B/WT	0.20	ppbv	0.41	<0.20	<0.20	<0.20	1.20	
Dioxane, 1,4-	123-91-1	EC621B/WT	0.72	µg/m³	<0.76	<0.72	<0.72	<0.72	<0.79	
Dioxane, 1,4-	123-91-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Ethyl acetate	141-78-6	EC621B/WT	0.72	µg/m³	<0.76	<0.72	<0.72	<0.72	<0.79	
Ethyl acetate	141-78-6	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Ethylbenzene	100-41-4	EC621B/WT	0.43	µg/m³	3.08	1.39	0.61	0.82	3.26	
Ethylbenzene	100-41-4	E621B/WT	0.10	ppbv	0.71	0.32	0.14	0.19	0.75	
Ethyltoluene, 4-	622-96-8	EC621B/WT	1.0	µg/m³	<1.0	<1.0	<1.0	<1.0	<1.1	
Ethyltoluene, 4-	622-96-8	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Heptane, n-	142-82-5	EC621B/WT	0.82	µg/m³	7.42	6.93	3.12	<0.82	6.84	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Heptane, n-	142-82-5	E621B/WT	0.20	ppbv	1.81	1.69	0.76	<0.20	1.67	
Hexachlorobutadiene	87-68-3	EC621B/WT	2.1	µg/m <sup>3</sup>	<2.2	<2.1	<2.1	<2.1	<2.3	
Hexachlorobutadiene	87-68-3	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Hexane, n-	110-54-3	EC621B/WT	0.70	µg/m <sup>3</sup>	11.0	22.2	4.44	0.81	9.38	
Hexane, n-	110-54-3	E621B/WT	0.20	ppbv	3.12	6.30	1.26	0.23	2.66	
Hexanone, 2-	591-78-6	EC621B/WT	4.10	µg/m <sup>3</sup>	<4.51	5.33	<4.10	<4.10	<4.51	
Hexanone, 2-	591-78-6	E621B/WT	1.0	ppbv	<1.1	1.3	<1.0	<1.0	<1.1	
Isopropylbenzene	98-82-8	EC621B/WT	1.0	µg/m <sup>3</sup>	<1.0	<1.0	<1.0	<1.0	<1.1	
Isopropylbenzene	98-82-8	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Methyl ethyl ketone [MEK]	78-93-3	EC621B/WT	0.59	µg/m <sup>3</sup>	4.98	<0.59	<0.59	1.62	5.37	
Methyl ethyl ketone [MEK]	78-93-3	E621B/WT	0.20	ppbv	1.69 <sup>AI</sup>	<0.20	<0.20	0.55	1.82 <sup>AI</sup>	
Methyl isobutyl ketone [MIBK]	108-10-1	EC621B/WT	0.82	µg/m <sup>3</sup>	<0.86	<0.82	<0.82	<0.82	<0.90	
Methyl isobutyl ketone [MIBK]	108-10-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Methyl-tert-butyl ether [MTBE]	1634-04-4	EC621B/WT	0.72	µg/m <sup>3</sup>	<0.76	<0.72	<0.72	<0.72	<0.79	
Methyl-tert-butyl ether [MTBE]	1634-04-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Naphthalene	91-20-3	EC621B/WT	0.52	µg/m <sup>3</sup>	<0.58	<0.52	<0.52	<0.52	<0.58	
Naphthalene	91-20-3	E621B/WT	0.10	ppbv	<0.11	<0.10	<0.10	<0.10	<0.11	
Propylene	115-07-1	EC621B/WT	0.34	µg/m <sup>3</sup>	<177	484	<0.69	<8.09	<184	
Propylene	115-07-1	E621B/WT	0.20	ppbv	<103 <sup>DLQ</sup>	281	<0.40 <sup>DLQ</sup>	<4.70 <sup>DLQ</sup>	<107 <sup>DLQ</sup>	
Styrene	100-42-5	EC621B/WT	0.85	µg/m <sup>3</sup>	<0.89	<0.85	<0.85	<0.85	<0.94	
Styrene	100-42-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Tetrachloroethane, 1,1,2,2-	79-34-5	EC621B/WT	1.4	µg/m³	<1.4	<1.4	<1.4	<1.4	<1.5	
Tetrachloroethane, 1,1,2,2-	79-34-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Tetrachloroethylene	127-18-4	EC621B/WT	1.4	µg/m³	<1.4	<1.4	<1.4	<1.4	<1.5	
Tetrachloroethylene	127-18-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Tetrahydrofuran	109-99-9	EC621B/WT	0.59	µg/m³	<0.62	<0.59	<0.59	<0.59	<0.65	
Tetrahydrofuran	109-99-9	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Toluene	108-88-3	EC621B/WT	0.38	µg/m³	21.0	6.29	3.39	8.59	21.6	
Toluene	108-88-3	E621B/WT	0.10	ppbv	5.56 <sup>RRR</sup>	1.67	0.90	2.28	5.73 <sup>RRR</sup>	
Trichloro-1,2,2-trifluoroethane, 1,1,2- [Freon 113]	76-13-1	EC621B/WT	1.5	µg/m³	<1.6	<1.5	<1.5	<1.5	<1.7	
Trichloro-1,2,2-trifluoroethane, 1,1,2- [Freon 113]	76-13-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Trichlorobenzene, 1,2,4-	120-82-1	EC621B/WT	1.5	µg/m³	<1.6	<1.5	<1.5	<1.5	<1.6	
Trichlorobenzene, 1,2,4-	120-82-1	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Trichloroethane, 1,1,1-	71-55-6	EC621B/WT	1.1	µg/m³	<1.1	<1.1	<1.1	188	<1.2	
Trichloroethane, 1,1,1-	71-55-6	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	34.5	<0.22	
Trichloroethane, 1,1,2-	79-00-5	EC621B/WT	1.1	µg/m³	<1.1	<1.1	<1.1	<1.1	<1.2	
Trichloroethane, 1,1,2-	79-00-5	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Trichloroethylene	79-01-6	EC621B/WT	1.1	µg/m³	10.7	3.8	1.9	2.7	10.5	
Trichloroethylene	79-01-6	E621B/WT	0.20	ppbv	1.99	0.70	0.36	0.50	1.96	
Trichlorofluoromethane	75-69-4	EC621B/WT	1.1	µg/m³	<1.2	<1.1	1.7	<1.1	<1.2	
Trichlorofluoromethane	75-69-4	E621B/WT	0.20	ppbv	<0.21	<0.20	0.30	<0.20	<0.22	
Trimethylbenzene, 1,2,4-	95-63-6	EC621B/WT	1.0	µg/m³	3.0	2.0	<1.0	1.7	3.0	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Volatile Organic Compounds</b>										
Trimethylbenzene, 1,2,4-	95-63-6	E621B/WT	0.20	ppbv	0.62	0.40	<0.20	0.35	0.62	
Trimethylbenzene, 1,3,5-	108-67-8	EC621B/WT	1.0	µg/m³	<1.0	1.0	<1.0	<1.0	<1.1	
Trimethylbenzene, 1,3,5-	108-67-8	E621B/WT	0.20	ppbv	<0.21	0.21	<0.20	<0.20	<0.22	
Trimethylpentane, 2,2,4-	540-84-1	EC621B/WT	0.9	µg/m³	28.4	17.9	<0.9	<0.9	28.4	
Trimethylpentane, 2,2,4-	540-84-1	E621B/WT	0.20	ppbv	6.07 <sup>AI</sup>	3.83 <sup>AI</sup>	<0.20	<0.20	6.08 <sup>AI</sup>	
Vinyl acetate	108-05-4	EC621B/WT	1.8	µg/m³	<1150	<19.7	<1.8	<2.3	<1160	
Vinyl acetate	108-05-4	E621B/WT	0.50	ppbv	<326 <sup>DLO</sup>	<5.60 <sup>DLO</sup>	<0.50	<0.65 <sup>DLO</sup>	<330 <sup>DLO</sup>	
Vinyl bromide	593-60-2	EC621B/WT	0.9	µg/m³	<0.9	<0.9	<0.9	<0.9	<1.0	
Vinyl bromide	593-60-2	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Vinyl chloride	75-01-4	EC621B/WT	0.51	µg/m³	<0.54	<0.51	<0.51	<0.51	<0.56	
Vinyl chloride	75-01-4	E621B/WT	0.20	ppbv	<0.21	<0.20	<0.20	<0.20	<0.22	
Xylene, m+p-	179601-23-1	EC621B/WT	0.87	µg/m³	9.25	5.12	2.30	3.00	9.90	
Xylene, m+p-	179601-23-1	E621B/WT	0.20	ppbv	2.13	1.18	0.53	0.69	2.28	
Xylene, o-	95-47-6	EC621B/WT	0.43	µg/m³	3.00	2.26	0.74	1.17	3.13	
Xylene, o-	95-47-6	E621B/WT	0.10	ppbv	0.69	0.52	0.17	0.27	0.72	
Xylenes, total	1330-20-7	EC621B/WT	1.3	µg/m³	12.2	7.4	3.0	4.2	13.0	
Xylenes, total	1330-20-7	E621B/WT	0.30	ppbv	2.82	1.70	0.70	0.96	3.00	
BTEX, total	----	EC621B/WT	1.2	µg/m³	54.7	19.4	9.2	14.2	54.8	
BTEX, total	----	E621B/WT	0.30	ppbv	14.9	5.06	2.41	3.64	14.8	
<b>Hydrocarbons</b>										
Aliphatic (C10-C12)	----	E593C/WT	15	µg/m³	<15	686	<15	23	<15	



## Analytical Results

Sub-Matrix: Canister  
 (Matrix: Air)

					Client sample ID	VW-02	24VW-06	24VW-07	24VW-08	DUPLICATE
					Client sampling date / time	04-Dec-2024 11:44	04-Dec-2024 12:44	04-Dec-2024 12:28	04-Dec-2024 12:07	04-Dec-2024 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2418081-001	CG2418081-002	CG2418081-003	CG2418081-004	CG2418081-005	
					Result	Result	Result	Result	Result	
<b>Hydrocarbons</b>										
Aliphatic (C12-C16)	---	E593C/WT	30	µg/m <sup>3</sup>	<30	48	<30	<30	<30	
Aliphatic (C6-C8)	---	E593C/WT	15	µg/m <sup>3</sup>	1560	743	42	134	1570	
Aliphatic (C8-C10)	---	E593C/WT	15	µg/m <sup>3</sup>	172	802	29	83	195	
Aromatic (C10-C12)	---	E593C/WT	15	µg/m <sup>3</sup>	<15	22	<15	<15	<15	
Aromatic (C12-C16)	---	E593C/WT	30	µg/m <sup>3</sup>	<30	<30	<30	<30	<30	
Aromatic (C6-C8)	---	E593C/WT	15	µg/m <sup>3</sup>	33	<15	<15	<15	34	
Aromatic (C8-C10)	---	E593C/WT	15	µg/m <sup>3</sup>	19	23	<15	<15	21	
F1 (C6-C10)	---	E593A/WT	15	µg/m <sup>3</sup>	1600	1490	66	201	1630	
F1-BTEX	---	EC592A/WT	15	µg/m <sup>3</sup>	1540	1470	57	187	1580	
F2 (C10-C16)	---	E593A/WT	15	µg/m <sup>3</sup>	18	939	<15	46	20	
F2-Naphthalene	---	EC593D/WT	15	µg/m <sup>3</sup>	18	939	<15	46	20	
TVOC (C10-C12)	---	E593C/WT	15	µg/m <sup>3</sup>	<15	708	<15	23	<15	
TVOC (C12-C16)	---	E593C/WT	30	µg/m <sup>3</sup>	<30	48	<30	<30	<30	
TVOC (C6-C8)	---	E593C/WT	15	µg/m <sup>3</sup>	1590	743	42	134	1600	
TVOC (C8-C10)	---	E593C/WT	15	µg/m <sup>3</sup>	191	825	29	83	216	
<b>Hydrocarbons Surrogates</b>										
Bromofluorobenzene, 4-	460-00-4	E593C/WT	1	%	94.2	97.4	97.3	98.7	94.7	
<b>Volatile Organic Compounds Surrogates</b>										
Bromofluorobenzene, 4-	460-00-4	E621B/WT	0.20	%	104	106	99.1	99.6	102	

Please refer to the General Comments section for an explanation of any result qualifiers detected.



## QUALITY CONTROL INTERPRETIVE REPORT

<p><b>Work Order</b> : <b>CG2418081</b></p> <p><b>Client</b> : <b>Tetra Tech Canada Inc.</b></p> <p><b>Contact</b> : Darby Madalena</p> <p><b>Address</b> : 110, 140 Quarry Park Blvd SE Calgary AB Canada T2C 3G3</p> <p><b>Telephone</b> : 403 203 3355</p> <p><b>Project</b> : SWM.SWOP04071-04.006</p> <p><b>PO</b> : SWM.SWOP04071-04.006</p> <p><b>C-O-C number</b> : CORD SLIP VWs</p> <p><b>Sampler</b> : Willem Verduyn</p> <p><b>Site</b> : ----</p> <p><b>Quote number</b> : CG22-EBAE100-0021 City of Red Deer (CORD) Pre-1972 Landfill Sites</p> <p><b>No. of samples received</b> : 5</p> <p><b>No. of samples analysed</b> : 5</p>	<p><b>Page</b> : 1 of 8</p> <p><b>Laboratory</b> : ALS Environmental - Calgary</p> <p><b>Account Manager</b> : Patryk Wojciak</p> <p><b>Address</b> : 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5</p> <p><b>Telephone</b> : +1 403 407 1800</p> <p><b>Date Samples Received</b> : 06-Dec-2024 14:30</p> <p><b>Issue Date</b> : 20-Dec-2024 08:56</p>
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This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

**Key**

- Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO: Data Quality Objective.
- LOR: Limit of Reporting (detection limit).
- RPD: Relative Percent Difference.

### Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

### Summary of Outliers

#### Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

#### Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

***Outliers : Analysis Holding Time Compliance (Breaches)***

- No Analysis Holding Time Outliers exist.

***Outliers : Frequency of Quality Control Samples***

- No Quality Control Sample Frequency Outliers occur.



## Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: Air

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec Actual		Eval	Analysis Date	Holding Times Rec Actual		Eval
<b>Field Tests : Air Canister Information</b>										
Canister 24VW-06	EF001	04-Dec-2024	----	----	----		13-Dec-2024	----	9 days	
<b>Field Tests : Air Canister Information</b>										
Canister 24VW-07	EF001	04-Dec-2024	----	----	----		13-Dec-2024	----	9 days	
<b>Field Tests : Air Canister Information</b>										
Canister 24VW-08	EF001	04-Dec-2024	----	----	----		13-Dec-2024	----	9 days	
<b>Field Tests : Air Canister Information</b>										
Canister DUPLICATE	EF001	04-Dec-2024	----	----	----		13-Dec-2024	----	9 days	
<b>Field Tests : Air Canister Information</b>										
Canister VW-02	EF001	04-Dec-2024	----	----	----		13-Dec-2024	----	9 days	
<b>Hydrocarbons : TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)</b>										
Canister 24VW-06	E593C	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)</b>										
Canister 24VW-07	E593C	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔



Matrix: Air Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
<b>Hydrocarbons : TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)</b>										
Canister 24VW-08	E593C	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)</b>										
Canister DUPLICATE	E593C	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)</b>										
Canister VW-02	E593C	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)</b>										
Canister 24VW-06	E593A	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)</b>										
Canister 24VW-07	E593A	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)</b>										
Canister 24VW-08	E593A	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)</b>										
Canister DUPLICATE	E593A	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Hydrocarbons : TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)</b>										
Canister VW-02	E593A	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Permanent Gases : Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)</b>										
Canister 24VW-06	E629B-H	04-Dec-2024	----	----	----		12-Dec-2024	30 days	8 days	✔



Matrix: Air Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
<b>Permanent Gases : Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)</b>										
Canister 24VW-07	E629B-H	04-Dec-2024	----	----	----		12-Dec-2024	30 days	8 days	✔
<b>Permanent Gases : Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)</b>										
Canister 24VW-08	E629B-H	04-Dec-2024	----	----	----		12-Dec-2024	30 days	8 days	✔
<b>Permanent Gases : Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)</b>										
Canister DUPLICATE	E629B-H	04-Dec-2024	----	----	----		12-Dec-2024	30 days	8 days	✔
<b>Permanent Gases : Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)</b>										
Canister VW-02	E629B-H	04-Dec-2024	----	----	----		12-Dec-2024	30 days	8 days	✔
<b>Volatile Organic Compounds : VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)</b>										
Canister 24VW-06	E621B	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Volatile Organic Compounds : VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)</b>										
Canister 24VW-07	E621B	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Volatile Organic Compounds : VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)</b>										
Canister 24VW-08	E621B	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Volatile Organic Compounds : VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)</b>										
Canister DUPLICATE	E621B	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔
<b>Volatile Organic Compounds : VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)</b>										
Canister VW-02	E621B	04-Dec-2024	----	----	----		17-Dec-2024	30 days	13 days	✔

[Legend & Qualifier Definitions](#)

Page : 6 of 8  
Work Order : CG2418081  
Client : Tetra Tech Canada Inc.  
Project : SWM.SWOP04071-04.006

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Rec. HT: ALS recommended hold time (see units).



## Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: Air

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
<b>Analytical Methods</b>							
<b>Laboratory Duplicates (DUP)</b>							
Permanent Gases (Methane, CO <sub>2</sub> , CO, N <sub>2</sub> , and O <sub>2</sub> ) in Air (Routine Level, %)	E629B-H	1806697	1	9	11.1	5.0	✔
TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)	E593C	1811965	1	9	11.1	5.0	✔
TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)	E593A	1811964	1	9	11.1	5.0	✔
VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)	E621B	1811963	1	9	11.1	5.0	✔
<b>Laboratory Control Samples (LCS)</b>							
Permanent Gases (Methane, CO <sub>2</sub> , CO, N <sub>2</sub> , and O <sub>2</sub> ) in Air (Routine Level, %)	E629B-H	1806697	1	9	11.1	5.0	✔
TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)	E593C	1811965	1	9	11.1	5.0	✔
TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)	E593A	1811964	1	9	11.1	5.0	✔
VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)	E621B	1811963	1	9	11.1	5.0	✔
<b>Method Blanks (MB)</b>							
Air Canister Information	EF001	1808510	1	17	5.8	5.0	✔
Permanent Gases (Methane, CO <sub>2</sub> , CO, N <sub>2</sub> , and O <sub>2</sub> ) in Air (Routine Level, %)	E629B-H	1806697	1	9	11.1	5.0	✔
TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)	E593C	1811965	1	9	11.1	5.0	✔
TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)	E593A	1811964	1	9	11.1	5.0	✔
VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)	E621B	1811963	1	9	11.1	5.0	✔



## Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
TVOC (F1, F2) in Canisters or Bags by GC-MS (µg/m3)	E593A ALS Environmental - Waterloo	Air	EPA TO-15 (mod)	Total Volatile Organic Compounds (TVOC) in canisters (or bags) are transferred to a preconcentrator system and then thermally desorbed prior to injection into a GC-MS system for analysis.
TVOC (C6-C16) Fractionation in Canisters or Bags by GC-MS (ug/m3)	E593C ALS Environmental - Waterloo	Air	EPA TO-15 (mod)	Total Volatile Organic Compounds (TVOC) in canisters (or bags) are transferred to a preconcentrator system and then thermally desorbed prior to injection into a GC-MS system for analysis.
VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ppbV)	E621B ALS Environmental - Waterloo	Air	EPA TO-15 (mod)	Volatile Organic Compounds (VOC) in canisters (or bags) are transferred to a preconcentrator system and then thermally desorbed prior to injection into a GC-MS system for analysis.
Permanent Gases (Methane, CO2, CO, N2, and O2) in Air (Routine Level, %)	E629B-H ALS Environmental - Waterloo	Air	EPA Method 3C & ASTM D1946	This analysis is performed using procedures adapted from EPA Method 3C & ASTM D1946. Air samples are collected into cleaned evacuated canisters. A volume of air is removed from the canister and injected by means of a gas-sampling/backflush valve onto a series of packed GC columns and measured using a thermal conductivity detector (TCD).  Oxygen is not separated from Argon.  Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your account manager.
F1-BTEX in Canisters or Bags GC-MS (µg/m3)	EC592A ALS Environmental - Waterloo	Air	unit conversion	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
F2-Naphthalene in Canisters by GC-MS (ug/m3)	EC593D ALS Environmental - Waterloo	Air	CCME PHC	F2-PAH = CCME Fraction 2 (C10-C16) minus Naphthalene
VOCs (TO-15 List) in Air by Canister or Bag by GC-MS (ug/m3)	EC621B ALS Environmental - Waterloo	Air	unit conversion	Convert ppbV to ug/m3
Air Canister Information	EF001 ALS Environmental - Waterloo	Air	In-house	Air canister information provided by client and recorded on ALS report may affect the validity of results.



## QUALITY CONTROL REPORT

**Work Order** : **CG2418081**

**Client** : Tetra Tech Canada Inc.

**Contact** : Darby Madalena

**Address** : 110, 140 Quarry Park Blvd SE  
Calgary AB Canada T2C 3G3

**Telephone** : 403 203 3355

**Project** : SWM.SWOP04071-04.006

**PO** : SWM.SWOP04071-04.006

**C-O-C number** : CORD SLIP VWs

**Sampler** : Willem Verduyn

**Site** : ---

**Quote number** : CG22-EBAE100-0021 City of Red Deer (CORD) Pre-1972 Landfill  
Sites

**No. of samples received** : 5

**No. of samples analysed** : 5

**Page** : 1 of 11

**Laboratory** : ALS Environmental - Calgary

**Account Manager** : Patryk Wojciak

**Address** : 2559 29th Street NE  
Calgary, Alberta Canada T1Y 7B5

**Telephone** : +1 403 407 1800

**Date Samples Received** : 06-Dec-2024 14:30

**Date Analysis Commenced** : 12-Dec-2024

**Issue Date** : 20-Dec-2024 08:56

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

### Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
David Tremblett	VOC Section Supervisor	Waterloo Air Quality, Waterloo, Ontario

Page : 2 of 11  
Work Order : CG2418081  
Client : Tetra Tech Canada Inc.  
Project : SWM.SWOP04071-04.006



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## General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

# = Indicates a QC result that did not meet the ALS DQO.

## Workorder Comments

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Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

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### Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Air

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
<b>Permanent Gases (QC Lot: 1806697)</b>											
CG2418080-001	Anonymous	Carbon dioxide	124-38-9	E629B-H	0.050	%	2.93	2.82	3.71%	20%	----
		Carbon monoxide	630-08-0	E629B-H	0.050	%	<0.050	<0.050	0	Diff <2x LOR	----
		Methane	74-82-8	E629B-H	0.050	%	<0.050	<0.050	0	Diff <2x LOR	----
		Nitrogen	7727-37-9	E629B-H	1.0	%	70.8	70.0	1.17%	20%	----
		Oxygen	7782-44-7	E629B-H	0.10	%	18.0	17.8	1.07%	20%	----
<b>Volatile Organic Compounds (QC Lot: 1811963)</b>											
CG2418080-001	Anonymous	Acetone	67-64-1	E621B	1.1	ppbv	2.2	2.2	0.03	Diff <2x LOR	----
		Allyl chloride	107-05-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Benzene	71-43-2	E621B	0.50	ppbv	4.49	4.38	2.46%	30%	----
		Benzyl chloride	100-44-7	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Bromodichloromethane	75-27-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Bromoform	75-25-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Bromomethane	74-83-9	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Butadiene, 1,3-	106-99-0	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Carbon disulfide	75-15-0	E621B	0.54	ppbv	<0.54	<0.54	0	Diff <2x LOR	----
		Carbon tetrachloride	56-23-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Chlorobenzene	108-90-7	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Chloroethane	75-00-3	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Chloroform	67-66-3	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Chloromethane	74-87-3	E621B	0.22	ppbv	1.43	1.41	0.02	Diff <2x LOR	----
		Cyclohexane	110-82-7	E621B	0.22	ppbv	2.20	2.13	3.04%	30%	----
		Dibromochloromethane	124-48-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dibromoethane, 1,2-	106-93-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichlorobenzene, 1,3-	541-73-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichlorodifluoromethane	75-71-8	E621B	0.22	ppbv	0.56	0.54	0.02	Diff <2x LOR	----
		Dichloroethane, 1,1-	75-34-3	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloroethane, 1,2-	107-06-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloroethylene, 1,1-	75-35-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----



Sub-Matrix: Air					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
<b>Volatile Organic Compounds (QC Lot: 1811963) - continued</b>											
CG2418080-001	Anonymous	Dichloroethylene, cis-1,2-	156-59-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloroethylene, trans-1,2-	156-60-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloromethane	75-09-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloropropane, 1,2-	78-87-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloropropylene, cis+trans-1,3-	542-75-6	E621B	0.31	ppbv	<0.31	<0.31	0	Diff <2x LOR	----
		Dichloropropylene, cis-1,3-	10061-01-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichloropropylene, trans-1,3-	10061-02-6	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dichlorotetrafluoroethane, 1,2- [Freon 114]	76-14-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Dioxane, 1,4-	123-91-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Ethyl acetate	141-78-6	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E621B	0.11	ppbv	0.36	0.36	0.004	Diff <2x LOR	----
		Ethyltoluene, 4-	622-96-8	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Heptane, n-	142-82-5	E621B	0.22	ppbv	2.67	2.57	3.62%	30%	----
		Hexachlorobutadiene	87-68-3	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Hexane, n-	110-54-3	E621B	0.22	ppbv	4.22	4.11	2.56%	30%	----
		Hexanone, 2-	591-78-6	E621B	1.1	ppbv	<1.1	<1.1	0	Diff <2x LOR	----
		Isopropylbenzene	98-82-8	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Methyl ethyl ketone [MEK]	78-93-3	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Methyl isobutyl ketone [MIBK]	108-10-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Naphthalene	91-20-3	E621B	0.11	ppbv	0.18	0.18	0.001	Diff <2x LOR	----
		Propylene	115-07-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Styrene	100-42-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Tetrachloroethylene	127-18-4	E621B	0.22	ppbv	1.59	1.60	0.600%	30%	----
		Tetrahydrofuran	109-99-9	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Toluene	108-88-3	E621B	0.11	ppbv	4.20	3.90	7.29%	30%	----
		Trichloro-1,2,2-trifluoroethane, 1,1,2- [Freon 113]	76-13-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Trichlorobenzene, 1,2,4-	120-82-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Trichloroethane, 1,1,1-	71-55-6	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Trichloroethane, 1,1,2-	79-00-5	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E621B	0.22	ppbv	0.79	0.75	0.04	Diff <2x LOR	----
		Trichlorofluoromethane	75-69-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----



Sub-Matrix: Air					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
<b>Volatile Organic Compounds (QC Lot: 1811963) - continued</b>											
CG2418080-001	Anonymous	Trimethylbenzene, 1,2,4-	95-63-6	E621B	0.22	ppbv	0.40	0.39	0.007	Diff <2x LOR	----
		Trimethylbenzene, 1,3,5-	108-67-8	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Trimethylpentane, 2,2,4-	540-84-1	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Vinyl acetate	108-05-4	E621B	0.54	ppbv	<0.54	<0.54	0	Diff <2x LOR	----
		Vinyl bromide	593-60-2	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Vinyl chloride	75-01-4	E621B	0.22	ppbv	<0.22	<0.22	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E621B	0.22	ppbv	1.06	1.06	0.002	Diff <2x LOR	----
		Xylene, o-	95-47-6	E621B	0.11	ppbv	0.34	0.34	0.0009	Diff <2x LOR	----
<b>Hydrocarbons (QC Lot: 1811964)</b>											
CG2418080-001	Anonymous	F1 (C6-C10)	----	E593A	15	µg/m³	227	221	2.87%	30%	----
		F2 (C10-C16)	----	E593A	15	µg/m³	28	28	0.6	Diff <2x LOR	----
<b>Hydrocarbons (QC Lot: 1811965)</b>											
CG2418080-001	Anonymous	Aromatic (C10-C12)	----	E593C	15	µg/m³	<15	<15	0	Diff <2x LOR	----
		Aromatic (C12-C16)	----	E593C	30	µg/m³	<30	<30	0	Diff <2x LOR	----
		Aromatic (C6-C8)	----	E593C	15	µg/m³	22	21	0.9	Diff <2x LOR	----
		Aromatic (C8-C10)	----	E593C	15	µg/m³	<15	<15	0	Diff <2x LOR	----
		TVOC (C10-C12)	----	E593C	15	µg/m³	16	<15	0.9	Diff <2x LOR	----
		TVOC (C12-C16)	----	E593C	30	µg/m³	<30	<30	0	Diff <2x LOR	----
		TVOC (C6-C8)	----	E593C	15	µg/m³	168	164	2.37%	50%	----
		TVOC (C8-C10)	----	E593C	15	µg/m³	75	74	1.72%	50%	----



## Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Air

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
<b>Field Tests (QCLot: 1808510)</b>						
Pressure on receipt	---	EF001	0.1	Inches Hg	-30.0	---
<b>Permanent Gases (QCLot: 1806697)</b>						
Carbon dioxide	124-38-9	E629B-H	0.05	%	<0.050	---
Carbon monoxide	630-08-0	E629B-H	0.05	%	<0.050	---
Methane	74-82-8	E629B-H	0.05	%	<0.050	---
Nitrogen	7727-37-9	E629B-H	1	%	<1.0	---
Oxygen	7782-44-7	E629B-H	0.1	%	<0.10	---
<b>Volatile Organic Compounds (QCLot: 1811963)</b>						
Acetone	67-64-1	E621B	1	ppbv	<1.0	---
Allyl chloride	107-05-1	E621B	0.2	ppbv	<0.20	---
Benzene	71-43-2	E621B	0.1	ppbv	<0.10	---
Benzyl chloride	100-44-7	E621B	0.2	ppbv	<0.20	---
Bromodichloromethane	75-27-4	E621B	0.2	ppbv	<0.20	---
Bromoform	75-25-2	E621B	0.2	ppbv	<0.20	---
Bromomethane	74-83-9	E621B	0.2	ppbv	<0.20	---
Butadiene, 1,3-	106-99-0	E621B	0.2	ppbv	<0.20	---
Carbon disulfide	75-15-0	E621B	0.5	ppbv	<0.50	---
Carbon tetrachloride	56-23-5	E621B	0.2	ppbv	<0.20	---
Chlorobenzene	108-90-7	E621B	0.2	ppbv	<0.20	---
Chloroethane	75-00-3	E621B	0.2	ppbv	<0.20	---
Chloroform	67-66-3	E621B	0.2	ppbv	<0.20	---
Chloromethane	74-87-3	E621B	0.2	ppbv	<0.20	---
Cyclohexane	110-82-7	E621B	0.2	ppbv	<0.20	---
Dibromochloromethane	124-48-1	E621B	0.2	ppbv	<0.20	---
Dibromoethane, 1,2-	106-93-4	E621B	0.2	ppbv	<0.20	---
Dichlorobenzene, 1,2-	95-50-1	E621B	0.2	ppbv	<0.20	---
Dichlorobenzene, 1,3-	541-73-1	E621B	0.2	ppbv	<0.20	---
Dichlorobenzene, 1,4-	106-46-7	E621B	0.2	ppbv	<0.20	---
Dichlorodifluoromethane	75-71-8	E621B	0.2	ppbv	<0.20	---
Dichloroethane, 1,1-	75-34-3	E621B	0.2	ppbv	<0.20	---
Dichloroethane, 1,2-	107-06-2	E621B	0.2	ppbv	<0.20	---
Dichloroethylene, 1,1-	75-35-4	E621B	0.2	ppbv	<0.20	---



Sub-Matrix: Air

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
<b>Volatile Organic Compounds (QCLot: 1811963) - continued</b>						
Dichloroethylene, cis-1,2-	156-59-2	E621B	0.2	ppbv	<0.20	----
Dichloroethylene, trans-1,2-	156-60-5	E621B	0.2	ppbv	<0.20	----
Dichloromethane	75-09-2	E621B	0.2	ppbv	<0.20	----
Dichloropropane, 1,2-	78-87-5	E621B	0.2	ppbv	<0.20	----
Dichloropropylene, cis-1,3-	10061-01-5	E621B	0.2	ppbv	<0.20	----
Dichloropropylene, trans-1,3-	10061-02-6	E621B	0.2	ppbv	<0.20	----
Dichlorotetrafluoroethane, 1,2- [Freon 114]	76-14-2	E621B	0.2	ppbv	<0.20	----
Dioxane, 1,4-	123-91-1	E621B	0.2	ppbv	<0.20	----
Ethyl acetate	141-78-6	E621B	0.2	ppbv	<0.20	----
Ethylbenzene	100-41-4	E621B	0.1	ppbv	<0.10	----
Ethyltoluene, 4-	622-96-8	E621B	0.2	ppbv	<0.20	----
Heptane, n-	142-82-5	E621B	0.2	ppbv	<0.20	----
Hexachlorobutadiene	87-68-3	E621B	0.2	ppbv	<0.20	----
Hexane, n-	110-54-3	E621B	0.2	ppbv	<0.20	----
Hexanone, 2-	591-78-6	E621B	1	ppbv	<1.0	----
Isopropylbenzene	98-82-8	E621B	0.2	ppbv	<0.20	----
Methyl ethyl ketone [MEK]	78-93-3	E621B	0.2	ppbv	<0.20	----
Methyl isobutyl ketone [MIBK]	108-10-1	E621B	0.2	ppbv	<0.20	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E621B	0.2	ppbv	<0.20	----
Naphthalene	91-20-3	E621B	0.1	ppbv	<0.10	----
Propylene	115-07-1	E621B	0.2	ppbv	<0.20	----
Styrene	100-42-5	E621B	0.2	ppbv	<0.20	----
Tetrachloroethane, 1,1,1,2,2-	79-34-5	E621B	0.2	ppbv	<0.20	----
Tetrachloroethylene	127-18-4	E621B	0.2	ppbv	<0.20	----
Tetrahydrofuran	109-99-9	E621B	0.2	ppbv	<0.20	----
Toluene	108-88-3	E621B	0.1	ppbv	<0.10	----
Trichloro-1,2,2-trifluoroethane, 1,1,2- [Freon 113]	76-13-1	E621B	0.2	ppbv	<0.20	----
Trichlorobenzene, 1,2,4-	120-82-1	E621B	0.2	ppbv	<0.20	----
Trichloroethane, 1,1,1-	71-55-6	E621B	0.2	ppbv	<0.20	----
Trichloroethane, 1,1,2-	79-00-5	E621B	0.2	ppbv	<0.20	----
Trichloroethylene	79-01-6	E621B	0.2	ppbv	<0.20	----
Trichlorofluoromethane	75-69-4	E621B	0.2	ppbv	<0.20	----
Trimethylbenzene, 1,2,4-	95-63-6	E621B	0.2	ppbv	<0.20	----
Trimethylbenzene, 1,3,5-	108-67-8	E621B	0.2	ppbv	<0.20	----
Trimethylpentane, 2,2,4-	540-84-1	E621B	0.2	ppbv	<0.20	----



Sub-Matrix: Air

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
<b>Volatile Organic Compounds (QCLot: 1811963) - continued</b>						
Vinyl acetate	108-05-4	E621B	0.5	ppbv	<0.50	----
Vinyl bromide	593-60-2	E621B	0.2	ppbv	<0.20	----
Vinyl chloride	75-01-4	E621B	0.2	ppbv	<0.20	----
Xylene, m+p-	179601-23-1	E621B	0.2	ppbv	<0.20	----
Xylene, o-	95-47-6	E621B	0.1	ppbv	<0.10	----
<b>Hydrocarbons (QCLot: 1811964)</b>						
F1 (C6-C10)	----	E593A	15	µg/m³	<15	----
F2 (C10-C16)	----	E593A	15	µg/m³	<15	----
<b>Hydrocarbons (QCLot: 1811965)</b>						
Aromatic (C10-C12)	----	E593C	15	µg/m³	<15	----
Aromatic (C12-C16)	----	E593C	30	µg/m³	<30	----
Aromatic (C6-C8)	----	E593C	15	µg/m³	<15	----
Aromatic (C8-C10)	----	E593C	15	µg/m³	<15	----
TVOC (C10-C12)	----	E593C	15	µg/m³	<15	----
TVOC (C12-C16)	----	E593C	30	µg/m³	<30	----
TVOC (C6-C8)	----	E593C	15	µg/m³	<15	----
TVOC (C8-C10)	----	E593C	15	µg/m³	<15	----



## Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Air

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
<b>Permanent Gases (QCLot: 1806697)</b>									
Carbon dioxide	124-38-9	E629B-H	0.05	%	4.98 %	95.5	70.0	130	----
Carbon monoxide	630-08-0	E629B-H	0.05	%	0.747 %	100	70.0	130	----
Methane	74-82-8	E629B-H	0.05	%	15 %	100	70.0	130	----
Nitrogen	7727-37-9	E629B-H	1	%	50.4 %	96.6	70.0	130	----
Oxygen	7782-44-7	E629B-H	0.1	%	7.41 %	99.4	70.0	130	----
<b>Volatile Organic Compounds (QCLot: 1811963)</b>									
Acetone	67-64-1	E621B	1	ppbv	1.06 ppbv	95.8	70.0	130	----
Allyl chloride	107-05-1	E621B	0.2	ppbv	1.04 ppbv	93.4	70.0	130	----
Benzene	71-43-2	E621B	0.1	ppbv	1.06 ppbv	95.5	70.0	130	----
Benzyl chloride	100-44-7	E621B	0.2	ppbv	1.06 ppbv	80.8	70.0	130	----
Bromodichloromethane	75-27-4	E621B	0.2	ppbv	1.02 ppbv	99.1	70.0	130	----
Bromoform	75-25-2	E621B	0.2	ppbv	1.06 ppbv	105	70.0	130	----
Bromomethane	74-83-9	E621B	0.2	ppbv	1.04 ppbv	95.0	70.0	130	----
Butadiene, 1,3-	106-99-0	E621B	0.2	ppbv	1.06 ppbv	95.7	70.0	130	----
Carbon disulfide	75-15-0	E621B	0.5	ppbv	1.06 ppbv	93.2	70.0	130	----
Carbon tetrachloride	56-23-5	E621B	0.2	ppbv	1.06 ppbv	97.6	70.0	130	----
Chlorobenzene	108-90-7	E621B	0.2	ppbv	1.07 ppbv	106	70.0	130	----
Chloroethane	75-00-3	E621B	0.2	ppbv	1.01 ppbv	93.6	70.0	130	----
Chloroform	67-66-3	E621B	0.2	ppbv	1.05 ppbv	94.0	70.0	130	----
Chloromethane	74-87-3	E621B	0.2	ppbv	1.01 ppbv	92.5	70.0	130	----
Cyclohexane	110-82-7	E621B	0.2	ppbv	1.06 ppbv	92.5	70.0	130	----
Dibromochloromethane	124-48-1	E621B	0.2	ppbv	1.07 ppbv	97.5	70.0	130	----
Dibromoethane, 1,2-	106-93-4	E621B	0.2	ppbv	1.08 ppbv	94.4	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E621B	0.2	ppbv	1.06 ppbv	101	70.0	130	----
Dichlorobenzene, 1,3-	541-73-1	E621B	0.2	ppbv	1.06 ppbv	104	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E621B	0.2	ppbv	1.05 ppbv	102	70.0	130	----
Dichlorodifluoromethane	75-71-8	E621B	0.2	ppbv	1.02 ppbv	91.9	70.0	130	----
Dichloroethane, 1,1-	75-34-3	E621B	0.2	ppbv	1.04 ppbv	92.9	70.0	130	----
Dichloroethane, 1,2-	107-06-2	E621B	0.2	ppbv	1.04 ppbv	103	70.0	130	----
Dichloroethylene, 1,1-	75-35-4	E621B	0.2	ppbv	1.04 ppbv	97.2	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E621B	0.2	ppbv	1.06 ppbv	97.7	70.0	130	----
Dichloroethylene, trans-1,2-	156-60-5	E621B	0.2	ppbv	1.06 ppbv	100	70.0	130	----



Sub-Matrix: Air

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
<b>Volatile Organic Compounds (QCLot: 1811963) - continued</b>									
Dichloromethane	75-09-2	E621B	0.2	ppbv	1.04 ppbv	97.8	70.0	130	----
Dichloropropane, 1,2-	78-87-5	E621B	0.2	ppbv	1.05 ppbv	92.8	70.0	130	----
Dichloropropylene, cis-1,3-	10061-01-5	E621B	0.2	ppbv	1.05 ppbv	94.9	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E621B	0.2	ppbv	1.07 ppbv	88.1	70.0	130	----
Dichlorotetrafluoroethane, 1,2- [Freon 114]	76-14-2	E621B	0.2	ppbv	0.97 ppbv	96.6	70.0	130	----
Dioxane, 1,4-	123-91-1	E621B	0.2	ppbv	1.07 ppbv	90.9	70.0	130	----
Ethyl acetate	141-78-6	E621B	0.2	ppbv	1.05 ppbv	99.1	70.0	130	----
Ethylbenzene	100-41-4	E621B	0.1	ppbv	1.09 ppbv	97.9	70.0	130	----
Ethyltoluene, 4-	622-96-8	E621B	0.2	ppbv	1.06 ppbv	103	70.0	130	----
Heptane, n-	142-82-5	E621B	0.2	ppbv	1.06 ppbv	91.9	70.0	130	----
Hexachlorobutadiene	87-68-3	E621B	0.2	ppbv	1.09 ppbv	93.7	70.0	130	----
Hexane, n-	110-54-3	E621B	0.2	ppbv	1.07 ppbv	93.0	70.0	130	----
Hexanone, 2-	591-78-6	E621B	1	ppbv	1.09 ppbv	86.1	70.0	130	----
Isopropylbenzene	98-82-8	E621B	0.2	ppbv	1.04 ppbv	102	70.0	130	----
Methyl ethyl ketone [MEK]	78-93-3	E621B	0.2	ppbv	1.07 ppbv	90.3	70.0	130	----
Methyl isobutyl ketone [MIBK]	108-10-1	E621B	0.2	ppbv	1.07 ppbv	85.8	70.0	130	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E621B	0.2	ppbv	1.07 ppbv	91.4	70.0	130	----
Naphthalene	91-20-3	E621B	0.1	ppbv	1.12 ppbv	89.5	70.0	130	----
Propylene	115-07-1	E621B	0.2	ppbv	1.08 ppbv	89.6	70.0	130	----
Styrene	100-42-5	E621B	0.2	ppbv	1.06 ppbv	102	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E621B	0.2	ppbv	1.07 ppbv	101	70.0	130	----
Tetrachloroethylene	127-18-4	E621B	0.2	ppbv	1.04 ppbv	111	70.0	130	----
Tetrahydrofuran	109-99-9	E621B	0.2	ppbv	1.04 ppbv	90.7	70.0	130	----
Toluene	108-88-3	E621B	0.1	ppbv	1.09 ppbv	95.4	70.0	130	----
Trichloro-1,2,2-trifluoroethane, 1,1,2- [Freon 113]	76-13-1	E621B	0.2	ppbv	1.03 ppbv	100	70.0	130	----
Trichlorobenzene, 1,2,4-	120-82-1	E621B	0.2	ppbv	1.07 ppbv	97.6	70.0	130	----
Trichloroethane, 1,1,1-	71-55-6	E621B	0.2	ppbv	1.05 ppbv	94.3	70.0	130	----
Trichloroethane, 1,1,2-	79-00-5	E621B	0.2	ppbv	1.08 ppbv	93.7	70.0	130	----
Trichloroethylene	79-01-6	E621B	0.2	ppbv	1.08 ppbv	98.8	70.0	130	----
Trichlorofluoromethane	75-69-4	E621B	0.2	ppbv	1.07 ppbv	94.8	70.0	130	----
Trimethylbenzene, 1,2,4-	95-63-6	E621B	0.2	ppbv	1.07 ppbv	101	70.0	130	----
Trimethylbenzene, 1,3,5-	108-67-8	E621B	0.2	ppbv	1.06 ppbv	102	70.0	130	----
Trimethylpentane, 2,2,4-	540-84-1	E621B	0.2	ppbv	1.06 ppbv	93.6	70.0	130	----
Vinyl acetate	108-05-4	E621B	0.5	ppbv	1.1 ppbv	89.0	70.0	130	----
Vinyl bromide	593-60-2	E621B	0.2	ppbv	1.04 ppbv	97.7	70.0	130	----
Vinyl chloride	75-01-4	E621B	0.2	ppbv	1.01 ppbv	93.5	70.0	130	----



Sub-Matrix: Air

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
<b>Volatile Organic Compounds (QCLot: 1811963) - continued</b>									
Xylene, m+p-	179601-23-1	E621B	0.2	ppbv	2.12 ppbv	103	70.0	130	----
Xylene, o-	95-47-6	E621B	0.1	ppbv	1.07 ppbv	101	70.0	130	----
<b>Hydrocarbons (QCLot: 1811964)</b>									
F1 (C6-C10)	----	E593A	15	µg/m <sup>3</sup>	815 µg/m <sup>3</sup>	82.3	50.0	150	----
<b>Hydrocarbons (QCLot: 1811965)</b>									
Aromatic (C10-C12)	----	E593C	15	µg/m <sup>3</sup>	60.8 µg/m <sup>3</sup>	102	50.0	150	----
Aromatic (C12-C16)	----	E593C	30	µg/m <sup>3</sup>	60.1 µg/m <sup>3</sup>	136	50.0	150	----
Aromatic (C6-C8)	----	E593C	15	µg/m <sup>3</sup>	60.1 µg/m <sup>3</sup>	106	50.0	150	----
Aromatic (C8-C10)	----	E593C	15	µg/m <sup>3</sup>	59.6 µg/m <sup>3</sup>	107	50.0	150	----
TVOC (C10-C12)	----	E593C	15	µg/m <sup>3</sup>	121 µg/m <sup>3</sup>	105	50.0	150	----
TVOC (C12-C16)	----	E593C	30	µg/m <sup>3</sup>	120 µg/m <sup>3</sup>	130	50.0	150	----
TVOC (C6-C8)	----	E593C	15	µg/m <sup>3</sup>	120 µg/m <sup>3</sup>	109	50.0	150	----
TVOC (C8-C10)	----	E593C	15	µg/m <sup>3</sup>	119 µg/m <sup>3</sup>	110	50.0	150	----

# Batch Proof Report



right solutions.  
right partner.

Batch Proof ID: 241108.132  
Canister ID: 01400-0236  
Analysis Date: 24-Nov-24

1,1,1-Trichloroethane	<0.02	ppb(V)	cis-1,3-Dichloropropene	<0.02	ppb(V)
1,1,1,2-Tetrachloroethane	<0.02	ppb(V)	Cyclohexane	<0.20	ppb(V)
1,1,2,2-Tetrachloroethane	<0.02	ppb(V)	Dibromochloromethane	<0.20	ppb(V)
1,1,2-Trichloroethane	<0.02	ppb(V)	Dichlorodifluoromethane	<0.20	ppb(V)
1,1-Dichloroethane	<0.02	ppb(V)	Ethyl Acetate	<0.20	ppb(V)
1,1-Dichloroethene	<0.02	ppb(V)	Ethyl Benzene	<0.02	ppb(V)
1,2,4-Trichlorobenzene	<0.20	ppb(V)	Freon 113	<0.20	ppb(V)
1,2,4-Trimethylbenzene	<0.20	ppb(V)	Freon 114	<0.20	ppb(V)
1,2-Dibromoethane	<0.01	ppb(V)	Hexachlorobutadiene	<0.02	ppb(V)
1,2-Dichlorobenzene	<0.02	ppb(V)	Isooctane	<0.20	ppb(V)
1,2-Dichloroethane	<0.01	ppb(V)	Isopropyl Alcohol	<0.20	ppb(V)
1,2-Dichloropropane	<0.02	ppb(V)	Isopropylbenzene	<0.20	ppb(V)
1,3,5-Trimethylbenzene	<0.20	ppb(V)	m&p-Xylene	<0.04	ppb(V)
1,3-Butadiene	<0.20	ppb(V)	Methyl Ethyl Ketone	<0.20	ppb(V)
1,3-Dichlorobenzene	<0.02	ppb(V)	Methylcyclohexane	<0.20	ppb(V)
1,4-Dichlorobenzene	<0.02	ppb(V)	Methyl Isobutyl Ketone	<0.20	ppb(V)
1,4-Dioxane	<0.20	ppb(V)	Methylene Chloride	<0.02	ppb(V)
2-Chlorophenol	<0.20	ppb(V)	MTBE	<0.20	ppb(V)
2-Hexanone	<1.0	ppb(V)	Naphthalene	<0.05	ppb(V)
4-Ethyltoluene	<0.20	ppb(V)	n-Decane	<0.20	ppb(V)
Acetone	<1.0	ppb(V)	n-Heptane	<0.20	ppb(V)
Acrolein	<0.10	ppb(V)	n-Hexane	<0.02	ppb(V)
Allyl Chloride	<0.20	ppb(V)	o-Xylene	<0.02	ppb(V)
Benzene	<0.02	ppb(V)	Propylene	<0.20	ppb(V)
Benzyl Chloride	<0.20	ppb(V)	Styrene	<0.02	ppb(V)
Bromodichloromethane	<0.20	ppb(V)	Tetrachloroethylene	<0.02	ppb(V)
Bromobenzene	<0.20	ppb(V)	Tetrahydrofuran	<0.20	ppb(V)
Bromoform	<0.02	ppb(V)	Toluene	<0.02	ppb(V)
Bromomethane	<0.20	ppb(V)	trans-1,2-Dichloroethene	<0.02	ppb(V)
Carbon Disulfide	<0.50	ppb(V)	trans-1,3-Dichloropropene	<0.02	ppb(V)
Carbon Tetrachloride	<0.02	ppb(V)	Trichloroethylene	<0.02	ppb(V)
Chlorobenzene	<0.20	ppb(V)	Trichlorofluoromethane	<0.20	ppb(V)
Chloroethane	<0.02	ppb(V)	Vinyl Acetate	<0.50	ppb(V)
Chloroform	<0.02	ppb(V)	Vinyl Bromide	<0.20	ppb(V)
Chloromethane	<0.20	ppb(V)	Vinyl Chloride	<0.02	ppb(V)
cis-1,2-Dichloroethene	<0.02	ppb(V)	4-Bromofluorobenzene	104.57	%

# Batch Proof Report



right solutions.  
right partner.

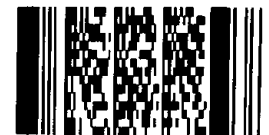
Batch Proof ID: 241111.128  
Canister ID: 01400-0505  
Analysis Date: 24-Nov-24

1,1,1-Trichloroethane	<0.02	ppb(V)	cis-1,3-Dichloropropene	<0.02	ppb(V)
1,1,1,2-Tetrachloroethane	<0.02	ppb(V)	Cyclohexane	<0.20	ppb(V)
1,1,2,2-Tetrachloroethane	<0.02	ppb(V)	Dibromochloromethane	<0.20	ppb(V)
1,1,2-Trichloroethane	<0.02	ppb(V)	Dichlorodifluoromethane	<0.20	ppb(V)
1,1-Dichloroethane	<0.02	ppb(V)	Ethyl Acetate	<0.20	ppb(V)
1,1-Dichloroethene	<0.02	ppb(V)	Ethyl Benzene	<0.02	ppb(V)
1,2,4-Trichlorobenzene	<0.20	ppb(V)	Freon 113	<0.20	ppb(V)
1,2,4-Trimethylbenzene	<0.20	ppb(V)	Freon 114	<0.20	ppb(V)
1,2-Dibromoethane	<0.01	ppb(V)	Hexachlorobutadiene	<0.02	ppb(V)
1,2-Dichlorobenzene	<0.02	ppb(V)	Isooctane	<0.20	ppb(V)
1,2-Dichloroethane	<0.01	ppb(V)	Isopropyl Alcohol	<0.20	ppb(V)
1,2-Dichloropropane	<0.02	ppb(V)	Isopropylbenzene	<0.20	ppb(V)
1,3,5-Trimethylbenzene	<0.20	ppb(V)	m&p-Xylene	<0.04	ppb(V)
1,3-Butadiene	<0.20	ppb(V)	Methyl Ethyl Ketone	<0.20	ppb(V)
1,3-Dichlorobenzene	<0.02	ppb(V)	Methylcyclohexane	<0.20	ppb(V)
1,4-Dichlorobenzene	<0.02	ppb(V)	Methyl Isobutyl Ketone	<0.20	ppb(V)
1,4-Dioxane	<0.20	ppb(V)	Methylene Chloride	<0.02	ppb(V)
2-Chlorophenol	<0.20	ppb(V)	MTBE	<0.20	ppb(V)
2-Hexanone	<1.0	ppb(V)	Naphthalene	<0.05	ppb(V)
4-Ethyltoluene	<0.20	ppb(V)	n-Decane	<0.20	ppb(V)
Acetone	<1.0	ppb(V)	n-Heptane	<0.20	ppb(V)
Acrolein	<0.10	ppb(V)	n-Hexane	<0.02	ppb(V)
Allyl Chloride	<0.20	ppb(V)	o-Xylene	<0.02	ppb(V)
Benzene	<0.02	ppb(V)	Propylene	<0.20	ppb(V)
Benzyl Chloride	<0.20	ppb(V)	Styrene	<0.02	ppb(V)
Bromodichloromethane	<0.20	ppb(V)	Tetrachloroethylene	<0.02	ppb(V)
Bromobenzene	<0.20	ppb(V)	Tetrahydrofuran	<0.20	ppb(V)
Bromoform	<0.02	ppb(V)	Toluene	<0.02	ppb(V)
Bromomethane	<0.20	ppb(V)	trans-1,2-Dichloroethene	<0.02	ppb(V)
Carbon Disulfide	<0.50	ppb(V)	trans-1,3-Dichloropropene	<0.02	ppb(V)
Carbon Tetrachloride	<0.02	ppb(V)	Trichloroethylene	<0.02	ppb(V)
Chlorobenzene	<0.20	ppb(V)	Trichlorofluoromethane	<0.20	ppb(V)
Chloroethane	<0.02	ppb(V)	Vinyl Acetate	<0.50	ppb(V)
Chloroform	<0.02	ppb(V)	Vinyl Bromide	<0.20	ppb(V)
Chloromethane	<0.20	ppb(V)	Vinyl Chloride	<0.02	ppb(V)
cis-1,2-Dichloroethene	<0.02	ppb(V)	4-Bromofluorobenzene	98.82	%



<b>Report to:</b>		<b>Report Format / Distribution</b>			<b>Service Requested:</b>													
Company: Tetra Tech Canada Inc.		<input type="checkbox"/> Standard <input type="checkbox"/> Other			<input checked="" type="checkbox"/> Regular Service (Default)													
Contact: Darby Madalena		<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Fax			<input type="checkbox"/> Rush Service (2-3 Days)													
Address: 110, 140 Quarry Park Blvd SE, Calgary, AB T2C 3G3		Email 1: darby.madalena@tetrattech.com			<input type="checkbox"/> Priority Service (1 Day or ASAP)													
		Email 2: jaymes.going@tetrattech.com			<input type="checkbox"/> Emergency Service (<1 Day / Wkend) - Contact ALS													
Phone: 403-723-6867 Fax: 403-203-3301		ALS Digital Crosstab results			<b>Analysis Request</b>													
Invoice to: <input checked="" type="checkbox"/> Same as Report		Indicate Bottles: Filtered / Preserved (F/P) →																
Company: SAME AS REPORT		<b>Client / Project Information:</b>																
Contact:		Job #: SWM.SWOP04071-04.006																
Address:		PO/AFE: SWM.SWOP04071-04.006																
Sample:		Legal Site Description:																
Phone: Fax:		Quote #: CG22-EBAE100-0021																
Lab Work Order # (lab use only)		ALS Contact: Patryk Wojciak	Sampler (Initials): Willem V.															
Sample #	Sample Identification (This description will appear on the report)			Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	EP592	S621E - Aliphatic and Aromatic	S629B - Methane, CO2, CO							Hazardous?	Highly Contaminated?	Number of Containers
	VV-02			04-Dec-24	11:44	Air	X	X	X									
	24VV-06			↓	12:44	Air	X	X	X									
	24VV-07				12:28	Air	X	X	X									
	24VV-08				12:07	Air	X	X	X									
	Duplicate			↓		Air	X	X	X									
Guidelines / Regulations										Special Instructions / Hazardous Details								
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																		
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.																		
Relinquished By:	Willems Verduyn	Date & Time:	Dec 6, 14:30	Received By:	XJB	Date & Time:	Dec. 6th/24 (1930)	Sample Condition (lab use of)										
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature	18.4	Samples Received in Good Condition? Y / N (if no provided details)								

Environmental Division  
Calgary  
Work Order Reference  
**CG2418081**



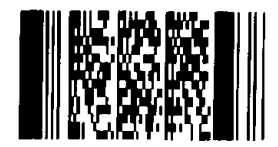
Telephone : - 1 403 407 1800



Environmental Division

<b>Report to:</b>		<b>Report Format / Distribution</b>			<b>Service Requested:</b>														
Company: Tetra Tech Canada Inc.		<input type="checkbox"/> Standard <input type="checkbox"/> Other			<input checked="" type="checkbox"/> Regular Service (Default)														
Contact: Darby Madalena		<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Fax			<input type="checkbox"/> Rush Service (2-3 Days)														
Address: 110, 140 Quarry Park Blvd SE, Calgary, AB T2C 3G3		Email 1: darby.madalena@tetrattech.com			<input type="checkbox"/> Priority Service (1 Day or ASAP)														
		Email 2: jaymes.going@tetrattech.com			<input type="checkbox"/> Emergency Service (<1 Day / Wkend) - Contact ALS														
Phone: 403-723-6867 Fax: 403-203-3301		ALS Digital Crosstab results			<b>Analysis Request</b>														
Invoice To: <input checked="" type="checkbox"/> Same as Report		Indicate Bottles: Filtered / Preserved (F/P) →																	
Company: SAME AS REPORT		<b>Client / Project Information:</b>																	
Contact:		Job #: SWM.SWOP04071-04.006																	
Address:		PO/AFE: SWM.SWOP04071-04.006																	
Sample:		Legal Site Description:																	
Phone: Fax:		Quote #: CG22-EBAE100-0021																	
Lab Work Order # (lab use only)		ALS Contact: Patryk Wojciak		Sampler (Initials): Willem V.															
Sample #	Sample Identification (This description will appear on the report)			Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	EP592	S621E - Aliphatic and Aromatic	S629B - Methane, CO2, CO,								Hazardous?	Highly Contaminated?	Number of Containers
	VW-02			04-Dec-24	11:44	Air	X	X	X										
	24VW-06			↓	12:44	Air	X	X	X										
	24VW-07			↓	12:28	Air	X	X	X										
	24VW-08			↓	12:07	Air	X	X	X										
	Duplicate			↓		Air	X	X	X										
Guidelines / Regulations										Special Instructions / Hazardous Details									
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																			
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.																			
Relinquished By:	Willems Verduyn	Date & Time:	Dec 6, 14:30	Received By:	[Signature]	Date & Time:	Dec. 6th/24 17:30	Sample Condition (lab use only)											
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature:	18.4	Samples Received in Good Condition? Y / N (if no provided details)									

Environmental Division  
Calgary  
Work Order Reference  
**CG2418081**



Telephone: +1 403 407 1800

## APPENDIX E

### HISTORICAL ANALYTICAL RESULTS

**Table 1**  
**Groundwater Monitoring and Soil Vapour Well Elevations**

Test Location	Well Depth (m)	Elevations				Screen Length (m)
		Ground (m)	Top of Pipe (m)	Screen Interval		
				Bottom	Top	
MW-01	7.6	854.669	854.539	847.069	851.669	4.6
MW-02	8.4	855.257	855.097	846.857	851.457	4.6
MW-03	7.6	854.551	854.461	846.951	851.551	4.6
VW-01	4.6	854.444	854.243	849.844	850.144	0.3
VW-02	6.1	855.329	854.429	849.229	849.529	0.3
TH-01	NA	854.665	--	--	--	--
TH-04	NA	855.279	--	--	--	--
TH-07	NA	855.058	--	--	--	--
TH-08	NA	854.759	--	--	--	--
TH-10	NA	854.418	--	--	--	--

Notes:

- 1) Geodetic elevations are determined from multiple datums, ASCM Nos. 36574 and 124339.
- 2) MW - Monitoring Well.
- 3) VW - Soil Vapour Well.
- 4) TH - Testhole.
- 5) NA - Not Applicable.
- 6) -- No value established.

**Table 2**  
**Site Monitoring Results**

Test Location	Elevations		Groundwater Elevation		Headspace Vapour				Notes
	Ground (m)	Top of Pipe (m)	(m)		01/08/13		Combustible	Volatile	
			01/08/13		Combustible	Volatile			
MW-01	854.669	854.539	849.752		510	ND			
MW-02	855.257	855.097	850.004		155	ND			
MW-03	854.551	854.461	849.421		460	ND			
VW-01	854.444	--	--	--	1,750	ND			
VW-02	855.329	--	--	--	1,300	1			
TH-01	854.665	--	--	--	--	--	--	--	--
TH-04	855.279	--	--	--	--	--	--	--	--
TH-07	855.058	--	--	--	--	--	--	--	--
TH-08	854.759	--	--	--	--	--	--	--	--
TH-10	854.418	--	--	--	--	--	--	--	--

## Notes:

- 1) Measurement of combustible and volatile vapours by RKI Eagle 2. Units ppmv.  
Combustible vapour sensor calibrated to hexane and photoionization detector calibrated to isobutylene.
- 2) ND - Not Detected, less than the limit of instrument detection.
- 3) -- No value established.

**Table 3**  
**Analytical Results - Soil - Drill Cuttings (Soil Bag)**

Parameter	Detection Limit	Soil Bag		Class II Landfill Acceptance Criteria
		1 of 2	2 of 2	
pH	0.10	8.47	8.80	2-12.5
Flash Point (°C)	30.0	>75	>75	>61
Paint Filter Test	-	PASS	PASS	PASS
Total Organic Carbon	0.10	0.85	0.36	--
<b><u>Hydrocarbons</u></b>				
Benzene	0.0050	ND	ND	0.5
Toluene	0.0050	ND	ND	0.5
Ethylbenzene	0.0050	ND	ND	0.5
Xylenes	0.0050	ND	ND	0.5
<b><u>Leachable Metals</u></b>				
Antimony (Sb)	5.0	ND	ND	500
Arsenic (As)	0.20	ND	ND	5
Barium (Ba)	5.0	ND	ND	100
Beryllium (Be)	0.50	ND	ND	5
Boron (B)	5.0	ND	ND	500
Cadmium (Cd)	0.050	ND	ND	1
Chromium (Cr)	0.50	ND	ND	5
Cobalt (Co)	5.0	ND	ND	100
Copper (Cu)	5.0	ND	ND	100
Iron (Fe)	5.0	ND	ND	1,000
Lead (Pb)	0.50	ND	ND	5
Mercury (Hg)	0.010	ND	ND	0.2
Nickel (Ni)	0.50	ND	ND	5
Selenium (Se)	0.20	ND	ND	1
Silver (Ag)	0.50	ND	ND	5
Thallium (Tl)	0.50	ND	ND	5
Uranium (U)	1.0	ND	ND	2
Vanadium (V)	5.0	ND	ND	100
Zinc (Zn)	5.0	ND	ND	500
Zirconium (Zr)	5.0	ND	ND	500

## Notes:

- 1) Class II Landfill Acceptance Criteria - per Table 2, Part 4 Schedule to the Alberta User Guide for Waste Managers 3/95. Applicable waste screening for The City of Red Deer Class II Waste Management Facility.
- 2) All units are mg/L unless otherwise stated.
- 3) ND - Not Detected
- 4) Soil Bags were sampled July 14, 2013.
- 5) For further laboratory information, refer to the specific laboratory report in Appendix A.

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Phase II ESA - Riverside Light Industrial Park  
Historic Waste Disposal Sites, The City of Red Deer

**Table 4A**  
**Groundwater Indices Measured Time of Sampling**

Monitoring Well	pH	Electrical Conductivity ( $\mu\text{S/cm}$ )	Temperature ( $^{\circ}\text{C}$ )	Dissolved Oxygen ( $\text{mg/L}$ )	Total Dissolved Solids ( $\text{mg/L}$ )	Redox ( $\pm\text{mV}$ )
MW-01	8.22	1,025	8.8	0.92	968.50	-11.9
MW-02	7.64	584	9.4	3.47	539.50	+45.1
MW-03	8.35	1,378	8.7	2.29	1,287.00	-68.1

Notes:

- 1) Samples collected on August 01, 2013.
- 2) Groundwater indices measured by YSI Pro Plus multi-meter.

**Table 4B**  
**Analytical Results - Groundwater - General Water Quality**

Parameter	Unit	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
			08/01/13			
<b><u>General Water Quality</u></b>						
Biochemical Oxygen Demand	mg/L	2.0	2.2	ND	2.2	--
Chemical Oxygen Demand	mg/L	5.0	210	130	190	--
Conductivity	µS/cm	1.0	1,800	910	2,300	--
pH	Unitless	NA	7.07	7.48	7.23	6.5-8.5
Total Organic Carbon (C)	mg/L	0.50	5.2	2.9	16	--
Dissolved Cadmium (Cd)	µg/L	0.0050	0.080	0.040	0.047	--
Total Cadmium (Cd)	µg/L	0.0050	<b>0.810</b>	<b>0.470</b>	<b>0.460</b>	0.060*
Alkalinity (CaCO <sub>3</sub> )	mg/L	0.50	620	350	940	--
Bicarbonate (HCO <sub>3</sub> )	mg/L	0.50	750	430	1,100	--
Carbonate (CO <sub>3</sub> )	mg/L	0.50	ND	ND	ND	--
Hydroxide (OH)	mg/L	0.50	ND	ND	ND	--
Sulphates (SO <sub>4</sub> )	mg/L	1.0	160	39	34	--
Chlorides (Cl)	mg/L	1.0	110	59	190	--
Total Ammonia (NH <sub>3</sub> -N)	mg/L	0.050 - 0.50	ND	ND	<b>16</b>	1.37*
Total Phosphorus (P)	mg/L	0.1	1.8	0.63	0.69	--
Total Nitrogen (N)	mg/L	0.050	23	2.1	14	--
Total Kjeldahl Nitrogen (TKN)	mg/L	0.050 - 0.50	2.4	0.86	14	--
Nitrite (NO <sub>2</sub> )	mg/L	0.0030	0.91	ND	ND	--
Nitrate (NO <sub>3</sub> )	mg/L	0.0030 - 0.030	19	1.3	ND	--
Nitrate plus Nitrite (N)	mg/L	0.0030 - 0.030	20	1.3	ND	--
<b><u>Trace Organics</u></b>						
Acetic Acid	mg/L	50	ND	ND	ND	--
Formic Acid	mg/L	50	ND	ND	ND	--
Propionic Acid	mg/L	50	ND	ND	ND	--
Adsorbable Organic Halogen	mg/L	0.004 - 0.02	0.075	0.055	0.05	--

## Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for commercial/industrial land use.
- 2) \* Surface Water Quality Guidelines for Use in Alberta (AENV, 1999) on aquatic life pathway. Canadian Council of Ministers of the Environment (CCME) guidelines are referenced.
- 3) ND - Not Detected, less than the limit of method detection.
- 4) -- No value established in the reference criteria.
- 5) Bold & Shaded - Exceeds the referenced Alberta Tier 1 Guidelines and CCME guidelines.
- 6) For further laboratory information, refer to the specific laboratory report in Appendix A.

**Table 4C**  
**Analytical Results - Groundwater - Metals**

Parameter	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
		01/08/13			
<b>Total Metals</b>					
Aluminum (Al)	0.0030	<b>21</b>	<b>9.3</b>	<b>8.7</b>	0.1*
Antimony (Sb)	0.00060	0.00098	0.00079	0.00087	0.006
Arsenic (As)	0.00020	<b>0.035</b>	<b>0.018</b>	<b>0.017</b>	0.005
Barium (Ba)	0.010	<b>1.4</b>	0.53	0.95	1
Beryllium (Be)	0.0010	0.0018	ND	ND	--
Boron (B)	0.020	0.12	0.061	0.17	1.5
Calcium (Ca)	0.30	350	150	250	--
Chromium (Cr)	0.0010	<b>0.049</b>	<b>0.019</b>	<b>0.021</b>	0.001*
Cobalt (Co)	0.00030	0.019	0.010	0.017	--
Copper (Cu)	0.00020	<b>0.072</b>	<b>0.031</b>	<b>0.025</b>	0.003*
Iron (Fe)	0.060	<b>62</b>	<b>24</b>	<b>30</b>	0.3
Lead (Pb)	0.00020	<b>0.034</b>	<b>0.014</b>	<b>0.015</b>	0.004*
Lithium (Li)	0.020	0.075	0.036	0.051	--
Magnesium (Mg)	0.20	110	48	96	--
Manganese (Mn)	0.0040	<b>1.6</b>	<b>0.68</b>	<b>2.2</b>	0.05
Molybdenum (Mo)	0.00020	0.0035	0.0030	0.0049	0.073*
Nickel (Ni)	0.00050	0.071	0.032	0.035	0.11*
Phosphorus (P)	0.10	1.8	0.63	0.69	--
Potassium (K)	0.30	13	7.3	29	--
Selenium (Se)	0.00020	<b>0.0020</b>	<b>0.0028</b>	0.00077	0.001
Silicon (Si)	0.10 - 0.50	59	27	31	--
Silver (Ag)	0.00010	<b>0.00066</b>	<b>0.00031</b>	<b>0.00021</b>	0.0001*
Sodium (Na)	0.50	70	36	150	--
Strontium (Sr)	0.020	1.2	0.63	1.7	--
Sulphur (S)	0.20	47	10	11	--
Thallium (Tl)	0.00020	0.0004	ND	ND	0.0008*
Tin (Sn)	0.0010	0.0012	ND	0.0015	--
Titanium (Ti)	0.0010	0.29	0.15	0.16	--
Uranium (U)	0.00010	0.0099	0.0040	0.0047	0.02
Vanadium (V)	0.0010	0.07	0.03	0.025	--
Zinc (Zn)	0.0030	<b>0.19</b>	<b>0.094</b>	<b>0.1</b>	0.03
<b>Dissolved Metals</b>					
Aluminum (Al)	0.0030	ND	ND	ND	--
Antimony (Sb)	0.00060	ND	ND	ND	--
Arsenic (As)	0.00020	0.00033	0.00051	0.0059	--
Barium (Ba)	0.010	0.15	0.20	0.55	--
Beryllium (Be)	0.0010	ND	ND	ND	--
Boron (B)	0.020	0.11	0.057	0.16	--
Calcium (Ca)	0.30	230	110	210	--
Chromium (Cr)	0.0010	ND	ND	ND	--
Cobalt (Co)	0.00030	0.0015	0.00073	0.0092	--
Copper (Cu)	0.00020	0.0019	0.0021	0.0012	--
Iron (Fe)	0.060	0.08	ND	4.1	--
Lead (Pb)	0.00020	ND	ND	ND	--
Lithium (Li)	0.020	0.035	0.021	0.035	--
Magnesium (Mg)	0.20	73	35	80	--
Manganese (Mn)	0.0040	0.22	0.14	1.8	--
Molybdenum (Mo)	0.00020	0.0013	0.0017	0.0039	--
Nickel (Ni)	0.00050	0.0086	0.0022	0.012	--
Phosphorus (P)	0.10	ND	ND	0.13	--
Potassium (K)	0.30	7.5	4.7	26	--
Selenium (Se)	0.00020	0.00047	0.0016	0.00028	--
Silicon (Si)	0.10	6.8	5.2	8.1	--
Silver (Ag)	0.00010	ND	ND	ND	--
Sodium (Na)	0.50	68	36	140	--
Strontium (Sr)	0.020	1.1	0.58	1.7	--
Sulphur (S)	0.20	44	9.3	9.0	--
Thallium (Tl)	0.00020	ND	ND	ND	--
Tin (Sn)	0.0010	ND	ND	ND	--
Titanium (Ti)	0.0010	ND	ND	ND	--
Uranium (U)	0.00010	0.0078	0.0028	0.0035	--
Vanadium (V)	0.0010	ND	ND	ND	--
Zinc (Zn)	0.0030	ND	ND	0.0077	--

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for commercial/industrial land use.
- 2) \* Surface Water Quality Guidelines for Use in Alberta (AENV, 1999) on aquatic life pathway. Canadian Council of Ministers of the Environment (CCME) guidelines are referenced.
- 3) ND - Not Detected, less than the limit of method detection.
- 4) Unless specified all units are mg/L.
- 5) -- No value established in the reference criteria.
- 6) Bold & Shaded - Exceeds the referenced Alberta Tier 1 and CCME guidelines.
- 7) For further laboratory information, refer to the specific laboratory report in Appendix A.

**Table 4D**  
**Analytical Results - Groundwater - VOCs**

Parameter	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
		01/08/13			
<b><u>Volatile Organic Compounds</u></b>					
Benzene	0.00040	ND	ND	ND	0.005
Toluene	0.00040	ND	ND	ND	0.024
Ethylbenzene	0.00040	ND	ND	ND	0.0024
Xylenes (Total)	0.00080	ND	ND	ND	0.3
F1 (C <sub>6</sub> -C <sub>10</sub> )	0.10	ND	ND	ND	2.2
F2 (C <sub>10</sub> -C <sub>16</sub> )	0.10	ND	ND	ND	1.1
Trihalomethanes (THMs)	0.0020	ND	ND	ND	0.1
Bromodichloromethane	0.00050	ND	ND	ND	--
Bromoform	0.00050	ND	ND	ND	--
Bromomethane	0.0020	ND	ND	ND	--
Carbon tetrachloride	0.00050	ND	ND	ND	0.005
Chlorobenzene	0.00050	ND	ND	ND	0.0013
Chlorodibromomethane	0.0010	ND	ND	ND	--
Chloroethane	0.0010	ND	ND	ND	--
Chloroform	0.00050	ND	ND	ND	0.0018
Chloromethane	0.0020	ND	ND	ND	--
1,2-dibromoethane	0.00050	ND	ND	ND	--
1,2-dichlorobenzene	0.00050	ND	ND	ND	0.0007
1,3-dichlorobenzene	0.00050	ND	ND	ND	--
1,4-dichlorobenzene	0.00050	ND	ND	ND	0.001
1,1-dichloroethane	0.00050	ND	ND	ND	--
1,2-dichloroethane	0.00050	ND	ND	ND	0.005
1,1-dichloroethene	0.00050	ND	ND	ND	0.014
cis-1,2-dichloroethene	0.00050	ND	ND	ND	--
trans-1,2-dichloroethene	0.00050	ND	ND	ND	--
Dichloromethane	0.0020	ND	ND	ND	0.05
1,2-dichloropropane	0.00050	ND	ND	ND	--
cis-1,3-dichloropropene	0.00050	ND	ND	ND	--
trans-1,3-dichloropropene	0.00050	ND	ND	ND	--
Methyl methacrylate	0.00050	ND	ND	ND	0.47
Methyl-tert-butylether (MTBE)	0.00050	ND	ND	ND	0.015
Styrene	0.00050	ND	ND	ND	0.072
1,1,1,2-tetrachloroethane	0.0020	ND	ND	ND	--
1,1,2,2-tetrachloroethane	0.0020	ND	ND	ND	--
Tetrachloroethene	0.00050	ND	ND	ND	0.03
1,2,3-trichlorobenzene	0.0010	ND	ND	ND	0.008
1,2,4-trichlorobenzene	0.0010	ND	ND	ND	0.015
1,3,5-trichlorobenzene	0.00050	ND	ND	ND	0.014
1,1,1-trichloroethane	0.00050	ND	ND	ND	--
1,1,2-trichloroethane	0.00050	ND	ND	ND	--
Trichloroethene	0.00050	ND	ND	ND	0.005
Trichlorofluoromethane	0.00050	ND	ND	ND	--
1,2,4-trimethylbenzene	0.00050	ND	ND	ND	--
1,3,5-trimethylbenzene	0.00050	ND	ND	ND	--
Vinyl chloride	0.00050	ND	ND	ND	0.002

## Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for commercial/industrial land use.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) Unless specified all units are mg/L
- 4) -- No value established in the reference criteria.
- 5) Bold & Shaded - Exceeds the referenced Alberta Tier 1 Guidelines.
- 6) For further laboratory information, refer to the specific laboratory report in Appendix A.

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Phase II ESA - Riverside Light Industrial Park  
Historic Waste Disposal Sites, The City of Red Deer

**Table 5A**  
**Summary of Field Parameters Measured During Sampling of Soil Vapour**

Parameter	Well Diameter (mm)	Screen Length (cm)	Well Depth (m)	Headspace Volume (cm <sup>3</sup> )	Purge Rate (cm <sup>3</sup> /min)	Purge Time (min)	Pressure (psi)	
							Ambient	Vapour Well
VW-01	25	30	4.6	2,558.02	943.3	3 min 7 sec	15.08	15.03
VW-02	25	30	6.1	2,994.33	943.3	3 min 36 sec	15.17	15.18

Notes:

- 1) Measurement of pressure by digital Cole-Parmer absolute pressure gauge.
- 2) Purge time is elapsed time prior to the collection of a soil vapour sample.
- 3) Screen set at base of well.
- 4) Soil vapour sampling was completed July 31, 2013.

**Table 5B**  
**Analytical Results - Soil Vapour - General Indices**

Parameter	Unit	Detection Limit	VW-01	VW-02
<b><u>Gauge Pressure</u></b>				
Following sampling	psi	--	-4.7	-5.0
Reported by laboratory	psi	--	-3.6	-3.6
<b><u>Fixed Gases</u></b>				
Oxygen	% v/v	0.2 - 0.3	2	5
Nitrogen	% v/v	0.2 - 0.3	50.9	67.0
Carbon monoxide	% v/v	0.2 - 0.3	ND	ND
Methane	% v/v	0.2 - 0.3	27.4	17.6
Carbon dioxide	% v/v	0.2 - 0.3	19.8	10.4

## Notes:

- 1) Soil vapour sample collected on Wednesday, July 31, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) -- No value established in the detection limit and reference criteria.
- 4) For further information, the reader should refer to the laboratory report in Appendix A.

**Table 5C**  
**Analytical Results - Soil Vapour - VOCs**

Parameter	Unit	Detection Limit	VW-01	VW-02
			07/31/2013	
<b><u>Volatile Hydrocarbon Fractions</u></b>				
Aliphatic >C <sub>7</sub> -C <sub>6</sub>	µg/m <sup>3</sup>	5.0 - 13	205	2,530
Aliphatic >C <sub>6</sub> -C <sub>8</sub>	µg/m <sup>3</sup>	5.0	483	651
Aliphatic >C <sub>8</sub> -C <sub>10</sub>	µg/m <sup>3</sup>	5.0	176	106
Aliphatic >C <sub>10</sub> -C <sub>12</sub>	µg/m <sup>3</sup>	5.0	412	185
Aliphatic >C <sub>12</sub> -C <sub>16</sub>	µg/m <sup>3</sup>	5.0	125	91.1
Aromatic >C <sub>7</sub> -C <sub>8</sub> (TEX Excluded)	µg/m <sup>3</sup>	5.0	ND	ND
Aromatic >C <sub>8</sub> -C <sub>10</sub>	µg/m <sup>3</sup>	5.0	86.0	47.5
Aromatic >C <sub>10</sub> -C <sub>12</sub>	µg/m <sup>3</sup>	5.0	71.1	41.7
Aromatic >C <sub>12</sub> -C <sub>16</sub>	µg/m <sup>3</sup>	5.0	ND	ND
<b><u>Select Volatile Gases</u></b>				
Acetylene	ppm	0.21 - 0.26	ND	ND
Ethane	ppm	0.21 - 0.26	1.7	1.3
Ethylene	ppm	0.21 - 0.26	ND	ND
n-Butane	ppm	0.41 - 0.51	ND	0.47
n-Pentane	ppm	0.21 - 0.26	ND	ND
Propane	ppm	0.21 - 0.26	1.1	0.69
Propene	ppm	0.21 - 0.26	ND	ND
Propyne	ppm	0.41 - 0.51	ND	ND
<b><u>Volatile Organic Compounds</u></b>				
Dichlorodifluoromethane (FREON 12)	ppbv	0.20 - 0.80	3.34	341
1,2-Dichlorotetrafluoroethane	ppbv	0.17	ND	ND
Chloromethane	ppbv	0.30	0.87	ND
Vinyl chloride	ppbv	0.18	0.60	ND
Chloroethane	ppbv	0.30	ND	ND
1,3-Butadiene	ppbv	0.50	ND	ND
Trichlorofluoromethane (FREON 11)	ppbv	0.20	ND	ND
Ethanol (ethyl alcohol)	ppbv	2.3	34.4	23.5
Trichlorotrifluoroethane	ppbv	0.15	ND	ND
2-Propanol	ppbv	3.0	11.5	6.1
2-Propanone	ppbv	0.80	32.0	19.8
Methyl ethyl ketone (MEK) (2-Butanone)	ppbv	3.0	16.8	12.2
Methyl isobutyl ketone	ppbv	3.2	ND	ND
Methyl butyl ketone (MBK) (2-Hexanone)	ppbv	2.0	ND	ND
Methyl t-butyl ether (MTBE)	ppbv	0.20	ND	ND
Ethyl acetate	ppbv	2.2	2.6	ND
1,1-Dichloroethylene	ppbv	0.25	ND	ND
cis-1,2-Dichloroethylene	ppbv	0.19	ND	ND
trans-1,2-Dichloroethylene	ppbv	0.20	ND	ND
Methylene chloride (Dichloromethane)	ppbv	0.80	ND	ND
Chloroform	ppbv	0.15	ND	ND
Carbon tetrachloride	ppbv	0.30	ND	ND
1,1-Dichloroethane	ppbv	0.20	ND	ND
<b>1,2-Dichloroethane</b>	<b>ppbv</b>	<b>0.20</b>	<b>ND</b>	<b>0.29</b>
Ethylene dibromide	ppbv	0.17	ND	ND
1,1,1-Trichloroethane	ppbv	0.30	ND	ND
1,1,2-Trichloroethane	ppbv	0.15	ND	ND
1,1,2,2-Tetrachloroethane	ppbv	0.20	ND	ND
cis-1,3-Dichloropropene	ppbv	0.18	ND	ND
trans-1,3-Dichloropropene	ppbv	0.17	ND	ND
1,2-Dichloropropane	ppbv	0.40	ND	ND
Bromomethane	ppbv	0.18	ND	ND
Bromoform	ppbv	0.20	ND	ND
Bromodichloromethane	ppbv	0.20	ND	ND
Dibromochloromethane	ppbv	0.20	ND	ND
Trichloroethylene (TCE)	ppbv	0.30	2.23	1.82
Tetrachloroethylene (PCE)	ppbv	0.20	0.64	ND
Benzene	ppbv	0.18	2.93	1.15
Toluene	ppbv	0.20	14.1	11.1
Ethylbenzene	ppbv	0.20	4.01	2.53
p+m-xylene	ppbv	0.37	11.6	7.03
o-xylene	ppbv	0.20	5.01	2.85
Styrene	ppbv	0.20	1.4	0.81
4-Ethyltoluene	ppbv	2.2	ND	ND
1,3,5-Trimethylbenzene	ppbv	3.6 - 8.3	ND	ND
1,2,4-Trimethylbenzene	ppbv	0.50	3.76	2.27
Chlorobenzene	ppbv	0.20	ND	ND
Benzyl chloride	ppbv	1.0	ND	ND
1,3-Dichlorobenzene	ppbv	0.40	ND	ND
1,4-Dichlorobenzene	ppbv	0.40	ND	ND
1,2-Dichlorobenzene	ppbv	0.40	ND	ND
1,2,4-Trichlorobenzene	ppbv	2.0	ND	ND
Hexachlorobutadiene	ppbv	3.0	ND	ND
Hexane	ppbv	0.30	11.4	7.70
Heptane	ppbv	0.30	3.79	1.87
Cyclohexane	ppbv	0.20	34.9	8.60
Tetrahydrofuran	ppbv	0.40	8.14	7.87
1,4-Dioxane	ppbv	2.0	ND	ND
Xylene (Total)	ppbv	0.60	16.6	9.88
Vinyl bromide	ppbv	0.20	ND	ND
Propene	ppbv	220 - 240	ND	ND
2,2,4-Trimethylpentane	ppbv	0.20	4.62	3.52
Carbon disulfide	ppbv	0.50	5.31	3.24
Vinyl acetate	ppbv	0.20	ND	ND

Notes:

- 1) Results are from sampling performed on Wednesday, July 31, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) - - No value established in the detection limit and reference criteria.
- 4) For further information, the reader should refer to the laboratory report in Appendix A.

**Table 5D**  
**Analytics Results - Soil Vapour - Siloxanes**

Parameter	Detection Limit		VW-01		VW-02	
			07/31/2013			
	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>	ppm
Trimethylsilyl Fluoride	--	--	ND	ND	ND	ND
Tetramethylsilane	0.0001	0.0001	ND	ND	ND	ND
Methoxytrimethylsilane	0.0032	0.0007	ND	ND	ND	ND
Ethoxytrimethylsilane	0.0030 - 0.0031	0.0006	ND	ND	ND	ND
Trimethylsilanol	--	--	0.0243	0.0066	0.0172	0.0047
Isopropoxytrimethylsilane	0.0013	0.0002	ND	ND	ND	ND
Trimethoxymethyl Silane #	--	--	ND	ND	ND	ND
Hexamethyl Disiloxane - L2	0.0001	0.0001	ND	ND	ND	ND
Propoxytrimethylsilane	0.0035	0.0006	ND	ND	ND	ND
1-Methylbutoxytrimethylsilane *	--	--	ND	ND	ND	ND
Butoxytrimethylsilane *	--	--	ND	ND	ND	ND
Trimethoxyvinyl Silane #	--	--	ND	ND	ND	ND
Hexamethyl Cyclotrisiloxane - D3	--	--	0.0212	0.0023	0.0141	0.0016
Octamethyl Trisiloxane - L3	0.0002	0.0001	ND	ND	ND	ND
Triethoxyvinyl Silane #	--	--	ND	ND	ND	ND
Triethoxyethyl Silane #	--	--	ND	ND	ND	ND
Octamethyl Cyclotetrasiloxane - D4	--	--	0.0580	0.0048	0.0250	0.0021
Decamethyl Tetrasiloxane - L4	--	--	0.0022	0.0002	0.0009	0.0001
Tetraethylsilicate #	--	--	ND	ND	ND	ND
Decamethyl Cyclopentasiloxane - D5	--	--	0.8254	0.0545	0.5350	0.3530
Dodecamethyl Pentasiloxane - L5	0.0030	0.0002	ND	ND	ND	ND
Dodecamethyl Cyclohexasiloxane - D6	--	--	0.6919	0.0381	0.3017	0.0166
Sum	--	--	1.6375	0.1089	0.9083	0.0628

Notes:

- 1) Soil vapour samples collected on Wednesday, July 31, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) -- No value established in the detection limit and reference criteria.
- 4) V=200 mL, where V is volume of air/gas sampled.
- 5) \* - Semiquantitative (response factor set at 5).
- 6) # - Unstable, poor detectability, commercial standards tested.
- 7) For further information, the reader should refer to the laboratory report in Appendix A.

## APPENDIX F

### BOREHOLE LOGS

<b>PROJECT:</b> Phase II ESA Historic Waste Disposal Sites	<b>BOREHOLE No.:</b> VW-01
<b>PROJECT No.:</b> 12-435	<b>DRILL TYPE:</b> SS Auger
<b>LOCATION:</b> Riverside Light Industrial Park	<b>GROUND ELEVATION:</b> 854.444 m
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 06/17/2013

<b>Sample Type:</b> Shelby Tube  Split Spoon  Core  Disturbed  No Recovery
<b>Backfill Type:</b> Bentonite  Silica Sand  Grout  Pea Gravel  Drill Cuttings  Bentonite : Sand

**Notes:** Soil Vapour Well is at northwest corner of 46A Avenue and 61 Street, on grassed boulevard.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Sod and loam - loose, silty, trace sand, moist, dark olive (~ 15 cm thick). Clay (fill) - stiff, silty, loamy, some gravel, moist, olive.					
1.0	wood fragments with loam and sand at 2 m.					
2.0	Sand and gravel (fill) - compact, moist, olive.					
3.0	No obvious waste material.					
4.0	Clay (fill) - firm, silty, some loam, trace loam, trace wood fragments, trace gravel, trace sand, moist, olive grey.					
4.6	End of hole at 4.6 m. 25 mm diameter 30 cm length 020 PVC screen. Flush mount bolt-down steel casing set in concrete.					
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						

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Slough :	Completion Depth (m): 4.6
Depth to Groundwater :	Checked By: LTM
Logged By: LTM	Page: 1 of 1

<b>PROJECT:</b> Phase II ESA Historic Waste Disposal Sites	<b>BOREHOLE No.:</b> VW-02
<b>PROJECT No.:</b> 12-435	<b>DRILL TYPE:</b> SS Auger/ODEX
<b>LOCATION:</b> Riverside Light Industrial Park	<b>GROUND ELEVATION:</b> 855.329 m
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 06/17/2013

<b>Sample Type:</b> Shelby Tube  Split Spoon  Core  Disturbed  No Recovery
<b>Backfill Type:</b> Bentonite  Silica Sand  Grout  Pea Gravel  Drill Cuttings  Bentonite : Sand

**Notes:** Soil Vapour Well is at 61 Street on grass boulevard across from 4622 - 61 Street.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Sod and loam - soft, sand, silty, trace rootlets, moist, olive brown. (~ 8 cm thick). Sand (fill) - loose, trace silts, moist, light olive.					
1.0	Loam - firm, silty, some sand, trace clay, moist, dark olive. wood fragments at 1.1 m. mixture of loam, sand, clay, silt, trace gravel, musty odor, moist, dark olive.					
2.0						
3.0	Sand - loose to compact, trace silt, damp, olive grey. No obvious waste material.					
4.0	becomes silty at 3.8 m.					
5.0	Gravel (native) - dense, sandy, trace silt, damp to moist, dark olive.					
6.0	End of hole at 6.1 m. 25 mm diameter 30 cm length 020 PVC screen. Flush mount bolt-down steel casing set in concrete.					
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						

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Slough :	0.9 m	Completion Depth (m):	6.1
Depth to Groundwater :		Checked By:	LTM
Logged By:	LTM	Page:	1 of 1

<b>PROJECT:</b> Phase II ESA Historic Waste Disposal Sites	<b>BOREHOLE No.:</b> MW-01
<b>PROJECT No.:</b> 12-435	<b>DRILL TYPE:</b> SS Auger/ODEX
<b>LOCATION:</b> Riverside Light Industrial Park	<b>GROUND ELEVATION:</b> 854.669 m
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 06/18/2013

<b>Sample Type:</b> Shelby Tube  Split Spoon  Core  Disturbed  No Recovery
<b>Backfill Type:</b> Bentonite  Silica Sand  Grout  Pea Gravel  Drill Cuttings  Bentonite : Sand

**Notes:** Groundwater Monitoring Well on 47 Avenue roadway, east of 61 Street.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Asphalt pavement (~ 7 cm thick). Gravel (fill) - compact, sandy, silty, some clay, moist, olive.					
1.0	Clay (fill) - stiff to firm, some loam, moist, olive. No obvious waste material.					
2.0	Sand (fill) - compact, silty, some pebbles, trace organics (rootlets, wood chips), moist, olive.					
3.0	Sand (native) - compact, trace silt, moist, olive.					
4.0	becomes silty at 4.1 m. becomes wet at 4.4 m.					
5.0	Sand and gravel (native) - compact to dense, trace silt, wet, olive.					
6.0	Shale (bedrock) - weak, highly weathered, moist, blue-grey.					
7.0						
8.0	End of hole at 7.6 m. 51 mm diameter 4.6 m length 010 PVC screen. Flush mount bolt-down steel casing set in concrete.					
9.0						
10.0						
11.0						
12.0						

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Slough :	Completion Depth (m): 7.6
Depth to Groundwater :	Checked By: LTM
Logged By: JAL/LTM	Page: 1 of 1

<b>PROJECT:</b> Phase II ESA Historic Waste Disposal Sites	<b>BOREHOLE No.:</b> MW-02
<b>PROJECT No.:</b> 12-435	<b>DRILL TYPE:</b> SS Auger/ODEX
<b>LOCATION:</b> Riverside Light Industrial Park	<b>GROUND ELEVATION:</b> 855.257 m
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 06/18/2013

**Sample Type:**  Shelby Tube  Split Spoon  Core  Disturbed  No Recovery

**Backfill Type:**  Bentonite  Silica Sand  Grout  Pea Gravel  Drill Cuttings  Bentonite : Sand

**Notes:** Groundwater Monitoring Well is at Unit #6, 4669 - 62 Street ~ 0.5 m from curb face in gravel boulevard.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Gravel (fill) - compact, silty, some sand, moist, olive.					
1.0	Sand (fill) - compact, silty, trace loam, moist, olive to dark olive.					
	No obvious waste material.					
2.0	Sand and gravel (native) - dense, trace silt, damp, olive.					
3.0						
4.0						
5.0						
6.0	becomes wet at 6.1 m.					
7.0	Clay - soft, trace silt, wet, olive.					
8.0	Sand - compact, trace gravel, wet, olive.					
9.0	End of hole at 8.4 m. 51 mm diameter 010 PVC screen. 3.0 m solid PVC pipe. Flush mount bolt-down steel casing set in concrete.					
10.0						
11.0						
12.0						

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Slough :	Completion Depth (m): 8.4
Depth to Groundwater :	Checked By: LTM
Logged By: JAL/LTM	Page: 1 of 1

<b>PROJECT:</b> Phase II ESA Historic Waste Disposal Sites	<b>BOREHOLE No.:</b> MW-03
<b>PROJECT No.:</b> 12-435	<b>DRILL TYPE:</b> SS Auger/ODEX
<b>LOCATION:</b> Riverside Light Industrial Park	<b>GROUND ELEVATION:</b> 854.551 m
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 06/19/2013

**Sample Type:** Shelby Tube Split Spoon Core Disturbed No Recovery

**Backfill Type:** Bentonite Silica Sand Grout Pea Gravel Drill Cuttings Bentonite : Sand

**Notes:** Groundwater Monitoring Well on north side of 46 Avenue ~ 3 m west of the CN track R/W on grassed boulevard

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Sod - loam, silty, sandy, moist, dark olive. (~ 15 cm thick) Sand and gravel (fill) - compact, trace organics, trace clay, moist, olive.					
1.0	Clay (fill) - firm, sandy, trace silts, trace organics, moist, olive.					
2.0	wood fragments at 1.8 m to 2.4 m.					
3.0	Loam - firm, silty, sandy, damp, dark olive. some oxides at 2.9 m. No obvious waste material.					
4.0	Sand (native) - loose to compact, trace silts, damp, light olive.					
5.0	Sand and gravels - compact to dense, trace silt, olive.					
6.0	Gravel - compact, wet at 5.2 m.					
7.0	Clay at 5.5 m to 5.8 m.					
8.0	End of hole at 7.6 m. 51 mm diameter 4.6 m length 010 PVC screen. 3.0 m solid PVC pipe. Flush mount bolt-down steel casing set in concrete.					
9.0						
10.0						
11.0						
12.0						

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Slough :	Completion Depth (m): 7.6
Depth to Groundwater :	Checked By: LTM
Logged By: LTM	Page: 1 of 1

<b>PROJECT:</b> ESA Landfill Variance Request	<b>BOREHOLE No.:</b> Lot 4 - VW-01
<b>PROJECT No.:</b> 12-435A	<b>DRILL TYPE:</b> SS Auger
<b>LOCATION:</b> 4615 Riverside Drive, Red Deer, Alberta	<b>GROUND ELEVATION:</b> 100.108
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 03/20/2013

<b>Sample Type:</b> <input checked="" type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> Split Spoon <input checked="" type="checkbox"/> Core <input type="checkbox"/> Disturbed <input type="checkbox"/> No Recovery
<b>Backfill Type:</b> <input checked="" type="checkbox"/> Bentonite <input checked="" type="checkbox"/> Silica Sand <input checked="" type="checkbox"/> Grout <input type="checkbox"/> Pea Gravel <input type="checkbox"/> Drill Cuttings

**Notes:** Vapour well at south end of site.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Loam (~10 cm thick), soft, silty, sandy, damp, olive. Sand (native) - compact, trace silt, trace pebbles, damp, olive brown.					
1.0				11		
2.0	Silt - firm, trace sand, moist, olive brown. becomes sandy at 2.4 m					
3.0	Sand - compact, silty, some gravel, moist, olive brown.			3		
4.0						
5.0	End of hole at 4.6 m 0.3 m 25 mm diameter 020 PVC screen Above ground lockable casing					
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						

<b>PROJECT:</b> ESA Landfill Variance Request	<b>BOREHOLE No.:</b> Lot 4 - MW-01
<b>PROJECT No.:</b> 12-435A	<b>DRILL TYPE:</b> Percussion Hammer
<b>LOCATION:</b> 4615 Riverside Drive, Red Deer, Alberta	<b>GROUND ELEVATION:</b> 100.108
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 03/21/2013

<b>Sample Type:</b> <input type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> Split Spoon <input type="checkbox"/> Core <input type="checkbox"/> Disturbed <input type="checkbox"/> No Recovery
<b>Backfill Type:</b> <input type="checkbox"/> Bentonite <input type="checkbox"/> Silica Sand <input type="checkbox"/> Grout <input type="checkbox"/> Pea Gravel <input type="checkbox"/> Drill Cuttings

**Notes:** Monitoring well about 1 m north of vapour well VP-01.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Loam (~10 cm thick), soft, silty, sandy, damp, olive.					
1.0	Silty sand (native) - compact, trace gravel, moist, light olive brown.					
2.0	trace oxides, trace gypsum, becomes olive brown at ~ 2 m					
3.0						
4.0	becomes wet at ~ 4.4 m					
5.0						
6.0	Mudstone (bedrock) - silty, some grey-blue shale nodules, weak, highly weathered,, moist to damp, dark olive to grey.					
7.0	Shale, weak, highly weathered, damp, blue-grey.					
8.0	End of hole at 7.6 m 3 m 50 mm diameter 010 PVC screen Above ground lockable casing					
9.0						
10.0						
11.0						
12.0						

<b>PROJECT:</b> ESA Landfill Variance Request	<b>BOREHOLE No.:</b> Lot 4 - VW-02
<b>PROJECT No.:</b> 12-435A	<b>DRILL TYPE:</b> SS Auger
<b>LOCATION:</b> 4615 Riverside Drive, Red Deer, Alberta	<b>GROUND ELEVATION:</b> 98.866
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 03/20/2013

<b>Sample Type:</b> <input checked="" type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> Split Spoon <input checked="" type="checkbox"/> Core <input type="checkbox"/> Disturbed <input type="checkbox"/> No Recovery
<b>Backfill Type:</b> <input checked="" type="checkbox"/> Bentonite <input checked="" type="checkbox"/> Silica Sand <input checked="" type="checkbox"/> Grout <input type="checkbox"/> Pea Gravel <input type="checkbox"/> Drill Cuttings

**Notes:** Vapour well at north end of site.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Loam (~5 cm thick), soft, silty, sandy, damp, olive. Sand - compact, silty, trace pebbles, damp to moist, light olive brown.					
1.0				19		
2.0	Becomes gravelly with sand, trace silt, damp, olive brown at ~1.8 m.					
3.0	Sand and gravel - compact, trace silt, moist, olive brown.			33		
4.0						
5.0	End of hole at 4.6 m 0.3 m 25 mm diameter 020 PVC screen Above ground lockable casing					
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						

<b>PROJECT:</b> ESA Landfill Variance Request	<b>BOREHOLE No.:</b> Lot 4 -MW-02
<b>PROJECT No.:</b> 12-435A	<b>DRILL TYPE:</b> Percussion Hammer
<b>LOCATION:</b> 4615 Riverside Drive, Red Deer, Alberta	<b>GROUND ELEVATION:</b> 98.866
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 03/21/2013

<b>Sample Type:</b> <input checked="" type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> Split Spoon <input checked="" type="checkbox"/> Core <input type="checkbox"/> Disturbed <input type="checkbox"/> No Recovery
<b>Backfill Type:</b> <input checked="" type="checkbox"/> Bentonite <input checked="" type="checkbox"/> Silica Sand <input checked="" type="checkbox"/> Grout <input type="checkbox"/> Pea Gravel <input type="checkbox"/> Drill Cuttings

**Notes:** Monitoring well about 1.5 m north of vapour well VP-02.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Loam (~5 cm thick), soft, silty, sandy, damp, olive. Sand - compact, trace clay, trace silt, trace rootlets, moist, olive brown.					
1.0	Silty sand - compact, trace gravels, trace rootlets, traces oxides, moist, olive brown.					
2.0						
3.0	Sand and gravels - compact, moist, light olive brown.					
4.0	Becomes wet at ~ 4.5 m.					
5.0	Mudstone (bedrock) - very weak, highly weathered, moist, dark olive to grey.					
6.0	End of hole at 5.8 m 3 m 50 mm diameter 010 PVC Screen Above ground lockable casing					
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						

<b>PROJECT:</b> ESA Landfill Variance Request	<b>BOREHOLE No.:</b> Lot 4 -MW-03
<b>PROJECT No.:</b> 12-435A	<b>DRILL TYPE:</b> Percussion Hammer
<b>LOCATION:</b> 4615 Riverside Drive, Red Deer, Alberta	<b>GROUND ELEVATION:</b> 99.722
<b>CLIENT:</b> The City of Red Deer	<b>COMPLETION DATE:</b> 03/21/2013

<b>Sample Type:</b> <input type="checkbox"/> Shelby T <input checked="" type="checkbox"/> Split Spoon <input type="checkbox"/> Core <input type="checkbox"/> Disturbed <input type="checkbox"/> No Recovery
<b>Backfill Type:</b> <input type="checkbox"/> Bentonit <input type="checkbox"/> Silic sand <input type="checkbox"/> Grout <input type="checkbox"/> Pea Gravel <input type="checkbox"/> Drill Cuttings

**Notes:** Monitoring well located in the middle of the north and south ends of the site.

Depth (m)	Soil Description	Sample Type	Sample No.	SPT (N)	Combustible Soil Vapours (ppm)	Well Details
0.0	Loam (~5 cm thick), soft, silty, sandy, damp, olive. Silty sand - compact, trace clay, trace gravels, trace rootlets, moist, olive brown.					
1.0	Sand - compact, trace gravel, moist, light olive brown.  becomes silty at ~ 1.4 m.					
2.0	Sand and gravel - compact, moist, light olive brown.					
3.0						
4.0						
5.0	becomes wet at ~ 5 m.					
6.0	Mudstone (bedrock) - very weak, highly weathered, moist, olive to grey.					
7.0	End of hole at 6.8 m 3 m 50 mm diameter 010 PVC screen Above ground lockable casing					
8.0						
9.0						
10.0						
11.0						
12.0						



# Borehole No: 22MW-04

Project: 2023 Pre-1972 Site Monitoring Program

Project No: SWM.SWOP04071-03.009

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

Depth (m)	Method	Soil Description	Notes and Comments	Depth (ft)
0				0
0 to 0.25		TOPSOIL - (200 mm thick)	Pipe stickup = 0.85 metres	0 to 1
0.25 to 2.75		CLAY - silty, some gravel, damp, stiff, brown, coal and iron inclusions  - some sand, moist, soft		1 to 3
2.75 to 3.25	Solid stem auger	SAND - trace gravel  - gravelly, wet		3 to 4
3.25 to 6.00		CLAY - silty, some gravel, moist, soft, grey		4 to 6
6.00		END OF BOREHOLE (6.00 metres) slough - 1.07 metres at 0 hrs. Monitoring well installed to 6.00 metres		6 to 7.5



Contractor: CP Drilling

Completion Depth: 6 m

Equipment Type: Skid Steer

Start Date: 2022 December 10

Logged By: RM

Completion Date: 2022 December 10

Reviewed By:

Page 1 of 1



# Borehole No: 22VW-01

Project: 2023 Pre-1972 Site Monitoring Program

Project No: SWM.SWOP04071-03.009

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

Depth (m)	Method	Soil Description	Notes and Comments	22VW-01	Depth (ft)
0		TOPSOIL - (100 mm thick) CLAY - silty, trace gravel, dry to damp, coal inclusions	Flush mount		0
1	Solid stem auger	- trace sand, damp, greyish black, no discernible odour - some gravel			1
2				2	
3				3	
4		- 200 mm thick sand inclusion		4	
5		END OF BOREHOLE (4.50 metres) slough - none at 0 hrs. Monitoring well installed to 4.50 metres			5
6					6
7					7
7.5					7.5



Contractor: CP Drilling

Completion Depth: 4.5 m

Equipment Type: Skid Steer

Start Date: 2022 December 5

Logged By: RM

Completion Date: 2022 December 5

Reviewed By:

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# Borehole No: 22VW-03

Project: 2023 Pre-1972 Site Monitoring Program

Project No: SWM.SWOP04071-03.009

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

Depth (m)	Method	Soil Description	Notes and Comments	22VW-03	Depth (ft)
0					0
	Solid stem auger	TOPSOIL - (200 mm thick)	Flush mount		0
		CLAY (FILL) - silty, trace gravel, dry to damp, soft, brown			1
1		- 1.00 metre thick sand seam - fine grained sand, moist, greyish brown, iron inclusions			4
2		CLAY (ORGANIC) - damp, medium plastic, black			7
3		END OF BOREHOLE (3.00 metres) slough - none at 0 hrs. Monitoring well installed to 3.00 metres			10
4					13
5					16
6					19
7					22
7.5					24



Contractor: CP Drilling

Completion Depth: 3 m

Equipment Type: Skid Steer

Start Date: 2022 December 5

Logged By: RM

Completion Date: 2022 December 5

Reviewed By:

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# Borehole No: 22VW-04

Project: 2023 Pre-1972 Site Monitoring Program

Project No: SWM.SWOP04071-03.009

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

Depth (m)	Method	Soil Description	Notes and Comments	Depth (ft)
0				0
0 to 0.2	Solid stem auger	TOPSOIL - (200 mm thick)	Pipe stickup = 1.00 metre	0 to 0.2
0.2 to 2.0		CLAY - silty, some sand, damp, soft, low plastic, brown  - trace gravel, sand inclusions		0.2 to 2.0
2.0 to 3.0		END OF BOREHOLE (3.00 metres) slough - none at 0 hrs. Monitoring well installed to 3.00 metres		2.0 to 3.0



Contractor: CP Drilling

Completion Depth: 3 m

Equipment Type: Skid Steer

Start Date: 2022 December 10

Logged By: RM

Completion Date: 2022 December 10

Reviewed By:

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# Borehole No: 22VW-05

Project: 2023 Pre-1972 Site Monitoring Program

Project No: SWM.SWOP04071-03.009

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

Depth (m)	Method	Soil Description	Notes and Comments	22VW-05	Depth (ft)
0					0
0 to 1.9	Solid stem auger	<p>SAND (FILL) - silty, trace gravel, dry, loose</p> <p>- trace wood chips</p>			0 to 1.9
1.9 to 2.9		<p>CLAY - silty, damp, medium plastic, trace orange, white and black inclusions</p> <p>- trace wood waste</p> <p>- some sand</p>			1.9 to 2.9
2.9 to 7.5		<p>END OF BOREHOLE (3.00 metres)</p> <p>slough - none at 0 hrs.</p> <p>Monitoring well installed to 3.00 metres</p>			2.9 to 7.5



Contractor: CP Drilling

Completion Depth: 3 m

Equipment Type: Skid Steer

Start Date: 2022 December 5

Logged By: RM

Completion Date: 2022 December 5

Reviewed By:

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# Borehole No: 24VW-06

Project: Reiverside Light Industrial Park

Project No: SWM.SWOP04071-04.006

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

UTM: 308844 E; 5796561 N; Z 12

Depth (m)	Method	Soil Description	Notes and Comments	24VW-06	Depth (ft)
0					0
0 - 1	Hydrovacc		Flush mount		0 - 1
1 - 2					1 - 2
2 - 3	Hydrovac	SAND - trace silt, trace clay, fine to medium grained sand, poorly graded, damp, soft, brown			2 - 3
3 - 4	Solid Stem Auger	SILT - some sand, trace clay, trace gravel, fine to coarse grained sand, gravel to 10 mm diameter, well graded, moist, soft, non to low plastic, grey			3 - 4
4 - 5		END OF BOREHOLE (4.6 metres) Vapour well installed to 4.6 metres			4.6 - 5



Contractor: Ernco Environmental Drilling & Coring Inc.

Completion Depth: 4.6 m

Equipment Type: GeoProbe 3230DT

Start Date: 2024 September 3

Logged By: LL

Completion Date: 2024 September 3

Reviewed By: CW

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# Borehole No: 24VW-07

Project: Reiverside Light Industrial Park

Project No: SWM.SWOP04071-04.006

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

UTM: 308687 E; 5796279 N; Z 12

Depth (m)	Method	Soil Description	Notes and Comments	24VW-07	Depth (ft)
0					0
1					1
2	Solid Stem Auger	<p>SAND - trace silt, trace clay, trace gravel, fine to coarse grained sand, gravel to 35 mm diameter, poorly graded, damp, soft to firm</p> <p>- some gravel, subangular to subrounded gravel</p>	Flush mount	24VW-07	2
3					3
4					4
5		<p>END OF BOREHOLE (4.6 metres) slough - 1.67 metres Vapour well installed to 4.4 metres</p>			5



Contractor: Ernco Environmental Drilling & Coring Inc.

Completion Depth: 4.6 m

Equipment Type: GeoProbe 3230DT

Start Date: 2024 September 3

Logged By: LL

Completion Date: 2024 September 3

Reviewed By: CW

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# Borehole No: 24VW-08

Project: Reiverside Light Industrial Park

Project No: SWM.SWOP04071-04.006

Location: NW 1/4, Sec. 21-38-27 W4M

Red Deer, Alberta

UTM: 308567 E; 5796198 N; Z 12

Depth (m)	Method	Soil Description	Notes and Comments	24VW-08	Depth (ft)
0					0
		TOPSOIL AND ORGANICS - (150 mm thick)	Flush mount		
		SAND - some silt, trace clay, trace gravel, subrounded gravel, well graded, damp, soft, dark brown			1
		SILT - some sand, some clay, trace gravel, subangular to subrounded gravel to 20 mm diameter, well graded, damp, low plastic, dark brown  - grey clay lens			2
1					3
		SAND - trace silt, trace clay, fine to medium grained sand, poorly graded, damp, soft, brown			4
2	Solid Stem Auger			5	
		- some silt		6	
3				7	
		SILT - some sand, trace clay, trace gravel, subangular to subrounded gravel to 30 mm diameter, well graded, damp, low plastic, brown		8	
4				9	
				10	
				11	
				12	
				13	
				14	
5		END OF BOREHOLE (4.6 metres) slough - 4.5 metres Vapour well installed to 4.5 metres		15	
				16	



Contractor: Ernco Environmental Drilling & Coring Inc.

Completion Depth: 4.6 m

Equipment Type: GeoProbe 3230DT

Start Date: 2024 September 4

Logged By: WV

Completion Date: 2024 September 4

Reviewed By: CW

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