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Public Services and Procurement Canada

ENVIRONMENTAL SITE ASSESSMENT

Resolute Bay Airport Land Treatment Units

March 23, 2016

ENVIRONMENTAL SITE ASSESSMENT

Resolute Bay Airport Land Treatment Units

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EXECUTIVE SUMMARY

Arcadis Canada Inc. (Arcadis) was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) to conduct a data gap Environmental Site Assessment (ESA) at the Resolute Bay Airport Land Treatment Units (LTUs) ("the site") in Resolute Bay, NU.

Arcadis first developed construction specifications for tilling two LTUs and removing heat piping infrastructure. After no bids were received in response to the tender for the tilling work, Arcadis modified the program in consultation with PSPC to assess soil and groundwater conditions, evaluate infrastructure, and develop recommendations for future work at the LTUs.

The two large LTUs (identified as LTU 1 and LTU 2) at the site were constructed in 2002 as part of the remediation of a former firefighter training area (FFTA). The FFTA included a mock-up area, four aboveground storage tanks, a fuel pump house and underground piping. The volume of soils in the LTUs was reported to be 5,800 m^3 at the time of the remediation. Neither the contents of the aboveground storage tanks nor the specific nature of any other sources of soil contamination were indicated in the remedial reports.

TC was granted a licence by the Nunavut Water Board for the operations, maintenance and eventual decommissioning of LTU 1 and LTU 2. The licence stipulates sampling, reporting, water use, waste, and other requirements for the operation of the LTUs.

Two smaller LTUs (identified as LTU 3 and LTU 4) are also present in the area; however, no background information on the source, contents or construction of these LTUs is available. TC has indicated that it is not the custodian of the smaller LTUs, and the Water Licence does not cover these LTUs.

Arcadis visited the site on September 22, 2015 to carry out site investigation activities: making observations about LTU conditions, advancing test pits and collecting soil samples from each LTU, and attempting to collect groundwater samples. During the site visit, weather conditions were windy and clear, with a temperature of -5 °C.

LTU Conditions

Exposure to ultraviolet (UV) rays has degraded the condition of the geomembrane that was used to line the LTUs where it is visible around the edges of the LTUs. While the visible liner is degraded, this degradation is not necessarily the case for the liner below the LTU soil, as it has not been exposed to UV rays. Arcadis was unable to assess the condition of the liner below the LTUs during the field investigation in order to preserve liner integrity.

A ground heating system was installed in LTU 2 enhance bioremediation in 2004. It operated briefly and is still in place. The infrastructure of the heating system includes pipes, junction boxes and an air exchange housing at the north end of the LTU. The area of LTU where the heating system was operational is covered by a geomembrane similar to that used as a liner for the LTU. It was not possible to remove the geomembrane during the field investigation as it was frozen in place.

Arcadis was unable to measure the depth of soil in the LTUs because of weather conditions and was therefore unable to accurately measure the total volume of soil. Arcadis did, however, measure the total areal extent of LTUs 1 and 2 at 4,300 m^2. If the volume estimated in previous reports in the LTUs is

correct (i.e., 5,800 m^3), the LTUs are filled to an average approximate height of 1.3 metres. This result is consistent with test pits extending as far as 0.7 metres below ground surface before encountering permafrost in the LTUs.

This calculated depth of soil in the LTUs is substantially higher than the height recommended in federal guidance for landfarms. As a result, the addition of further soil is not recommended.

Soil Analytical Results

LTUs 1 and 2

All eleven samples collected for benzene, toluene, ethylbenzene, xylenes and petroleum hydrocarbon (PHC) analysis exhibited at least one exceedance of guidelines. The results ranged from concentrations below laboratory detection limits to 67 times the CCME guideline for toluene in one sample. The most prevalent exceedance of guidelines was for PHC fraction F2 in every sample collected.

None of the six samples collected and analyzed for polycyclic aromatic hydrocarbons (PAHs) exhibited any exceedances of guidelines. Similarly, none of the 11 samples collected for metals analysis exhibited exceedances of guidelines.

Two soil samples were collected from the LTUs and submitted for the laboratory analysis of perfluorinated compounds. Both samples collected exceeded the interim federal advice guidelines for perfluorooctanesulfonic acid.

LTUs 3 and 4

Both samples collected for benzene, toluene, ethylbenzene, xylenes and PHC analysis exhibited at least one exceedance of guidelines. Exceedances of PHC F2, benzene and toluene guidelines were observed.

Neither the sample collected for PAHs nor the two samples collected for metals analysis exhibited exceedances of guidelines.

No samples were collected for perfluorinated compounds from LTU 3 or 4.

Groundwater Conditions

There are no protective casings installed around the site monitoring wells. As a result, the wells showed some damage from the elements.

All groundwater wells were frozen during the site visit. In the absence of installation information or a detailed site survey, Arcadis was not able to determine groundwater flow direction from the measured water levels. Based on the topography of the area, however, Arcadis expects that any groundwater present during the short un-frozen ground period will move from east to west across the LTU area, towards Resolute Bay.

Landfarm Remediation Effectiveness

Arcadis compared the concentrations of PHC fraction F2 in the LTUs between 2015 and the beginning of the remedial program in 2002. PHC F2 was the major component of the PHC-impacted soil placed in the LTUs, and as such should function as a reasonable indicator of bioremediation. For both LTU 1 and LTU 2, Arcadis was unable to confirm any decrease in concentrations of PHC F2 between 2002 and 2015.

Recommendations

The operating period of the Resolute Bay Airport LTUs will be substantially longer than the average of 6 months to 2 years provided in federal guidance, because of the short summer season when temperatures are above zero. As a result, it is important that optimal landfarming conditions are maintained if any remediation is to progress. Optimal conditions include regular tilling, maintenance of appropriate moisture content and pH, and regular sampling.

In order to ensure optimal conditions for the landfarm, Arcadis recommends updating the landfarm Operations and Maintenance Plan. The updated Plan will identify sampling requirements, priorities for additional work, and requirements for compliance with the LTU Water Licence. The priorities for the updated Plan should be identifying a local contractor who can be responsible for regular maintenance of the LTUs, outlining the scope of regular maintenance work (tilling, water addition) and developing a sampling plan.

The presence of PFCs above guidelines in the LTUs means that successful operation of the landfarm will not necessarily remediate all contaminants. PFCs should be included in the update to the Operations and Maintenance Plan. Additional sampling will help to delineate PFCs in the LTUs.

Groundwater monitoring is required as part of the LTU Water Licences. Because monitoring wells were frozen and the ground was snow covered during the 2015 site visit, it was difficult to fully assess well conditions. A full assessment of monitoring well conditions should be made at the next Licence monitoring and sampling event.

Arcadis is not aware of a Phase I ESA prepared for the site, and previous remedial reports concentrate solely on PHCs and related compounds. As a result, future sampling programs should consider the potential for other contaminants in the LTUs.

1 INTRODUCTION

Arcadis Canada Inc. (Arcadis) was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) to conduct and a data gap Environmental Site Assessment (ESA) at the Resolute Bay Airport Land Treatment Units (LTU's) in Resolute Bay, NU. The ESA was conducted in order to fill any data gaps associated with the Resolute Bay LTUs. The ESA was conducted under PSPC project number R.056019.001.

This report is submitted under Northern Standing Offer Contract EW699/141143/001 and conducted in according with the Terms of Reference (ToR) entitled, "Data Gap/Remediation Design/Supervision Services Resolute Bay, Nunavut" and the Arcadis proposal "Proposal for Resolute Bay Airport Landfill and LTU Projects, 2015" dated, June 24, 2015. Throughout this report the Resolute Bay LTUs will be referred to as "the site."

1.1 Background

The Resolute Bay airport is five kilometres northwest of the Inuit hamlet of Resolute, in the Qikiqtaaluk Region of Nunavut (Figure 1). The airport was constructed by the Royal Canadian Air Force in 1949, and is now owned and operated by the Government of Nunavut.

Firefighter Training Area and Land Treatment Units

There is a former firefighter training area (FFTA) north of the Resolute Airport. In 2002, Winnipeg Environmental Remediation Inc. (WERI) conducted demolition and remedial activities at the FFTA in attempt to bring the Resolute Bay Airport into compliance with environmental legislation. Remediation and confirmatory sampling in the FFTA was completed between 2002 and 2005. Contaminated soils were excavated and placed in two LTUs.

Neither the contents of the aboveground storage tanks nor the specific nature of any other sources of soil contamination were indicated in the remedial reports.

There is reportedly approximately 5,800 m^3 of impacted soil in the two LTUs (LTU 1 and LTU 2). LTU 1 has external dimensions of 70 m x 40 m and is divided into three zones. Zones 1 and 2 contained soils impacted with heavier hydrocarbons while zone 3 contained soils impacted with lighter hydrocarbons. LTU 2 has external dimensions of 80 m x 30 m. LTU 2 contains soils impacted with lighter hydrocarbons and was not subdivided into zones.

As part of the remediation, a ground heating system was installed in one of the LTUs (LTU 2) to enhance hydrocarbon degradation by providing an optimum temperature for microbial growth, but the system only operated once in 2004.

Between 2002 and 2005, sampling was completed annually to determine if contaminant levels were being reduced. Nutrients were placed in the LTUs in 2002 and 2003.

TC was granted Licence No. 1BR-RLF1520 by the Nunavut Water Board for the operations, maintenance and eventual decommissioning of LTU 1 and LTU 2. The licence stipulates sampling, reporting, water use, waste, and other requirements for the operation of the LTUs.

Two smaller LTUs are present in the area (LTU 3 and LTU 4); however, no background information on the source of contents or construction of the LTUs is available. TC has indicated that it is not the custodian of the smaller LTUs. Arcadis was not able to obtain any additional information regarding these LTUs while in Resolute Bay. The Water Licence does not cover these additional LTUs.

From discussions with PSPC and TC, Arcadis understands that a future landfill remediation program may transfer approximately 100 m^3 of PHC-impacted soil to LTUs 1 and 2.

1.2 Objectives

The objectives of the data gap ESA at the Resolute Bay Airport Dam, as stated in the ToR and Arcadis's proposal, were to:

- Develop construction specifications for tilling two LTUs and removing heat piping infrastructure;
- Understand soil and groundwater conditions at all LTUs, including any biodegradation of PHCs;
- Evaluate the conditions of monitoring wells and liners at LTUs; and,
- Develop recommendations for enhancing bioremediation if necessary.

Arcadis developed the construction specifications for tilling two LTUs and removing heat piping infrastructure in July, 2015; however, no bids were received from contractors to complete the work. The work program continued with slight revisions to meet the remainder of the project objectives. Namely, Arcadis retained an excavation contractor to advance test pits instead of collecting samples during soil turning.

Based on the discovery of perflourinated compounds (PFCs) in the LTUs, no bioremediation treatment program was developed.

2 ENVIRONMENTAL QUALITY GUIDELINES

Analytical results for the soil samples collected were evaluated against the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, specifically the Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQGs) and the Canada-Wide Standards for Petroleum Hydrocarbons in Soil (CWS-PHC) for industrial land use and coarse grain size. Grain size analysis of soils samples collected by WERI in 2003 indicate that the soil at the site is coarse grained.

The CSQGs (CCME, 1999) are a subsection of the Canadian Environmental Quality Guidelines, and are derived to approximate a no- to low- effect level (or threshold level) based only on scientific data, including toxicology, fate, and behaviour. The guidelines are based on direct contact, ingestion, and inhalation toxicity data, as well as check mechanisms to ensure that the guidelines are protective of receptors exposed indirectly to contaminants. Fact sheets are provided for 31 compounds. In this report, the benzene, toluene, ethylbenzene and xylenes fact sheets were used as sources of comparative guidelines.

The Canada-Wide Standards for Petroleum Hydrocarbons (CWS-PHC) (CCME, 2008) is the present guidelines for petroleum hydrocarbons in soil. These numerical standards are based on the assessment and consistent management of risks posed to humans, plants, animals and environmental processes under four common land uses (agricultural, residential/parkland, commercial and industrial). Under Tier 1 of the CWS-PHC, specific numerical levels are presented for the four land uses, two soil textures (coarse and fine) and the four defined petroleum hydrocarbon fractions [F1 (nC6-nC10); F2 (nC10-nC16); F3 (nC16-nC34); F4 (nC34+)] for various exposure pathways, including vapour inhalation, drinking water and eco soil contact.

The CWS-PHC also include the option to generate Tier 2 levels where site-specific information indicates that site conditions exist that modify human or ecological exposure to PHC contamination. Such conditions may alter risks significantly relative to the generic conditions used to derive Tier 1 levels. A third tier in the CWS-PHC involves developing site-specific cleanup levels and management options using general and site-specific information in conducting a risk assessment.

As a preliminary and conservative determination of protection of human health and the environment at the site, Arcadis has applied the Tier 1 levels with industrial land use and coarse grained soils to all analytical results. The appropriate levels are presented with the laboratory analytical data in tables.

PAHs

In 2010, the CCME promulgated guidelines for polycyclic aromatic hydrocarbons (PAHs). The Canadian Soil Quality Guidelines Polycyclic Aromatic Hydrocarbons factsheet (CCME, 2010) provides the background information and rationale for the derivation of the guidelines. As with other compounds in the CSQGs, environmental and human health soil quality guidelines were developed for four land uses: agricultural, residential/parkland, commercial and industrial. In other ways, however, the guidelines for PAHs are presented differently from traditional CSQG factsheets. According to the PAH factsheet, “PAHs are found in environmental samples almost always as complex mixtures.” There are also multiple PAHs

that are known or strongly suspected to be carcinogenic. The combination of carcinogenicity and complex mixtures requires an approach that considers PAHs together and not individually.

Because the approach was different from other CSQGs, the CCME developed a three-step process to evaluate PAHs in soil. The steps correspond with the following evaluations:

Step 1: Protection of human health impacts from soil contact;

Step 2: Protection of human health impacts from ingestion of potable water; and

Step 3: Protection of the environment.

In order to address PAH exposure to humans through direct contact (Step 1), the CCME adopted a scheme relating carcinogenic PAHs to benzo(a)pyrene. Modifying an approach initially developed by the World Health Organization, the CCME relates the relative magnitude of cancer potency of each PAH compound to benzo(a)pyrene through a potency equivalency factor (PEF). For example, benzo[g,h,i]perylene is assigned a PEF of 0.01, indicating that it can be considered 100 times less carcinogenic at equivalent exposure than benzo(a)pyrene. The concentration of each carcinogenic (or suspected-carcinogenic) PAH in soil is multiplied by its PEF, and the results are added together to create an artificial concentration with approximately the equivalent carcinogenicity of benzo(a)pyrene. This concentration is known as benzo(a)pyrene total potency equivalent (B[a]P TPE), and is the sole guideline provided for human health exposure through direct contact to PAHs in soil.

In order to assess exposure to potable water (Step 2), the CCME used the PEFs and consideration of volatility and lipophilicity to determine the likelihood that PAH compounds leaching into groundwater would present a risk to human health. The resulting equation is known as the Index of Additive Cancer Risk (IACR). This drinking water pathway is excluded for Resolute, as continuous permafrost means ground water is not a viable source of drinking water.

No values are provided for non-carcinogenic effects of PAHs in humans by the CCME.

In order to assess the effects of PAHs on environmental health (Step 3), the factsheet provides soil quality pathway-specific guidelines. Guidelines are provided for the ecological soil contact pathway, the ecological soil and food ingestion pathway, and the protection of freshwater life. Because of data limitations on the ecological soil contact pathway, there are only three PAH compounds for which an Environmental Soil Quality Guideline has been calculated: anthracene, benzo(a)pyrene, and fluoranthene. For other compounds, the user is directed to use previously-developed interim soil quality criteria values from 1991 or provisional soil quality guidelines from 1997. Where applicable, the fact sheet also indicates that guideline values for the protection of freshwater life should be used.

To take a conservative approach, Arcadis has adopted the lowest applicable environmental health guideline value listed for each compound. As the site is located greater than one kilometre from the nearest major water body (Arctic Ocean) Arcadis has excluded the protection of freshwater life pathway.

PFOS Compounds

Perfluorooctane sulfonate (PFOS) and other perflourinated compounds (PFCs) are anthropogenic chemicals that have been introduced to the environment through their broad application including manufacturing products and consumer products. Based on risk assessment activities under the Canadian Environmental Protection Act, 1999, it was concluded that PFOS and its associated salts and precursors may be entering the environment in concentrations that may have an immediate or long-term harmful effect on the environment or biological diversity. Historically PFOS and other PFCs were used in aqueous fil forming foams which were typically used during fire fighting training activities.

In October 2015, the National Guidelines and Standards Office, Environment Canada, issued Version 1.3 of the Director General-approved Federal Soil Quality Guidelines (FSQGs) for Perfluorooctane Sulfonate (PFOS) available to the Federal Contaminated Sites Action Plan (FCSAP). Based on these FSQGs, all soil analytical results were compared to the soil guideline for an industrial site with coarse soil (130 µg/kg).

3 SCOPE OF WORK

Based on the historical work that has been conducted at the site, Arcadis designed a confirmatory soil sampling program for the LTUs and a groundwater sampling program for the six surrounding groundwater monitoring wells. Due to the unsuccessful tendering of a contract to turn the soil at the LTUs, the site investigation was delayed until September 22, 2015. At the time of the site visit the groundwater in the six surrounding groundwater monitoring wells was frozen and therefore, no samples could be collected. The north end of LTU 2 where the heat treatment system was located was inaccessible during the field program as it was covered by a tarp that could not be removed without compromising the integrity of the LTU.

3.1 Health and Safety Plan

Before commencing any field activities, Arcadis prepared a site-specific health and safety plan (HASP). The HASP identified and provided mitigative actions for potential physical and chemical hazards associated with the work involved during the field program. The HASP also contained a listing of emergency contact numbers and provided protocols to follow in the event of an emergency. Arcadis communicated the information contained within the HASP to site personnel, and made them aware of any contamination of significant concern within the site area. A copy of the HASP has been retained on file by Arcadis.

3.2 Soil Investigation

The soil investigation consisted of excavating nine test pits in the study area. ATCO Structures and Logistics Services Ltd. (ATCO) was subcontracted by Arcadis to advance the test pits using a mechanical excavator. Test pits were excavated to permafrost or suspected LTU depth ranging in depth from approximately 0.45 to 0.75 metres below ground surface (m bgs). Five test pits were advanced across LTU 1 and a single sample was collected from each test pit. Four test pits were advanced across LTU 2 and a single sample was collected from each test pit. Two additional grab samples were collected from LTU 3 and LTU 4 respectively. The soil grab samples collected from LTUs 3 and 4 were collected with the use of a stainless steel shovel. All soil samples were submitted for the laboratory analysis of benzene, toluene, ethylbenzene, xylenes (BTEX), PHCs, and metals. In addition, select soil samples from the LTUs were also submitted for the laboratory analysis of PAHs. Two PFC samples were collected from the LTUs in general accordance with the TC PFC sampling guidance.

The location of the test pits is illustrated on Figure 2. Photos taken during test pitting activities are provided in Appendix A. Field observations and soil sampling details at each test pit location are summarized in the individual test pit logs provided in Appendix B.

The field program consisted of the following elements:

- Discrete soil samples were collected with contaminant-free utensils directly into laboratory supplied sample jars.
- Soils were examined for soil type, moisture content, colour, consistency and presence of debris and olfactory evidence of contamination.

- Arcadis completed a combustible vapour survey on each soil sample following a stabilization period using a headspace method.
- To de-contaminate sampling equipment, all re-usable soil sampling apparatus such as a stainless steel shovel was successively washed with alconox and triple-rinsed with distilled water. Fresh nitrile gloves were used for each sample location.
- Approximately 10% collected soil samples submitted to the laboratory were blind field duplicates. The duplicates are in addition to any duplicates and replicates analyzed as part of the standard lab QA/QC procedures.
- Arcadis documented all aspects of the sampling program which could potentially cause sampling bias. The documentation included daily field summary sheets, separate filing of field notes, chain-of-custody forms and memos written when any major deviation from ideal protocol occurs (e.g., an ice-pack melts, a bottle is broken, etc.).

3.2.1 Laboratory Analysis

All chemical analysis were completed by Maxxam Analytics (Maxxam) in Ottawa, Ontario. Maxxam is certified by the Canadian Association for Laboratory Accreditation Inc. (CALA). The laboratory program included verification that the selected analytical methods had minimum detection limits which were less than the applicable environmental quality criteria or standard on which the numerical comparison was based.

3.2.2 Quality Assurance/Quality Control and Chemical Analyses

Field Quality Assurance/Quality Control (QA/QC) Program

The field QA/QC program consisted of the following elements:

- Use of standard operating procedures for routine sampling activities.
- Appropriate training of field staff.
- Proper documentation of all aspects of the sampling program, which could potentially cause sampling bias. The documentation included daily field summary sheets, separate filing of field notes, chain-of-custody forms and memos written when any major deviation from ideal protocol occurs (e.g., an ice-pack melts, a bottle is broken, etc.).
- Decontamination of all soil and surface water sampling equipment. All re-usable soil and water sampling apparatus such as hand shovels was successively washed with alconox, rinsed with distilled water, rinsed with methanol and rinsed with distilled water.
- A minimum of 10% collected soil and water samples were submitted to the laboratory as blind field duplicates. These duplicates were in addition to any duplicates and replicates analyzed as part of the standard lab QA/QC procedures.
- Arcadis was aware of the sample holding time requirements. Immediately following collection, all samples were transferred and stored in coolers with ice packs to hold the sample temperature at approximately 4 -10°C, as required by most laboratory protocols.

- All samples were delivered to the laboratory as soon as possible following the sampling, by courier, accompanied by a Chain of Custody form.

Laboratory Quality Assurance/Quality Control (QA/QC) Program

To assess the reliability of the laboratory data, one duplicate sample was taken. Arcadis personnel generated the duplicate soil samples by alternately placing approximately 10 percent of the sample volume into the primary sample container and then placing the same amount into the duplicate container. The field staff continued placing aliquots of approximately 10 percent of the container volume into each container until both containers were filled.

Analytical data quality was assessed by submission of the following:

- Soil sample LTU1-1 (primary) and LTU-DUP2 (duplicate) were analyzed for BTEX, PHCs, PAHs, and metals.
- Soil sample LTU2-2 (primary) and LTU-DUP1 (duplicate) were analyzed for BTEX, PHCs, PAHs, and metals

The relative percent difference (RPD) was calculated using the following formula:

$$RPD = \frac{|X_1 - X_2|}{X_{average}} \times 100$$

where, X_1 and X_2 are the duplicate concentrations and $X_{average}$ is the mean of these two values. Results for duplicate analyses of field duplicate samples were considered acceptable where RPD values were <100% for soil duplicate analyses, consistent with common industry practices. Note that consistent with laboratory practices, meaningful RPD values for field duplicate analyses were calculated only where detected concentrations in both samples were greater than five times the laboratory reportable detection limit (RDL).

3.3 Groundwater Assessment

Arcadis attempted to collect groundwater samples from the six monitoring wells surrounding LTU 1 and LTU 2. The monitoring wells are stickup PVC risers with caps and no monuments. Many of the wells were not at right angles to the ground at the time of the site visit, indicating that frost heave may have altered their condition.

Arcadis attempted to open and measure water levels at all wells.

3.4 LTU Observations

During the site visit, Arcadis made observations about the conditions of the LTUs, the conditions of the geomembrane liners, and the dimensions of the LTUs.

Because the soil in the LTUs was frozen at the time of the site visit, it was not possible to conduct an investigation of the liners below the soil in the LTUs. Mechanical excavation was required to move the soil; however, hand excavation would have been required to expose the liner below the soil without damage. The frozen soil conditions did not permit such hand excavation to expose the liner below the LTUs.

The liner on LTU 1 was very shallow in some areas, which resulted in inadvertent exposure of the liner in the area around the sample location LTU1-1, where minor damage was observed. No damage was observed to the liner of LTU 2. However, a tarp was covering the northern portion of LTU 2 and no test pits could be advanced in that area.

Because Arcadis could not expose the liner for fear of damaging it, and because part of LTU 2 was inaccessible, it was not possible to make detailed measurements of the depth of soil in the LTUs.

4 RESULTS

4.1 Site Conditions

At the time of Arcadis's site visit, temperatures were approximately -5 °C with wind and substantial snow cover. As a result, mechanical excavation in the LTUs was difficult and hand excavation impossible. Snow cover made measurement of soil depths difficult. Groundwater was frozen in all monitoring wells.

4.2 Geology and Surficial Geology

Surficial geology in the area of site consists of colluvial deposits. Colluvial deposits are colluvial and residual materials deposited as veneers and blankets of debris through downslope movement and in place disintegration of bedrock, including areas of rock outcrop. Specifically the overburden is comprised of colluvial rubble, which contains rubble and silt derived from carbonate and consolidated fine clastic sedimentary rock substrate. The bedrock is of Paleozoic era, specifically the Arctic Platform and is composed Silurian carbonate and siliciclastic rocks (Canada-Nunavut Geoscience Office, 2006).

The Resolute Bay area is subject to continuous permafrost. Groundwater is not used as a drinking water source as glacial water is readily available and is used as the potable water supply.

During the intrusive investigation carried out at the site on September 22, 2015, the soils encountered consisted of brown silt mixed with some rock and stones extending to the maximum depth investigated of approximately 0.7 m bgs. Soils encountered at each test pit location are described in greater detail in the test pit logs provided in Appendix B.

4.3 Soil Analytical Results

Soil analytical results are provided in Tables 7 to 10, presented on Figure 3, and discussed in greater detail in sections 4.2.1 to 4.2.4 below. Laboratory certificate of analysis including lab QA/QC results are included in Appendix C.

4.3.1 Petroleum Hydrocarbons

Thirteen soil samples (including two duplicate samples) were collected from the LTUs and submitted for the laboratory analysis of BTEX and PHCs. Of the thirteen soil samples analyzed, six samples (including one duplicate sample) were collected from LTU 1, five samples (including one duplicate sample) were collected from LTU 2, and one sample was collected from each of LTU 3 and LTU 4. Analytical Results for the soil samples are provided in Table 7 and presented on Figure 3.

One or more of benzene, toluene, ethylbenzene, xylenes, PHC F1, and/or PHC F2 exceeded the CCME guidelines in all thirteen soil samples analyzed. The results ranged from concentrations below laboratory detection limits to 67 times the CCME guideline for toluene in LTU2-1. The most prevalent exceedances of guidelines were for PHC F2 (11 exceedances in primary samples) and PHC F1 (6 exceedances in primary samples).

The laboratory RDL exceeded the applicable CCME guideline for the benzene analysis of soil samples LTU1-4 and LTU-DUP1.

4.3.2 Polycyclic Aromatic Hydrocarbons

Seven soil samples (including two duplicate samples) were collected from the LTUs and submitted for the laboratory analysis of PAHs. The parent sample for LTU-DUP2 (LTU1-1) was not submitted for the laboratory analysis of PAHs due to a laboratory submission error. Of the seven soil samples analyzed, three samples (including one duplicate sample) were collected from LTU 1, three samples (including one duplicate sample) were collected from LTU 2, and one sample was collected from LTU 3. Analytical Results for the soil samples are provided in Table 8 and presented on Figure 3.

All soil samples were below the CCME guidelines for PAH parameters. The results ranged from concentrations below laboratory detection limits to 0.7 times the CCME guideline for naphthalene in LTU2-1. The most prevalent contaminant detected was pyrene, in six primary samples.

4.3.3 Metals

Thirteen soil samples (including two duplicate samples) were collected from the LTUs and submitted for the laboratory analysis of metals. Of the thirteen soil samples analyzed, six samples (including one duplicate sample) were collected from LTU 1, five samples (including one duplicate sample) were collected from LTU 2, and one sample was collected from each of LTU 3 and LTU 4. Analytical Results for the soil samples are provided in Table 9 and presented on Figure 3.

All soil samples were below the CCME guidelines for metals parameters. The results ranged from concentrations below laboratory detection limits to 0.2 times the CCME guideline for arsenic, selenium and zinc in various samples. The most prevalent contaminants detected were arsenic, barium, cobalt, copper, lead, nickel, uranium, vanadium and zinc, each detected in 11 primary samples.

4.3.4 Perfluorinated Compounds

Two soil samples were collected from the LTUs and submitted for the laboratory analysis of PFCs. One sample was collected from LTU 1 (LTU1-2) and one sample was collected from LTU 2 (LTU2-4). Analytical Results for the soil samples are provided in Table 10 and presented on Figure 3.

Both soil samples analyzed exceeded the interim advice guidelines for PFOS, with the range of exceedances between seven and 22 times the guideline value.

4.4 Quality Assurance and Quality Control Results

The results of field duplicate soil analyses and the relative percent difference (RPD) calculations for duplicate analyses are summarized in the tables along with their respective parent samples. The results of other QA/QC analyses are provided in the Laboratory Certificates of Analysis (Appendix C). Results of field and laboratory duplicate analyses generally agreed with their respective analytical pairs, and laboratory and field RPD values (where calculated) were generally within acceptance criteria and alert limits, respectively.

The laboratory and field QC were generally within acceptance criteria and alert limits, respectively. No specific deviations were identified. Overall, the laboratory and field QA/QC results confirm that sample handling and analytical protocols were acceptable, and the results were reproducible.

4.5 Groundwater Conditions

Arcadis measured groundwater depths at all wells. In all cases where groundwater depths were measured, the water was frozen. Depths are shown in Table 1, below. Arcadis assigned identifiers to monitoring wells in the field, as no previous identifying numbers were provided in previous reports.

Table 1: Groundwater Monitoring Results

Monitoring Well	Depth to Frozen (m)	Comment
MW1	1.110	
MW2	1.110	
MW3	1.160	
MW4	NA	Well cap frozen in place
MW5	1.535	
MW6	1.490	

There were no protective casings installed around the stickup PVC risers. As a result, the wells showed some damage from the elements.

Arcadis is unaware of any well installation logs, and did not survey the elevations of the monitoring wells. As a result, it is not possible to determine groundwater flow direction from the measured water levels.

Based on the topography of the area, Arcadis expects that any groundwater present during the short un-frozen ground period will move from east to west across the LTU area, towards Resolute Bay.

4.6 LTU Observations

During the site visit Arcadis observed that a berm was constructed around all of the LTUs. The berm varied in width from one to two metres.

Arcadis confirmed the LTU dimensions as shown in Table 2, below. Dimensions are internal measurements from berm to berm, whereas previous measurements by WERI were external and included the berms in measurements.

Table 2: LTU Dimensions

Unit	Dimensions	Total Area (calculated, rounded)
LTU 1	55 m x 35 m	1,900 m^2
LTU 2	80 m x 30 m	2,400 m^2
LTU 3	30 m x 4 m	120 m^2
LTU 4	30 m x 4 m	120 m^2

Arcadis did not measure the depth of the soil in the LTUs to avoid damaging the liners. As a result, Arcadis cannot make an estimate of the volume of soils present in the LTUs.

Exposure to ultraviolet (UV) rays has degraded the condition of the geomembrane that was used to line the LTUs where it is visible around the edges of the LTUs and not covered by soil in the typical manner. While the visible liner is degraded, this degradation is not necessarily the case for the liner below the LTU soil, as it has not been exposed to UV rays.

The liner was reportedly originally provided by TC and is made of 20 mil oil resistant polyethylene. (WERI, 2005.)

The tarped area shown on Figures 2 and 3 is the area where the piping was installed in and is adjacent to the heating unit.

5 DISCUSSION

5.1 Effectiveness of Remediation

WERI performed sampling in the LTUs between their construction in 2002 and 2005. Franz Environmental Inc. (Franz), a predecessor company to Arcadis, collected soil samples from the LTUs in 2009.

As a proxy for the effectiveness of remediating all PHCs and associated contaminants, Arcadis has compared concentrations of PHC fraction F2 over time. Concentrations of PHC F2 were the highest of all PHC fractions measured at the start of remediation. It is also less likely to volatilize than BTEX components and PHC F1, so a confirmed decrease in PHC F2 concentrations over time likely means that bioremediation is proceeding successfully.

Arcadis notes that the 2009 samples were not collected using a mechanical excavator, and were only advanced to a maximum depth of 15 cm below the surface. These samples are likely to give a best-case estimate of concentrations of PHCs in soil.

Table 3: LTU 1 Concentrations of PHC F2

Date	Average PHC F2 Concentration (ug/g)
August, 2002	2961
September, 2003	3068
September, 2005	2426
August 19, 2009	513
September 22, 2015	1957

Table 4: LTU 2 Concentrations of PHC F3

Date	Average PHC F2 Concentration (ug/g)
August 1, 2002	2044
September 1, 2003	1679
September 1, 2005	1622
August 19, 2009	1610
September 22, 2015	1772

Arcadis performed the simple statistical analysis known as a t-test on the data from 2002 and 2015 to assess whether the mean concentration in 2002 was significantly different from 2015, i.e., whether the analytical data supports the conclusion that an observable decrease has occurred over the thirteen years.

For both LTU 1 and LTU 2, Arcadis was unable to reject the null hypothesis that the samples had the same mean value – i.e., it is not possible to confirm any decrease in concentration based on the analytical results.

5.2 Landfarm Operations and Management

The Federal Contaminated Sites Action Plan (FCSAP) has developed Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils (FCSAP, 2013). The Guidelines provide recommendations for construction and maintenance of landfarms.

The guide notes that most biodegradation of PHCs occurs at temperatures above freezing. Arcadis referred to the Canadian Climate Normals provided by Environment Canada and obtained the average soil temperatures by month at specific depths below surface, shown in Table 5, below. Arcadis selected afternoon/evening observations for the table, which is likely representative of maximum temperatures.

Table 5: Average Evening-Observed Soil Temperatures by Month, Resolute

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
10 cm depth (T °C)	-17.5	-19.5	-20.4	-19.5	-15.4	-1.2	5.3	3.1	-0.4	-5.3	-10.4	-14.2	-9.6
20 cm depth (T °C)	-17.8	-19.8	-20.8	-19.9	-16.1	-2.9	3.4	1.6	-1.1	-5.8	-10.8	-14.5	-10.4
50 cm depth (T °C)	-14.7	-16.5	-17.8	-17.5	-14.8	-5.1	0.7	1.4	0.5	-3.1	-7.7	-11.1	-8.8

All months where soil temperatures at depth were above zero are highlighted in yellow, illustrating the limited operational season of a landfarm in Resolute.

The Federal Guidelines also make recommendations for the construction of landfarms, including recommendations on site security, leachate control, emission control, and other matters. Among the design recommendations is that soil depths should be between 0.30 and 0.45 metres. Because LTUs 1 and 2 were constructed before the Guidelines were first available, Arcadis has not compared the construction techniques of the LTUs with the Guidelines.

The Guidelines also, however, make recommendations on operations and maintenance of landfarms. Arcadis has summarized Section 8.4 of the Guidelines on Operations and Maintenance below, with comments on the Resolute Bay LTUs.

Table 6: Landfarm Guidelines on O&M, Summary and Comments

Guidelines on O&M Summary	Comments for Resolute
Operation Period The operating period of a landfarm depends on climatic conditions. It is recommended that the landfarm should operate for between 6 months to 2 years. This operation period assumes optimal conditions are maintained (i.e. regular tilling; moisture control; nutrient amendment, if required).	The overall operating period in Resolute will be substantially longer than average because of the low average temperatures. As a result, it is important that optimal conditions are maintained if any remediation is to progress.

Guidelines on O&M Summary	Comments for Resolute
Microbial Population Density Monitoring Monitoring of the microbial population should be conducted during the landfarm operations if remediation progress is suspected to be stalled. Although amending soils with bacteria has had limited success, commercially-available inoculates may be used, particularly in southern regions of Canada. Cold-adapted microorganisms native to arctic and sub-arctic regions are not readily available.	Relatively high microbial populations were measured at the LTUs in the past (WERI, 2005), although hydrocarbon-reducing bacteria were not measured at high levels. If bioremediation does not progress after addressing other operational issues, bacterial analysis should be conducted. Bacterial inoculations are unlikely to be available that are appropriate for Resolute, so analysis is not a high priority.
pH Maintenance The optimal pH for landfarming operations is between 6 and 8.	pH should be analysed in a future field program.
Moisture Content Monitoring Landfarm moisture should be monitored and adjusted where required. Effective moisture levels are 40 - 85 % of water-holding capacity in the soil, but 20 - 85 % will support microbes. Water spraying is often needed during summer months, particularly prior to tilling, in order to reduce wind erosion.	Soil moisture content was low in samples collected in 2009 (less than 10% in all samples) and again in 2015 (less than 10% in all samples). This is not unexpected in an arctic desert environment, but is outside the realm where bioremediation can be expected. Water addition will be required if the LTUs are to be effective, although this will require an amendment to the Water Licence.
Nutrient Amendments Requirements If available nutrients are not sufficient, soil amendment in the form of commercial fertilizers may be required. Nutrients can be supplied to the soil in either liquid or solid form, and may be added directly to the soil when the soil is mixed prior to placement in the landfarm or during tilling events once the landfarm is operational.	Nutrients may be required for optimization of landfill performance; however, other considerations (water, tilling) are likely of higher priority. Analysis in a future field program will help to assess requirements.
Tilling Tilling is recommended once per month during the operating season of the landfarm, provided the soil is uniformly moist but not saturated. Tilling must be carefully carried-out by an experienced operator to avoid damaging the liner.	The landfarm has not been tilled on a regular basis. Regular tilling will be required in the future to ensure optimal operation.
System Maintenance Regular (i.e., weekly and after a major storm) inspections are recommended for drainage control systems and leachate collection systems.	No such systems are in place, but inspection of the LTUs should be conducted regularly.

Guidelines on O&M Summary	Comments for Resolute
Monitoring and Closure When monitoring the soils on the landfarm, samples should be taken at regular intervals according to a sampling plan. Environmental quality guidelines will provide the termination criteria for remediation. Remediated soil may be used in a manner that is consistent and appropriate with site use. If other contaminants exceed guidelines, landfarmed materials should be further remediated using an alternative remediation technique.	Regular sampling should be conducted to confirm any reduction in concentrations at the LTUs.

5.3 Soil Volumes

Arcadis was unable to measure the depth of soil in the LTUs and was therefore unable to accurately measure the total volume of soil. This inability to measure depth was the result of snow cover and the inadvisability of excavating fully to the liner.

During the field program, however, Arcadis measured the total areal extent of LTUs 1 and 2 at 4,300 m^2. If the volume estimated by WERI in previous reports as present in the LTUs is correct (i.e., 5,800 m^3), the LTUs are filled to an average approximate height of 1.3 metres.

This result is consistent with test pits extending as far as 0.7 metres below ground surface before encountering permafrost in the LTUs.

The depth of soil in the LTUs is substantially higher than the height recommended in the Guidance. As a result, the addition of further soil is not recommended.

5.4 Future Planning

Arcadis recommends developing an update to the landfarm Operations and Maintenance Plan (O&M Plan) for the LTUs. The updated O&M Plan will identify sampling requirements, priorities for additional work, and requirements for compliance with the LTU Water Licence. The priorities for the updated O&M Plan should be identifying a local contractor who can be responsible for regular maintenance of the LTUs, outlining the scope of regular maintenance work (tilling, water addition) and developing a sampling plan.

The O&M plan should use the Federal Landfarming Guidelines as a basis.

Because equipment and operators are at a premium during the summer construction season, the updated O&M plan may also have to identify contracting strategies that will ensure that the work will be done.

The presence of PFCs in the LTUs means that successful operation of the landfarm will not necessarily remediate all contaminants. PFCs should be included in the update to the O&M plan, and additional sampling will help to delineate PFCs in the LTUs.

Groundwater monitoring is required as part of the LTU Water Licences. Because monitoring wells were frozen and the ground was snow covered during the 2015 site visit, it was difficult to fully assess well conditions. A full assessment of monitoring well conditions should be made at the next Licence monitoring and sampling event.

Arcadis is not aware of a Phase I ESA prepared for the site, and previous remedial reports concentrate solely on PHCs and related compounds. Federal risk assessment guidance (Health Canada, 2010 revised 2012) recommends the consideration of the following compounds for fire training areas – only some of which have been previously addressed: PHCs, PAHs, volatile organic compounds (notably solvents), lead, methyl tert-butyl ether, and perfluorinated compounds. As a result, future sampling programs should consider the potential for other contaminants in the LTUs.

6 CONCLUSIONS

1. Arcadis Canada Inc. (Arcadis) was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) to conduct a data gap Environmental Site Assessment (ESA) at the Resolute Bay Airport Land Treatment Units (LTUs) in Resolute Bay, NU. The ESA was conducted under PSPC project number R.056019.001.
2. There is a former firefighter training area (FFTA) north of the Resolute Bay Airport. In 2002, Winnipeg Environmental Remediations Inc. (WERI) conducted demolition and remedial activities at the FFTA in attempt to bring the Resolute Bay Airport into compliance with environmental legislation. Remediation and confirmatory sampling in the FFTA was completed between 2002 and 2005. Contaminated soils were excavated and placed in two LTUs.
3. Two smaller LTUs are present in the area (LTU 3 and LTU 4); however, no background information on the source of contents or construction of the LTUs is available. TC has indicated that it is not the custodian of the smaller LTUs.
4. Arcadis was on site on September 22, 2015 to carry out the site investigation activities. Investigation activities included the inspection of monitoring well and the LTU liner conditions and the advancement of test pits with associated soil sampling to document the current soil conditions. Groundwater samples were scheduled to be collected; however, groundwater in the site monitoring wells was frozen and no samples could be collected.
5. During the site visit, Arcadis noted that the liner on LTU 1 was very shallow in some areas. As a result, minor damage to the liner was noted around sample location of LTU1-1. No damage was observed to the liner of LTU 2; however, a tarp was covering the northern portion of LTU 2 and no test pits could be advanced in that area.
6. Nine test pits were advanced in the four LTUs. Test pits were excavated to permafrost ranging in depth from approximately 0.45 to 0.75 metres below ground surface (m bgs).
    a. Five test pits were advanced in LTU 1. A single sample was collected from each test pit.
    b. Four test pits were advanced in LTU 2. A single sample was collected from each test pit.
    c. Two additional grab samples were collected from LTU 3 and LTU 4 respectively.
7. All soil samples were submitted for the laboratory analysis of benzene, toluene, ethylbenzene and xylenes (BTEX); petroleum hydrocarbons (PHCs); and metals. Select soil samples from the LTUs were also submitted for the laboratory analysis of polycyclic aromatic hydrocarbons (PAHs) and perfluorinated compounds (PFCs).
8. One or more of BTEX, PHC F1, and/or PHC F2 exceeded the Canadian Council of Ministers of the Environment (CCME) guidelines in all thirteen soil samples (including two duplicate samples). The soil samples were below CCME guidelines for all PAH and metals parameters. Both soil samples (LTU1-2 and LTU2-4) analyzed for PFCs exceeded the applicable Federal Soil Quality Guidelines for PFOS.
9. Arcadis compared the concentrations of PHC F2 in the LTUs between 2015 and the beginning of the remedial program. For both LTU 1 and LTU 2, Arcadis was unable to reject the null hypothesis

that the samples had the same mean value – i.e., it is not possible to confirm any decrease in concentrations of PHC F2 between 2002 and 2015.

10. The operating period of the Resolute Bay Airport LTUs will be substantially longer than the average of 6 months to 2 years provided in federal guidance, because of the short summer season when temperatures are above zero. As a result, it is important that optimal landfarming conditions are maintained if any remediation is to progress. These conditions include regular tilling, maintenance of appropriate moisture content and pH, and regular sampling.
11. In order to ensure optimal conditions for the landfarm, Arcadis recommends developing an updated Operations and Maintenance Plan.
12. The presence of PFCs above guidelines in the LTUs means that successful operation of the landfarm will not necessarily remediate all contaminants. PFCs should be included in the Operations and Maintenance Plan. Additional sampling will help to delineate PFCs in the LTUs.
13. Groundwater monitoring is required as part of the LTU Water Licences. Because monitoring wells were frozen and the ground was snow covered during the 2015 site visit, it was difficult to fully assess well conditions. A full assessment of monitoring well conditions should be made at the next Licence monitoring and sampling event.

7 REFERENCES

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8 LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by Arcadis Canada Inc. (Arcadis) for Public Services and Procurement Canada (PSPC). It is intended for the sole and exclusive use of PSPC. Any use, reliance on or decision made by any other person other than PSPC based on this report is the sole responsibility of such other person. PSPC and Arcadis make no representation or warranty to any other person with regard to this report and the work referred to in this report and they accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

This report has been prepared in accordance with generally accepted engineering and environmental practices for the exclusive use of PSPC. This report is based on the historical information provided and information obtained during this work program.

Third party information reviewed and used to compile the data and conclusions contained in this report is assumed to be complete and correct. Arcadis used this information in good faith and will not accept any responsibility for deficiencies, misinterpretation or incompleteness of the information contained in documents prepared by third parties.

The investigation undertaken by Arcadis with respect to this report and any conclusions or recommendations made in this report reflect Arcadis' judgment based on the site conditions observed at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. This report has been prepared for specific application to the site and it is based, in part, upon visual observation of the site, subsurface investigation at discrete locations and depths, and specific analysis of specific chemical parameters and materials during a specific time interval, all as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, portions of the site which were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters, materials or analysis which were not addressed. Substances other than those addressed by the investigation described in this report may exist within the site, substances addressed by the investigation may exist in areas of the site not investigated and concentrations of substances addressed which are different than those reported may exist in areas other than the locations from which samples were taken. Notwithstanding these limitations, this report is believed to provide a reasonable representation of activities completed and Site conditions as of September 2015.

If site conditions or applicable standards change or if any additional information becomes available at a future date, modifications to the findings, conclusions and recommendations in this report may be necessary.

Other than by PSPC, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of Arcadis. Nothing in this report is intended to constitute or provide a legal opinion.

TABLES

Table 7
Soil Analytical Results - Petroleum Hydrocarbons
PWGSC
Resolute Bay LTUs

Sample Location					LTU 1							
Sample Date					2015/09/22	2015/09/22			2015/09/22	2015/09/22	2015/09/22	2015/09/22
Sample ID	Units	Lowest RDL	CCME CSQG	CCME CWS-PHCs	LTU 1-1	LTU-DUP2	RPD		LTU1-2	LTU1-3	LTU1-4	LTU1-5
Sampling Company					Arcadis	Arcadis			Arcadis	Arcadis	Arcadis	Arcadis
Laboratory			Industrial	Industrial	Maxxam	Maxxam			Maxxam	Maxxam	Maxxam	Maxxam
Sample Depth (m)					0.45	0.45			0.45	0.45	0.60	0.65
BTEX/Petroleum Hydrocarbons												
Benzene	ug/g	0.01	0.03	n/v	<0.005	<0.01	nc	Acceptable	**0.24**	**0.25**	*<0.05*	<0.03
Toluene	ug/g	0.02	0.37	n/v	<0.02	<0.04	nc	Acceptable	0.2	<0.1	**1.8**	0.1
Ethylbenzene	ug/g	0.01	0.082	n/v	<0.01	<0.02	nc	Acceptable	**0.09**	<0.05	**0.4**	<0.05
o-Xylene	ug/g	0.02	n/v	n/v	0.02	<0.04	nc	Acceptable	3.3	3.3	33	1.1
p+m-Xylene	ug/g	0.04	n/v	n/v	<0.04	<0.08	nc	Acceptable	2.4	1.1	27	0.2
Total Xylenes	ug/g	0.04	11	n/v	<0.04	<0.08	nc	Acceptable	5.7	4.4	**60**	1.3
PHC F1 (C6-C10 range)	ug/g	10	n/v	n/v	170	230	30%	Acceptable	530	830	2400	600
PHC F1 (C6-C10 range) minus BTEX (calc)	ug/g	10	n/v	320	170	230	30%	Acceptable	**530**	**830**	**2400**	**600**
PHC F2 (>C10-C16 range)	ug/g	10	n/v	260	**810**	**780**	4%	Acceptable	**650**	**1800**	**5100**	**2600**
PHC F3 (>C16-C34 range)	ug/g	50	n/v	1700	250	190	nc	Acceptable	130	370	1000	660
PHC F4 (>C34-C50 range)	ug/g	50	n/v	3300	92	71	nc	Acceptable	<50	150	370	320

Notes:

CCME CSQG	Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Protection of Environmental and Human Health, Summary Table, Update 7.1, 2010, Industrial Land Use and Coarse grained soil.
CCME CWS-PHCs	Canadian Council of Ministers of the Environment Canada Wide Standards for Petroleum Hydrocarbons, Summary Table 1, Sumnmary of Tier 1 Levels for Surface Soils, Industrial Land Use and Coarse grained soil.
6.5	Concentration exceeds the CCME guidelines
Italics	Laboratory RDL exceeds CCME guideline
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

Table 7
Soil Analytical Results - Petroleum Hydrocarbons
PWGSC
Resolute Bay LTUs

Sample Location					LTU 2							LTU 3	LTU 4
Sample Date					2015/09/22	2015/09/22	2015/09/22			2015/09/22	2015/09/22	2015/09/22	2015/09/22
Sample ID	Units	Lowest RDL	CCME CSQG	CCME CWS-PHCs	LTU2-1	LTU2-2	LTU-DUP1	RPD		LTU2-3	LTU2-4	LTU3-1	LTU4-1
Sampling Company					Arcadis	Arcadis	Arcadis			Arcadis	Arcadis	Arcadis	Arcadis
Laboratory			Industrial	Industrial	Maxxam	Maxxam	Maxxam			Maxxam	Maxxam	Maxxam	Maxxam
Sample Depth (m)					0.75	0.60	0.60			0.70	0.75	0.10	0.10
BTEX/Petroleum Hydrocarbons													
Benzene	ug/g	0.01	0.03	n/v	**1.3**	**0.2**	*<0.05*	nc	Acceptable	<0.005	0.009	**0.11**	<0.005
Toluene	ug/g	0.02	0.37	n/v	**25**	**0.5**	**0.4**	22%	Acceptable	<0.02	<0.02	**15**	0.02
Ethylbenzene	ug/g	0.01	0.082	n/v	**3.6**	**0.11**	**0.2**	58%	Acceptable	<0.01	<0.01	0.03	<0.01
o-Xylene	ug/g	0.02	n/v	n/v	50	16	11	37%	Acceptable	<0.02	0.13	0.04	0.03
p+m-Xylene	ug/g	0.04	n/v	n/v	99	23	15	42%	Acceptable	<0.04	0.15	0.06	<0.04
Total Xylenes	ug/g	0.04	11	n/v	**150**	**39**	**26**	40%	Acceptable	<0.04	0.28	0.1	<0.04
PHC F1 (C6-C10 range)	ug/g	10	n/v	n/v	4100	1300	780	50%	Acceptable	39	120	40	160
PHC F1 (C6-C10 range) minus BTEX (calc)	ug/g	10	n/v	320	**3900**	**1200**	**760**	45%	Acceptable	39	120	25	160
PHC F2 (>C10-C16 range)	ug/g	10	n/v	260	**4600**	**1600**	**2000**	22%	Acceptable	**280**	**380**	**400**	**Ba**
PHC F3 (>C16-C34 range)	ug/g	50	n/v	1700	830	330	330	0%	Acceptable	120	250	<50	53
PHC F4 (>C34-C50 range)	ug/g	50	n/v	3300	380	120	110	nc	Acceptable	<50	140	<50	<50

Notes:

CCME CSQG	Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Protection of Environmental and Human Health, Summary Table, Update 7.1, 2010, Industrial Land Use and Coarse grained soil.
CCME CWS-PHCs	Canadian Council of Ministers of the Environment Canada Wide Standards for Petroleum Hydrocarbons, Summary Table 1, Sumnmary of Tier 1 Levels for Surface Soils, Industrial Land Use and Coarse grained soil.
6.5	Concentration exceeds the CCME guidelines
Italics	Laboratory RDL exceeds CCME guideline
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

Table 8
Soil Analytical Results - Polycyclic Aromatic Hydrocarbons
PWGSC
Resolute Bay LTUs

Sample Location					LTU 1				LTU 2			LTU 3
Sample Date				2015/09/22	2015/09/22	2015/09/22	2015/09/22	2015/09/22	2015/09/22			2015/09/22
Sample ID	Units	Lowest RDL	CCME CSQG	LTU-DUP2	LTU1-3	LTU1-5	LTU2-1	LTU2-2	LTU-DUP1	RPD		LTU3-1
Sampling Company				Arcadis	Arcadis	Arcadis	Arcadis	Arcadis	Arcadis			Arcadis
Laboratory			Industrial	Maxxam	Maxxam	Maxxam	Maxxam	Maxxam	Maxxam			Maxxam
Sample Depth (m)				0.45	0.45	0.65	0.75	0.60	0.60			0.10
Polycyclic Aromatic Hydrocarbons												
Benzo[a]pyrene equivalency (BaP PEF[2])	ug/g	n/v	5.3	n/a	0.0305	0.1052	0.0382	0.0074	0.0074	1%	Acceptable	0.0015
Methylnaphthalene, 2-(1-)	ug/g	0.0071	n/v	0.97	9.4	0.47	47	17	15	13%	Acceptable	<0.10
Benzo(e)pyrene	ug/g	0.0050	n/v	<0.0050	0.019	0.047	0.025	0.0075	0.0067	nc	Acceptable	0.005
Acenaphthene	ug/g	0.0050	n/v	0.077	0.25	0.21	0.28	0.15	0.14	7%	Acceptable	0.034
Acenaphthylene	ug/g	0.0050	n/v	0.019	0.066	0.067	0.084	0.041	0.04	2%	Acceptable	<0.050
Anthracene	ug/g	0.0050	32	<0.0050	0.023	0.054	0.052	0.011	0.011	nc	Acceptable	<0.0050
Benzo(a)anthracene	ug/g	0.0050	10	<0.0050	0.022	0.069	0.028	0.0066	0.006	nc	Acceptable	0.0053
Benzo(a)pyrene	ug/g	0.0050	1.4	<0.0050	0.021	0.072	0.027	0.0051	0.0053	nc	Acceptable	<0.0050
Benzo(b/j)fluoranthene	ug/g	0.0050	10	<0.0050	0.034	0.093	0.038	0.0083	0.0079	nc	Acceptable	0.0089
Benzo(g,h,i)perylene	ug/g	0.0050	n/v	<0.0050	0.026	0.069	0.045	0.012	0.01	nc	Acceptable	<0.0050
Benzo(k)fluoranthene	ug/g	0.0050	10	<0.0050	0.011	0.03	0.012	<0.0050	<0.0050	nc	Acceptable	<0.0050
Chrysene	ug/g	0.0050	n/v	<0.0050	0.023	0.065	0.029	0.0075	0.0069	nc	Acceptable	0.0063
Dibenz(a,h)anthracene	ug/g	0.0050	10	<0.0050	<0.0050	0.0062	<0.0050	<0.0050	<0.0050	nc	Acceptable	<0.0050
Fluoranthene	ug/g	0.0050	180	0.016	0.076	0.18	0.11	0.028	0.026	7%	Acceptable	0.0057
Fluorene	ug/g	0.0050	n/v	0.073	0.28	0.22	0.51	0.21	0.2	5%	Acceptable	<0.050
Indeno(1,2,3-cd)pyrene	ug/g	0.0050	10	<0.0050	0.023	0.065	0.027	0.0063	0.0051	nc	Acceptable	<0.0050
1-Methylnaphthalene	ug/g	0.0050	n/v	0.76	5.4	0.31	19	6.9	6.1	12%	Acceptable	0.03
2-Methylnaphthalene	ug/g	0.0050	n/v	0.22	4	0.16	28	10	8.7	14%	Acceptable	<0.10
Naphthalene	ug/g	0.0050	22	0.22	1.8	<0.50	16	5.7	4.6	21%	Acceptable	<0.10
Phenanthrene	ug/g	0.0050	50	0.044	0.25	0.16	0.58	0.16	0.15	6%	Acceptable	<0.0050
Pyrene	ug/g	0.0050	100	0.024	0.13	0.32	0.16	0.044	0.041	7%	Acceptable	0.032
Biphenyl	ug/g	0.0050	n/v	<0.010	<0.050	<0.050	1.5	<0.50	<0.10	nc	Acceptable	<0.010
Perylene	ug/g	0.0050	n/v	<0.0050	<0.0050	0.013	0.0059	<0.0050	<0.0050	nc	Acceptable	<0.0050

Notes:

CCME CSQG	Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for
BaP PEF[2]	Benzo[a]pyrene Total Potency Equivalents, which is the sum of estimated cancer potency relative to B[a]P for all potentially carcinogenic unsubstituted PAHs. The B[a]P TPE for a soil sample is calculated by multiplying the concentration of each PAH in the sample by its B[a]P Potency Equivalence Factor (PEF), given in the column, and summing these products. B[a]P PEFs are order of magnitude estimates of carcinogenic potential and are based on the World Health Organization (WHO/IPCS 1998) scheme.
6.5	Concentration exceeds the CCME guidelines
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

Table 9
Soil Analytical Results - Metals
PWGSC
Resolute Bay LTUs

Sample Location				LTU 1							
Sample Date				2015/09/22	2015/09/22			2015/09/22	2015/09/22	2015/09/22	2015/09/22
Sample ID	Units	Lowest RDL	CCME CSQG	LTU 1-1	LTU-DUP2	RPD		LTU1-2	LTU1-3	LTU1-4	LTU1-5
Sampling Company				Arcadis	Arcadis			Arcadis	Arcadis	Arcadis	Arcadis
Laboratory			Industrial	Maxxam	Maxxam			Maxxam	Maxxam	Maxxam	Maxxam
Sample Depth (m)				0.45	0.45			0.45	0.45	0.60	0.65
Metals											
Sulphur (S)	ug/g	50	n/v	200	200	nc	Acceptable	200	210	240	250
Antimony (Sb)	ug/g	0.2	40	<0.2	<0.2	nc	Acceptable	<0.2	<0.2	<0.2	<0.2
Arsenic (As)	ug/g	1	12	2	2	nc	Acceptable	2	2	2	2
Barium (Ba)	ug/g	0.5	2000	11	12	9%	Acceptable	14	24	16	26
Beryllium (Be)	ug/g	0.2	8	<0.2	<0.2	nc	Acceptable	<0.2	<0.2	0.2	<0.2
Cadmium (Cd)	ug/g	0.1	22	<0.1	<0.1	nc	Acceptable	0.1	0.1	0.1	0.2
Chromium (Cr)	ug/g	1	87	5	6	18%	Acceptable	5	6	6	5
Cobalt (Co)	ug/g	0.1	300	1.3	1.6	21%	Acceptable	1.6	1.5	1.7	1.3
Copper (Cu)	ug/g	0.5	91	2.5	2.9	15%	Acceptable	3.2	3.3	4.5	4.5
Lead (Pb)	ug/g	1	600	12	14	15%	Acceptable	17	43	64	68
Molybdenum (Mo)	ug/g	0.5	40	0.6	0.7	nc	Acceptable	0.7	0.6	0.6	0.6
Nickel (Ni)	ug/g	0.5	89	4.9	5.6	13%	Acceptable	5.2	4.9	4.9	4.3
Selenium (Se)	ug/g	0.5	2.9	<0.5	<0.5	nc	Acceptable	<0.5	<0.5	<0.5	<0.5
Silver (Ag)	ug/g	0.2	40	<0.2	<0.2	nc	Acceptable	<0.2	<0.2	<0.2	<0.2
Thallium (TI)	ug/g	0.05	1	<0.05	<0.05	nc	Acceptable	0.05	<0.05	0.05	<0.05
Tin (Sn)	ug/g	5	300	<5	<5	nc	Acceptable	<5	<5	<5	<5
Uranium (U)	ug/g	0.05	300	0.33	0.35	6%	Acceptable	0.37	0.37	0.49	0.39
Vanadium (V)	ug/g	5	130	7	8	nc	Acceptable	7	7	8	6
Zinc (Zn)	ug/g	5	360	20	23	nc	Acceptable	22	28	41	82

Notes:

CCME CSQG	Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Protection of Environmental and Human Health, Summary Table, Update 7.1, 2010, Industrial Land Use and Coarse grained soil.
6.5	Concentration exceeds the CCME guidelines
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

Table 9
Soil Analytical Results - Metals
PWGSC
Resolute Bay LTUs

Sample Location				LTU 2							LTU 3	LTU 4
Sample Date				2015/09/22	2015/09/22	2015/09/22			2015/09/22	2015/09/22	2015/09/22	2015/09/22
Sample ID	Units	Lowest RDL	CCME CSQG	LTU2-1	LTU2-2	LTU-DUP1	RPD		LTU2-3	LTU2-4	LTU3-1	LTU4-1
Sampling Company				Arcadis	Arcadis	Arcadis			Arcadis	Arcadis	Arcadis	Arcadis
Laboratory			Industrial	Maxxam	Maxxam	Maxxam			Maxxam	Maxxam	Maxxam	Maxxam
Sample Depth (m)				0.75	0.60	0.60			0.70	0.75	0.10	0.10
Metals												
Sulphur (S)	ug/g	50	n/v	220	200	200	nc	Acceptable	220	200	440	400
Antimony (Sb)	ug/g	0.2	40	<0.2	<0.2	<0.2	nc	Acceptable	<0.2	<0.2	<0.2	<0.2
Arsenic (As)	ug/g	1	12	2	2	2	nc	Acceptable	2	2	2	2
Barium (Ba)	ug/g	0.5	2000	12	11	11	0%	Acceptable	12	11	38	44
Beryllium (Be)	ug/g	0.2	8	<0.2	<0.2	<0.2	nc	Acceptable	0.2	<0.2	<0.2	0.2
Cadmium (Cd)	ug/g	0.1	22	0.1	0.1	0.1	nc	Acceptable	<0.1	0.1	0.2	0.2
Chromium (Cr)	ug/g	1	87	5	5	6	18%	Acceptable	5	5	9	9
Cobalt (Co)	ug/g	0.1	300	1.7	1.6	1.6	0%	Acceptable	1.6	1.6	2.4	2.4
Copper (Cu)	ug/g	0.5	91	3.5	3.2	3	6%	Acceptable	3.0	2.7	5.3	6.2
Lead (Pb)	ug/g	1	600	34	11	11	0%	Acceptable	10	14	18	15
Molybdenum (Mo)	ug/g	0.5	40	0.5	0.6	0.5	nc	Acceptable	0.6	0.7	0.5	<0.5
Nickel (Ni)	ug/g	0.5	89	4.3	4.9	5.2	6%	Acceptable	5.1	4.9	6.6	7.4
Selenium (Se)	ug/g	0.5	2.9	0.5	<0.5	0.6	nc	Acceptable	<0.5	<0.5	<0.5	<0.5
Silver (Ag)	ug/g	0.2	40	<0.2	<0.2	<0.2	nc	Acceptable	<0.2	<0.2	<0.2	<0.2
Thallium (Tl)	ug/g	0.05	1	0.06	0.06	<0.05	nc	Acceptable	0.06	<0.05	0.06	0.07
Tin (Sn)	ug/g	5	300	<5	<5	<5	nc	Acceptable	<5	<5	<5	<5
Uranium (U)	ug/g	0.05	300	0.39	0.36	0.33	9%	Acceptable	0.35	0.36	0.41	0.45
Vanadium (V)	ug/g	5	130	7	7	8	nc	Acceptable	6	6	8	10
Zinc (Zn)	ug/g	5	360	25	19	19	nc	Acceptable	18	23	37	36

Notes:

CCME CSQG	Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Protection of Environmental and Human Health, Summary Table, Update 7.1, 2010, Industrial Land Use and Coarse grained soil.
6.5	Concentration exceeds the CCME
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

Table 10
Soil Analytical Results - Perflourinated Compounds
PWGSC
Resolute Bay LTUs

Sample Location				LTU 1	LTU 2
Sample Date				2015/09/22	2015/09/22
Sample ID	Units	Lowest RDL	FSQG	LTU1-2	LTU2-4
Sampling Company				Arcadis	Arcadis
Laboratory			Industrial	Maxxam	Maxxam
Sample Depth (m)				0.45	0.75
Perfluorinated Compounds					
Perfluorobutane Sulfonate (PFBS)	ug/kg	10	n/v	<100	<10
Perfluorobutanoic acid	ug/kg	10	n/v	<100	<10
Perfluorodecane Sulfonate	ug/kg	10	n/v	<100	<10
Perfluorodecanoic Acid (PFDA)	ug/kg	10	n/v	<100	<10
Perfluorododecanoic Acid (PFDoA)	ug/kg	10	n/v	<100	<10
Perfluoroheptane sulfonate	ug/kg	10	n/v	<100	16
Perfluoroheptanoic Acid (PFHpA)	ug/kg	10	n/v	<100	<10
Perfluorohexane Sulfonate (PFHxS)	ug/kg	10	n/v	420	51
Perfluorohexanoic Acid (PFHxA)	ug/kg	10	n/v	<100	<10
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg	10	n/v	<100	<10
Perfluorononanoic Acid (PFNA)	ug/kg	10	n/v	<100	<10
Perfluorooctane Sulfonamide (PFOSA)	ug/kg	10	n/v	<100	<10
Perfluorooctane Sulfonate (PFOS)	ug/kg	100	130	**2800**	**970**
Perfluoropentanoic Acid (PFPeA)	ug/kg	10	n/v	<100	<10
Perfluorotetradecanoic Acid	ug/kg	10	n/v	<100	<10
Perfluorotridecanoic Acid	ug/kg	10	n/v	<100	<10
Perfluoroundecanoic Acid (PFUnA)	ug/kg	10	n/v	<100	<10

Notes:

FSQG	Federal Contaminated Sites Action Plan - Interim Adivce to Federal Departments for the Management of Federal Contaminated Sites Containing PFOS, October 2015, Table 3 Federal Soil Quality Guiedlines for PFOS, Industrial land use and Coarse grain size.
6.5	Concentration exceeds the CCME guidelines
n/v	No standard/guideline value.
n/a	Not anlayzed
NC	Not Calculable
RDL	Reportable Detection Limit

FIGURES

Title: Site Location

ARCADIS

Project: Resolute Bay Airport
Land Treatment Units
Resolute Bay, Nunavut

Date: February 2016

Client: PWGSC

Figure 1

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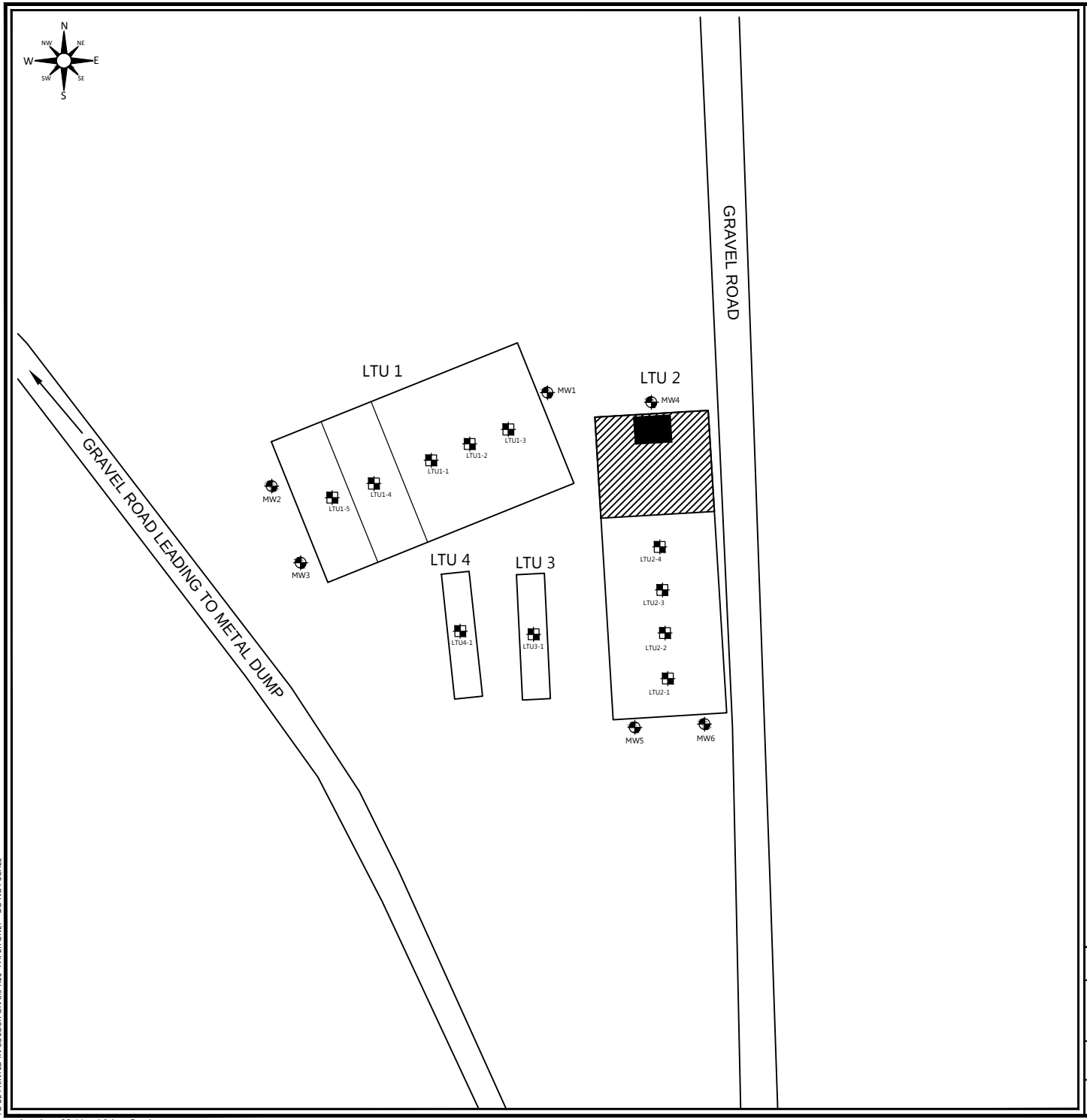
updated on: 22-Mar-16 by rfletcher

Z:\Projects\2015\1747-1501 Resolute Bay LTUs\Figures\1-CAD\100468-000 Resolute Bay Airport LTUs.dwg(layout)



Legend

- Test Pit (Arcadis, 2015)
- Monitoring Well (by others)
- Heating Unit
- Tarp

Title: Site Plan

ARCADIS

Project: Resolute Bay Airport
Land Treatment Units
Resolute Bay, Nunavut

Date: February 2016

Client: PWGSC

Metres
12 0 12 24
1:1499.9999

Figure 2

TO BE PRINTED IN COLOUR ON 8.5"X11" PAPER ONLY - DO NOT SCALE

updated on: 22-Mar-16 by rfletcher

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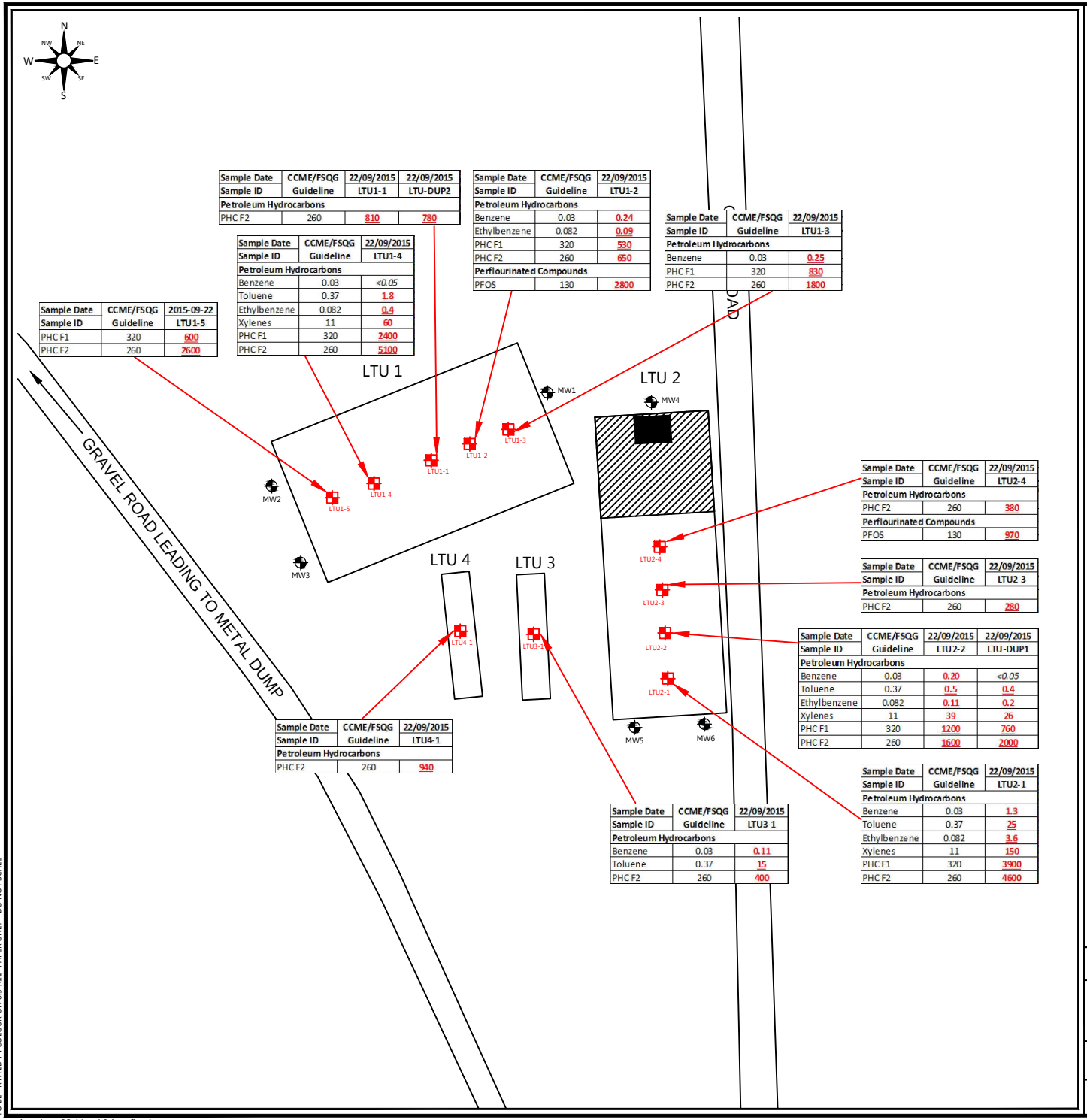

Sample Date	CCME/FSQG	22/09/2015	22/09/2015
Sample ID	Guideline	LTU1-1	LTU-DUP2
Petroleum Hydrocarbons			
PHC F2	260	810	780

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU1-2
Petroleum Hydrocarbons		
Benzene	0.03	0.24
Ethylbenzene	0.082	0.09
PHC F1	320	530
PHC F2	260	650
Perflourinated Compounds		
PFOS	130	2800

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU1-3
Petroleum Hydrocarbons		
Benzene	0.03	0.25
PHC F1	320	830
PHC F2	260	1800

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU1-4
Petroleum Hydrocarbons		
Benzene	0.03	<0.05
Toluene	0.37	1.8
Ethylbenzene	0.082	0.4
Xylenes	11	60
PHC F1	320	2400
PHC F2	260	5100

Sample Date	CCME/FSQG	2015-09-22
Sample ID	Guideline	LTU1-5
PHC F1	320	600
PHC F2	260	2600

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU2-4
Petroleum Hydrocarbons		
PHC F2	260	380
Perflourinated Compounds		
PFOS	130	970

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU2-3
Petroleum Hydrocarbons		
PHC F2	260	280

Sample Date	CCME/FSQG	22/09/2015	22/09/2015
Sample ID	Guideline	LTU2-2	LTU-DUP1
Petroleum Hydrocarbons			
Benzene	0.03	0.20	<0.05
Toluene	0.37	0.5	0.4
Ethylbenzene	0.082	0.11	0.2
Xylenes	11	39	26
PHC F1	320	1200	760
PHC F2	260	1600	2000

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU2-1
Petroleum Hydrocarbons		
Benzene	0.03	1.3
Toluene	0.37	25
Ethylbenzene	0.082	3.6
Xylenes	11	150
PHC F1	320	3900
PHC F2	260	4600

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU4-1
Petroleum Hydrocarbons		
PHC F2	260	940

Sample Date	CCME/FSQG	22/09/2015
Sample ID	Guideline	LTU3-1
Petroleum Hydrocarbons		
Benzene	0.03	0.11
Toluene	0.37	15
PHC F2	260	400

Legend

- Test Pit (Arcadis, 2015)
- Monitoring Well (by others)
- Heating Unit
- Tarp
- Test Pit Location - at least one analysed parameter exceeds the selected standard in at least one analysed sample

SITE CONDITION STANDARDS

Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Protection of Environmental and Human Health, Summary Table, Update 7.1, 2010, Industrial Land Use and Coarse grained soil.
AND
Canadian Council of Ministers of the Environment Canada Wide Standards for Petroleum Hydrocarbons, Summary Table 1, Summary of Tier 1 Levels for Surface Soils, Industrial Land Use and Coarse grained soil.
AND
Federal Contaminated Sites Action Plan - Interim Advice to Federal Departments for the Management of Federal Contaminated Sites Containing PFOS, October 2015, Table 3 Federal Quality Soil Guidelines for PFOS, Industrial land use and Coarse grain size.

Notes:
1. All Concentrations are in µg/g, except for PFOS which is shown in µg/kg
2. Green coloured concentrations satisfy the CCME/FSQG guidelines
3. Red coloured, bold and underlined concentrations exceed the CCME/FSQG guidelines
4. PFOS: Perfluorooctane sulfonate
5. ITALICS: Laboratory RDL exceeds the applicable CCME guideline
6. * : Index of Additive Cancer risk which addresses PAHs in soil leaching to potable groundwater. The IACR is calculated by dividing the soil concentration of carcinogenic PAHs by the SQG for protection of potable water, then summing the hazard indices.

Title: Soil Analytical Results

ARCADIS

Project: Resolute Bay Airport
Land Treatment Units
Resolute Bay, Nunavut

Date: February 2016

Client: PWGSC

Figure 3

TO BE PRINTED IN COLOUR ON 8.5"X11" PAPER ONLY - DO NOT SCALE

updated on: 22-Mar-16 by rfletcher

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APPENDIX A

Site Photographs

Project Photographs

Resolute Bay LTUs
Resolute Bay, Nunavut

Photo: #1

Date:
September 22, 2015

Description: LTU 2 with tarp cover

Photo: #2

Date:
September 22, 2015

Description: Corner of LTU 2 looking west towards ocean

Project Photographs

Resolute Bay LTUs
Resolute Bay, Nunavut

Photo: #3

Date:
September 22, 2015

Description: View of LTU 1 from LTU 2

Photo: #4

Date:
September 22, 2015

Description: Heating unit for LTU 2

Project Photographs

Resolute Bay LTUs
Resolute Bay, Nunavut

Photo: #5

Date:
September 22, 2015

Description: Excavation in LTU 2

Photo: #6

Date:
September 22, 2015

Description: Excavation in LTU 1

APPENDIX B

Test Pit Logs

Date: 22-Sep-15	**Test Pit: LTU1-1**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 1		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.45	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU1-1	0.45	390	BTEX, PHCs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU1-2**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 1		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.45	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU1-2	0.45	460	BTEX, PHCs, PFCs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU1-3**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 1		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.45	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU1-1	0.45	--	BTEX, PHCs, PAHs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU1-4**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 1		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.60	**Silt** light brown fine silt, some rock, dry	LTU1-4	0.60	760	BTEX, PHCs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU1-5**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 1		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.65	**Silt** light brown fine silt, some rock, dry	LTU1-5	0.65	355	BTEX, PHCs, PAHs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU2-1**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 2		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.75	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU2-1	0.75	990	BTEX, PHCs, PAHs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU2-2**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 2		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.60	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU2-2	0.60	685	BTEX, PHCs, PAHs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU2-3**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 2		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.70	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU2-3	0.70	80	BTEX, PHCs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU2-4**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: LTU 2		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.70	**Silt** brown, mix of stone and rock, diesel odour, dry	LTU2-4	0.75	360	BTEX, PHCs, PFCs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU3-1**	SAMPLES			
Logged by: S. Hannington Method: Shovel Location: LTU 3		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.10	**Silt** brown, mix of stone and rock, dry	LTU3-1	0.10	35	BTEX, PHCs, PAHs, and metals
End of Test Pit at Permafrost					

Date: 22-Sep-15	**Test Pit: LTU4-1**	SAMPLES			
Logged by: S. Hannington Method: Shovel Location: LTU 4		Sample I.D.	Sample Depth (m)	OVM (ppm)	Sample Analysis
Depth (m)	Description				
0.0 - 0.10	**Silt** brown, mix of stone and rock, dry	LTU4-1	0.10	65	BTEX, PHCs, and metals
End of Test Pit at Permafrost					

APPENDIX C

Laboratory Certificate of Analysis

Maxxam
A Bureau Veritas Group Company

Your P.O. #: 700336248
Your C.O.C. #: 530642-04-01, 530642-05-01

Attention:Andrew Henderson

Franz Environmental Inc.
200-329 Churchhill Ave
Ottawa, ON
Canada K1Z 5B8

Report Date: 2015/10/08
Report #: R3714743
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5J5790
Received: 2015/09/28, 10:00

Sample Matrix: Soil
Samples Received: 13

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum (1)	7	N/A	2015/10/02	CAM SOP-00301	EPA 8270D m
Petroleum Hydro. CCME F1 & BTEX in Soil (2)	5	N/A	2015/10/02	OTT SOP-00002	CCME CWS
Petroleum Hydro. CCME F1 & BTEX in Soil (2)	8	N/A	2015/10/05	OTT SOP-00002	CCME CWS
Petroleum Hydrocarbons F2-F4 in Soil (3)	12	2015/09/28	2015/09/29	OTT SOP-00001	CCME CWS
Petroleum Hydrocarbons F2-F4 in Soil (3)	1	2015/09/28	2015/09/30	OTT SOP-00001	CCME CWS
Acid Extr. Metals (aqua regia) by ICPMS	13	2015/09/29	2015/09/30	OTT SOP-00003	EPA 6020
Acid Extractable Metals Analysis by ICP (1)	13	2015/10/01	2015/10/01	CAM SOP-00408	EPA 6010C m
MOISTURE	13	N/A	2015/09/29	CAM SOP-00445	McKeague 2nd ed 1978
PAH Compounds in Soil by GC/MS (SIM) (1)	7	2015/09/30	2015/10/01	CAM SOP-00318	EPA 8270D m
PFOS and PFOA in soil (1)	2	2015/10/06	2015/10/07	CAM SOP-00894	EPA537 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

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

(1) This test was performed by Maxxam Analytics Mississauga
(2) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is the date sampled unless otherwise stated.
(3) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Madison Bingley, Project Manager Assistant
Email: MBingley@maxxam.ca
Phone# (613)274-0573

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

Maxxam ID		BBD754	BBD755	BBD756	BBD757	BBD758		
Sampling Date		2015/09/22 10:36	2015/09/22 10:30	2015/09/22 10:45	2015/09/22 11:30	2015/09/22 13:15		
COC Number		530642-04-01	530642-04-01	530642-04-01	530642-04-01	530642-04-01		
	UNITS	LTU2-1	LTU2-2	LTU2-3	LTU2-4	LTU1-1	RDL	QC Batch
Inorganics								
Moisture	%	5.8	5.6	6.3	6.0	5.0	0.2	4207479
Miscellaneous Parameters								
Perfluorobutane Sulfonate (PFBS)	ug/kg				<10		10	4218156
Perfluorobutanoic acid	ug/kg				<10		10	4218156
Perfluorodecane Sulfonate	ug/kg				<10		10	4218156
Perfluorodecanoic Acid (PFDA)	ug/kg				<10		10	4218156
Perfluorododecanoic Acid (PFDoA)	ug/kg				<10		10	4218156
Perfluoroheptane sulfonate	ug/kg				16		10	4218156
Perfluoroheptanoic Acid (PFHpA)	ug/kg				<10		10	4218156
Perfluorohexane Sulfonate (PFHxS)	ug/kg				51		10	4218156
Perfluorohexanoic Acid (PFHxA)	ug/kg				<10		10	4218156
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg				<10		10	4218156
Perfluorononanoic Acid (PFNA)	ug/kg				<10		10	4218156
Perfluorooctane Sulfonamide (PFOSA)	ug/kg				<10		10	4218156
Perfluorooctane Sulfonate (PFOS)	ug/kg				970		100	4218156
Perfluoropentanoic Acid (PFPeA)	ug/kg				<10		10	4218156
Perfluorotetradecanoic Acid	ug/kg				<10		10	4218156
Perfluorotridecanoic Acid	ug/kg				<10		10	4218156
Perfluoroundecanoic Acid (PFUnA)	ug/kg				<10		10	4218156
Surrogate Recovery (%)								
13C4-Perfluorooctanesulfonate	%				76 (1)			4218156
13C4-Perfluorooctanoic acid	%				89			4218156
13C8-Perfluorooctanesulfonamide	%				77 (1)			4218156

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

(1) Surrogate recovery was below the defined lower control limit (LCL). Laboratory spike soil resulted in satisfactory recovery of the surrogate. When considered together, these QC data suggest that matrix interferences may be biasing the data low. Because quantitation is performed using isotope dilution techniques, any losses of the native compound that may occur during any of the sample preparation, extraction, cleanup or determinative steps will be mirrored by a similar loss of the labeled standard, and as such can be accounted for and corrected. Therefore, the quantification of this target compound is not affected by the low surrogate recovery.

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

Maxxam ID		BBD759	BBD760	BBD761	BBD762	BBD763		
Sampling Date		2015/09/22 13:45	2015/09/22 17:00	2015/09/22 17:15	2015/09/22 17:30	2015/09/22 17:45		
COC Number		530642-04-01	530642-04-01	530642-04-01	530642-04-01	530642-04-01		
	UNITS	**LTU1-2**	**LTU1-3**	**LTU1-4**	**LTU1-5**	**LTU3-1**	**RDL**	**QC Batch**
Inorganics								
Moisture	%	6.3	8.1	6.1	5.1	14	0.2	4207479
Miscellaneous Parameters								
Perfluorobutane Sulfonate (PFBS)	ug/kg	<100					100	4218156
Perfluorobutanoic acid	ug/kg	<100					100	4218156
Perfluorodecane Sulfonate	ug/kg	<100					100	4218156
Perfluorodecanoic Acid (PFDA)	ug/kg	<100					100	4218156
Perfluorododecanoic Acid (PFDoA)	ug/kg	<100					100	4218156
Perfluoroheptane sulfonate	ug/kg	<100					100	4218156
Perfluoroheptanoic Acid (PFHpA)	ug/kg	<100					100	4218156
Perfluorohexane Sulfonate (PFHxS)	ug/kg	420					100	4218156
Perfluorohexanoic Acid (PFHxA)	ug/kg	<100					100	4218156
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg	<100					100	4218156
Perfluorononanoic Acid (PFNA)	ug/kg	<100					100	4218156
Perfluorooctane Sulfonamide (PFOSA)	ug/kg	<100					100	4218156
Perfluorooctane Sulfonate (PFOS)	ug/kg	2800					100	4218156
Perfluoropentanoic Acid (PFPeA)	ug/kg	<100					100	4218156
Perfluorotetradecanoic Acid	ug/kg	<100					100	4218156
Perfluorotridecanoic Acid	ug/kg	<100					100	4218156
Perfluoroundecanoic Acid (PFUnA)	ug/kg	<100					100	4218156
Surrogate Recovery (%)								
13C4-Perfluorooctanesulfonate	%	77 (1)						4218156
13C4-Perfluorooctanoic acid	%	77 (1)						4218156
13C8-Perfluorooctanesulfonamide	%	68 (1)						4218156

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

(1) Surrogate recovery was below the defined lower control limit (LCL). Laboratory spike soil resulted in satisfactory recovery of the surrogate. When considered together, these QC data suggest that matrix interferences may be biasing the data low. Because quantitation is performed using isotope dilution techniques, any losses of the native compound that may occur during any of the sample preparation, extraction, cleanup or determinative steps will be mirrored by a similar loss of the labeled standard, and as such can be accounted for and corrected. Therefore, the quantification of this target compound is not affected by the low surrogate recovery.

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

Maxxam ID		BBD783	BBD784	BBD785		
Sampling Date		2015/09/22 17:55	2015/09/22	2015/09/22		
COC Number		530642-05-01	530642-05-01	530642-05-01		
	UNITS	LTU4-1	LTU-DUP1	LTU-DUP2	RDL	QC Batch
Inorganics						
Moisture	%	8.3	5.1	7.1	0.2	4207479

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		BBD754	BBD755	BBD756	BBD757	BBD758		
Sampling Date		2015/09/22 10:36	2015/09/22 10:30	2015/09/22 10:45	2015/09/22 11:30	2015/09/22 13:15		
COC Number		530642-04-01	530642-04-01	530642-04-01	530642-04-01	530642-04-01		
	UNITS	LTU2-1	LTU2-2	LTU2-3	LTU2-4	LTU1-1	RDL	QC Batch
Metals								
Acid Extractable Sulphur (S)	ug/g	220	200	220	200	200	50	4212664
Acid Extractable Antimony (Sb)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	4208967
Acid Extractable Arsenic (As)	ug/g	2	2	2	2	2	1	4208967
Acid Extractable Barium (Ba)	ug/g	12	11	12	11	11	0.5	4208967
Acid Extractable Beryllium (Be)	ug/g	<0.2	<0.2	0.2	<0.2	<0.2	0.2	4208967
Acid Extractable Cadmium (Cd)	ug/g	0.1	0.1	<0.1	0.1	<0.1	0.1	4208967
Acid Extractable Chromium (Cr)	ug/g	5	5	5	5	5	1	4208967
Acid Extractable Cobalt (Co)	ug/g	1.7	1.6	1.6	1.6	1.3	0.1	4208967
Acid Extractable Copper (Cu)	ug/g	3.5	3.2	3.0	2.7	2.5	0.5	4208967
Acid Extractable Lead (Pb)	ug/g	34	11	10	14	12	1	4208967
Acid Extractable Molybdenum (Mo)	ug/g	0.5	0.6	0.6	0.7	0.6	0.5	4208967
Acid Extractable Nickel (Ni)	ug/g	4.3	4.9	5.1	4.9	4.9	0.5	4208967
Acid Extractable Selenium (Se)	ug/g	0.5	<0.5	<0.5	<0.5	<0.5	0.5	4208967
Acid Extractable Silver (Ag)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	4208967
Acid Extractable Thallium (Tl)	ug/g	0.06	0.06	0.06	<0.05	<0.05	0.05	4208967
Acid Extractable Tin (Sn)	ug/g	<5	<5	<5	<5	<5	5	4208967
Acid Extractable Uranium (U)	ug/g	0.39	0.36	0.35	0.36	0.33	0.05	4208967
Acid Extractable Vanadium (V)	ug/g	7	7	6	6	7	5	4208967
Acid Extractable Zinc (Zn)	ug/g	25	19	18	23	20	5	4208967

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		BBD759		BBD760		BBD761	BBD762		
Sampling Date		2015/09/22 13:45		2015/09/22 17:00		2015/09/22 17:15	2015/09/22 17:30		
COC Number		530642-04-01		530642-04-01		530642-04-01	530642-04-01		
	UNITS	LTU1-2	QC Batch	LTU1-3	QC Batch	LTU1-4	LTU1-5	RDL	QC Batch
Metals									
Acid Extractable Sulphur (S)	ug/g	200	4212658	210	4212664	240	250	50	4212658
Acid Extractable Antimony (Sb)	ug/g	<0.2	4208967	<0.2	4208967	<0.2	<0.2	0.2	4208967
Acid Extractable Arsenic (As)	ug/g	2	4208967	2	4208967	2	2	1	4208967
Acid Extractable Barium (Ba)	ug/g	14	4208967	24	4208967	16	26	0.5	4208967
Acid Extractable Beryllium (Be)	ug/g	<0.2	4208967	<0.2	4208967	0.2	<0.2	0.2	4208967
Acid Extractable Cadmium (Cd)	ug/g	0.1	4208967	0.1	4208967	0.1	0.2	0.1	4208967
Acid Extractable Chromium (Cr)	ug/g	5	4208967	6	4208967	6	5	1	4208967
Acid Extractable Cobalt (Co)	ug/g	1.6	4208967	1.5	4208967	1.7	1.3	0.1	4208967
Acid Extractable Copper (Cu)	ug/g	3.2	4208967	3.3	4208967	4.5	4.5	0.5	4208967
Acid Extractable Lead (Pb)	ug/g	17	4208967	43	4208967	64	68	1	4208967
Acid Extractable Molybdenum (Mo)	ug/g	0.7	4208967	0.6	4208967	0.6	0.6	0.5	4208967
Acid Extractable Nickel (Ni)	ug/g	5.2	4208967	4.9	4208967	4.9	4.3	0.5	4208967
Acid Extractable Selenium (Se)	ug/g	<0.5	4208967	<0.5	4208967	<0.5	<0.5	0.5	4208967
Acid Extractable Silver (Ag)	ug/g	<0.2	4208967	<0.2	4208967	<0.2	<0.2	0.2	4208967
Acid Extractable Thallium (Tl)	ug/g	0.05	4208967	<0.05	4208967	0.05	<0.05	0.05	4208967
Acid Extractable Tin (Sn)	ug/g	<5	4208967	<5	4208967	<5	<5	5	4208967
Acid Extractable Uranium (U)	ug/g	0.37	4208967	0.37	4208967	0.49	0.39	0.05	4208967
Acid Extractable Vanadium (V)	ug/g	7	4208967	7	4208967	8	6	5	4208967
Acid Extractable Zinc (Zn)	ug/g	22	4208967	28	4208967	41	82	5	4208967

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		BBD763	BBD783		BBD784	BBD785		
Sampling Date		2015/09/22 17:45	2015/09/22 17:55		2015/09/22	2015/09/22		
COC Number		530642-04-01	530642-05-01		530642-05-01	530642-05-01		
	UNITS	LTU3-1	LTU4-1	QC Batch	LTU-DUP1	LTU-DUP2	RDL	QC Batch
Metals								
Acid Extractable Sulphur (S)	ug/g	440	400	4212664	200	200	50	4212658
Acid Extractable Antimony (Sb)	ug/g	<0.2	<0.2	4208967	<0.2	<0.2	0.2	4208967
Acid Extractable Arsenic (As)	ug/g	2	2	4208967	2	2	1	4208967
Acid Extractable Barium (Ba)	ug/g	38	44	4208967	11	12	0.5	4208967
Acid Extractable Beryllium (Be)	ug/g	<0.2	0.2	4208967	<0.2	<0.2	0.2	4208967
Acid Extractable Cadmium (Cd)	ug/g	0.2	0.2	4208967	0.1	<0.1	0.1	4208967
Acid Extractable Chromium (Cr)	ug/g	9	9	4208967	6	6	1	4208967
Acid Extractable Cobalt (Co)	ug/g	2.4	2.4	4208967	1.6	1.6	0.1	4208967
Acid Extractable Copper (Cu)	ug/g	5.3	6.2	4208967	3.0	2.9	0.5	4208967
Acid Extractable Lead (Pb)	ug/g	18	15	4208967	11	14	1	4208967
Acid Extractable Molybdenum (Mo)	ug/g	0.5	<0.5	4208967	0.5	0.7	0.5	4208967
Acid Extractable Nickel (Ni)	ug/g	6.6	7.4	4208967	5.2	5.6	0.5	4208967
Acid Extractable Selenium (Se)	ug/g	<0.5	<0.5	4208967	0.6	<0.5	0.5	4208967
Acid Extractable Silver (Ag)	ug/g	<0.2	<0.2	4208967	<0.2	<0.2	0.2	4208967
Acid Extractable Thallium (Tl)	ug/g	0.06	0.07	4208967	<0.05	<0.05	0.05	4208967
Acid Extractable Tin (Sn)	ug/g	<5	<5	4208967	<5	<5	5	4208967
Acid Extractable Uranium (U)	ug/g	0.41	0.45	4208967	0.33	0.35	0.05	4208967
Acid Extractable Vanadium (V)	ug/g	8	10	4208967	8	8	5	4208967
Acid Extractable Zinc (Zn)	ug/g	37	36	4208967	19	23	5	4208967

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		BBD754		BBD755		BBD760		BBD762		
Sampling Date		2015/09/22 10:36		2015/09/22 10:30		2015/09/22 17:00		2015/09/22 17:30		
COC Number		530642-04-01		530642-04-01		530642-04-01		530642-04-01		
	UNITS	LTU2-1	RDL	LTU2-2	RDL	LTU1-3	RDL	LTU1-5	RDL	QC Batch
Calculated Parameters										
Methylnaphthalene, 2-(1-)	ug/g	47	0.0071	17	0.0071	9.4	0.0071	0.47	0.0071	4207242
Polyaromatic Hydrocarbons										
Benzo(e)pyrene	ug/g	0.025	0.0050	0.0075	0.0050	0.019	0.0050	0.047	0.0050	4211688
Acenaphthene	ug/g	0.28	0.0050	0.15	0.0050	0.25	0.0050	0.21	0.0050	4211688
Acenaphthylene	ug/g	0.084	0.0050	0.041	0.0050	0.066	0.0050	0.067	0.0050	4211688
Anthracene	ug/g	0.052	0.0050	0.011	0.0050	0.023	0.0050	0.054	0.0050	4211688
Benzo(a)anthracene	ug/g	0.028	0.0050	0.0066	0.0050	0.022	0.0050	0.069	0.0050	4211688
Benzo(a)pyrene	ug/g	0.027	0.0050	0.0051	0.0050	0.021	0.0050	0.072	0.0050	4211688
Benzo(b/j)fluoranthene	ug/g	0.038	0.0050	0.0083	0.0050	0.034	0.0050	0.093	0.0050	4211688
Benzo(g,h,i)perylene	ug/g	0.045	0.0050	0.012	0.0050	0.026	0.0050	0.069	0.0050	4211688
Benzo(k)fluoranthene	ug/g	0.012	0.0050	<0.0050	0.0050	0.011	0.0050	0.030	0.0050	4211688
Chrysene	ug/g	0.029	0.0050	0.0075	0.0050	0.023	0.0050	0.065	0.0050	4211688
Dibenz(a,h)anthracene	ug/g	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050	0.0062	0.0050	4211688
Fluoranthene	ug/g	0.11	0.0050	0.028	0.0050	0.076	0.0050	0.18	0.0050	4211688
Fluorene	ug/g	0.51	0.0050	0.21	0.0050	0.28	0.0050	0.22	0.0050	4211688
Indeno(1,2,3-cd)pyrene	ug/g	0.027	0.0050	0.0063	0.0050	0.023	0.0050	0.065	0.0050	4211688
1-Methylnaphthalene	ug/g	19	0.0050	6.9	0.0050	5.4	0.0050	0.31	0.0050	4211688
2-Methylnaphthalene	ug/g	28	0.0050	10	0.0050	4.0	0.0050	0.16	0.0050	4211688
Naphthalene	ug/g	16	0.0050	5.7	0.0050	1.8	0.0050	<0.50 (1)	0.50	4211688
Phenanthrene	ug/g	0.58	0.0050	0.16	0.0050	0.25	0.0050	0.16	0.0050	4211688
Pyrene	ug/g	0.16	0.0050	0.044	0.0050	0.13	0.0050	0.32	0.0050	4211688
Biphenyl	ug/g	1.5	0.0050	<0.50 (1)	0.50	<0.050 (1)	0.050	<0.050 (1)	0.050	4211688
Perylene	ug/g	0.0059	0.0050	<0.0050	0.0050	<0.0050	0.0050	0.013	0.0050	4211688
Surrogate Recovery (%)										
D10-Anthracene	%	94		85		96		87		4211688
D14-Terphenyl (FS)	%	96		86		97		89		4211688
D8-Acenaphthylene	%	77		85		100		89		4211688

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection Limit was raised due to matrix interferences.

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Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		BBD763		BBD784		BBD785		
Sampling Date		2015/09/22 17:45		2015/09/22		2015/09/22		
COC Number		530642-04-01		530642-05-01		530642-05-01		
	UNITS	LTU3-1	RDL	LTU-DUP1	RDL	LTU-DUP2	RDL	QC Batch
Calculated Parameters								
Methylnaphthalene, 2-(1-)	ug/g	<0.10	0.10	15	0.0071	0.97	0.0071	4207242
Polyaromatic Hydrocarbons								
Benzo(e)pyrene	ug/g	0.0050	0.0050	0.0067	0.0050	<0.0050	0.0050	4211688
Acenaphthene	ug/g	0.034	0.0050	0.14	0.0050	0.077	0.0050	4211688
Acenaphthylene	ug/g	<0.050 (1)	0.050	0.040	0.0050	0.019	0.0050	4211688
Anthracene	ug/g	<0.0050	0.0050	0.011	0.0050	<0.0050	0.0050	4211688
Benzo(a)anthracene	ug/g	0.0053	0.0050	0.0060	0.0050	<0.0050	0.0050	4211688
Benzo(a)pyrene	ug/g	<0.0050	0.0050	0.0053	0.0050	<0.0050	0.0050	4211688
Benzo(b/j)fluoranthene	ug/g	0.0089	0.0050	0.0079	0.0050	<0.0050	0.0050	4211688
Benzo(g,h,i)perylene	ug/g	<0.0050	0.0050	0.010	0.0050	<0.0050	0.0050	4211688
Benzo(k)fluoranthene	ug/g	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050	4211688
Chrysene	ug/g	0.0063	0.0050	0.0069	0.0050	<0.0050	0.0050	4211688
Dibenz(a,h)anthracene	ug/g	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050	4211688
Fluoranthene	ug/g	0.0057	0.0050	0.026	0.0050	0.016	0.0050	4211688
Fluorene	ug/g	<0.050 (1)	0.050	0.20	0.0050	0.073	0.0050	4211688
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	0.0050	0.0051	0.0050	<0.0050	0.0050	4211688
1-Methylnaphthalene	ug/g	0.030	0.0050	6.1	0.0050	0.76	0.0050	4211688
2-Methylnaphthalene	ug/g	<0.10 (1)	0.10	8.7	0.0050	0.22	0.0050	4211688
Naphthalene	ug/g	<0.10 (1)	0.10	4.6	0.0050	0.22	0.0050	4211688
Phenanthrene	ug/g	<0.0050	0.0050	0.15	0.0050	0.044	0.0050	4211688
Pyrene	ug/g	0.032	0.0050	0.041	0.0050	0.024	0.0050	4211688
Biphenyl	ug/g	<0.010 (1)	0.010	<0.10 (1)	0.10	<0.010 (1)	0.010	4211688
Perylene	ug/g	<0.0050	0.0050	<0.0050	0.0050	<0.0050	0.0050	4211688
Surrogate Recovery (%)								
D10-Anthracene	%	90		90		93		4211688
D14-Terphenyl (FS)	%	90		90		92		4211688
D8-Acenaphthylene	%	98		89		98		4211688

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection Limit was raised due to matrix interferences.

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		BBD754		BBD755		BBD756	BBD757	BBD758		
Sampling Date		2015/09/22 10:36		2015/09/22 10:30		2015/09/22 10:45	2015/09/22 11:30	2015/09/22 13:15		
COC Number		530642-04-01		530642-04-01		530642-04-01	530642-04-01	530642-04-01		
	UNITS	LTU2-1	RDL	LTU2-2	RDL	LTU2-3	LTU2-4	LTU1-1	RDL	QC Batch
BTEX & F1 Hydrocarbons										
Benzene	ug/g	1.3	0.1	0.20	0.03	<0.005	0.009	<0.005	0.005	4213334
Toluene	ug/g	25	0.4	0.5	0.1	<0.02	<0.02	<0.02	0.02	4213334
Ethylbenzene	ug/g	3.6	0.2	0.11	0.05	<0.01	<0.01	<0.01	0.01	4213334
o-Xylene	ug/g	50	0.4	16	0.1	<0.02	0.13	0.02	0.02	4213334
p+m-Xylene	ug/g	99	0.8	23	0.2	<0.04	0.15	<0.04	0.04	4213334
Total Xylenes	ug/g	150	0.8	39	0.2	<0.04	0.28	<0.04	0.04	4213334
F1 (C6-C10)	ug/g	4100	200	1300	50	39	120	170	10	4213334
F1 (C6-C10) - BTEX	ug/g	3900	200	1200	50	39	120	170	10	4213334
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/g	4600	10	1600	10	280	380	810	10	4207566
F3 (C16-C34 Hydrocarbons)	ug/g	830	50	330	50	120	250	250	50	4207566
F4 (C34-C50 Hydrocarbons)	ug/g	380	50	120	50	<50	140	92	50	4207566
Reached Baseline at C50	ug/g	Yes		Yes		Yes	Yes	Yes		4207566
Surrogate Recovery (%)										
1,4-Difluorobenzene	%	106		106		104	105	103		4213334
4-Bromofluorobenzene	%	91		94		90	96	101		4213334
D10-Ethylbenzene	%	91		119		107	108	103		4213334
D4-1,2-Dichloroethane	%	113		124		116	119	111		4213334
o-Terphenyl	%	90		90		86	93	87		4207566

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		BBD759	BBD760		BBD761		BBD762		BBD763		
Sampling Date		2015/09/22 13:45	2015/09/22 17:00		2015/09/22 17:15		2015/09/22 17:30		2015/09/22 17:45		
COC Number		530642-04-01	530642-04-01		530642-04-01		530642-04-01		530642-04-01		
	UNITS	**LTU1-2**	**LTU1-3**	**RDL**	**LTU1-4**	**RDL**	**LTU1-5**	**RDL**	**LTU3-1**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons											
Benzene	ug/g	0.24	0.25	0.03	<0.05	0.05	<0.03	0.03	0.11	0.005	4213334
Toluene	ug/g	0.2	<0.1	0.1	1.8	0.2	0.1	0.1	15	0.02	4213334
Ethylbenzene	ug/g	0.09	<0.05	0.05	0.4	0.1	<0.05	0.05	0.03	0.01	4213334
o-Xylene	ug/g	3.3	3.3	0.1	33	0.2	1.1	0.1	0.04	0.02	4213334
p+m-Xylene	ug/g	2.4	1.1	0.2	27	0.4	0.2	0.2	0.06	0.04	4213334
Total Xylenes	ug/g	5.7	4.4	0.2	60	0.4	1.3	0.2	0.10	0.04	4213334
F1 (C6-C10)	ug/g	530	830	50	2400	100	600	50	40	10	4213334
F1 (C6-C10) - BTEX	ug/g	530	830	50	2400	100	600	50	25	10	4213334
F2-F4 Hydrocarbons											
F2 (C10-C16 Hydrocarbons)	ug/g	650	1800	10	5100	10	2600	10	400	10	4207566
F3 (C16-C34 Hydrocarbons)	ug/g	130	370	50	1000	50	660	50	<50	50	4207566
F4 (C34-C50 Hydrocarbons)	ug/g	<50	150	50	370	50	320	50	<50	50	4207566
Reached Baseline at C50	ug/g	Yes	Yes		Yes		Yes		Yes		4207566
Surrogate Recovery (%)											
1,4-Difluorobenzene	%	108	106		102		106		99		4213334
4-Bromofluorobenzene	%	91	93		103		96		95		4213334
D10-Ethylbenzene	%	100	88		127		79		105		4213334
D4-1,2-Dichloroethane	%	107	109		117		106		103		4213334
o-Terphenyl	%	89	80		83		91		90		4207566

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		BBD783		BBD784		BBD785		
Sampling Date		2015/09/22 17:55		2015/09/22		2015/09/22		
COC Number		530642-05-01		530642-05-01		530642-05-01		
	UNITS	LTU4-1	RDL	LTU-DUP1	RDL	LTU-DUP2	RDL	QC Batch
BTEX & F1 Hydrocarbons								
Benzene	ug/g	<0.005	0.005	<0.05	0.05	<0.01	0.01	4213334
Toluene	ug/g	0.02	0.02	0.4	0.2	<0.04	0.04	4213334
Ethylbenzene	ug/g	<0.01	0.01	0.2	0.1	<0.02	0.02	4213334
o-Xylene	ug/g	0.03	0.02	11	0.2	<0.04	0.04	4213334
p+m-Xylene	ug/g	<0.04	0.04	15	0.4	<0.08	0.08	4213334
Total Xylenes	ug/g	<0.04	0.04	26	0.4	<0.08	0.08	4213334
F1 (C6-C10)	ug/g	160	10	780	100	230	20	4213334
F1 (C6-C10) - BTEX	ug/g	160	10	760	100	230	20	4213334
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	940	10	2000	10	780	10	4207566
F3 (C16-C34 Hydrocarbons)	ug/g	53	50	330	50	190	50	4207566
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	110	50	71	50	4207566
Reached Baseline at C50	ug/g	Yes		Yes		Yes		4207566
Surrogate Recovery (%)								
1,4-Difluorobenzene	%	98		106		107		4213334
4-Bromofluorobenzene	%	91		87		90		4213334
D10-Ethylbenzene	%	101		103		75		4213334
D4-1,2-Dichloroethane	%	122		126		111		4213334
o-Terphenyl	%	91		88		84		4207566

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

TEST SUMMARY

Maxxam ID: BBD754
Sample ID: LTU2-1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

Maxxam ID: BBD754 Dup
Sample ID: LTU2-1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/30	2015/09/30	Raigamage Perera

Maxxam ID: BBD755
Sample ID: LTU2-2
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/02	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

Maxxam ID: BBD756
Sample ID: LTU2-3
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici

Maxxam ID: BBD757
Sample ID: LTU2-4
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/02	Lyndsey Hart

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

TEST SUMMARY

Maxxam ID: BBD757
Sample ID: LTU2-4
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PFOS and PFOA in soil	LCMS	4218156	2015/10/06	2015/10/07	Colm McNamara

Maxxam ID: BBD758
Sample ID: LTU1-1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/02	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici

Maxxam ID: BBD759
Sample ID: LTU1-2
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212658	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PFOS and PFOA in soil	LCMS	4218156	2015/10/06	2015/10/07	Colm McNamara

Maxxam ID: BBD760
Sample ID: LTU1-3
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

TEST SUMMARY

Maxxam ID: BBD761
Sample ID: LTU1-4
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/02	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212658	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici

Maxxam ID: BBD762
Sample ID: LTU1-5
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212658	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

Maxxam ID: BBD763
Sample ID: LTU3-1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/30	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

Maxxam ID: BBD783
Sample ID: LTU4-1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212664	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

TEST SUMMARY

Maxxam ID: BBD784
Sample ID: LTU-DUP1
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/02	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212658	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

Maxxam ID: BBD785
Sample ID: LTU-DUP2
Matrix: Soil

Collected: 2015/09/22
Shipped:
Received: 2015/09/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	4207242	N/A	2015/10/02	Automated Statchk
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	4213334	N/A	2015/10/05	Lyndsey Hart
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	4207566	2015/09/28	2015/09/29	Arezoo Habibagahi
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	4208967	2015/09/29	2015/09/30	Raigamage Perera
Acid Extractable Metals Analysis by ICP	ICP	4212658	2015/10/01	2015/10/01	Suban Kanapathippllai
MOISTURE	BAL	4207479	N/A	2015/09/29	Liliana Gaburici
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	4211688	2015/09/30	2015/10/01	Lingyun Feng

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GENERAL COMMENTS

Cooler custody seal was present and intact.

Sample BBD754-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD755-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD757-01 : Perfluorinated Compounds (PFCs): Due to high concentrations of the target analytes, sample required dilution. Detection limits were adjusted accordingly.

Sample BBD759-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Perfluorinated Compounds (PFCs): Due to high concentrations of the target analytes, sample required dilution. Detection limits were adjusted accordingly.

Sample BBD760-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD761-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD762-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD784-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

Sample BBD785-01 : F1/BTEX Analysis: Sample was diluted due to high concentration of target compounds. Reporting limits were adjusted accordingly.

PETROLEUM HYDROCARBONS (CCME)

Petroleum Hydrocarbons F2-F4 in Soil: F2-F4 Analysis: Matrix spiked recoveries were not calculated (NC) because of high concentration of target compounds in the parent sample.

Results relate only to the items tested.

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Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
4207479	LGA	RPD	Moisture	2015/09/29	9.5		%	50
4207566	AH1	Matrix Spike [BBD754-01]	o-Terphenyl	2015/09/29		90	%	30 - 130
			F2 (C10-C16 Hydrocarbons)	2015/09/29		NC	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2015/09/29		NC	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2015/09/29		NC	%	50 - 130
4207566	AH1	Spiked Blank	o-Terphenyl	2015/09/29		98	%	30 - 130
			F2 (C10-C16 Hydrocarbons)	2015/09/29		99	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2015/09/29		99	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2015/09/29		99	%	80 - 120
4207566	AH1	Method Blank	o-Terphenyl	2015/09/29		92	%	30 - 130
			F2 (C10-C16 Hydrocarbons)	2015/09/29	<10		ug/g	
			F3 (C16-C34 Hydrocarbons)	2015/09/29	<50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2015/09/29	<50		ug/g	
4207566	AH1	RPD	F2 (C10-C16 Hydrocarbons)	2015/09/29	NC		%	50
			F3 (C16-C34 Hydrocarbons)	2015/09/29	NC		%	50
			F4 (C34-C50 Hydrocarbons)	2015/09/29	NC		%	50
4208967	RAI	Matrix Spike [BBD754-01]	Acid Extractable Antimony (Sb)	2015/09/30		101	%	75 - 125
			Acid Extractable Arsenic (As)	2015/09/30		105	%	75 - 125
			Acid Extractable Barium (Ba)	2015/09/30		102	%	75 - 125
			Acid Extractable Beryllium (Be)	2015/09/30		104	%	75 - 125
			Acid Extractable Cadmium (Cd)	2015/09/30		102	%	75 - 125
			Acid Extractable Chromium (Cr)	2015/09/30		107	%	75 - 125
			Acid Extractable Cobalt (Co)	2015/09/30		106	%	75 - 125
			Acid Extractable Copper (Cu)	2015/09/30		99	%	75 - 125
			Acid Extractable Lead (Pb)	2015/09/30		NC	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2015/09/30		105	%	75 - 125
			Acid Extractable Nickel (Ni)	2015/09/30		103	%	75 - 125
			Acid Extractable Selenium (Se)	2015/09/30		104	%	75 - 125
			Acid Extractable Silver (Ag)	2015/09/30		100	%	75 - 125
			Acid Extractable Thallium (Tl)	2015/09/30		96	%	75 - 125
			Acid Extractable Tin (Sn)	2015/09/30		104	%	75 - 125
			Acid Extractable Uranium (U)	2015/09/30		97	%	75 - 125
			Acid Extractable Vanadium (V)	2015/09/30		108	%	75 - 125
			Acid Extractable Zinc (Zn)	2015/09/30		NC	%	75 - 125
4208967	RAI	Spiked Blank	Acid Extractable Antimony (Sb)	2015/09/30		101	%	80 - 120
			Acid Extractable Arsenic (As)	2015/09/30		105	%	80 - 120
			Acid Extractable Barium (Ba)	2015/09/30		107	%	80 - 120
			Acid Extractable Beryllium (Be)	2015/09/30		104	%	80 - 120
			Acid Extractable Cadmium (Cd)	2015/09/30		101	%	80 - 120
			Acid Extractable Chromium (Cr)	2015/09/30		108	%	80 - 120
			Acid Extractable Cobalt (Co)	2015/09/30		108	%	80 - 120
			Acid Extractable Copper (Cu)	2015/09/30		108	%	80 - 120
			Acid Extractable Lead (Pb)	2015/09/30		104	%	80 - 120
			Acid Extractable Molybdenum (Mo)	2015/09/30		103	%	80 - 120
			Acid Extractable Nickel (Ni)	2015/09/30		106	%	80 - 120
			Acid Extractable Selenium (Se)	2015/09/30		107	%	80 - 120
			Acid Extractable Silver (Ag)	2015/09/30		100	%	80 - 120
			Acid Extractable Thallium (Tl)	2015/09/30		101	%	80 - 120
			Acid Extractable Tin (Sn)	2015/09/30		103	%	80 - 120
			Acid Extractable Uranium (U)	2015/09/30		99	%	80 - 120
			Acid Extractable Vanadium (V)	2015/09/30		111	%	80 - 120
			Acid Extractable Zinc (Zn)	2015/09/30		106	%	80 - 120
4208967	RAI	Method Blank	Acid Extractable Antimony (Sb)	2015/09/30	<0.2		ug/g	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Arsenic (As)	2015/09/30	<1		ug/g	
			Acid Extractable Barium (Ba)	2015/09/30	<0.5		ug/g	
			Acid Extractable Beryllium (Be)	2015/09/30	<0.2		ug/g	
			Acid Extractable Cadmium (Cd)	2015/09/30	<0.1		ug/g	
			Acid Extractable Chromium (Cr)	2015/09/30	<1		ug/g	
			Acid Extractable Cobalt (Co)	2015/09/30	<0.1		ug/g	
			Acid Extractable Copper (Cu)	2015/09/30	<0.5		ug/g	
			Acid Extractable Lead (Pb)	2015/09/30	<1		ug/g	
			Acid Extractable Molybdenum (Mo)	2015/09/30	<0.5		ug/g	
			Acid Extractable Nickel (Ni)	2015/09/30	<0.5		ug/g	
			Acid Extractable Selenium (Se)	2015/09/30	<0.5		ug/g	
			Acid Extractable Silver (Ag)	2015/09/30	<0.2		ug/g	
			Acid Extractable Thallium (Tl)	2015/09/30	<0.05		ug/g	
			Acid Extractable Tin (Sn)	2015/09/30	<5		ug/g	
			Acid Extractable Uranium (U)	2015/09/30	<0.05		ug/g	
			Acid Extractable Vanadium (V)	2015/09/30	<5		ug/g	
			Acid Extractable Zinc (Zn)	2015/09/30	<5		ug/g	
4208967	RAI	RPD [BBD754-01]	Acid Extractable Antimony (Sb)	2015/09/30	NC		%	35
			Acid Extractable Arsenic (As)	2015/09/30	NC		%	35
			Acid Extractable Barium (Ba)	2015/09/30	0.52		%	35
			Acid Extractable Beryllium (Be)	2015/09/30	NC		%	35
			Acid Extractable Cadmium (Cd)	2015/09/30	NC		%	35
			Acid Extractable Chromium (Cr)	2015/09/30	0.98		%	35
			Acid Extractable Cobalt (Co)	2015/09/30	0.012		%	35
			Acid Extractable Copper (Cu)	2015/09/30	2.6		%	35
			Acid Extractable Lead (Pb)	2015/09/30	2.5		%	35
			Acid Extractable Molybdenum (Mo)	2015/09/30	NC		%	35
			Acid Extractable Nickel (Ni)	2015/09/30	11		%	35
			Acid Extractable Selenium (Se)	2015/09/30	NC		%	35
			Acid Extractable Silver (Ag)	2015/09/30	NC		%	35
			Acid Extractable Thallium (Tl)	2015/09/30	NC		%	35
			Acid Extractable Tin (Sn)	2015/09/30	NC		%	35
			Acid Extractable Uranium (U)	2015/09/30	0.21		%	25
			Acid Extractable Vanadium (V)	2015/09/30	NC		%	35
			Acid Extractable Zinc (Zn)	2015/09/30	NC		%	35
4211688	LFE	Matrix Spike	D10-Anthracene	2015/09/30		91	%	50 - 130
			D14-Terphenyl (FS)	2015/09/30		92	%	50 - 130
			D8-Acenaphthylene	2015/09/30		93	%	50 - 130
			Benzo(e)pyrene	2015/09/30		83	%	50 - 130
			Acenaphthene	2015/09/30		88	%	50 - 130
			Acenaphthylene	2015/09/30		83	%	50 - 130
			Anthracene	2015/09/30		75	%	50 - 130
			Benzo(a)anthracene	2015/09/30		97	%	50 - 130
			Benzo(a)pyrene	2015/09/30		89	%	50 - 130
			Benzo(b/j)fluoranthene	2015/09/30		84	%	50 - 130
			Benzo(g,h,i)perylene	2015/09/30		70	%	50 - 130
			Benzo(k)fluoranthene	2015/09/30		89	%	50 - 130
			Chrysene	2015/09/30		89	%	50 - 130
			Dibenz(a,h)anthracene	2015/09/30		92	%	50 - 130
			Fluoranthene	2015/09/30		89	%	50 - 130
			Fluorene	2015/09/30		95	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2015/09/30		85	%	50 - 130
			1-Methylnaphthalene	2015/09/30		81	%	50 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			2-Methylnaphthalene	2015/09/30		79	%	50 - 130
			Naphthalene	2015/09/30		71	%	50 - 130
			Phenanthrene	2015/09/30		79	%	50 - 130
			Pyrene	2015/09/30		84	%	50 - 130
			Biphenyl	2015/09/30		82	%	50 - 130
			Perylene	2015/09/30		86	%	50 - 130
4211688	LFE	Spiked Blank	D10-Anthracene	2015/09/30		95	%	50 - 130
			D14-Terphenyl (FS)	2015/09/30		95	%	50 - 130
			D8-Acenaphthylene	2015/09/30		114	%	50 - 130
			Benzo(e)pyrene	2015/09/30		91	%	50 - 130
			Acenaphthene	2015/09/30		87	%	50 - 130
			Acenaphthylene	2015/09/30		84	%	50 - 130
			Anthracene	2015/09/30		78	%	50 - 130
			Benzo(a)anthracene	2015/09/30		95	%	50 - 130
			Benzo(a)pyrene	2015/09/30		93	%	50 - 130
			Benzo(b/j)fluoranthene	2015/09/30		94	%	50 - 130
			Benzo(g,h,i)perylene	2015/09/30		75	%	50 - 130
			Benzo(k)fluoranthene	2015/09/30		87	%	50 - 130
			Chrysene	2015/09/30		91	%	50 - 130
			Dibenz(a,h)anthracene	2015/09/30		89	%	50 - 130
			Fluoranthene	2015/09/30		96	%	50 - 130
			Fluorene	2015/09/30		94	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2015/09/30		88	%	50 - 130
			1-Methylnaphthalene	2015/09/30		78	%	50 - 130
			2-Methylnaphthalene	2015/09/30		75	%	50 - 130
			Naphthalene	2015/09/30		69	%	50 - 130
			Phenanthrene	2015/09/30		86	%	50 - 130
			Pyrene	2015/09/30		94	%	50 - 130
			Biphenyl	2015/09/30		79	%	50 - 130
			Perylene	2015/09/30		90	%	50 - 130
4211688	LFE	Method Blank	D10-Anthracene	2015/09/30		92	%	50 - 130
			D14-Terphenyl (FS)	2015/09/30		91	%	50 - 130
			D8-Acenaphthylene	2015/09/30		90	%	50 - 130
			Benzo(e)pyrene	2015/09/30	<0.0050		ug/g	
			Acenaphthene	2015/09/30	<0.0050		ug/g	
			Acenaphthylene	2015/09/30	<0.0050		ug/g	
			Anthracene	2015/09/30	<0.0050		ug/g	
			Benzo(a)anthracene	2015/09/30	<0.0050		ug/g	
			Benzo(a)pyrene	2015/09/30	<0.0050		ug/g	
			Benzo(b/j)fluoranthene	2015/09/30	<0.0050		ug/g	
			Benzo(g,h,i)perylene	2015/09/30	<0.0050		ug/g	
			Benzo(k)fluoranthene	2015/09/30	<0.0050		ug/g	
			Chrysene	2015/09/30	<0.0050		ug/g	
			Dibenz(a,h)anthracene	2015/09/30	<0.0050		ug/g	
			Fluoranthene	2015/09/30	<0.0050		ug/g	
			Fluorene	2015/09/30	<0.0050		ug/g	
			Indeno(1,2,3-cd)pyrene	2015/09/30	<0.0050		ug/g	
			1-Methylnaphthalene	2015/09/30	<0.0050		ug/g	
			2-Methylnaphthalene	2015/09/30	<0.0050		ug/g	
			Naphthalene	2015/09/30	<0.0050		ug/g	
			Phenanthrene	2015/09/30	<0.0050		ug/g	
			Pyrene	2015/09/30	<0.0050		ug/g	
			Biphenyl	2015/09/30	<0.0050		ug/g	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Perylene	2015/09/30	<0.0050		ug/g	
4211688	LFE	RPD	Acenaphthene	2015/09/30	NC		%	40
			Acenaphthylene	2015/09/30	NC		%	40
			Anthracene	2015/09/30	NC		%	40
			Benzo(a)anthracene	2015/09/30	NC		%	40
			Benzo(a)pyrene	2015/09/30	NC		%	40
			Benzo(b/j)fluoranthene	2015/09/30	51 (1)		%	40
			Benzo(g,h,i)perylene	2015/09/30	NC		%	40
			Benzo(k)fluoranthene	2015/09/30	NC		%	40
			Chrysene	2015/09/30	NC		%	40
			Dibenz(a,h)anthracene	2015/09/30	NC		%	40
			Fluoranthene	2015/09/30	32		%	40
			Fluorene	2015/09/30	NC		%	40
			Indeno(1,2,3-cd)pyrene	2015/09/30	NC		%	40
			1-Methylnaphthalene	2015/09/30	NC		%	40
			2-Methylnaphthalene	2015/09/30	NC		%	40
			Naphthalene	2015/09/30	NC		%	40
			Phenanthrene	2015/09/30	NC		%	40
			Pyrene	2015/09/30	30		%	40
4212658	SUK	Matrix Spike	Acid Extractable Sulphur (S)	2015/10/01		NC	%	75 - 125
4212658	SUK	Spiked Blank	Acid Extractable Sulphur (S)	2015/10/01		100	%	80 - 120
4212658	SUK	Method Blank	Acid Extractable Sulphur (S)	2015/10/01	<50		ug/g	
4212664	SUK	Matrix Spike	Acid Extractable Sulphur (S)	2015/10/01		NC	%	75 - 125
4212664	SUK	Spiked Blank	Acid Extractable Sulphur (S)	2015/10/01		99	%	80 - 120
4212664	SUK	Method Blank	Acid Extractable Sulphur (S)	2015/10/01	<50		ug/g	
4213334	LHR	Matrix Spike	1,4-Difluorobenzene	2015/10/02		104	%	60 - 140
			4-Bromofluorobenzene	2015/10/02		92	%	60 - 140
			D10-Ethylbenzene	2015/10/02		104	%	30 - 130
			D4-1,2-Dichloroethane	2015/10/02		125	%	60 - 140
			Benzene	2015/10/02		91	%	60 - 140
			Toluene	2015/10/02		85	%	60 - 140
			Ethylbenzene	2015/10/02		96	%	60 - 140
			o-Xylene	2015/10/02		96	%	60 - 140
			p+m-Xylene	2015/10/02		86	%	60 - 140
			F1 (C6-C10)	2015/10/02		97	%	60 - 140
4213334	LHR	Spiked Blank	1,4-Difluorobenzene	2015/10/01		104	%	60 - 140
			4-Bromofluorobenzene	2015/10/01		87	%	60 - 140
			D10-Ethylbenzene	2015/10/01		105	%	30 - 130
			D4-1,2-Dichloroethane	2015/10/01		123	%	60 - 140
			Benzene	2015/10/01		94	%	60 - 140
			Toluene	2015/10/01		85	%	60 - 140
			Ethylbenzene	2015/10/01		96	%	60 - 140
			o-Xylene	2015/10/01		94	%	60 - 140
			p+m-Xylene	2015/10/01		86	%	60 - 140
			F1 (C6-C10)	2015/10/01		93	%	80 - 120
4213334	LHR	Method Blank	1,4-Difluorobenzene	2015/10/01		106	%	60 - 140
			4-Bromofluorobenzene	2015/10/01		86	%	60 - 140
			D10-Ethylbenzene	2015/10/01		94	%	30 - 130
			D4-1,2-Dichloroethane	2015/10/01		124	%	60 - 140
			Benzene	2015/10/01	<0.005		ug/g	
			Toluene	2015/10/01	<0.02		ug/g	
			Ethylbenzene	2015/10/01	<0.01		ug/g	
			o-Xylene	2015/10/01	<0.02		ug/g	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			p+m-Xylene	2015/10/01	<0.04		ug/g	
			Total Xylenes	2015/10/01	<0.04		ug/g	
			F1 (C6-C10)	2015/10/01	<10		ug/g	
			F1 (C6-C10) - BTEX	2015/10/01	<10		ug/g	
4213334	LHR	RPD [BBD754-01]	Benzene	2015/10/05	44		%	50
			Toluene	2015/10/05	14		%	50
			Ethylbenzene	2015/10/05	15		%	50
			o-Xylene	2015/10/05	18		%	50
			p+m-Xylene	2015/10/05	14		%	50
			Total Xylenes	2015/10/05	15		%	50
			F1 (C6-C10)	2015/10/05	25		%	50
			F1 (C6-C10) - BTEX	2015/10/05	25		%	50
4218156	CM5	Matrix Spike	13C4-Perfluorooctanesulfonate	2015/10/07		101	%	80 - 140
			13C4-Perfluorooctanoic acid	2015/10/07		97	%	80 - 140
			13C8-Perfluorooctanesulfonamide	2015/10/07		93	%	80 - 140
			Perfluorobutane Sulfonate (PFBS)	2015/10/07		89	%	70 - 130
			Perfluorobutanoic acid	2015/10/07		123	%	70 - 130
			Perfluorodecane Sulfonate	2015/10/07		108	%	70 - 130
			Perfluorodecanoic Acid (PFDA)	2015/10/07		107	%	70 - 130
			Perfluorododecanoic Acid (PFDoA)	2015/10/07		104	%	70 - 130
			Perfluoroheptane sulfonate	2015/10/07		102	%	70 - 130
			Perfluorononanoic Acid (PFNA)	2015/10/07		112	%	70 - 130
			Perfluorooctane Sulfonamide (PFOSA)	2015/10/07		107	%	70 - 130
			Perfluorotetradecanoic Acid	2015/10/07		96	%	70 - 130
			Perfluorotridecanoic Acid	2015/10/07		124	%	70 - 130
			Perfluoroundecanoic Acid (PFUnA)	2015/10/07		104	%	70 - 130
			Perfluoroheptanoic Acid (PFHpA)	2015/10/07		115	%	70 - 130
			Perfluorohexane Sulfonate (PFHxS)	2015/10/07		95	%	70 - 130
			Perfluorohexanoic Acid (PFHxA)	2015/10/07		110	%	70 - 130
			Perfluoro-n-Octanoic Acid (PFOA)	2015/10/07		115	%	70 - 130
			Perfluorooctane Sulfonate (PFOS)	2015/10/07		106	%	70 - 130
			Perfluoropentanoic Acid (PFPeA)	2015/10/07		112	%	70 - 130
4218156	CM5	RPD	Perfluorobutane Sulfonate (PFBS)	2015/10/07	3.5		%	30
			Perfluorobutanoic acid	2015/10/07	0.33		%	30
			Perfluorodecane Sulfonate	2015/10/07	3.0		%	30
			Perfluorodecanoic Acid (PFDA)	2015/10/07	2.9		%	30
			Perfluorododecanoic Acid (PFDoA)	2015/10/07	7.4		%	30
			Perfluoroheptane sulfonate	2015/10/07	0.39		%	30
			Perfluorononanoic Acid (PFNA)	2015/10/07	0		%	30
			Perfluorooctane Sulfonamide (PFOSA)	2015/10/07	7.6		%	25
			Perfluorotetradecanoic Acid	2015/10/07	5.7		%	30
			Perfluorotridecanoic Acid	2015/10/07	1.3		%	30
			Perfluoroundecanoic Acid (PFUnA)	2015/10/07	9.2		%	30
			Perfluoroheptanoic Acid (PFHpA)	2015/10/07	5.4		%	30
			Perfluorohexane Sulfonate (PFHxS)	2015/10/07	8.4		%	30
			Perfluorohexanoic Acid (PFHxA)	2015/10/07	4.5		%	30
			Perfluoro-n-Octanoic Acid (PFOA)	2015/10/07	2.1		%	30
			Perfluorooctane Sulfonate (PFOS)	2015/10/07	0		%	30
			Perfluoropentanoic Acid (PFPeA)	2015/10/07	2.2		%	30
4218156	CM5	Spiked Blank	13C4-Perfluorooctanesulfonate	2015/10/07		99	%	80 - 140
			13C4-Perfluorooctanoic acid	2015/10/07		105	%	80 - 140
			13C8-Perfluorooctanesulfonamide	2015/10/07		81	%	80 - 140
			Perfluorobutane Sulfonate (PFBS)	2015/10/07		87	%	70 - 130

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Perfluorobutanoic acid	2015/10/07		126	%	70 - 130
			Perfluorodecane Sulfonate	2015/10/07		94	%	70 - 130
			Perfluorodecanoic Acid (PFDA)	2015/10/07		100	%	70 - 130
			Perfluorododecanoic Acid (PFDoA)	2015/10/07		106	%	70 - 130
			Perfluoroheptane sulfonate	2015/10/07		103	%	70 - 130
			Perfluorononanoic Acid (PFNA)	2015/10/07		112	%	70 - 130
			Perfluorooctane Sulfonamide (PFOSA)	2015/10/07		99	%	70 - 130
			Perfluorotetradecanoic Acid	2015/10/07		93	%	70 - 130
			Perfluorotridecanoic Acid	2015/10/07		107	%	70 - 130
			Perfluoroundecanoic Acid (PFUnA)	2015/10/07		108	%	70 - 130
			Perfluoroheptanoic Acid (PFHpA)	2015/10/07		109	%	70 - 130
			Perfluorohexane Sulfonate (PFHxS)	2015/10/07		101	%	70 - 130
			Perfluorohexanoic Acid (PFHxA)	2015/10/07		109	%	70 - 130
			Perfluoro-n-Octanoic Acid (PFOA)	2015/10/07		102	%	70 - 130
			Perfluorooctane Sulfonate (PFOS)	2015/10/07		103	%	70 - 130
			Perfluoropentanoic Acid (PFPeA)	2015/10/07		111	%	70 - 130
4218156	CM5	Method Blank	13C4-Perfluorooctanesulfonate	2015/10/07		94	%	80 - 140
			13C4-Perfluorooctanoic acid	2015/10/07		106	%	80 - 140
			13C8-Perfluorooctanesulfonamide	2015/10/07		85	%	80 - 140
			Perfluorobutane Sulfonate (PFBS)	2015/10/07	<1		ug/kg	
			Perfluorobutanoic acid	2015/10/07	<1		ug/kg	
			Perfluorodecane Sulfonate	2015/10/07	<1		ug/kg	
			Perfluorodecanoic Acid (PFDA)	2015/10/07	<1		ug/kg	
			Perfluorododecanoic Acid (PFDoA)	2015/10/07	<1		ug/kg	
			Perfluoroheptane sulfonate	2015/10/07	<1		ug/kg	
			Perfluorononanoic Acid (PFNA)	2015/10/07	<1		ug/kg	
			Perfluorooctane Sulfonamide (PFOSA)	2015/10/07	<1		ug/kg	
			Perfluorotetradecanoic Acid	2015/10/07	<1		ug/kg	
			Perfluorotridecanoic Acid	2015/10/07	<1		ug/kg	
			Perfluoroundecanoic Acid (PFUnA)	2015/10/07	<1		ug/kg	
			Perfluoroheptanoic Acid (PFHpA)	2015/10/07	<1		ug/kg	
			Perfluorohexane Sulfonate (PFHxS)	2015/10/07	<1		ug/kg	
			Perfluorohexanoic Acid (PFHxA)	2015/10/07	<1		ug/kg	
			Perfluoro-n-Octanoic Acid (PFOA)	2015/10/07	<1		ug/kg	
			Perfluorooctane Sulfonate (PFOS)	2015/10/07	<1		ug/kg	
			Perfluoropentanoic Acid (PFPeA)	2015/10/07	<1		ug/kg	

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B5J5790
Report Date: 2015/10/08

Franz Environmental Inc.
Your P.O. #: 700336248
Sampler Initials: AH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere, Scientific Services

Paul Rubinato, Analyst, Maxxam Analytics

Steve Roberts, Ottawa Lab Manager

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-Free:800-563-6266 Fax:(905) 817-5777 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#9041 Public Works & Gov't Services Canada	Company Name:	#16066 Franz Environmental Inc.	Quotation #:		Maxxam Job #:	Bottle Order #: 530642
Attention:	Chris Doupe	Attention:	Andrew Henderson	P.O. #:			
Address:	Telus Plaza North 5th Floor 10025 Jasper Ave Edmonton AB T5J 1S6	Address:	200-329 Churchhill Ave Ottawa ON K1Z 5B8	Project:			
Tel:	(403) 497-3868 Fax: (403) 497-3842	Tel:	(613) 721-0555 Fax:	Project Name:		COC #: C#530642-04-01	Project Manager: Marinela Sim
Email:	doupec@pwgsc.gc.ca	Email:	andrew.henderson@arcadis.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine; ☐ Table 2 ☐ Ind/Comm ☐ Coarse; ☐ Table 3 ☐ Agri/Other ☐ For RSC; ☐ Table ___

Other Regulations: ☒ CCME ☐ Sanitary Sewer Bylaw; ☐ Reg 558. ☐ Storm Sewer Bylaw; ☐ MISA Municipality ___; ☐ PWQO; ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests..
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	CCME Petroleum Hydrocarbons	PAH Compounds in Water by GC/MS (SIM)	Dissolved ICPMS Metals (Low Level)	Low Level Total Suspended Solids	pH/ Conductivity/ Hardness	PFOS and PFOA in water	CCME Petroleum Hydrocarbons in SOIL	CCME ICPMS & ICP Metals	O.Reg 153 PAHs (Soil)	PFOS and PFOA in soil	# of Bottles	Comments
1		LTU2-1	25/9/22	1030	SOIL		X PAH	X PAH	29/9/22				X	X	X	X	3	ALL SOIL ROCKY & COLLECTED FROZEN
2		LTU2-2		1030	SOIL								X	X	X		3	HEADSPACE MAY
3		LTU2-3		1045	SOIL								X	X			2	BE AN ISSUE
4		LTU2-4		1130	SOIL								X	X		X	3	
5		LTU1-1		1315	SOIL								X	X			2	
6		LTU1-2		1345	SOIL								X	X		X	3	
7		LTU1-3		1400	SOIL								X	X	X		3	
8		LTU1-4		1715	SOIL								X	X			2	
9		LTU1-5		1730	SOIL								X	X	X		3	
10		LTU3-1	↓	1745	SOIL								X	X	X		3	

28-Sep-15 10:00
Marinela Sim
B5J5790
FHB OTT-002

RECEIVED IN OTTAWA

on water

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
[illegible] / Andrew Henderson	15/9/22	1800	Kelsey Pilon Kelsey Pilon	15/09/28	10:00		Time Sensitive	Temperature (°C) on Receipt 10,6,6 6.7,7	Custody Seal	Yes	No
									Present	✓	
									Intact	✓	

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam
A Bureau Veritas Group Company

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-Free:800-563-6266 Fax:(905) 817-5777 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#9041 Public Works & Gov't Services Canada	Company Name:	#16066 Franz Environmental Inc.	Quotation #:		Maxxam Job #:	Bottle Order #: 530642
Attention:	Chris Doupe	Attention:	Andrew Henderson	P.O. #:			
Address:	Telus Plaza North 5th Floor 10025 Jasper Ave Edmonton AB T5J 1S6	Address:	200-329 Churchhill Ave Ottawa ON K1Z 5B8	Project:		COC #: C#530642-05-01	Project Manager: Marinela Sim
Tel:	(403) 497-3868 Fax: (403) 497-3842	Tel:	(613) 721-0555 Fax:	Project Name:			
Email:	doupec@pwgsc.gc.ca	Email:	andrew.henderson@arcadis.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
☐ Table 1 ☐ Res/Park ☐ Medium/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ For RSC
☐ Table ___

Other Regulations
☒ CCME ☐ Sanitary Sewer Bylaw
☐ Reg 558. ☐ Storm Sewer Bylaw
☐ MISA Municipality ___
☐ PWQO
☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	CCME Petroleum Hydrocarbons	PAH Compounds in Water by GC/MS (SIM)	Dissolved ICPMS Metals (Low Level)	Low Level Total Suspended Solids	pH/ Conductivity/ Hardness	PFOS and PFOA in water	CCME Petroleum Hydrocarbons in SOIL	CCME ICPMS & ICP Metals	O.Reg 153 PAHs (Soil)	PFOS and PFOA in soil	# of Bottles	Comments
1		LTU3-2	2015/4/22	1750	SOIL								X	X			2	Removed AH 22.9.15
2		LTU4-1	"	1755	SOIL								X	X			2	
3		LTU4-2	"	1800	SOIL								X	X			2	Removed AH 22.9.15
4		LTUDUP1	"	—	SOIL								X	X	X		3	
5		LTU-DUP2	"	—	SOIL								X	X	X		3	
6																		
7																		
8																		
9																		RECEIVED IN OTTAWA
10																		on water

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
A Henderson	15/9/22	1800	Kelsey Pilon	15/09/28	10:00				Present	✓	
									Intact	✓	

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

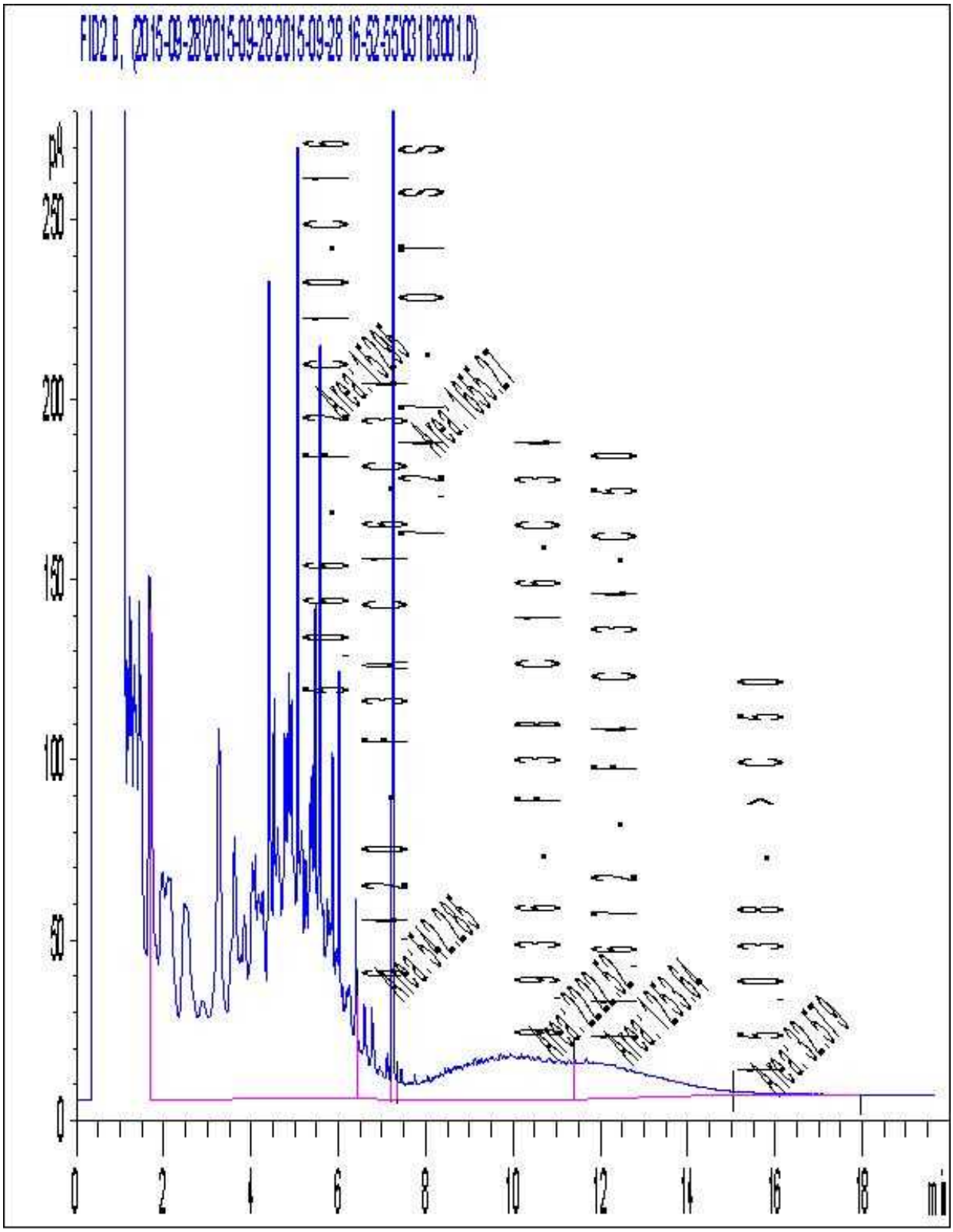
White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD754

Franz Environmental Inc.
Client ID: LTU2-1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

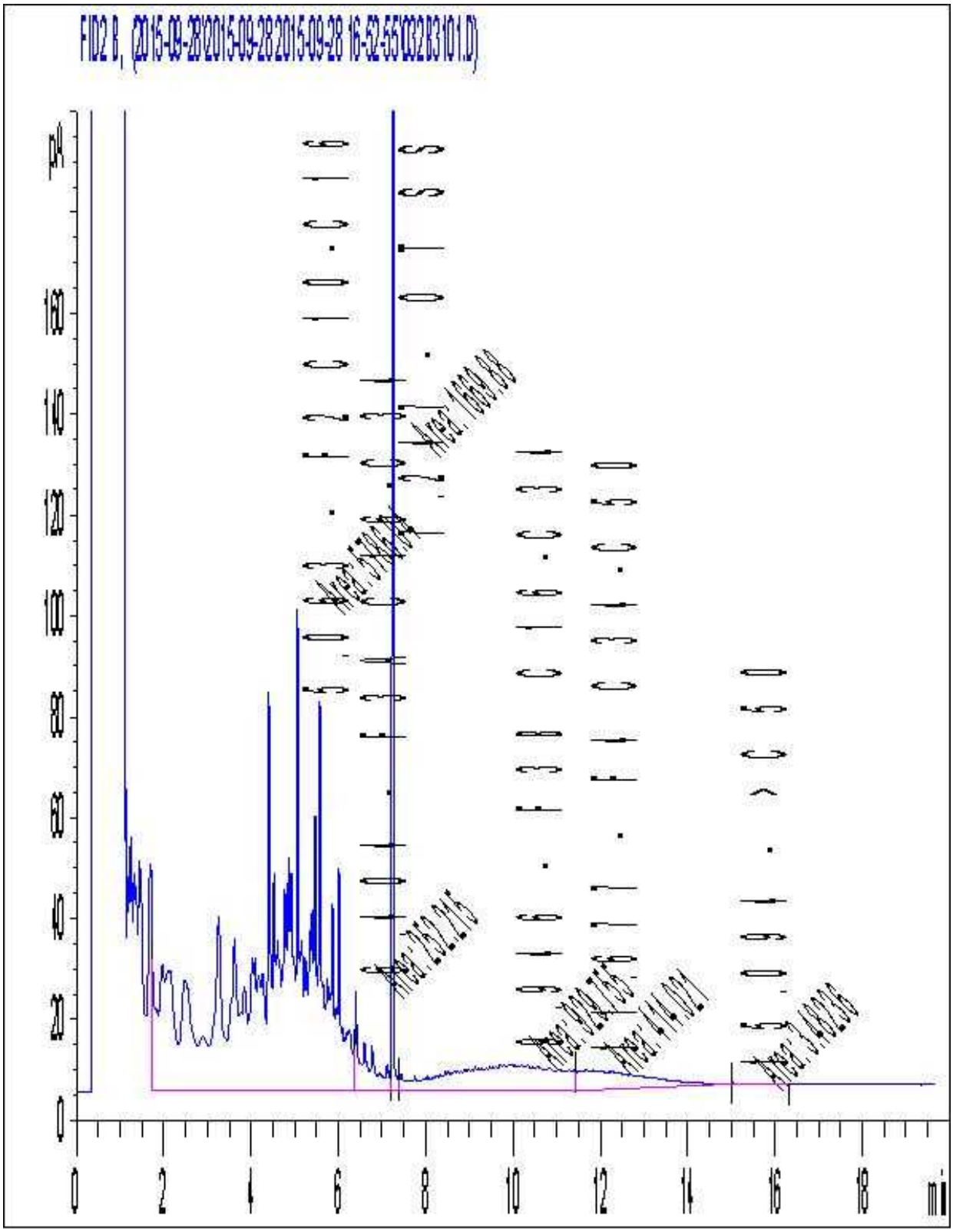


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD755

Franz Environmental Inc.
Client ID: LTU2-2

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

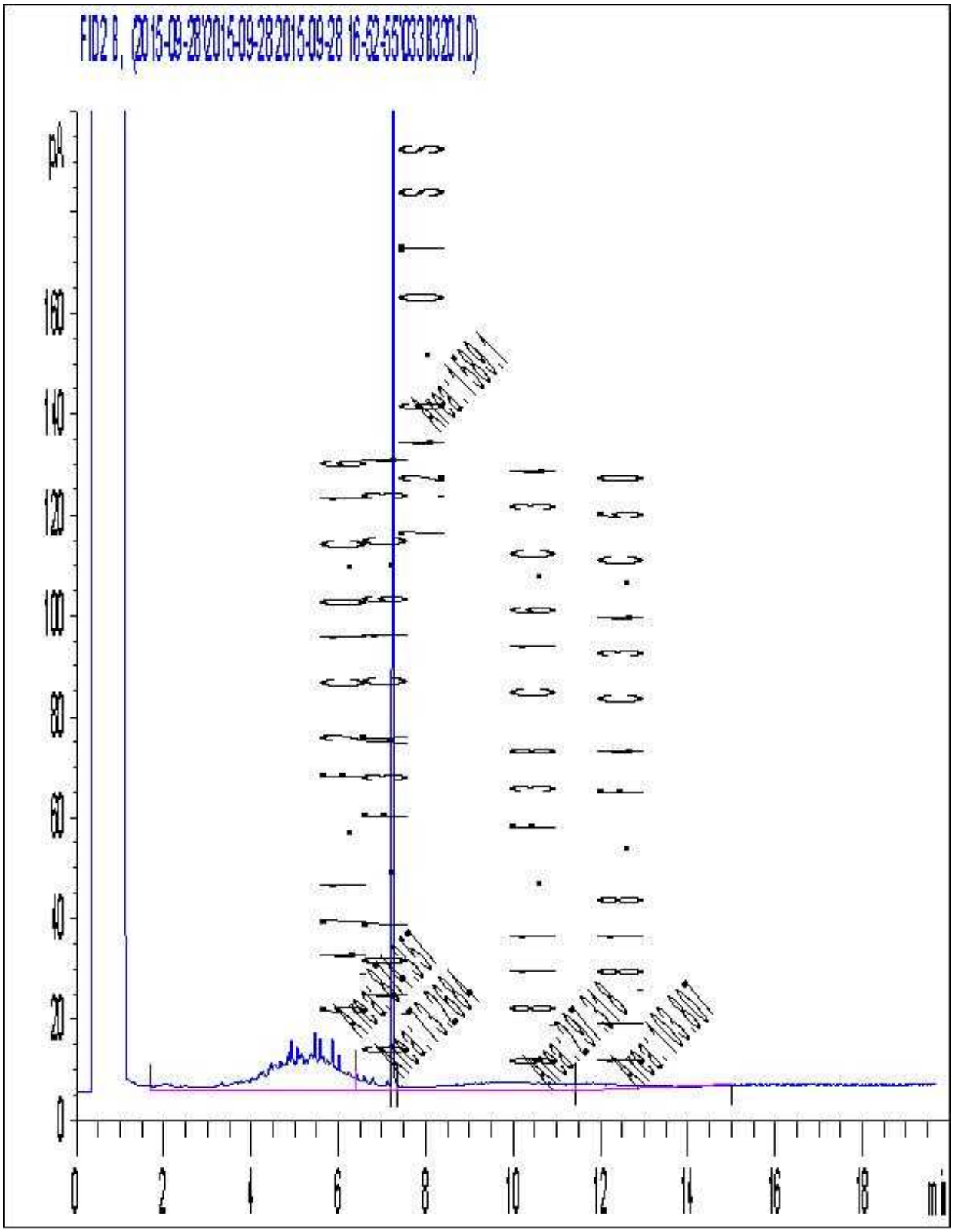


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD756

Franz Environmental Inc.
Client ID: LTU2-3

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

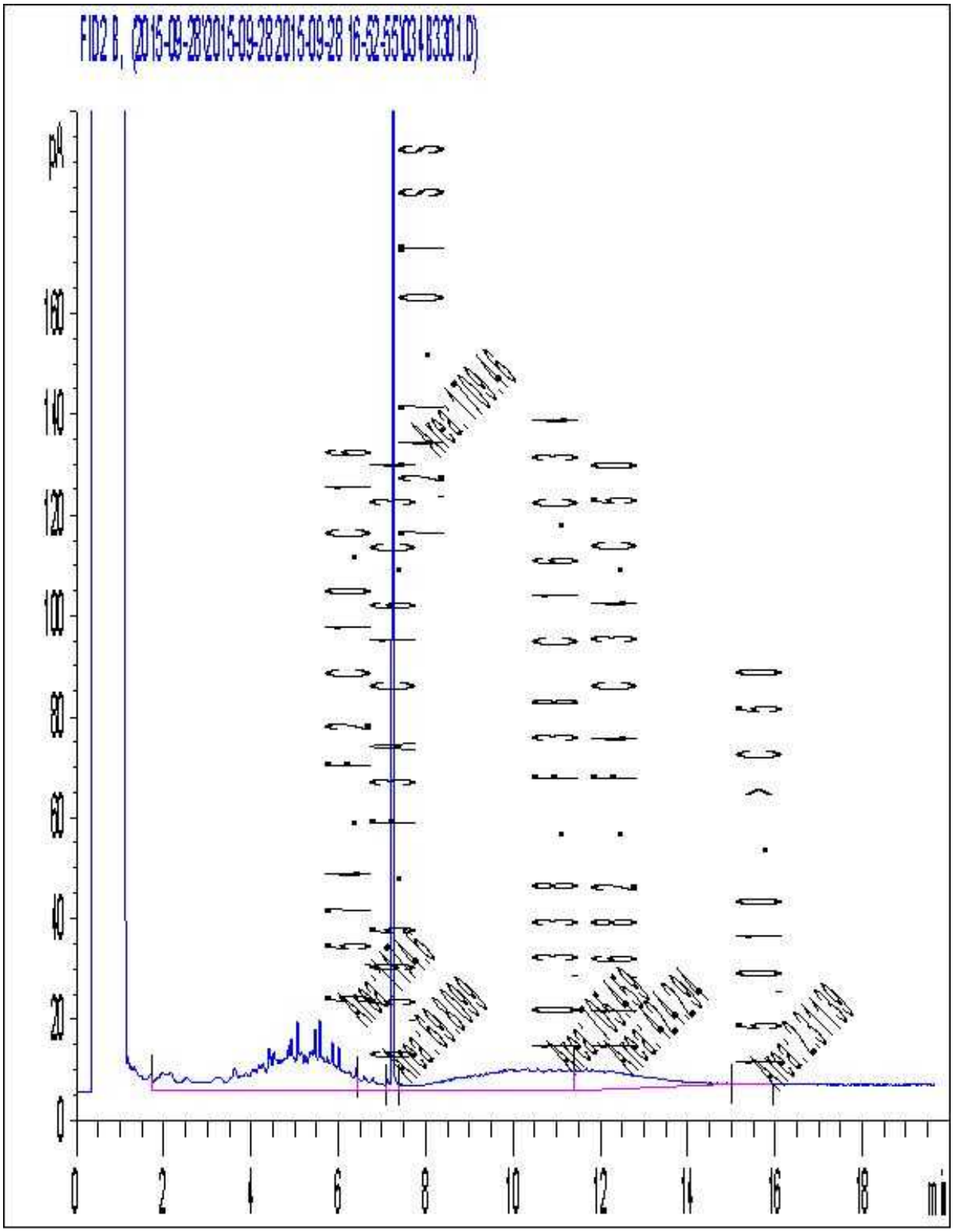


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD757

Franz Environmental Inc.
Client ID: LTU2-4

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

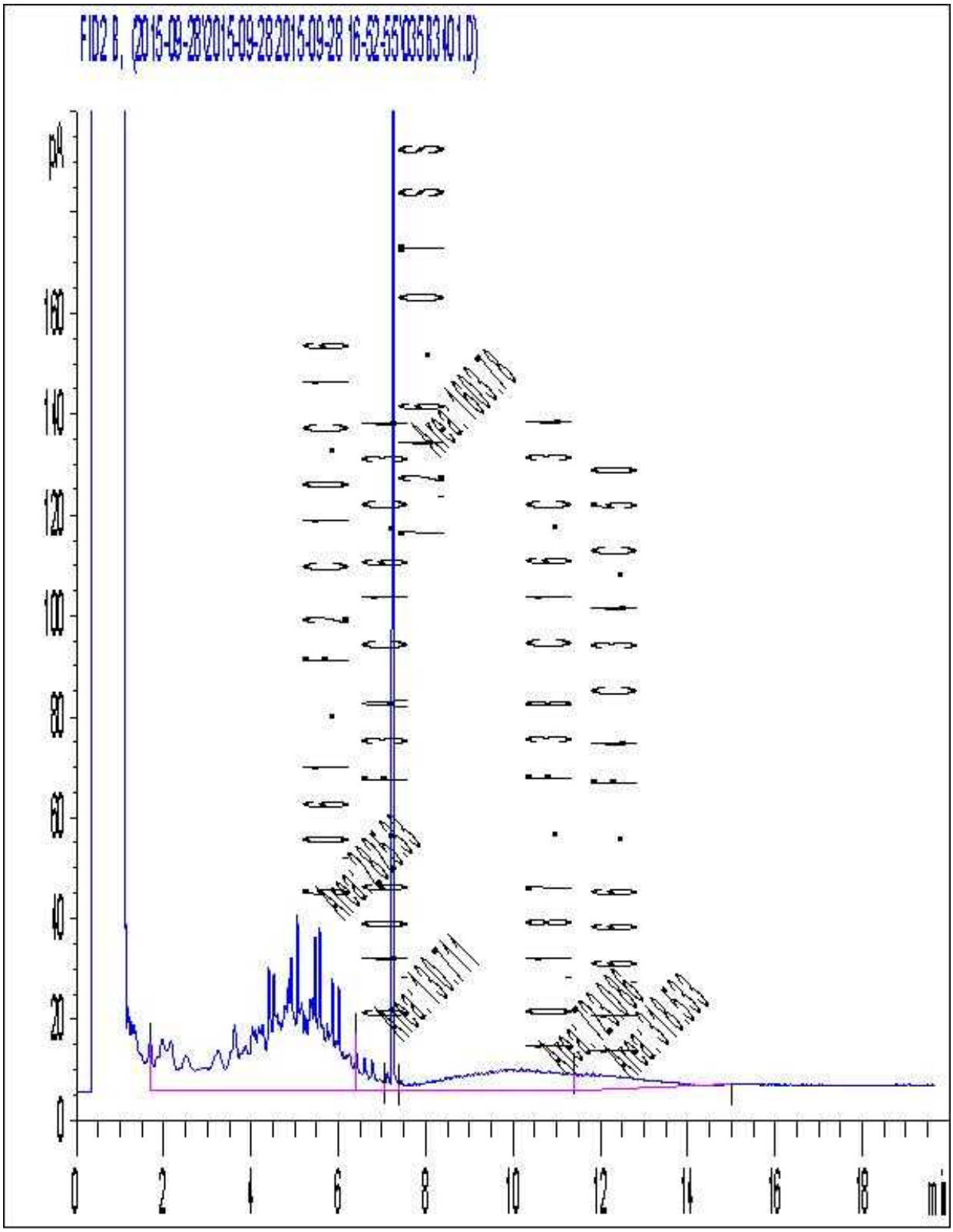


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD758

Franz Environmental Inc.
Client ID: LTU1-1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

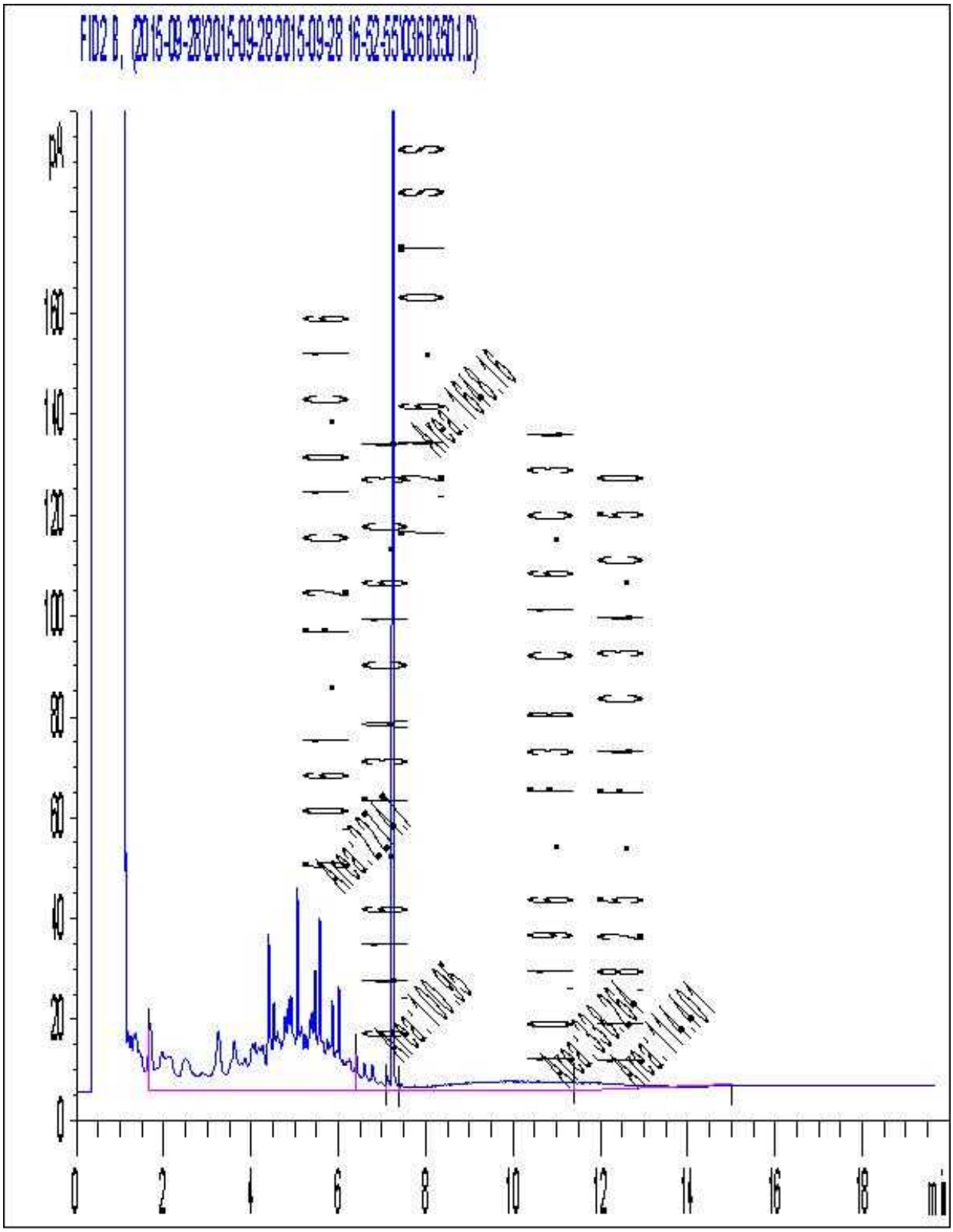


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD759

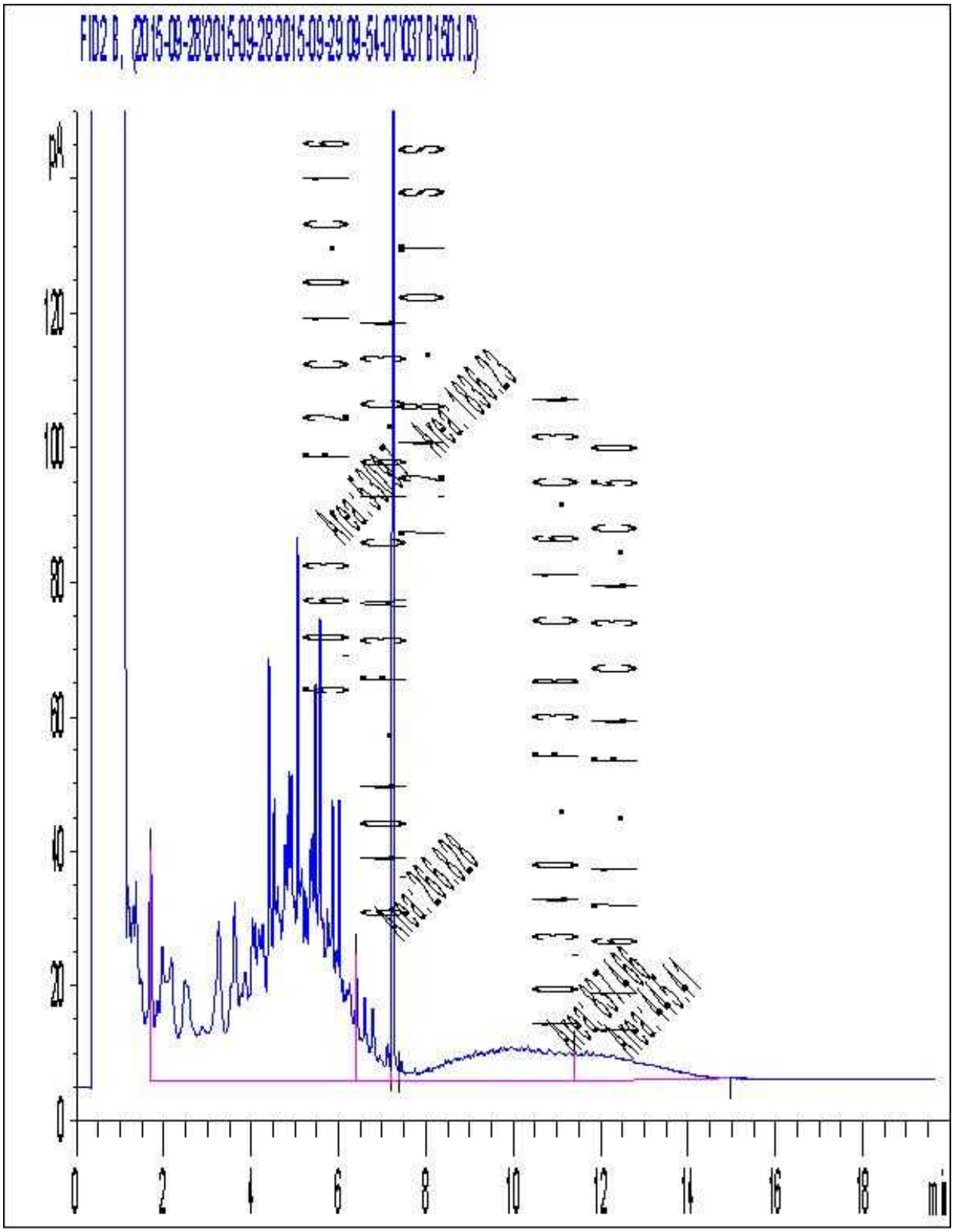
Franz Environmental Inc.
Client ID: LTU1-2

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

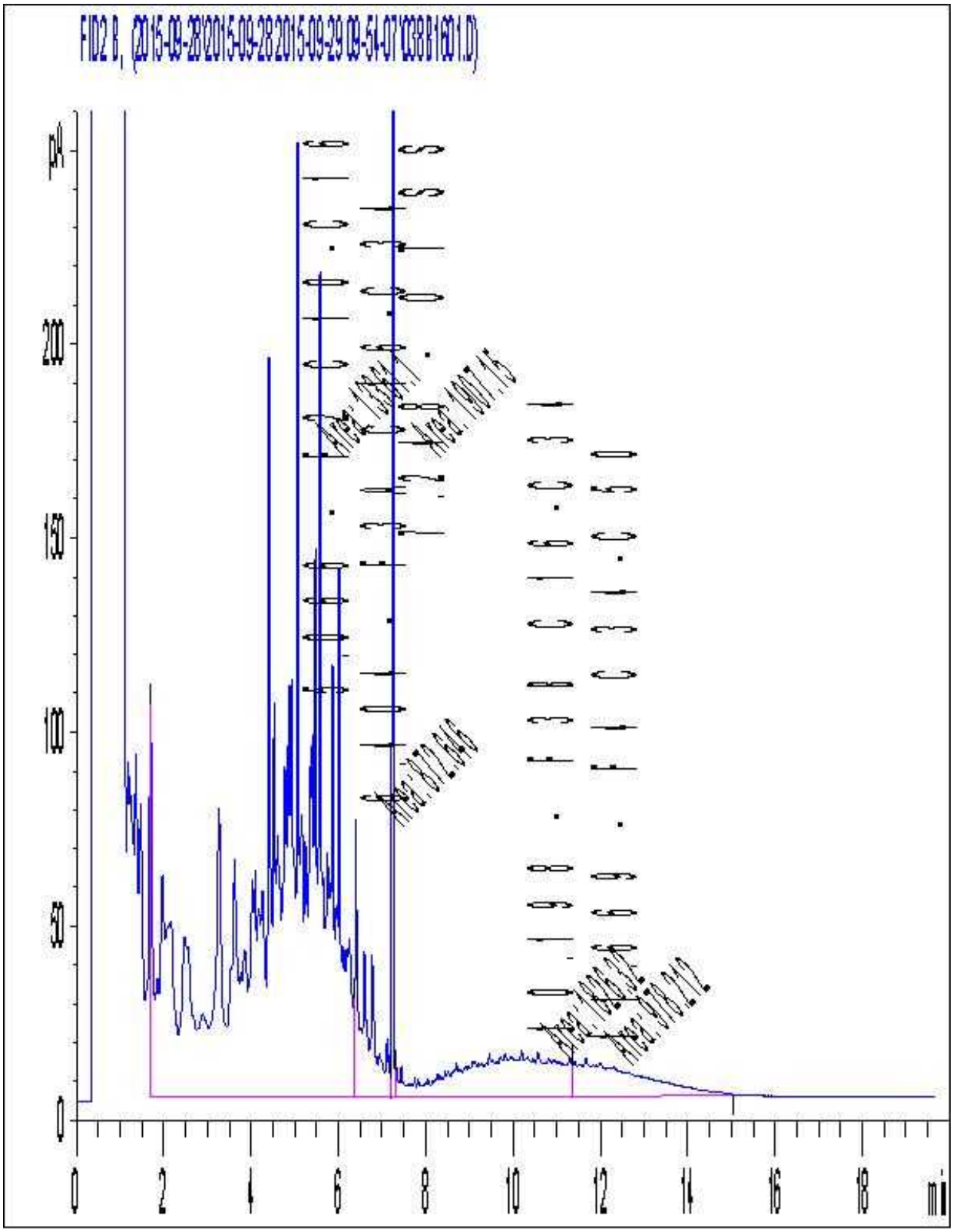


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD761

Franz Environmental Inc.
Client ID: LTU1-4

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

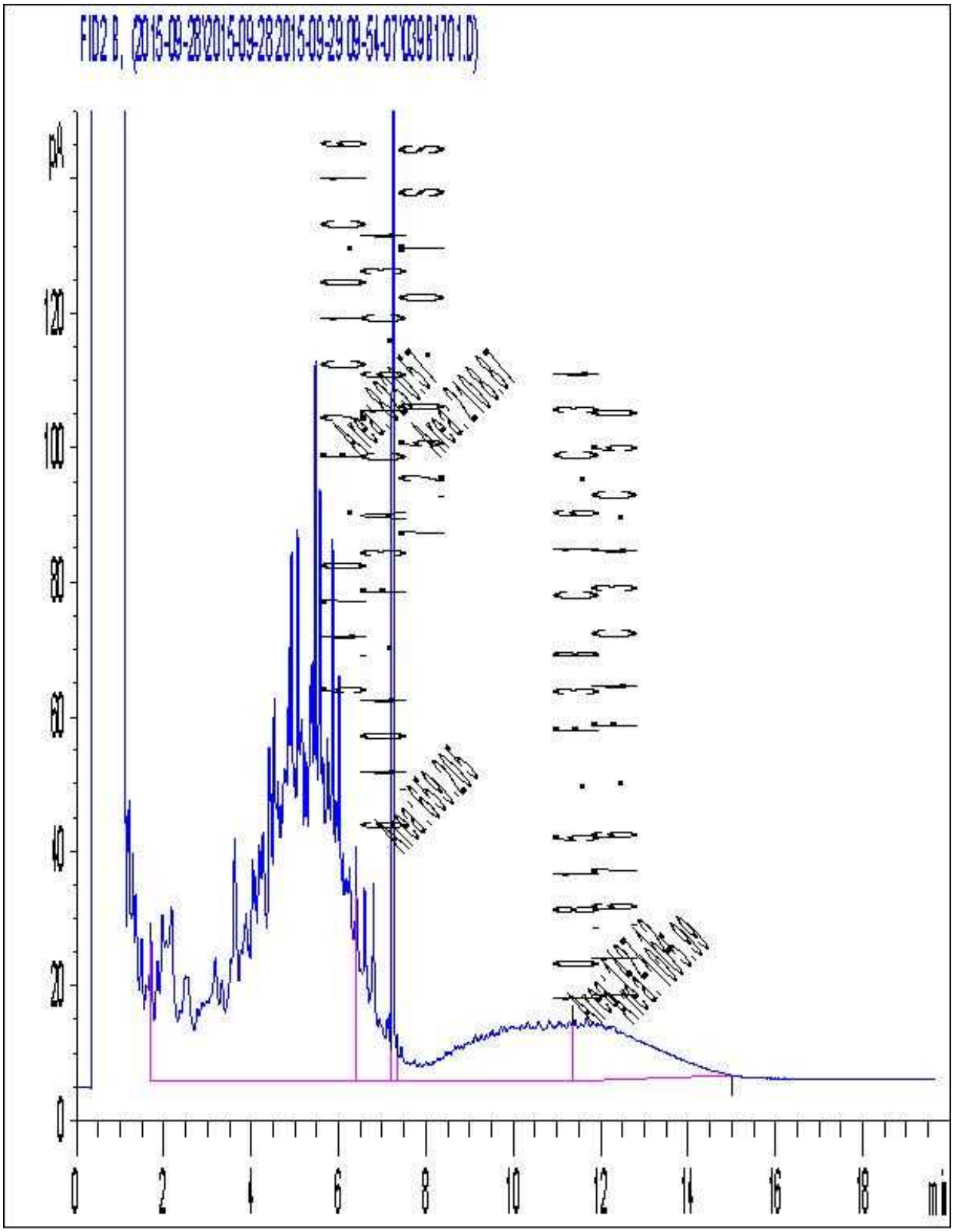


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD762

Franz Environmental Inc.
Client ID: LTU1-5

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

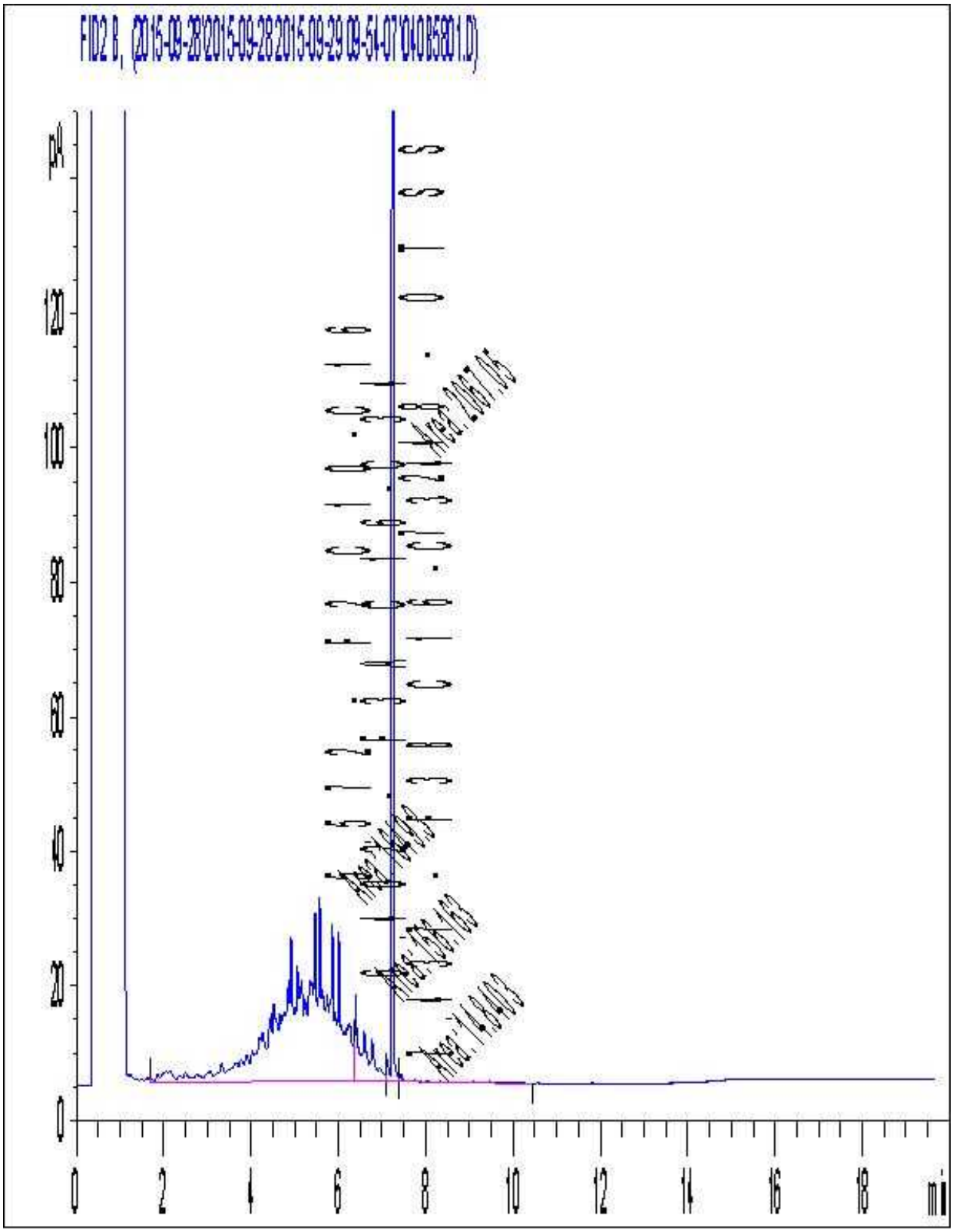


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD763

Franz Environmental Inc.
Client ID: LTU3-1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

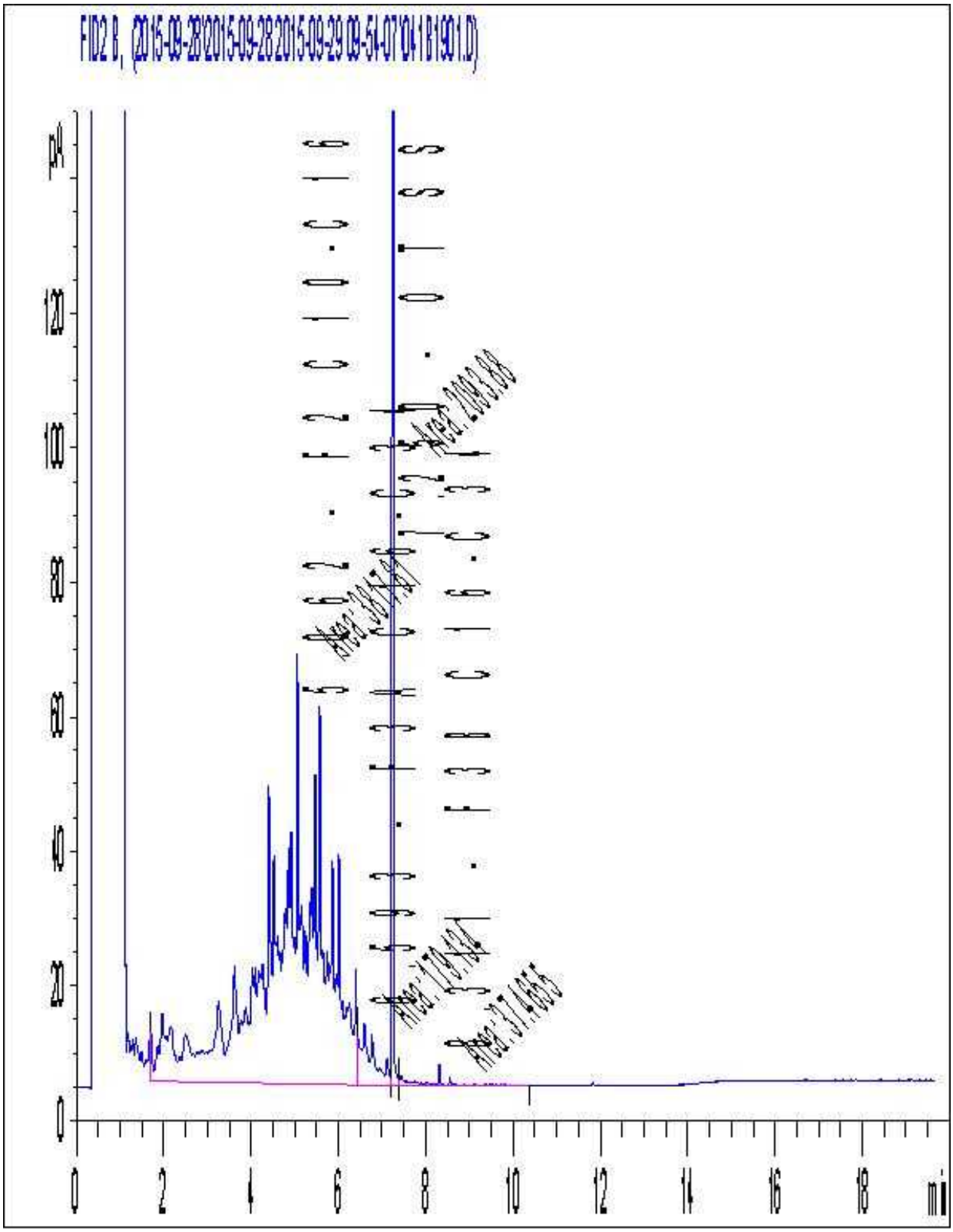


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD783

Franz Environmental Inc.
Client ID: LTU4-1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

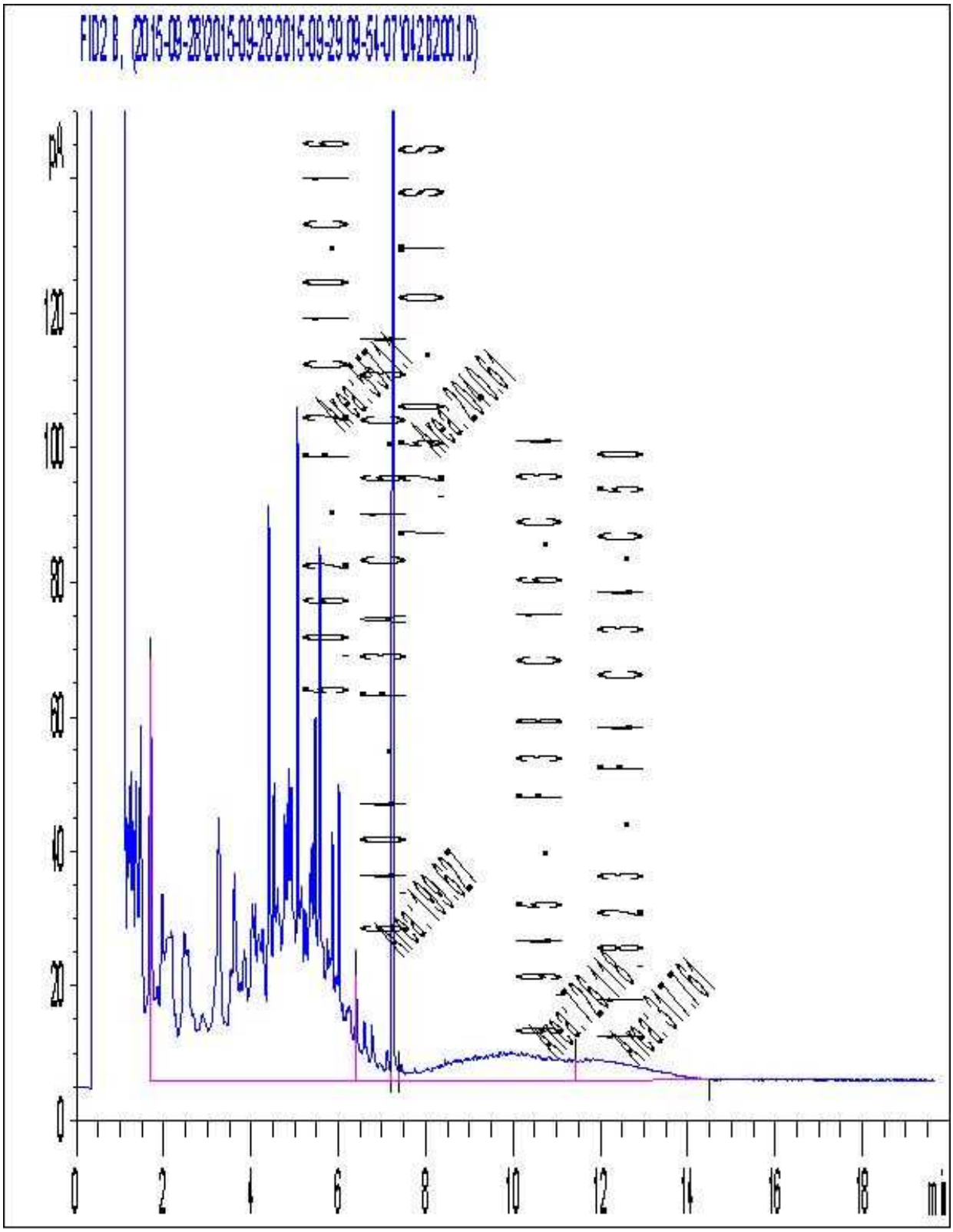


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD784

Franz Environmental Inc.
Client ID: LTU-DUP1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

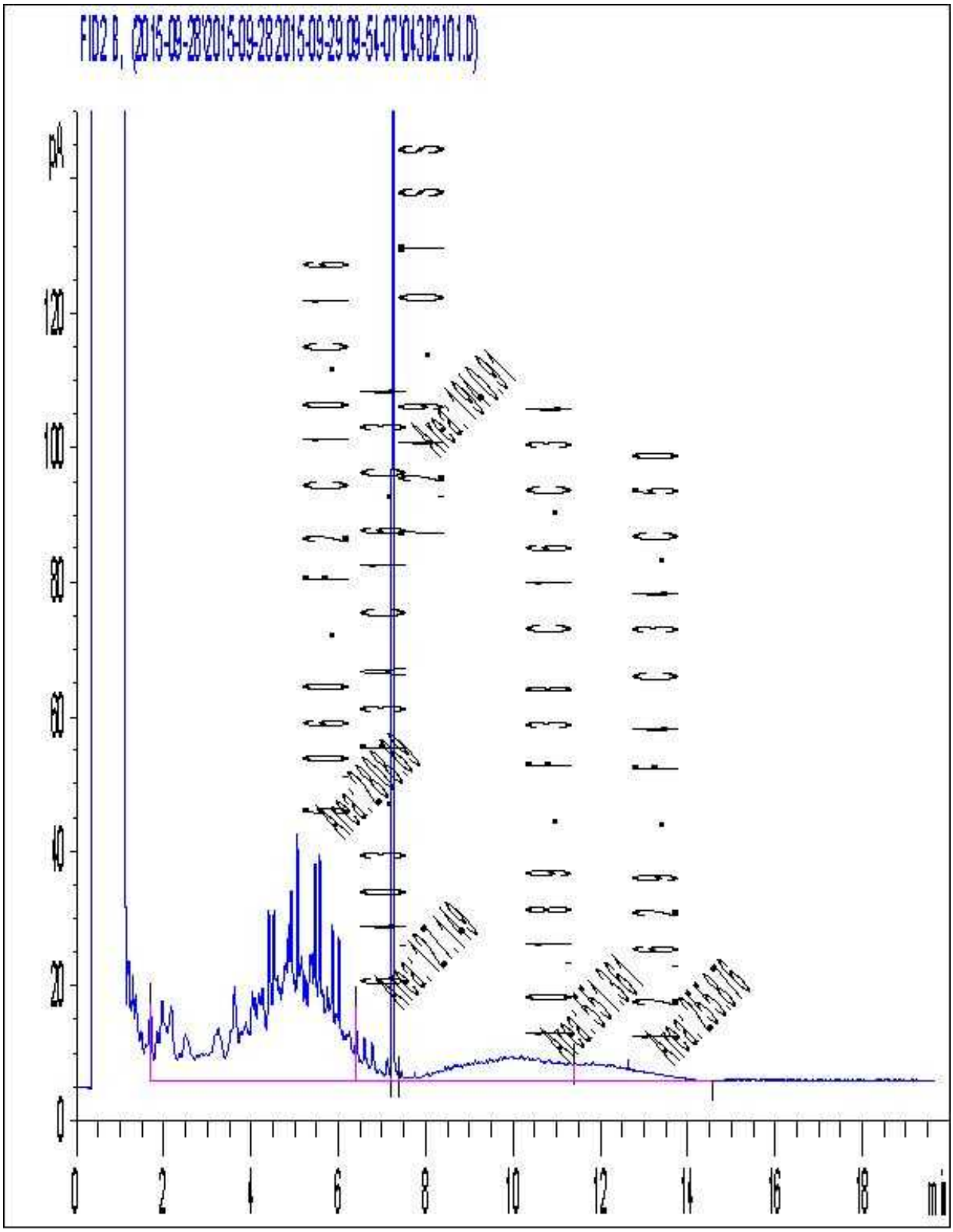


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B5J5790
Report Date: 2015/10/08
Maxxam Sample: BBD785

Franz Environmental Inc.
Client ID: LTU-DUP2

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



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Arcadis Canada Inc.

329 Churchill Avenue North

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