Suite 320, 6715 - 8 Street NE Calgary, AB T2E 7H7 Phone: 403-250-1362 1-800-351-0929 Fax: 403-250-1518



Alberta Environment and Parks 2nd Floor, Deerfoot Square 2938 – 11 Street NE Calgary, AB T2E 7L7 June 30, 2017 File: N:\2370\109\08\L12a-1.0

Attn: Mr. Dave Gower, P. Eng. Acting Director

Dear Mr. Gower:

Re: Sheep River Regional Utility Corporation (SRRUC) – EPEA Approval 1242-02-00 Application for Amending Approval No. 22 Direct Intake and Stilling Basin – Supplementary Information

This letter and attachment is submitted as supplementary information for the Amending Approval Application No. 022-1242 that was filed April 21, 2017. This is provided in response to a phone conversation June 29, and a subsequent e-mail received from Alberta Environment and Parks (AEP) on June 29, 2017. Several topics and comments were mentioned and we trust that the following information adequately addresses the topics.

Water Act Requirements

On May 5, 2017 two water act applications were submitted to AEP as follows:

- 1. Town of Black Diamond Water Act License #9684, File 16689, Transfer of Water Allocation This application requested that the point of diversion currently assigned to the Town of Black Diamond Wells no. 2 and 3 be transferred to the new Direct Intake infrastructure. Mr. Brajesh Gautam requested additional information via e-mail on June 26, 2017 regarding the status and standing of the old wells.
- Town of Turner Valley Water Act License #10987, File 18466, Transfer of Water Allocation This application requested that the point of diversion currently assigned to the dormant Town of Turner Valley Well no. 2 be transferred to the new Direct Intake infrastructure. Mr. Brajesh Gautam requested additional information regarding the status and standing of the old well.

We have provided (via e-mail from Ms. Jill Hardy) all supplementary information that was requested by Mr. Brajesh Gautam for both the Turner Valley (June 28/²17) and Black Diamond (June 30/²17) Licenses. We trust this is in order and completes the relevant applications.

Groundwater Monitoring Program

In the April 2017 application under Request 3, it is noted that **sampling of the direct intake is proposed to be twice a year**, which would be consistent with the source water wells that are used to supply raw water to this waterworks system. Reporting of the results to AEP would take place once a year with the Annual Waterworks Report. This monitoring would be incorporated into the existing monitoring programs including the *Water Well and Infiltration Galley Monitoring Program* and the *Remedial Action Plan for Specific Contaminants*.

The Sampling and Analytical Protocol will also be updated to reflect this additional monitoring.

There are two other monitoring programs that have been developed in the past that are used to monitor the existing raw water reservoir and site. The *Stored Water Quality Monitoring Program* requires that the water in the raw water reservoir be sampled monthly. This requirement will continue as scheduled throughout the duration of construction and thereafter once the direct intake and stilling basin have been constructed.

The second monitoring program is the *Groundwater Monitoring Program* which consists of 23 monitoring wells around the existing raw water reservoir. These 23 monitoring wells were installed at various depths around the site to monitor the groundwater depth, flow direction and quality surrounding the site. These monitoring wells are monitored according to the existing EPEA Approval and will continue as required.

Monitoring wells TVR 6.1 and 6.2 are currently located in the middle of the proposed stilling basin and will need to be relocated outside of the footprint of the proposed works. In addition to the 3 requests that make up the original application, it is also requested that monitoring wells TVR 6.1 and 6.2 be <u>relocated</u> further southwest outside of the proposed stilling basin footprint. By placing these two wells outside of the footprint this will allow for the stilling basin to be constructed, and will also allow for the stilling basin to be encompassed within the existing groundwater monitoring program. (See under Part I on page 9 of the application). No further groundwater monitoring wells are proposed.

Sampling of these wells is to occur 3 times a year as per the existing EPEA Approval, which will continue. However, note that as per the Stantec 2016 Annual Waterworks Report that was attached in Appendix D of the April 2017 application, these two wells have been consistently dry. As such no samples have been collected from these monitoring wells. An additional benefit of moving the monitoring wells is to attempt to capture a location where the groundwater in the wells is sufficient for sampling on a more regular basis.

Substance Delineation

As detailed in the April 2017 application and the Stantec *Settling Pond Assessment* that was attached as Appendix C of the April 2017 application, parameters of concern were identified during the geotechnical/limited Phase 2 assessment.

SRRUC then retained Stantec to delineate the substances of concern before the construction of the stilling basin. The drilling has been done, and Stantec has provided its interim report based on the latest drilling and testing. The Stantec memo (dated June 30, 2017) is provided as supplementary information, and this is herein supplied as an Appendix to this letter.

During construction, Stantec will be requested to test the excavated earthwork materials for possible soil contamination. In the event that soil contamination is discovered, construction activities will be halted until a detailed assessment can be completed, the extent and nature of contamination can be determined and remedial reclamation work can be identified.

Public Consultation and sharing information with stakeholders

The Sheep River Regional Utility Corporation, in conjunction with the Town of Turner Valley conducted a meeting with the Water Works Advisory Committee (WWAC) on **May 23, 2017**. AEP was invited to this meeting but unfortunately was unable to send a representative. At this WWAC meeting MPE presented details for the proposed Direct Intake project to the Committee, including a review of the Stantec environmental testing results.

The intent is to publish the information regarding the current EPEA and Water Act applications on the Town's website as soon as the text of the required Public Notice is received from AEP. The Stantec *Settling Pond Assessment* that was attached as Appendix C of the April 2017 application is also currently published and available for public review on the Town's website. The link to this website is provided as follows for your convenience: http://turnervalley.ca/sheep-river-regional-utility-corporation/

If further information is required, please do not hesitate to contact the undersigned at (403) 219-6319.

Yours truly,

MPE ENGINEERING LTD.

Juy

(for) Jill Hardy, P.Eng. Project Engineer

Encl.

cc: Barry Williamson, Acting CEO, SRRUC Delilah Miller, Chairperson, SRRUC Andy Pfeifer, Town of Turner Valley Theo Owel, MPE Engineering Ltd.

Encl. Appendix - Stantec Memo: Settling Pond Delineation Assessment - Interim Report

APPENDIX

Stantec Memo: Settling Pond Delineation Assessment – Interim Report June 30, 2017



To:	Jill Hardy – MPE Engineering Ltd.	From:	Lincoln Weller – Stantec Consulting Ltd.
	Calgary, AB		Calgary, AB
File:	123511754.600	Date:	June 30, 2017

Reference: Settling Pond Delineation Assessment – Interim Report

1.0 INTRODUCTION

Stantec was retained by the Sheep River Regional Utility Corporation (SRRUC) care of (c/o) Town of Turner valley c/o MPE Engineering Ltd. (MPE) to further delineate soil impacts identified during a previous limited Phase II Environmental Site Assessment (ESA), as summarized in a memo, dated February 3, 2017 (Stantec 2017a). It should be noted that this soil delineation program was intended to focus on delineating only an ethylbenzene exceedance (protection of Domestic Use Aquifer [DUA] pathway) identified in test hole TH6 during the previous limited Phase II ESA, therefore four test holes were advanced around TH6, instead of the originally proposed six test holes recommended in Stantec's memo dated March 9, 2017 (Stantec 2017b).

The delineation program, as well as the previous limited Phase II ESA, was conducted to support the construction of a settling pond, located adjacent to the southwest of the existing raw water reservoir (Turner Valley Raw Water Reservoir [TVR]), located at 835 Okalta Road, Turner Valley, AB (the Site), as shown in Figure 1, **Appendix A**. The settling pond is anticipated to be constructed approximately 6 m deep. The delineation program was one of the recommendations supplied in Stantec's updated memo dated March 9, 2017 (Stantec 2017b). Additional recommendations, including analysis of Polycyclic Aromatic Hydrocarbon (PAH) ratios, confirmatory soil sampling during settling pond construction, and the installation of three monitoring wells, should it be deemed necessary, will be completed at a later date and reported following the completion of the settling pond.

2.0 DELINEATION PROGRAM

Stantec personnel were on-site on June 13, 2017 to conduct private utility locates, and again on June 15, 2017 to conduct field screening and soil sampling. Four test holes (TH7 to TH10) were advanced to a maximum depth of 6.0 metres below ground surface (mbgs) using a solid stem auger drill rig as shown on Figure 1, **Appendix A**. The test holes were advanced around test hole TH6 to further delineate soil impacts that exceeded the DUA pathway for ethylbenzene during the previous limited Phase II ESA. Stantec collected soil samples at regular intervals of approximately 0.75 m during test hole advancement and assessed combustible soil vapours in the samples collected. One soil sample per borehole, based on worse-case soil vapour concentration and/or field observations, was submitted for laboratory analysis of benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbon (PHC) Fraction F1 to F4, PAHs, salinity parameters, and regulated metals, consistent with the previously conducted limited Phase II ESA. All boreholes were backfilled with soil cuttings and bentonite. Methods detailing the soil sampling are included in **Appendix B**.

The lithology encountered during drilling generally consisted of topsoil underlain by sand and gravel, and/or clay. No coal flecks were noted during this drilling program; however, were noted during previous soil assessments and/or construction of the TVR. No presence of staining or odours were



June 30, 2017 Jill Hardy – MPE Engineering Ltd. Page 2 of 6

Reference: Settling Pond Delineation Assessment – Interim Report

detected during the delineation program. A weathered siltstone and/or mudstone bedrock was encountered in three of the four test hole, ranging from depths 1.6 mbgs (TH7) to 4.7 mbgs (TH9). Groundwater levels from piezometers installed by Almor Engineering Associates Ltd. (Almor) during the limited Phase II ESA ranged from 0.34 mbgs to 3.18 mbgs approximately two weeks after installation (Stantec 2017a). During the delineation program, wet soils (indicating potential groundwater level) was identified in TH9 at approximately 3 mbgs. Combustible soil vapours ranged from below equipment detection (i.e., less than 5 parts per million [ppm]) in several of the soil samples to 110 ppm (TH7), which is consistent with the previous limited Phase II ESA. Borehole logs for the test holes completed during the limited Phase II ESA and the delineation program are included in **Appendix C**.

ASSESSMENT GUIDELINES

The generally accepted guidelines for the assessment and remediation of soil and groundwater for sites in Alberta are the Alberta Environment and Parks Alberta Tier 1 and Tier 2 Soil and Groundwater *Remediation Guidelines*, February 2016 (AEP 2016) herein after referred to as the "AEP Tier 1 Guidelines". The Guidelines provide limits for contaminants in soil and groundwater, and are intended to maintain, improve, and/or protect environmental quality and human health at contaminated sites in general.

The Tier 1 Guidelines are generic and are developed to be protective of most sites and are to be used without modification. The Tier 2 Guidelines allow for the modification of the Tier 1 Guidelines by excluding exposure pathways that may not be applicable to a particular site. If exposure pathways are excluded, the reference guidelines by default become Tier 2 guidelines.

These guidelines include numerical values for the assessment of soil and groundwater in the context of natural, agricultural, residential/parkland, commercial and industrial land uses. Selection of applicable land use guidelines is based on the most conservative allowable land use. In cases where a contaminated site is adjacent to a more sensitive land use, the vapour inhalation guidelines (soil and groundwater) and the direct ecological contact guidelines (groundwater only) for the most sensitive land use apply within 30 m of the more sensitive property boundary. For the purpose of this assessment, the current and future land uses of the Site were considered to be residential/parkland, and is consistent with previous assessments at the TVR. It should be noted that the DUA guidelines were developed for the protection of groundwater as a potable water source. Where applicable, exceedances of these guidelines were highlighted due to the proximity of the TVR (i.e., potable water source). Given the coarse and fine-grained texture of the soil profile observed during the drilling at the Site conducted herein, both the coarse-grained and fine-grained guidelines were utilized for comparison purposes. Therefore, the soil analytical results were compared to the AEP Tier 1 Guidelines residential/parkland land uses and the lowest guideline for coarse-grained and fine-grained soil.

RESULTS

The results of the delineation program are summarized in Tables D-1 to D-4 in **Appendix D**. A copy of the laboratory certificate of analysis for the delineation program is included in **Appendix E**. For reference purposes, analytical results for the limited Phase II ESA are included in Tables D-1 to D-4; however, only results from the delineation program are discussed below.

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June 30, 2017 Jill Hardy – MPE Engineering Ltd. Page 3 of 6

Reference: Settling Pond Delineation Assessment – Interim Report

Laboratory results indicated that majority of the parameters were below the AEP Tier 1 Guidelines except for the parameters outlined in Table 2-1, below:

Sample Number	Depth (mbg)	Lithology	Parameter
TH7-SA-03	2 – 2.25	Weathered Siltstone	PHC F2, PHC F3, Anthracene, Fluoranthene, Naphthalene, Phenanthrene, Pyrene, Molybdenum, Selenium, Electric Conductivity (EC)
QC-01 (Field Duplicate of TH7-SA-03	2 – 2.25	Weathered Siltstone	PHC F2, PHC F3, Anthracene, Fluoranthene, Naphthalene, Phenanthrene, Pyrene, Molybdenum, Selenium, EC
TH8-SA-05	3.5 – 3.75	Clay	Anthracene, Fluoranthene, Naphthalene, Phenanthrene, Pyrene
TH9-SA-01	0.5 – 0.75	Sand and Gravel	Naphthalene, Phenanthrene
TH10-SA-01	0.5 – 0.75	Sand and Gravel	Toluene, Naphthalene

Table 2-1.Summary of parameters exceeding AEP Tier 1 Guidelines

The concentration of toluene in soil sample TH10-SA-01 (0.13 mg/kg) was slightly above the AEP Tier 1 Guideline for the protection of freshwater aquatic life (FAL) of 0.12 mg/kg. Concentrations of PHC F2 (160 mg/kg and 180 mg/kg) and PHC F3 (460 mg/kg and 590 mg/kg) in samples TH7-SA-03 and QC-01 (duplicate of TH7-SA-03) exceeded the AEP Tier 1 Guidelines for human vapour inhalation (slab) and ecological direct soil contact of 130 mg/kg and 300 mg/kg, respectively.

Concentrations of select PAH parameters exceeded the AEP Tier 1 Guideline for ecological protection of FAL in samples from TH7 through TH10.

Concentrations of molybdenum (7.5 mg/kg and 7.1 mg/kg), and selenium (1.7 mg/kg and 1.6 mg/kg) exceeded the AEP Tier 1 Guidelines for ecological direct soil contact of 4 mg/kg, and 1 mg/kg, respectively in soil samples TH7-SA-03 and duplicate sample QC-01. These metal concentrations appear elevated when compared to the other soil samples analyzed during this assessment.

Electric conductivity (EC) concentrations (3.2 dS/m and 3.1 dS/m) exceeded the AEP Tier 1 Guideline of 3 dS/m for "good" subsoil in soil samples TH7-SA-03 and duplicate QC-01.

The analytical results for soil collected during the delineation assessment were below the DUA guidelines.

QUALITY ASSURANCE/QUALITY CONTROL

One duplicate soil sample was collected for quality assurance/quality control (QA/QC) purposes (Table D-5, **Appendix D**). QA/QC procedures are summarized in **Appendix B**. Maxxam indicated



June 30, 2017 Jill Hardy – MPE Engineering Ltd. Page 4 of 6

Reference: Settling Pond Delineation Assessment – Interim Report

that laboratory surrogate standard recoveries were within acceptable quality control limits for all parameters analyzed for the soil samples. Maxxam concluded that the overall quality control met the laboratory's acceptability criteria and the analytical data produced by Maxxam were reliable. In addition, all laboratory hold times and temperatures were acceptable for all lab results. Based on the results of the QA/QC process, the analytical results were within acceptable QA/QC guidelines.

CONCLUSIONS AND RECOMMENDATIONS

Upon review of the soil data gathered during the limited Phase II ESA and the subsequent delineation program, Stantec has the following conclusions:

- Results from the soil assessment conducted by Stantec as part of the delineation program identified PHC impacted soil at TH7 and TH10. While generally low-level PAH exceedances identified in test holes TH8, TH9 and TH10 may be attributed to background conditions (i.e., from coal inclusions that have previously been identified during construction of the TVR), the elevated PAH concentrations detected in soil collected from TH7 suggests potential PAH impacts may be present at this location. Select metal and salinity exceedances also identified in soil collected from TH7 were elevated when compared to the other soil samples analyzed during this assessment.
- Results from the delineation assessment did not show any DUA pathway exceedances, and therefore appears to have delineated the ethylbenzene DUA exceedance observed in test hole TH6 during the limited Phase II ESA.
- Generally, impacts were observed at test holes TH7 and TH10, south of TH6 and south of the proposed settling pond. Ethylbenzene concentrations exceeding the DUA pathway appear to be limited in extent in the vicinity of test hole TH6.
- Upon consultation with MPE Engineering Ltd., it is understood that the construction of the settling pond will consist of a hydrocarbon resistant, high-density polyvinyl liner, which will minimize the potential risk of the impacts entering the setting pond.

Based on the conclusions outlined above, the following recommendations are made:

- No further delineation of DUA impacts in soil are required.
- Following construction of the settling pond, piezometers TVR 6.1 and TVR 6.2 should be replaced to the southwest of the settling pond. No additional monitoring wells are recommended to support the TVR groundwater monitoring and sampling program.
- There is no clear evidence to suggest that the impacts observed to date would impact the water quality in the settling pond for its intended use, given the proposed construction (i.e., hydrocarbon resistant, high-density polyvinyl liner) and that the groundwater flow direction is anticipated to be toward the southeast (Stantec 2017c); however, consideration could be given to remediate the soil with DUA pathway exceedances in the area of TH6.



June 30, 2017 Jill Hardy – MPE Engineering Ltd. Page 5 of 6

Reference: Settling Pond Delineation Assessment - Interim Report

- Confirmatory soil sampling should be conducted during the settling pond construction to characterize the soil and the base and walls of the settling pond.
- Further delineation of impacts near MW5, TH7 and TH10 including a groundwater assessment could be conducted for due diligence purposes.

3.0 LIMITATIONS

This report documents work that was performed in accordance with generally accepted professional standards at the time and location in which the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report provides an evaluation of selected environmental conditions associated with the identified portion of the property that was assessed at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portion of the identified property that was assessed at the time the work was conducted. Activities at the property subsequent to Stantec's assessment may have significantly altered the property's condition. Stantec cannot comment on other areas of the property that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report, and are based solely on the scope of work described in the report, the limited data available and the results of the work. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report.

The conclusions are based on the site conditions encountered by Stantec at the time the work was performed at the specific testing and/or sampling locations, and conditions may vary among sampling locations. Factors such as areas of potential concern identified in previous studies, site conditions (e.g., utilities) and cost may have constrained the sampling locations used in this assessment. In addition, analysis has been carried out for only a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, Stantec does not warrant against undiscovered environmental liabilities nor that the sampling results are indicative of the condition of the entire Site. As the purpose of this report is to identify site conditions which may pose an environmental risk; the identification of non-environmental risks to structures or people on the Site is beyond the scope of this assessment.

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June 30, 2017 Jill Hardy – MPE Engineering Ltd. Page 6 of 6

Reference: Settling Pond Delineation Assessment – Interim Report

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.

This report was prepared by Mr. Lincoln Weller, B.Sc., P.Geo. and reviewed by Mr. David Alberti, M.Sc., P.Geol., MBA.

4.0 **REFERENCES**

- Stantec Consulting Ltd. 2017a. Settling Pond Assessment Memo dated February 3, 2017. Project No. 123511754.
- Stantec Consulting Ltd. 2017b. Settling Pond Assessment Memo Recommendation Update dated March 9, 2017. Project No. 123511754.
- Stantec Consulting Ltd. 2017c. 2016 Annual Report for Stored Raw Water, Reservoir Site Groundwater, Well and Infiltration Gallery Water Monitoring Programs – Turner Valley. Project No. 123511754.

5.0 CLOSURE

This memo was prepared for the Sheep River Regional Utility Corporation c/o Town of Turner Valley c/o MPE Engineering Ltd. by Stantec Consulting Ltd.; June 2017 and was produced by the following individuals:

Lincoln Weller, B.Sc., P. Geo. Environmental Geologist, Environmental Services Phone: 403-451-4416 Fax: 403-716-8001 lincoln.weller@stantec.com David Alberti, M.Sc., P.Geol., MBA Principal Hydrogeologist, Environmental Services Phone: 403-781-5472 Fax: 403-716-8001 david.alberti@stantec.com

APEGA Permit No. P 0258

Attachment: Appendix A – Figure Appendix B - Methods Appendix C - Tables Appendix D – Laboratory Certificate of Analysis



Figure



ORIGINAL SHEET - ANSI B - COLOR





200 - 325 25th St. SE Calgary, AB T2A 7H8 Stantec does not certify the accuracy of the data. This drawing is for reference only and should not be used for construction.

Legend:

TVSA Monitoring Well Location (Installed by Stantec)	X
Monitoring Well	X
Nested Piezometers (Installed by WDA Consultants In	ic.) 🚫
Nested Piezometers (Installed by Stantec)	\otimes
Geotechnical Piezometers	\otimes
Decommissioned Piezometers	\otimes
Subdivisions with Decommissioned Septic Fields	
Deep Groundwater Interceptor (Perforated PVC Pip	e) — — — —
Shallow Groundwater Interceptor (Perforated PVC Pip	be)— — — —
Shallow Groundwater Interceptor (Solid PVC Pipe)	
Registered Water Well Location	Q
Interceptors Sample Location	
Abandoned Wellhead	-¢-
Flowing Gas Wellhead	☆
Active Well (ERCB Registered)	☆
Soil And Groundwater Remediated Well	-☆-/
Partially Or Likely Remediated Well	-☆-/- 수 -
Abandoned But Not Yet Remediated Well	-☆-/- \
Abandoned But Remediation Status Unknown	-☆- <i>I</i> -수-
Pipeline Status:	
Operating	
Abandoned	
Discontinued	
Type of Pipeline Product:	
LVP Products	LV LV
Natural Gas	NG NG
Crude Oil	co co
Oil Well Effluent	OE OE
Sour Natural Gas	SG SG
Fuel Gas	

Notes: 1) Base drawing provided by MPE Engineering Ltd. 2) Stantec Source Water Report, 110860687.500, May 18, 2012 3) *Indicates water wells installed by others



Client/Project

SRRUC C/O TOWN OF TURNER VALLEY SETTLING POND DELINEATION ASSESSMENT TURNER VALLEY, ALBERTA

Figure No. <u>1.0</u> Title

Site Plan



Methods



Appendix B – Methods

B.1 SOIL SAMPLING METHODS

Soil samples were collected directly from the solid stem auger from discrete intervals. Care was taken to scrape the soil to obtain representative samples. Nitrile gloves were changed between each sample and sampling equipment was cleaned to prevent cross contamination.

All soil samples were collected following strict Stantec sampling procedures. Select samples were submitted for analysis based on field observations and screening. Observations included assessing samples for potential hydrocarbon staining and visual indicators of potential impact. Field screening was conducted using an RKI Eagle to assess for soil vapors which are considered a potential indicator of hydrocarbon contamination. The RKI Eagle consists of a vapor analyzer calibrated with hexane and set to eliminate methane response. To field screen for soil vapours, a separate bag of soil was collected and sealed for approximately 15 min, allowing volatilization to occur. Soil vapours were then measured from the bag using the RKI Eagle.

B.2 QUALITY ASSURANCE AND QUALITY CONTROL METHODS

The purpose of a QA/QC program is to assess the reliability of the data provided for an assessment. QA/QC samples were collected to assess the reproducibility of the sample collection methodology and laboratory analytical procedures.

All samples were collected following Stantec sampling procedures. Samples were uniquely labeled and control was maintained through use of chain of custody forms. All samples were collected in laboratory supplied containers and preserved in insulated coolers. Samples collected during the site investigation were submitted to Maxxam which uses recognized methods to conduct laboratory analyses and is approved by the Canadian Association for Laboratory Accreditation Inc. (CALA).

B.2.1 Laboratory QA/QC Program

The laboratory QA/QC program included the analysis of laboratory method blanks, duplicates, surrogate recovery, and chemical spikes. Surrogate recovery is analyzed by spiking samples with known quantities of surrogate chemicals which have similar chemical properties to the parameters being analyzed. The reported recovery provides an indication of the analytical method accuracy. Chemical spikes are conducted by adding known concentrations of the analyte of interest to a sample to evaluate the effects of the sample matrix on the analytical method. The analysis of selected samples in duplicate is used to evaluate the reproducibility of the analytical method.



B.2.2 Field QA/QC Program

The field QA/QC program included the collection of a sample in duplicate. The results of the blind field duplicate collected by Stantec personnel were evaluated using relative percent difference (RPD), calculated using the following equation:

$$RPD = \left[\frac{|S1 - S2|}{S3}\right] \times 100$$

where:

RPD = relative percent difference

S1 = original soil sample concentration

S2 = duplicate soil sample concentration

S3 = average concentration (S1 + S2)/2

RPD values of less than 100% for soil samples were considered an indication of acceptable duplicate sample variability. RPD values were not used to evaluate those compounds that are present at concentrations less than five times the reportable detection limit (RDL).

APPENDIX C

Borehole/Monitoring Logs

Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Location: Town of Turner Valley, AB 123511754.600 Number: Field investigator: M.Walchuck Contractor: Almor Testing Services Ltd.

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,215.02 m AMSL
Top of casing elevation:	1,215.64 m AMSL
Easting:	-20065
Northing:	5614180

SUBSURFACE PROFILE					SAMPLE DETAILS INSTALL/				
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	Vapour Concentratior (ppm) VHV CHV O • 100 200 300 400	Diagram	Description
	17. 8. 12	Ground Surface	1215.02	-				-	25 mm stickup solid PVC pipe
		black, damp SILTY CLAY, some sand, some gravel light brown, moist (FILL)	∫ <u>\1214.92</u> / 0.10	TH1-SA- 01	AS				 bentonite 0.0 to 0.3 m BGS
				TH1-SA- 02/	AS		- 35 • - 		← 25 mm solid PVC pipe
8 - 2.5 - 2.0		- below 2.6 m BGS: some sand to sandy. trace organics		TH1-SA- 03	AS				packed in soil cuttings 0.3 to 3.2 m BGS
		SANDY GRAVEL, trace to some silt light brown, damp	1211.92 3.10	TH1-SA- 04/	AS				
			1210.02	TH1-SA- 05/	AS				
		SILTY CLAY, some sand, some gravel light brown, moist	4.40	TH1-SA- 06 TH1-SA- 07	AS	BTEX F1-F4, PAH, RM, Salinity IV			 25 mm hand-slotted PVC pipe in soil cuttings 3.2 to 6.2 mBGS
18 5.5 19 - 19 - 20 - 20 - 21 -		End of Borehole	1208.82	TH1-SA- 08_/	AS				
21 6.5 Screen Interval: Sand Pack Interval: Well Seal Interval: 3.20 - 6.20 m BGS 0.00 - 0.30 m BGS Notes: m AMSL - metres above mean sea level m BGS - metres below ground surface AS - auger sample ppm - parts per million by volume n/a - not available CHV - combustible headspace vapour VHV - volatile headspace vapour BTEX F1-F4 - benzene, toluene, ethylbenzene, xylene, petroleum hydrocarbon fractions F1 to F4 PAH - Polycyclic aromatic hydrocarbons RM - regulated metals package Salinity IV - soil salinity package Coordinate system - 3TM-114						ie, xylene, 2016) Sheet 1 of 1			



Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Location: Town of Turner Valley, AB 123511754.600 Number: Field investigator: M.Walchuck Contractor: Almor Testing Services Ltd.

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,214.40 m AMSL
Top of casing elevation:	1,215.05 m AMSL
Easting:	-20039
Northing:	5614157

SUBSURFACE PROFILE						SAMPLE DETAILS	3	INS	TALLATION DETAILS
Depth	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	Vapour Concentration (ppm) VHV CHV O • 100 200 300 400	Diagram	Description
	·	Ground Surface	1215.05					-	25 mm stickup solid PVC pipe
		TOP SOIL damp SILTY CLAY, some sand, some gravel light brown, moist (FILL)	0.00 (1214.30/ 0.10						bentonite 0.0 to 0.3 m BGS
				TH2-SA- 01	AS			0000	
4 5 1.5				TH2-SA- 02	AS		<pre><5 < - </pre>		25 mm solid PVC pipe packed in soil cuttings
		- below 1.8 m BGS: trace organics	1212.00	TH2-SA- 03	AS	BTEX F1-F4, PAH, RM, Salinity IV		000000	0.3 to 3.0 m BGS
9		light brown, damp		TH2-SA- 04	AS		<pre><5 </pre>		
			1210.60	TH2-SA-	AS		$ \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 45 & 1 & 1 & 1 \\ \bullet^1 & 1 & 1 & 1 \\ \bullet^1 & 1 & 1 & 1 \\ \end{bmatrix} $		
		SILTY CLAY, some sand, some gravel light brown, moist	3.80	TH2-SA-	AS		 15 ●		
									 25 mm hand-slotted PVC pipe in soil cuttings 3.0 to 6.0 mBGS
				TH2-SA-	AS				
		End of Borehole	1208.30 6.10	TH2-SA- 08	AS				
Screen II Sand Pa Well Sea	21						ie, xylene, 2016) Sheet 1 of 1		



Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Location: Town of Turner Valley, AB 123511754.600 Number: Field investigator: M.Walchuck Contractor: Almor Testing Services Ltd.

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,214.40 m AMSL
Top of casing elevation:	1,215.04 m AMSL
Easting:	-20015
Northing:	5614146

Depth Organic Lithologic Description Big 2 m ALSD, m	ETAILS				
10 1215 10 1216 10	cription				
0 0.0 1.0 0.1	ckup solid				
1 1	m BGS				
11 3.0 - below 2.0 m BGS: trace to some organics 11 11 0 <t< td=""><td></td></t<>					
7 - below 2.0 m BGS: trace to some organics 30 - 1 - 1 - 0 0 8 - 2.5 9 - 1 - 1 - 0 0 0 9 - 3.0 - 1 - 1 - 0 0 0 10 - 3.0 - 3.0 - 3.0 - 1 - 1 - 0 0 11 - 3.0 - 3.0 - 3.0 - 1 - 1 - 0 0 11 - 3.0 - 3.0 - 1 - 1 - 0 0 0 11 - 3.0 - 3.0 - 1 - 0 0 0 0 11 - 3.0 - 1 - 1 - 0 0 0 0 11 - 3.0 - 1 - 1 - 0 0 0 0 12 - 3.0 - 1 - 1 - 0 0 0 0 12 - 3.0 - 1 - 1 - 0 0 0 0 12 - 3.0 - 1 - 1 - 0 0 0 0 12 - 1 - 1 - 1 - 1 0 0 0 12 - 4.0 - 1 - 1 - 1 0 0	id PVC pipe soil cuttings m BGS				
10 3.0 1211.30 111.35A- AS 04 111.11 111.11 0					
12 13 4.0 13 4.0 05 1					
ad - 4.5 ***(2) - below 4.4 m BGS: wet 15 - 06 - - 0 16 - - - - - 16 - - - - - 16 - - - - - 16 - - - - - 16 - - - - - 16 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - - 10 - - - - 10<	nd-slotted in soil				
	TIBGS				
17 0.000 PAH, KM, PAH, KM, 18 5.5 0.000 1 1 1 1 0 0 18 5.5 0.000 1 1 1 1 0					
$\begin{bmatrix} 1 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 1 \\ 2 \\ 1 \\ 1$					
Screen Interval: Sand Pack Interval: Well Seal Interval: 2.60 - 5.60 m BGS Well Seal Interval: 2.60 - 5.60 m BGS 0.00 - 0.30 m BGS Well Seal Interval: 2.60 - 5.60 m BGS Motes: m AMSL - metres above mean sea level m BGS - metres below ground surface AS - auger sample ppm - parts per million by volume n/a - not available CHV - combustible headspace vapour VHV - volatile headspace vapour BTEX F1-F4 - benzene, toluene, ethylbenzene, xylene, petroleum hydrocarbon fractions F1 to F4 PAH - Polycyclic aromatic hydrocarbons RM - regulated metals package Salinity IV - soil salinity package Coordinate system - 3TM-114					



Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Location: Town of Turner Valley, AB 123511754.600 Number: Field investigator: M.Walchuck Contractor: Almor Testing Services Ltd.

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,212.89 m AMSL
Top of casing elevation:	1,213.58 m AMSL
Easting:	-19976
Northing:	5614152

			SUBSURFACE PROFILE				SAMPLE DETAILS	8	INS	TALLATION DETAILS
	Depth	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	Vapour Concentration (ppm) VHV CHV O •	Diagram	Description
	(ft) (m)			1213.59				100 200 300 400		
	-2		Ground Surface	1212.89					-	25 mm stickup solid PVC pipe
	0.0	71 V V	TOP SOIL, trace to some organics	0.00						— hantanita
	1 0.5 2 3		black, moist		TH4-SA- 01	AS		<pre></pre>		 bentonite 0.0 to 0.3 m BGS
	4 4 5 1.5 6		SANDY GRAVEL, some silt light brown, damp	1211.19 1.70	TH4-SA- 02	AS		40, • • 		25 mm solid PVC pipe packed in soil cuttings 0.3 to 3.0 m BGS
	2.0 7				TH4-SA- 03	AS	BTEX F1-F4, PAH, RM, Salinity IV			
NMOTTAHEDEH	10 3.0 		SILTY CLAY, trace to some sand, some gravel light brown, moist	1209.59 3.30	TH4-SA- 04 TH4-SA- 05	AS				
TA TEMPLATE.GDT 6/30/17	13 <u>4</u> .0 14 <u>4</u> .0 14 <u>4</u> .1 15 <u>4</u> .5			1208.00	TH4-SA-	AS				← 25 mm hand-slotted PVC pipe in soil cuttings
OND.GPJ STANTEC - DA	16		SILTSTONE, weathered bedrock light brown, mosit - below 5.25 m BGS: damp	4.80		AS		15 ● 		3.0 to 6.0 mBGS
L V2 2017_SETTLING P	19 19 6.0 20 		End of Borehole	1206.79 6.10	TH4-SA-	AS		 15 ● 		
Screen Interval: 3.00 - 6.00 m BGS Sand Pack Interval: 3.00 - 6.00 m BGS Well Seal Interval: 0.00 - 0.30 m BGS Well Seal Interval: 0.00 - 0.30 m BGS Stantec						e, xylene, 016) Sheet 1 of 1				



Monitoring Well: TH5/MW5

Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Town of Turner Valley, AB Location: 123511754.600 Number: Field investigator: M.Walchuck Contractor: Almor Testing Services Ltd.

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,212.63 m AMSL
Top of casing elevation:	1,213.50 m AMSL
Easting:	-19974
Northing:	5614107

			SUBSURFACE PROFILE			:	SAMPLE DETAILS		INS	STALLATION DETAILS
	Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS) 1212.63	Sample Number	Sample Type	Lab Analyses	Vapour Concentration (ppm) VHV CHV O • 100 200 300 400	Diagram	Description
	$ \begin{array}{c} $		Drow Sull, trace organics black, damp to moist	1209.63	MW5-SA-01 MW5-SA-02 MW5-SA-03 MW5-SA-03	AS AS AS AS	BTEX F1-F4, PAH, RM, Salinity IV	I I I <td></td> <td> 51mm solid PVC pipe packed in bentonite 0.3 to 2.7 m BGS itica sand 2.7 to 3.0 m BGS </td>		 51mm solid PVC pipe packed in bentonite 0.3 to 2.7 m BGS itica sand 2.7 to 3.0 m BGS
FIEL V2 2017_SETTLING POND.GPJ STANTEC - DATA TEMPLATE.GDT 6/30/17 NMOTTAHEDEH	10		SANDY GRAVEL, some silt dark brown, moist - below 3.3 m BGS: wet SILTSTONE, weathered bedrock light brown, damp End of Borehole	3.00 1208.93 3.70 1207.53 5.10	MW5-SA- 05 MW5-SA- 06	AS		35		 51 mm slotted PVC pipe 3.0 to 3.7 m BGS sillica sand 3.7 to 3.8 m BGS bentonite 3.8 to 5.1 m BGS
STANTEC BOREHOLE AND W	Screen Ir Sand Par Well Sea	nterval: ck Interval I Interval	3.00 - 3.70 m BGS Notes: 12.70 - 3.80 m BGS m AMSL - metres above 0.00 - 2.70 m BGS m AMSL - metres below g AS - auger sample ppm - parts per million b n/a - not available Drawn By/Checked	Notes: m AMSL - metres above mean sea le m BGS - metres below ground surface AS - auger sample ppm - parts per million by volume n/a - not available Drawn By/Checked By: H.Zhan / L				pie headspace vapour adspace vapour ninzene, toluene, ett carbon fractions F1 aromatic hydrocart retals package salinity package m - 3TM-114 rehole log available	ur ıylbenzei to F4 xons (Almor,	ne, xylene, 2016) ^{Sheet 1 of 1}



Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Town of Turner Valley, AB Location: 123511754.600 Number: Field investigator: M.Walchuck Almor Testing Services Ltd. Contractor:

Drilling method:	Solid Stem Auger
Date started/completed:	29-Nov-2016
Ground surface elevation:	1,211.72 m AMSL
Top of casing elevation:	1,212.56 m AMSL
Easting:	-20050
Northing:	5614117



Screen Interval: Sand Pack Interval: Well Seal Interval:

2.00 - 5.00 m BGS 2.00 - 5.00 m BGS 0.00 - 0.30 m BGS



Notes: m AMSL - metres above mean sea level m BGS - metres below ground surface AS - auger sample ppm - parts per million by volume n/a - not available

Drawn By/Checked By: H.Zhan / L. Weller

CHV - combustible headspace vapour CHV - combustible headspace vapour VHV - volatile headspace vapour BTEX F1-F4 - benzene, toluene, ethylbenzene, xylene, petroleum hydrocarbon fractions F1 to F4 PAH - Polycyclic aromatic hydrocarbons RM - regulated metals package Salinity IV - soil salinity package Coordinate system - 3TM-114

Sheet 1 of 1 Geotechnical borehole log available (Almor, 2016)



Drawn By/Checked By: N. Mottahedeh/ L. Weller

Borehole: TH8

Project: Settling Pond Assessment Client: Sheep River Regional Utility Corporation c/o MPE Engineering Ltd. Town of Turner Valley, AB Location: 123511754.600 Number: Field investigator: M.Walchuck **CP** Drilling Contractor:

Drilling method:	Solid Stem Auger
Date started/completed:	15-Jun-2017
Ground surface elevation:	n/a
Top of casing elevation:	n/a
Easting:	n/a
Northing:	n/a





Drawn By/Checked By: N. Mottahedeh/ L. Weller



DATA TEMPLATE.GDT STANTEC STANTEC BOREHOLE AND WELL V2 2017_SETTLING POND.GPJ

Drawn By/Checked By:

APPENDIX D

Tables

Table D-1. Soil Analytical Results – Petroleum Hydrocarbons

	Date	Depth	CSV ¹	Benzene	Toluene	Fthylbenzene	Yvlenes	F1	F2	F3	F4
Sumple Nomber	Dule	(mbg)	(ppm)	benzene	Toitelle	Linyibenzene	Aylefies	(C₀-C ₁₀)	(>C ₁₀ -C ₁₆)	(>C ₁₆ -C ₃₄)	(>C ₃₄)
				Su	urface Soil (🕯	≤3 mbg)					
TH2-SA-03	29-Nov-16	2-2.25	70	<0.0050	0.042	<0.010	<0.040	<10	17	69	<50
TH4-SA-03	29-Nov-16	2-2.5	45	<0.0050	0.075	<0.010	<0.040	<10	<10	<50	<50
MW5-SA-03	29-Nov-16	2-2.5	100	<0.0050	<u>0.14</u>	<0.010	<0.040	<10	<10	52	<50
QC-01*	29-Nov-16	2-2.5	100	<0.0050	<u>0.13</u>	<0.010	<0.040	<10	<10	58	<50
TH7-SA-03	15-Jun-17	2-2.25	110	0.012	0.025	<0.010	<0.040	20	<u>160</u>	<u>460</u>	120
QC-01**	15-Jun-17	2-2.25	110	0.011	0.024	<0.010	<0.040	24	<u>180</u>	<u>590</u>	180
TH9-SA-01	15-Jun-17	0.5-0.75	55	<0.0050	<0.020	<0.010	<0.040	<10	16	66	<50
TH10-SA-01	15-Jun-17	0.5-0.75	30	0.016	<u>0.13</u>	0.025	0.49	<10	14	<50	<50
					Guidelin	es					
		Direct S	oil Contact	78	640	1,700	480	12,000	6,800	15,000	21,000
	Human	Vapour	Basement	0.10	130	60	16	30	160	-	-
	HUMAN	Inhalation	۱ Slab	0.073	95	44	12	24	130	-	-
AEP Tier 1 Guidelines ² for		Protecti	on of DUA ³	0.046	0.52	0.073	0.99	1,100	1,500	-	-
Surface Soil		Direct S	oil Contact	31	75	55	65	210	150	300	2,800
(<3.0 mbg)	Ecological	Nutrient / E C	nergy Cycling heck	-	-	-	-	-	-	-	-
		Protection of FAL ⁴		0.17	0.12	540	41	1,300	520	-	-
	Ma	ınagement l	imit	-	-	-	-	700	1,000	2,500	10,000
					Subsoil (>3	mbg)					
TH1-SA-07	29-Nov-16	5-5.25	55	<0.0050	<0.020	<0.010	<0.040	<10	<10	<50	<50
TH3-SA-07	29-Nov-16	5-5.25	55	0.012	0.05	<0.010	<0.040	<10	11	<50	<50
TH6-SA-06	29-Nov-16	4.25-4.5	290	0.013	0.057	<u>0.25</u>	0.73	<u>150</u>	<u>260</u>	490	140
TH8-SA-05	15-Jun-17	3.5-3.75	50	<0.0050	<0.020	<0.010	<0.040	<10	30	96	<50
					Guidelin	es					
		Direct S	oil Contact	78	640	1,700	480	12,000	6,800	15,000	21,000
	Human	Vapour	Basement	0.10	130	60	16	30	160	-	-
AEP Tier 1		Inhalation	ו Slab	0.14	180	86	23	55	290	-	-
Guidelines ² for		Protecti	on of DUA °	0.046	0.52	0.073	0.99	1,100	1,500	-	-
Subsoil (>3.0		Nutrient / E	nerav Cvclina	62	150	ΠU	130	420	300	600	3,600
	Ecological	c	heck	-	-	-	-	-	-	-	-
		Protect	ion of FAL ⁴	0.17	0.12	540	41	1,300	520	-	-
	Ma	inagement l	limit	-	-	-	-	700	1,000	2,500	10,000

Notes:

Analytical results and guidelines are expressed as milligrams per kilogram dry weight (mg/kg)

mbg – metres below grade

ppm – parts per million

"<" = below the laboratory method detection limit

"-" = no guideline established

*- soil sample field duplicate was MW5-SA-03

**- soil sample field duplicate was TH7-SA-03

¹ - Combustible Soil Vapour (CSV) measured with a RKI EAGLE portable gas detector calibrated to a hexane standard and set to methane elimination mode

² – Alberta Environment and Parks (AEP), Alberta Tier 1 Soil and Groundwater Remediation Guidelines (February 2016), for residential/parkland land use for fine-grained and coarsegrained soil (most stringent guideline reported)

³ - Domestic Use Aquifer (DUA) (i.e., potable groundwater)

⁴ – Freshwater Aquatic Life (FAL)





- exceeds referenced guideline

- exceeds referenced Protection of DUA guideline

June 2017

Table D-2. Soil Analytical Results – Polycyclic Aromatic Hydrocarbons

		Sar	mple Number /	Date / Depth (n	nbg) / CSV ¹ (pp	m)										AEP Tier 1	Guidelines ²			
	TH1-SA-07	TH2-SA-03	TH3-SA-07	TH4-SA-03	MW5-SA-03	QC-01*	TH6-SA-06	TH7-SA-03	QC-01**	TH8-SA-05	TH9-SA-01	TH10-SA-01		Hur	man			Ecological		
Parameter	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17		Vanauri	nhalation	Drotootion		Nutrient /	Duckaskan	Management
	5-5.25	2-2.25	5-5.25	2-2.5	2-2.5	2-2.5	4.25-4.5	2-2.25	2-2.25	3.5-3.75	0.5-0.75	0.5-0.75	Direct Soli	vapouri	malalion	of DUA ³	Direct Soli	Energy	of EAL 4	Limit
	55	70	55	45	100	100	290	110	110	50	55	30	connact	Basement	Slab	OI DOA	connact	Check	UTAL	
Acenaphthene	< 0.0050	<0.0050	<0.0050	< 0.0050	<0.0050	<0.0050	0.14	0.030	0.028	0.0072	< 0.0050	< 0.0050	5,300	4,800	3,900	NGR	-	-	0.32	-
Acenaphthylene	<0.0050	<0.0050	<0.0050	< 0.0050	<0.0050	<0.0050	0.045	0.0099	0.0091	<0.0050	<0.0050	< 0.0050	-	-	-	-	-	-	-	-
Acridine	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.11	0.040	0.039	0.012	<0.010	<0.010	-	-	-	-	-	-	-	-
Anthracene	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<u>0.0092</u>	<u>0.0096</u>	<u>0.0049</u>	<0.0040	<0.0040	24,000	780,000	670,000	NGR	2.5	-	0.0046	-
Benzo(a)anthracene	0.016	0.012	0.0079	< 0.0050	<0.0050	<0.0050	0.0094	0.0094	0.012	0.014	0.013	< 0.0050	-	-	-	- 7	-	-	0.070	-
Benzo(b&j)fluoranthene	0.036	0.031	0.021	0.011	0.013	0.010	0.092	0.069	0.081	0.040	0.032	0.011	-	-	-	- 7	-	-	-	-
Benzo(k)fluoranthene	0.0072	<0.0050	<0.0050	< 0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	< 0.0050	< 0.0050	-	-	-	- 7	-	-	-	-
Benzo(g,h,i)perylene	0.03	0.029	0.024	0.01	0.012	0.0071	0.16	0.085	0.10	0.046	0.026	0.0088	-	-	-	- 7	-	-	-	-
Benzo(c)phenanthrene	<0.0050	<0.0050	<0.0050	< 0.0050	<0.0050	<0.0050	0.0087	0.0063	0.0084	<0.0050	< 0.0050	< 0.0050	-	-	-	-	-	-	-	-
Benzo(a)pyrene	0.013	0.011	0.0082	< 0.0050	0.0075	<0.0050	0.025	0.018	0.022	0.015	0.010	< 0.0050	-	-	-	- 7	20	-	0.70	-
Benzo[e]pyrene	0.04	0.043	0.032	0.017	0.019	0.013	0.22	0.12	0.14	0.058	0.033	0.015	-	-	-	-	-	-	-	-
Chrysene	0.028	0.028	0.017	0.01	0.012	0.012	0.10	0.066	0.086	0.033	0.029	0.011	-	-	-	- 7	-	-	-	-
Dibenz(a,h)anthracene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0094	0.0058	0.0074	<0.0050	<0.0050	< 0.0050	-	-	-	- 7	-	-	-	-
Fluoranthene	0.023	0.021	0.016	< 0.0050	<0.0050	<0.0050	<u>0.035</u>	<u>0.052</u>	<u>0.064</u>	<u>0.035</u>	0.022	< 0.0050	3,500	550,000	480,000	NGR	50	-	0.032	-
Fluorene	0.0065	0.014	0.011	< 0.0050	<0.0050	<0.0050	<u>0.71</u>	0.11	0.090	0.018	0.011	<0.0050	2,700	10,000	8,600	NGR	-	-	0.29	-
Indeno(1,2,3-cd)pyrene	0.0084	0.0067	<0.0050	< 0.0050	0.0071	<0.0050	0.02	0.015	0.018	0.0090	0.0072	< 0.0050	-	-	-	- 7	-	-	-	-
1-Methylnaphthalene	na	na	na	na	na	na	na	0.12	0.10	0.066	0.058	0.034								
2-Methylnaphthalene	0.067	0.1	0.047	0.032	0.023	0.024	2.9	0.15	0.12	0.057	0.051	0.054	-	-	-	-	-	-	-	-
Naphthalene	<u>0.031</u>	<u>0.037</u>	<u>0.022</u>	<u>0.018</u>	<u>0.016</u>	<u>0.017</u>	<u>0.82</u>	<u>0.029</u>	<u>0.029</u>	<u>0.025</u>	<u>0.021</u>	<u>0.024</u>	1,800	2.9	2.2	28	-	-	0.014	-
Phenanthrene	0.048	<u>0.089</u>	<u>0.057</u>	0.041	0.038	0.040	<u>1.1</u>	<u>0.34</u>	<u>0.31</u>	<u>0.075</u>	<u>0.069</u>	0.042	-	-	-	-	-	-	0.051	-
Perylene	0.036	0.032	0.015	< 0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.029	0.033	< 0.0050	-	-	-	-	-	-	-	-
Pyrene	<u>0.038</u>	0.033	0.023	0.0075	<0.0050	0.0065	<u>0.18</u>	<u>0.13</u>	<u>0.15</u>	<u>0.050</u>	0.033	0.0067	2,100	810,000	730,000	NGR	-	-	0.034	-
Quinoline	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.14	0.028	0.024	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-
B(a)P TPE ⁵	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.035	0.043	0.025	0.018	< 0.0071	5.3	NGR	NGR	IACR<1.0	-	-	-	-
IACR ⁶ Coarse-grained (unitless)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.035	0.043	0.025	0.018	<0.0071	-	-	-	1.0	-	-	-	-

Notes:

Analytical results and guidelines are expressed as milligrams per kilogram dry weight (mg/kg) unless otherwise noted

mbg – metres below grade

ppm – parts per million

"<" = below the laboratory method detection limit

"-" = no guideline established

na - not analyzed

NGR - no guideline required: calculated value is greater than 1,000,000 mg/kg; or for PAH groundwater protection, calculated value results in groundwater concentration greater than solubility

* – Field duplicate of soil sample MW5-SA-03

** – Field duplicate of soil sample TH7-SA-03

¹ - Combustible Soil Vapour (CSV) measured with a RKI EAGLE portable gas detector calibrated to a hexane standard and set to methane elimination mode

² – Alberta Environment and Parks (AEP), Alberta Tier 1 Soil and Groundwater Remediation Guidelines (February 2016), for residential/parkland land use for fine-grained and coarse-grained soil (most stringent guideline reported)

³ – Domestic Use Aquifer (DUA) (i.e. potable groundwater)

⁴ – Freshwater Aquatic Life (FAL)

⁵ – Benzo(a)pyrene (B(a)P) Total Potency Equivalents (TPE) for carcinogenic PAH:

⁶ – Index of Additive Cancer Risk (IACR)

⁷ – used in calculation of IACR

- referenced guideline

BOLD - exceeds referenced guideline

Table D-3. Soil Analytical Results – Metals

			Sample N	umber / Date / D	epth (mbg)											AEP Tier 1	Guidelines ¹			
					MW5 5A 03	00.01*			00 01**					Ηυι	man			Ecological		
Parameter	111-3A-07	112-3A-03	1113-37-07	114-3A-03	101003-3A-03	QC-01	1110-37-00	117-3A-03	QC-01	1110-37-03	117-5A-01	1110-3A-01	Direct Soil	Vapour In	halation	Protection of	Direct Soil	Nutrient /	Protection	Management
	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17	Contact			DUA ²	Contact	Cycling	of FAL ³	Limit
	5-5.25	2-2.25	5-5.25	2-2.5	2-2.5	2-2.5	4.25-4.5	2-2.25	2-2.25	3.5-3.75	0.5-0.75	0.5-0.75		Basement	Slab			Check		
Antimony	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.84	0.50	0.59	0.61	0.66	0.62	-	-	-	-	20	-	-	-
Arsenic	7.7	7.8	7.9	6.9	6.8	6.5	<u>22</u>	13	13	9.6	8.6	7.9	21	-	-	-	17	-	-	-
Barium	490	250	270	200	190	190	100	280	330	280	290	230	-	-	-	-	500	-	-	-
Beryllium	0.80	0.70	0.66	0.61	0.63	0.66	0.74	0.42	0.48	0.66	0.67	0.50	-	-	-	-	5	-	-	-
Boron (mg/L in saturated paste extract)	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.31	<0.10	<0.10	<0.10	<0.10	<0.10	7,500	-	-	65	3.3	-	5.0	-
Cadmium	0.29	0.35	0.26	0.43	0.44	0.49	0.60	0.35	0.35	0.29	0.36	0.36	14	-	-	-	10	54	-	-
Chromium (total)	36	18	33	17	23	21	18	12	15	21	23	12	220	-	-	-	64	-	-	-
Chromium (hexavalent)	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	-	-	-	-	0.4	-	-	-
Cobalt	12	7.4	7.4	6.6	6.4	6.5	11	5.7	5.7	10	9.5	6.2	-	-	-	-	20	-	-	-
Copper	29	18	18	15	16	16	30	18	16	26	24	13	1,100	-	-	-	63	350	-	-
Lead	11	11	9.4	9.5	9.5	11	17	12	12	12	11	8.7	140	-	-	-	300	723	-	-
Mercury	< 0.050	<0.050	<0.050	< 0.050	<0.050	<0.050	<0.050	0.059	0.056	0.067	0.060	0.093	6.6	-	-	-	12	20	-	-
Molybdenum	1.1	0.95	1.6	1.1	0.99	1.0	<u>14</u>	<u>7.5</u>	<u>7.1</u>	2.3	1.4	0.99	-	-	-	-	4	-	-	-
Nickel	35	25	27	22	22	23	41	25	25	31	30	21	200	-	-	-	45	171	-	-
Selenium	<0.50	<0.50	0.51	<0.50	<0.50	<0.50	<u>2.9</u>	<u>1.7</u>	<u>1.6</u>	0.80	0.50	<0.50	80	-	-	-	1	-	-	-
Silver	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	-	-	20	-	-	-
Thallium	0.17	0.14	0.11	0.14	0.14	0.11	0.31	0.17	0.16	0.13	0.13	0.11	1	-	-	-	1.4	-	-	-
Tin	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	5	-	-	-
Uranium	0.67	0.61	0.69	0.5	0.48	0.49	1.6	1.7	1.8	0.80	0.76	0.56	23	-	-	-	500	-	-	-
Vanadium	42	30	28	28	31	30	35	19	20	27	29	22	-	-	-	-	130	255	-	-
Zinc	78	80	68	80	83	90	120	75	76	85	80	66	-	-	-	-	200	200	-	-

Notes:

Analytical results and guidelines are expressed as milligrams per kilogram dry weight (mg/kg)

mbg – metres below grade

"<" = below the laboratory method detection limit

- below the laboratory memory detection
 - i = no guideline established
 - Field duplicate of soil sample MW5-SA-03
 ** - Field duplicate of soil sample TH7-SA-03

¹ – Alberta Environment and Parks (AEP), Alberta Tier 1 Soil and Groundwater Remediation Guidelines (February 2016), for residential/parkland land use for fine-grained and coarse-grained soil (most stringent guideline reported)

² - Domestic Use Aquifer (DUA) (i.e., potable groundwater)
 ³ - Freshwater Aquatic Life (FAL)

- referenced guideline **BOLD** - exceeds referenced guideline

Table D-4. Soil Analytical Results – Physical & Salinity Parameters

				Sample Nun	nber / Date /	Depth (mbg)												AEP Tier 1 Gui	delines ¹			
		TH1-SA-07	TH2-5A-03	TH3-SA-07	TH4-SA-03	MW5-SA-03	QC-01*	AD-A2-AHT	TH7-SA-03	QC-01**	TH8-SA-05	10-A2-9HT	TH10-SA-01		Hun	nan			Ecological			Salt Remediation
Parameter	Unit		1112 0/ (00				QC 01	1110 07 000	111/ 0/ (00	0,001					Vapour li	nhalation			Nutrient/		l	Guidelines for
rarameter	Unit	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	29-Nov-16	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17	15-Jun-17	Direct Soil			Protection of	Direct Soil	Energy	Protection	Management	"good" subsoil
		5-5.25	2-2.25	5-5.25	2-2.5	2-2.5	2-2.5	4.25-4.5	2-2.25	2-2.25	3.5-3.75	0.5-0.75	0.5-0.75	Contact	Basement	Slab	DUA ²	Contact	Cycling Check	of FAL ³		and unrestricted land use
Cation/EC Ratio	N/A	9.6	15	10	12	11	11	14	12	13	11	13	12	-	-	-	-	-	-	-	-	-
Ion Balance	N/A	1.6	1.1	1.3	4.4	3.6	3.7	1.2	0.8	0.8	1.0	1.1	4.5	-	-	-	-	-	-	-	-	-
Chloride	mg/L	13	16	24	24	26	25	<5.0	150	160	21	<5.0	7.8	-	-	-	-	-	-	-	-	-
Electrical Conductivity (EC)	d\$/m	0.36	3.0	0.71	0.69	0.57	0.57	2.7	<u>3.2</u>	<u>3.1</u>	1.2	2.8	0.38	-	-	-	-	-	-	-	-	3
рН	N/A	7.89	7.59	7.79	7.24	7.21	7.2	7.25	7.52	7.55	7.72	7.58	7.62	-	-	-	-	6 - 8.5	-	-	-	-
Sodium Adsorption Ratio (SAR)	N/A	0.76	0.56	0.67	0.21	0.24	0.26	0.52	0.37	0.33	0.74	0.91	0.57	-	-	-	-	-	-	-	-	4
Calcium	mg/L	37	600	92	120	93	89	500	530	540	170	490	65	-	-	-	-	-	-	-	-	-
Magnesium	mg/L	7.9	130	18	17	13	13	120	120	130	41	110	7.9	-	-	-	-	-	-	-	-	-
Sodium	mg/L	19	58	27	9.3	9.2	10	50	36	33	42	86	18	-	-	-	-	-	-	-	-	-
Potassium	mg/L	6.2	11	9.3	16.0	15	15	42	28	28	14	15	2.2	-	-	-	-	-	-	-	-	-
Saturation Percentage	%	53	51	43	58	61	65	42	34	34	58	58	47	-	-	-	-	-	-	-	-	-
Sulphate	mg/L	89	1,900	250	56	51	48	1,500	2,100	2,200	640	1,700	40	-	-	-	-	-	-	-	-	-
Theoretical Gypsum Requirement	tonnes/ha	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	-	-	-	-	-	-	-

Notes:

mg/L – milligrams per litre

dS/m – deciSiemens per metre

mbg – metres below grade

N/A – not applicable

% – percentage

tonnes/ha – tonnes per hectare

"<" = below the laboratory method detection limit

"-" = no guideline established

* - Field duplicate of soil sample MW5-SA-03

** - Field duplicate of soil sample TH7-SA-03 ** - Field duplicate of soil sample TH7-SA-03 - Alberta Environment and Parks (AEP), Alberta Tier 1 Soil and Groundwater Remediation Guidelines (February 2016), for residential/parkland land use for fine-grained and coarse-grained soil (most stringent guideline reported)

² – Domestic Use Aquifer (DUA) (i.e., potable groundwater)

³ – Freshwater Aquatic Life (FAL)



Table D-5 Quality Assurance/Quality Control (QA/QC) – Soil Analytical Results

	1	2	Sample	Number		Sample	Number	3
Parameter	RDL '	5 x RDL ²	MW5-SA-03	QC-01	RPD (%) 3	TH7-SA-03	QC-01	RPD (%) °
Petroleum hydrocarbons (PHCs)								
Benzene	0.0050	0.025	<0.0050	<0.0050	N/A	0.012	0.011	N/A
Toluene	0.020	0.1	0.14	0.13	7.4	0.025	0.024	N/A
Ethylbenzene	0.010	0.05	<0.010	<0.010	N/A	<0.010	<0.010	N/A
Xylenes	0.040	0.2	<0.040	<0.040	N/A	<0.040	<0.040	N/A
F ₁ (C ₆ -C ₁₀)	10	50	<10	<10	N/A	20	24	N/A
F ₂ (>C ₁₀ -C ₁₆)	10	50	<10	<10	N/A	160	180	11.8
F ₃ (>C ₁₆ -C ₃₄)	50	250	52	58	N/A	460	590	24.8
F ₄ (>C ₃₄)	50	250	<50	<50	N/A	120	180	N/A
Polycyclic aromatic hydrocarbons (PAHs)			-					
Acenaphthene	0.0050	0.025	<0.0050	<0.0050	N/A	0.030	0.028	6.9
Acenaphthylene	0.0050	0.025	<0.0050	<0.0050	N/A	0.0099	0.0091	N/A
Acridine	0.010	0.050	<0.010	<0.010	N/A	0.040	0.039	N/A
Anthracene	0.0040	0.020	<0.0040	< 0.0040	N/A	0.0092	0.0096	N/A
Benzo(a)anthracene	0.0050	0.025	<0.0050	<0.0050	N/A	0.0094	0.012	N/A
Benzo(b&j)fluoranthene	0.0050	0.025	0.013	0.010	N/A	0.069	0.081	16.0
Benzo(k)fluoranthene	0.0050	0.025	<0.0050	<0.0050	N/A	<0.0050	<0.0050	N/A
Benzo(g,h,i)perylene	0.0050	0.025	0.012	0.0071	N/A	0.085	0.10	16.2
Benzo(c)phenanthrene	0.0050	0.025	<0.0050	<0.0050	N/A	0.0063	0.0084	N/A
Benzo(a)pyrene	0.0050	0.025	0.0075	< 0.0050	N/A	0.018	0.022	N/A
Benzo[e]pyrene	0.0050	0.025	0.019	0.013	N/A	0.12	0.14	15.4
Chrysene	0.0050	0.025	0.012	0.012	N/A	0.066	0.086	26.3
Dibenz(a,h)anthracene	0.0050	0.025	<0.0050	<0.0050	N/A	0.0058	0.0074	N/A
Fluoranthene	0.0050	0.025	<0.0050	<0.0050	N/A	0.052	0.064	20.7
Fluorene	0.0050	0.025	<0.0050	< 0.0050	N/A	0.11	0.090	20.0
Indeno(1,2,3-cd)pyrene	0.0050	0.025	0.0071	<0.0050	N/A	0.015	0.018	N/A
1-Methylnaphthalene	0.0050	0.025	na	na	N/A	0.12	0.10	18.2
2-Methylnaphthalene	0.0050	0.025	0.023	0.024	N/A	0.15	0.12	22.2
Naphthalene	0.0050	0.025	0.016	0.017	N/A	0.029	0.029	0.0
Phenanthrene	0.0050	0.025	0.038	0.040	5.1	0.34	0.31	9.2
Perylene	0.0050	0.025	<0.0050	< 0.0050	N/A	<0.0050	<0.0050	N/A
Pyrene	0.0050	0.025	<0.0050	0.0065	N/A	0.13	0.15	14.3
Quinoline	0.010	0.050	<0.010	<0.010	N/A	0.028	0.024	N/A

Notes:

na - not analyzed

Analytical results and guidelines are expressed as milligrams per kilogram dry weight (mg/kg)

N/A = Not Applicable (one or both results are less than 5 times the laboratory detection limit)

¹ – Reported Detection Limit (RDL)

 2 – Five times the Reported Detection Limit (5 x RDL)

³ – Relative Percent Difference (RPD)

BOLD - RPD exceeds 100% and both concentrations exceed 5 times RDL



Table D-5 Quality Assurance/Quality Control (QA/QC) – Soil Analytical Results (continued)

	1	2	Sample	Number	3	Sample	Number	
Parameter	RDL '	5 x RDL ²	MW5-SA-03	QC-01	RPD (%) [°]	TH7-SA-03	QC-01	RPD (%) °
Metals					•			
Antimony	0.5	2.5	<0.50	<0.50	N/A	0.50	0.59	N/A
Arsenic	1.0	5.0	6.8	6.5	4.5	13	13	0.0
Barium	1	5	190	190	0.0	280	330	16.4
Beryllium	0.40	2.0	0.63	0.66	N/A	0.42	0.48	N/A
Boron (hot water soluble)	0.10	0.50	<0.10	0.11	N/A	<0.10	<0.10	N/A
Cadmium	0.05	0.25	0.44	0.49	10.8	0.35	0.35	0.0
Chromium (total)	1.0	5.0	23	21	9.1	12	15	22.2
Chromium (hexavalent)	0.08	0.4	<0.080	<0.080	N/A	<0.080	<0.080	N/A
Cobalt	0.5	2.5	6.4	6.5	1.6	5.7	5.7	0.0
Copper	1.0	5	16	16	0.0	18	16	11.8
Lead	0.5	2.5	9.5	11	14.6	12	12	0.0
Mercury	0.050	0.25	<0.050	<0.050	N/A	0.059	0.056	N/A
Molybdenum	0.40	2.0	0.99	1	N/A	7.5	7.1	5.5
Nickel	1.0	5.0	22	23	4.4	25	25	0.0
Selenium	0.50	2.5	<0.50	<0.50	N/A	1.7	1.6	N/A
Silver	0.2	1.0	<0.20	<0.20	N/A	<0.20	<0.20	N/A
Thallium	0.10	0.5	0.14	0.11	N/A	0.17	0.16	N/A
Tin	1.0	5.0	<1.0	<1.0	N/A	<1.0	<1.0	N/A
Uranium	0.2	1.0	0.48	0.49	N/A	1.7	1.8	5.7
Vanadium	1.0	5.0	31	30	3.3	19	20	5.1
Zinc	10	50	83	90	8.1	75	76	1.3
Physical & salinity parameters								
Cation/EC Ratio	0.10	0.5	11	11	0.0	12	13	8.0
lon Balance	0.010	0.1	3.6	3.7	2.7	0.80	0.80	0.0
Chloride	5.0	25.0	26	25	3.9	150	160	6.5
Electrical Conductivity (EC)	0.020	0.1	0.57	0.57	0.0	3.2	3.1	3.2
рН	-	-	7.21	7.20	0.1	7.52	7.55	0.4
Sodium Adsorption Ratio (SAR)	0.10	0.5	0.24	0.26	N/A	0.37	0.33	N/A
Calcium	1.5	7.5	93	89	4.4	530	540	1.9
Magnesium	1.0	5.0	13	13	0.0	120	130	8.0
Sodium	2.5	12.5	9.2	10	N/A	36	33	8.7
Potassium	1.3	6.5	15	15	0.0	28	28	0.0
Saturation Percentage	-	-	61	65	6.3	34	34	0.0
Sulphate	5.0	25.0	51	48	6.1	2,100	2,200	4.7
Theoretical Gypsum Requirement	0.20	1.0	<0.20	<0.20	N/A	<0.20	<0.20	N/A

Notes:

Analytical results and guidelines are expressed as milligrams per kilogram dry weight (mg/kg)

N/A = Not Applicable (one or both results are less than 5 times the laboratory detection limit)

¹ - Reported Detection Limit (RDL)
 ² - Five times the Reported Detection Limit (5 x RDL)
 ³ - Relative Percent Difference (RPD)
 <u>BOLD</u> - RPD exceeds 100% and both concentrations exceed 5 times RDL



APPENDIX E

Laboratory Certificate of Analysis



Your Project #: 123511754 Site Location: TURNER VALLEY RESERVOIR PROJECT Your C.O.C. #: 1 OF 1

Attention:JILL HARDY

MPE ENGINEERING LTD. Suite 320, 6715 – 8 Street NE CALGARY, AB CANADA T2E 7H7

> Report Date: 2017/06/21 Report #: R2401020 Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B747875 Received: 2017/06/15, 14:18

Sample Matrix: Soil # Samples Received: 5

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Analytical Method
BTEX/F1 by HS GC/MS/FID (MeOH extract) (1)	5	N/A	2017/06/18	AB SOP-00039	CCME CWS/EPA 8260C m
Cation/EC Ratio	5	N/A	2017/06/21	AB WI-00065	Auto Calc
Chloride (Soluble)	5	2017/06/19	2017/06/21	AB SOP-00033 / AB SOP- 00020	SM 22-4500-Cl E m
Hexavalent Chromium (2)	5	2017/06/20	2017/06/20	AB SOP-00063	SM 22 3500-Cr B m
Conductivity @25C (Soluble)	5	2017/06/20	2017/06/20	AB SOP-00033 / AB SOP- 00004	SM 22 2510 B m
CCME Hydrocarbons (F2-F4 in soil) (3)	1	2017/06/16	2017/06/17	AB SOP-00036 / AB SOP- 00040	CCME PHC-CWS m
CCME Hydrocarbons (F2-F4 in soil) (3)	4	2017/06/16	2017/06/18	AB SOP-00036 / AB SOP- 00040	CCME PHC-CWS m
Elements by ICPMS - Soils	4	2017/06/20	2017/06/20	AB SOP-00001 / AB SOP- 00043	EPA 200.8 R5.4 m
Elements by ICPMS - Soils	1	2017/06/20	2017/06/21	AB SOP-00001 / AB SOP- 00043	EPA 200.8 R5.4 m
Ion Balance (as Cations/Anions Ratio)	5	N/A	2017/06/17	AB WI-00065	Auto Calc
Sum of Cations, Anions	5	N/A	2017/06/21	AB WI-00065	Auto Calc
Moisture	5	N/A	2017/06/17	AB SOP-00002	CCME PHC-CWS m
Benzo[a]pyrene Equivalency	5	N/A	2017/06/18	AB SOP-00003	Auto Calc
PAH in Soil by GC/MS	2	2017/06/16	2017/06/17	AB SOP-00036 / AB SOP- 00003	EPA 3540C/8270D m
PAH in Soil by GC/MS	3	2017/06/16	2017/06/18	AB SOP-00036 / AB SOP- 00003	EPA 3540C/8270D m
pH @25C (1:2 Calcium Chloride Extract)	5	2017/06/20	2017/06/20	AB SOP-00033 / AB SOP- 00006	SM 22 4500 H+B m
Sodium Adsorption Ratio	5	N/A	2017/06/21	AB WI-00065	Auto Calc
Soluble lons	5	2017/06/19	2017/06/20	AB SOP-00033 / AB SOP- 00042	EPA 200.7 CFR 2012 m
Soluble Paste	5	2017/06/19	2017/06/20	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Ions Calculation	5	N/A	2017/06/17	AB WI-00065	Auto Calc
Theoretical Gypsum Requirement (4)	5	N/A	2017/06/21	AB WI-00065	Auto Calc



Your Project #: 123511754 Site Location: TURNER VALLEY RESERVOIR PROJECT Your C.O.C. #: 1 OF 1

Attention:JILL HARDY

MPE ENGINEERING LTD. Suite 320, 6715 – 8 Street NE CALGARY, AB CANADA T2E 7H7

> Report Date: 2017/06/21 Report #: R2401020 Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B747875 Received: 2017/06/15, 14:18 <u>Remarks:</u>

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

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) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is date sampled unless otherwise stated.

(2) Some soil samples may react with the Cr(VI) spike reducing it to Cr(III). These samples are highly unlikely to contain native hexavalent chromium. Thus a failed spike recovery does not invalidate a negative result on the native sample.

(3) All CCME 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.

(4) TGR calculation is based on a theoretical SAR of 4. Salt Contamination and Assessment and remediation guideline 2001 recommended SAR is ranging 4-8. TGR is reported in tonnes/ha.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Wendy Sears, Project manager Email: WSears@maxxam.ca Phone# (403)735-2277

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.

Total Cover Pages : 2 Page 2 of 20





AT1 BTEX AND F1-F4 IN SOIL (VIALS)

Maxxam ID		RH4362	RH4362	RH4363	RH4364	RH4365	RH4367	RH4367		
Sampling Date		2017/06/15	2017/06/15	2017/06/15	2017/06/15	2017/06/15	2017/06/15	2017/06/15		
		09:15	09:15	,,	10:00	11:05	12:20	12:20		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1		ļ
	UNITS	TH7-SA-03	TH7-SA-03 Lab-Dup	QC-01	TH8-SA-05	TH9-SA-01	TH10-SA-01	TH10-SA-01 Lab-Dup	RDL	QC Batch
Physical Properties										
Moisture	%	9.1	N/A	9.4	13	17	15	N/A	0.30	8665777
Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/kg	160	N/A	180	30	16	14	17	10	8666514
F3 (C16-C34 Hydrocarbons)	mg/kg	460	N/A	590	96	66	<50	65	50	8666514
F4 (C34-C50 Hydrocarbons)	mg/kg	120	N/A	180	<50	<50	<50	<50	50	8666514
Reached Baseline at C50	mg/kg	Yes	N/A	Yes	Yes	Yes	Yes	Yes	N/A	8666514
Field Preserved Volatiles										
Benzene	mg/kg	0.012	0.013	0.011	<0.0050	<0.0050	0.016	N/A	0.0050	8665861
Toluene	mg/kg	0.025	0.029	0.024	<0.020	<0.020	0.13	N/A	0.020	8665861
Ethylbenzene	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.025	N/A	0.010	8665861
Xylenes (Total)	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	0.49	N/A	0.040	8665861
m & p-Xylene	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	0.37	N/A	0.040	8665861
o-Xylene	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.11	N/A	0.020	8665861
F1 (C6-C10) - BTEX	mg/kg	20	21	24	<10	<10	<10	N/A	10	8665861
F1 (C6-C10)	mg/kg	20	21	24	<10	<10	<10	N/A	10	8665861
Surrogate Recovery (%)										
1,4-Difluorobenzene (sur.)	%	104	102	101	101	99	98	N/A	N/A	8665861
4-Bromofluorobenzene (sur.)	%	97	96	97	97	98	99	N/A	N/A	8665861
D10-o-Xylene (sur.)	%	105	105	100	110	115	120	N/A	N/A	8665861
D4-1,2-Dichloroethane (sur.)	%	105	106	105	104	106	108	N/A	N/A	8665861
O-TERPHENYL (sur.)	%	107	N/A	115	107	111	101	102	N/A	8666514
RDL = Reportable Detection Lir	nit									
Lab-Dup = Laboratory Initiated	Duplica	ite								

N/A = Not Applicable





AT1 METALS & SALINITY IN SOIL (SOIL)

Maxxam ID		RH4362	RH4362		RH4363		RH4364	RH4364		
Sampling Date		2017/06/15 09:15	2017/06/15 09:15		2017/06/15		2017/06/15 10:00	2017/06/15 10:00		
COC Number		1 OF 1	1 OF 1		1 OF 1		1 OF 1	1 OF 1		
	UNITS	TH7-SA-03	TH7-SA-03 Lab-Dup	RDL	QC-01	RDL	TH8-SA-05	TH8-SA-05 Lab-Dup	RDL	QC Batch
Calculated Parameters										
Anion Sum	meq/L	48	N/A	N/A	50	N/A	14	N/A	N/A	8664514
Cation Sum	meq/L	39	N/A	N/A	40	N/A	14	N/A	N/A	8664514
Cation/EC Ratio	N/A	12	N/A	0.10	13	0.10	11	N/A	0.10	8664511
Ion Balance	N/A	0.80	N/A	0.010	0.80	0.010	1.0	N/A	0.010	8664512
Calculated Calcium (Ca)	mg/kg	180	N/A	0.51	190	0.52	100	N/A	0.87	8664957
Calculated Magnesium (Mg)	mg/kg	42	N/A	0.34	43	0.34	24	N/A	0.58	8664957
Calculated Sodium (Na)	mg/kg	12	N/A	0.85	11	0.86	24	N/A	1.5	8664957
Calculated Potassium (K)	mg/kg	9.6	N/A	0.44	9.5	0.45	8.2	N/A	0.76	8664957
Calculated Boron (B)	mg/kg	<0.034	N/A	0.034	<0.034	0.034	<0.058	N/A	0.058	8664957
Calculated Chloride (Cl)	mg/kg	53	N/A	1.7	54	1.7	12	N/A	2.9	8664957
Calculated Sulphate (SO4)	mg/kg	720	N/A	1.7	750	1.7	370	N/A	2.9	8664957
Elements										
Hex. Chromium (Cr 6+)	mg/kg	<0.080	N/A	0.080	<0.080	0.080	<0.080	N/A	0.080	8669808
Soluble Parameters										
Soluble Boron (B)	mg/L	<0.10	N/A	0.10	<0.10	0.10	<0.10	<0.10	0.10	8670121
Soluble Chloride (Cl)	mg/L	150	N/A	5.0	160	5.0	21	20	5.0	8670342
Soluble Conductivity	dS/m	3.2	N/A	0.020	3.1	0.020	1.2	1.3	0.020	8669805
Soluble (CaCl2) pH	рН	7.52	N/A	N/A	7.55	N/A	7.72	N/A	N/A	8668897
Sodium Adsorption Ratio	N/A	0.37	N/A	0.10	0.33	0.10	0.74	N/A	0.10	8664515
Soluble Calcium (Ca)	mg/L	530	N/A	1.5	540	1.5	170	150	1.5	8670121
Soluble Magnesium (Mg)	mg/L	120	N/A	1.0	130	1.0	41	36	1.0	8670121
Soluble Sodium (Na)	mg/L	36	N/A	2.5	33	2.5	42	39	2.5	8670121
Soluble Potassium (K)	mg/L	28	N/A	1.3	28	1.3	14	13	1.3	8670121
Saturation %	%	34	N/A	N/A	34	N/A	58	57	N/A	8668881
Soluble Sulphate (SO4)	mg/L	2100	N/A	5.0	2200	5.0	640	610	5.0	8670121
Theoretical Gypsum Requirement	tonnes/ha	<0.20	N/A	0.20	<0.20	0.20	<0.20	N/A	0.20	8664523
Elements				-						
Total Antimony (Sb)	mg/kg	0.50	0.54	0.50	0.59	0.50	0.61	N/A	0.50	8669490
Total Arsenic (As)	mg/kg	13	13	1.0	13	1.0	9.6	N/A	1.0	8669490
Total Barium (Ba)	mg/kg	280	290	1.0	330	1.0	280	N/A	1.0	8669490
RDL = Reportable Detection Limit										
Lab-Dup = Laboratory Initiated Dup	licate									

N/A = Not Applicable



AT1 METALS & SALINITY IN SOIL (SOIL)

Maxxam ID		RH4362	RH4362		RH4363		RH4364	RH4364		
Sampling Date		2017/06/15 09:15	2017/06/15 09:15		2017/06/15		2017/06/15 10:00	2017/06/15 10:00		
COC Number		1 OF 1	1 OF 1		1 OF 1		1 OF 1	1 OF 1		
	UNITS	TH7-SA-03	TH7-SA-03 Lab-Dup	RDL	QC-01	RDL	TH8-SA-05	TH8-SA-05 Lab-Dup	RDL	QC Batch
Total Beryllium (Be)	mg/kg	0.42	0.43	0.40	0.48	0.40	0.66	N/A	0.40	8669490
Total Cadmium (Cd)	mg/kg	0.35	0.34	0.050	0.35	0.050	0.29	N/A	0.050	8669490
Total Chromium (Cr)	mg/kg	12	11	1.0	15	1.0	21	N/A	1.0	8669490
Total Cobalt (Co)	mg/kg	5.7	5.7	0.50	5.7	0.50	10	N/A	0.50	8669490
Total Copper (Cu)	mg/kg	18	17	1.0	16	1.0	26	N/A	1.0	8669490
Total Lead (Pb)	mg/kg	12	11	0.50	12	0.50	12	N/A	0.50	8669490
Total Mercury (Hg)	mg/kg	0.059	0.055	0.050	0.056	0.050	0.067	N/A	0.050	8669490
Total Molybdenum (Mo)	mg/kg	7.5	7.3	0.40	7.1	0.40	2.3	N/A	0.40	8669490
Total Nickel (Ni)	mg/kg	25	25	1.0	25	1.0	31	N/A	1.0	8669490
Total Selenium (Se)	mg/kg	1.7	1.6	0.50	1.6	0.50	0.80	N/A	0.50	8669490
Total Silver (Ag)	mg/kg	<0.20	<0.20	0.20	<0.20	0.20	<0.20	N/A	0.20	8669490
Total Thallium (Tl)	mg/kg	0.17	0.16	0.10	0.16	0.10	0.13	N/A	0.10	8669490
Total Tin (Sn)	mg/kg	<1.0	<1.0	1.0	<1.0	1.0	<1.0	N/A	1.0	8669490
Total Uranium (U)	mg/kg	1.7	1.7	0.20	1.8	0.20	0.80	N/A	0.20	8669490
Total Vanadium (V)	mg/kg	19	18	1.0	20	1.0	27	N/A	1.0	8669490
Total Zinc (Zn)	mg/kg	75	74	10	76	10	85	N/A	10	8669490
RDL = Reportable Detection Limit										
Lab-Dup = Laboratory Initiated Dup	licate									
N/A = Not Applicable										



AT1 METALS & SALINITY IN SOIL (SOIL)

Maxxam ID		RH4365		RH4367		
Sampling Date		2017/06/15		2017/06/15		
		11:05		12:20		
COC Number		1 OF 1		1 OF 1		
	UNITS	TH9-SA-01	RDL	TH10-SA-01	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	36	N/A	1.1	N/A	8664514
Cation Sum	meq/L	38	N/A	4.7	N/A	8664514
Cation/EC Ratio	N/A	13	0.10	12	0.10	8664511
Ion Balance	N/A	1.1	0.010	4.5	0.010	8664512
Calculated Calcium (Ca)	mg/kg	280	0.87	30	0.70	8664957
Calculated Magnesium (Mg)	mg/kg	65	0.58	3.7	0.47	8664957
Calculated Sodium (Na)	mg/kg	50	1.5	8.5	1.2	8664957
Calculated Potassium (K)	mg/kg	8.7	0.75	1.0	0.61	8664957
Calculated Boron (B)	mg/kg	<0.058	0.058	<0.047	0.047	8664957
Calculated Chloride (Cl)	mg/kg	<2.9	2.9	3.6	2.3	8664957
Calculated Sulphate (SO4)	mg/kg	1000	2.9	19	2.3	8664957
Elements						
Hex. Chromium (Cr 6+)	mg/kg	<0.080	0.080	<0.080	0.080	8669808
Soluble Parameters						
Soluble Boron (B)	mg/L	<0.10	0.10	<0.10	0.10	8670121
Soluble Chloride (Cl)	mg/L	<5.0	5.0	7.8	5.0	8670342
Soluble Conductivity	dS/m	2.8	0.020	0.38	0.020	8669805
Soluble (CaCl2) pH	рН	7.58	N/A	7.62	N/A	8668897
Sodium Adsorption Ratio	N/A	0.91	0.10	0.57	0.10	8664515
Soluble Calcium (Ca)	mg/L	490	1.5	65	1.5	8670121
Soluble Magnesium (Mg)	mg/L	110	1.0	7.9	1.0	8670121
Soluble Sodium (Na)	mg/L	86	2.5	18	2.5	8670121
Soluble Potassium (K)	mg/L	15	1.3	2.2	1.3	8670121
Saturation %	%	58	N/A	47	N/A	8668881
Soluble Sulphate (SO4)	mg/L	1700	5.0	40	5.0	8670121
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	8664523
Elements						
Total Antimony (Sb)	mg/kg	0.66	0.50	0.62	0.50	8669490
Total Arsenic (As)	mg/kg	8.6	1.0	7.9	1.0	8669490
Total Barium (Ba)	mg/kg	290	1.0	230	1.0	8669490
RDL = Reportable Detection Limit						
N/A = Not Applicable						



AT1 METALS & SALINITY IN SOIL (SOIL)

Maxxam ID		RH4365		RH4367		
Sampling Data		2017/06/15		2017/06/15		
Sampling Date		11:05		12:20		
COC Number		1 OF 1		1 OF 1		
	UNITS	TH9-SA-01	RDL	TH10-SA-01	RDL	QC Batch
Total Beryllium (Be)	mg/kg	0.67	0.40	0.50	0.40	8669490
Total Cadmium (Cd)	mg/kg	0.36	0.050	0.36	0.050	8669490
Total Chromium (Cr)	mg/kg	23	1.0	12	1.0	8669490
Total Cobalt (Co)	mg/kg	9.5	0.50	6.2	0.50	8669490
Total Copper (Cu)	mg/kg	24	1.0	13	1.0	8669490
Total Lead (Pb)	mg/kg	11	0.50	8.7	0.50	8669490
Total Mercury (Hg)	mg/kg	0.060	0.050	0.093	0.050	8669490
Total Molybdenum (Mo)	mg/kg	1.4	0.40	0.99	0.40	8669490
Total Nickel (Ni)	mg/kg	30	1.0	21	1.0	8669490
Total Selenium (Se)	mg/kg	0.50	0.50	<0.50	0.50	8669490
Total Silver (Ag)	mg/kg	<0.20	0.20	<0.20	0.20	8669490
Total Thallium (Tl)	mg/kg	0.13	0.10	0.11	0.10	8669490
Total Tin (Sn)	mg/kg	<1.0	1.0	<1.0	1.0	8669490
Total Uranium (U)	mg/kg	0.76	0.20	0.56	0.20	8669490
Total Vanadium (V)	mg/kg	29	1.0	22	1.0	8669490
Total Zinc (Zn)	mg/kg	80	10	66	10	8669490
RDL = Reportable Detection Limit						



SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		RH4362	RH4363	RH4364	RH4365	RH4367	RH4367		
Sampling Date		2017/06/15 09:15	2017/06/15	2017/06/15 10:00	2017/06/15 11:05	2017/06/15 12:20	2017/06/15 12:20		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	TH7-SA-03	QC-01	TH8-SA-05	TH9-SA-01	TH10-SA-01	TH10-SA-01 Lab-Dup	RDL	QC Batch
Polycyclic Aromatics									
Acenaphthene	mg/kg	0.030	0.028	0.0072	<0.0050	<0.0050	<0.0050	0.0050	8666534
Benzo[a]pyrene equivalency	mg/kg	0.035	0.043	0.025	0.018	<0.0071	N/A	0.0071	8664393
Acenaphthylene	mg/kg	0.0099	0.0091	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8666534
Acridine	mg/kg	0.040	0.039	0.012	<0.010	<0.010	<0.010	0.010	8666534
Anthracene	mg/kg	0.0092	0.0096	0.0049	<0.0040	<0.0040	<0.0040	0.0040	8666534
Benzo(a)anthracene	mg/kg	0.0094	0.012	0.014	0.013	<0.0050	<0.0050	0.0050	8666534
Benzo(b&j)fluoranthene	mg/kg	0.069	0.081	0.040	0.032	0.011	0.014	0.0050	8666534
Benzo(k)fluoranthene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8666534
Benzo(g,h,i)perylene	mg/kg	0.085	0.10	0.046	0.026	0.0088	0.010	0.0050	8666534
Benzo(c)phenanthrene	mg/kg	0.0063	0.0084	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8666534
Benzo(a)pyrene	mg/kg	0.018	0.022	0.015	0.010	<0.0050	<0.0050	0.0050	8666534
Benzo[e]pyrene	mg/kg	0.12	0.14	0.058	0.033	0.015	0.018	0.0050	8666534
Chrysene	mg/kg	0.066	0.086	0.033	0.029	0.011	0.013	0.0050	8666534
Dibenz(a,h)anthracene	mg/kg	0.0058	0.0074	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8666534
Fluoranthene	mg/kg	0.052	0.064	0.035	0.022	<0.0050	<0.0050	0.0050	8666534
Fluorene	mg/kg	0.11	0.090	0.018	0.011	<0.0050	<0.0050	0.0050	8666534
Indeno(1,2,3-cd)pyrene	mg/kg	0.015	0.018	0.0090	0.0072	<0.0050	<0.0050	0.0050	8666534
1-Methylnaphthalene	mg/kg	0.12	0.10	0.066	0.058	0.034	0.049	0.0050	8666534
2-Methylnaphthalene	mg/kg	0.15	0.12	0.057	0.051	0.054	0.077	0.0050	8666534
Naphthalene	mg/kg	0.029	0.029	0.025	0.021	0.024	0.031	0.0050	8666534
Phenanthrene	mg/kg	0.34	0.31	0.075	0.069	0.042	0.053	0.0050	8666534
Perylene	mg/kg	<0.0050	<0.0050	0.029	0.033	<0.0050	<0.0050	0.0050	8666534
Pyrene	mg/kg	0.13	0.15	0.050	0.033	0.0067	0.0091	0.0050	8666534
Quinoline	mg/kg	0.028	0.024	<0.010	<0.010	<0.010	<0.010	0.010	8666534
Surrogate Recovery (%)									
D10-ANTHRACENE (sur.)	%	87	89	86	79	85	87	N/A	8666534
D8-ACENAPHTHYLENE (sur.)	%	87	88	87	81	85	89	N/A	8666534
D8-NAPHTHALENE (sur.)	%	84	86	84	78	85	87	N/A	8666534
TERPHENYL-D14 (sur.)	%	86	86	85	79	87	88	N/A	8666534
RDL = Reportable Detection L	imit								
lieb Door Lebenstein liebtete	-I D · · · · I! -	- 4 -							

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable



GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1 5.3°C

Results relate only to the items tested.



Maxxam Job #: B747875 Report Date: 2017/06/21

QUALITY ASSURANCE REPORT

MPE ENGINEERING LTD. Client Project #: 123511754

Site Location: TURNER VALLEY RESERVOIR PROJECT Sampler Initials: MW

			Matrix	Spike	Spiked	Blank	Method	Blank	RP	D	QC Sta	indard
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8665861	1,4-Difluorobenzene (sur.)	2017/06/18			95	60 - 130	96	%				
8665861	4-Bromofluorobenzene (sur.)	2017/06/18			102	60 - 130	100	%				
8665861	D10-o-Xylene (sur.)	2017/06/18			124	60 - 130	116	%				
8665861	D4-1,2-Dichloroethane (sur.)	2017/06/18			112	60 - 130	110	%				
8666514	O-TERPHENYL (sur.)	2017/06/17	101	60 - 130	104	60 - 130	120	%				
8666534	D10-ANTHRACENE (sur.)	2017/06/17	97	50 - 130	102	50 - 130	106	%				
8666534	D8-ACENAPHTHYLENE (sur.)	2017/06/17	94	50 - 130	99	50 - 130	101	%				
8666534	D8-NAPHTHALENE (sur.)	2017/06/17	92	50 - 130	98	50 - 130	102	%				
8666534	TERPHENYL-D14 (sur.)	2017/06/17	98	50 - 130	103	50 - 130	110	%				
8665777	Moisture	2017/06/17					<0.30	%	5.8	20		
8665861	Benzene	2017/06/18			126	60 - 130	<0.0050	mg/kg	8.2	50		
8665861	Ethylbenzene	2017/06/18			122	60 - 130	<0.010	mg/kg	NC	50		
8665861	F1 (C6-C10) - BTEX	2017/06/18					<10	mg/kg	4.6	30		
8665861	F1 (C6-C10)	2017/06/18	88	60 - 140	105	60 - 130	<10	mg/kg	4.6	30		
8665861	m & p-Xylene	2017/06/18			120	60 - 130	<0.040	mg/kg	NC	50		
8665861	o-Xylene	2017/06/18			122	60 - 130	<0.020	mg/kg	NC	50		
8665861	Toluene	2017/06/18			119	60 - 130	<0.020	mg/kg	14	50		
8665861	Xylenes (Total)	2017/06/18					<0.040	mg/kg	NC	50		
8666514	F2 (C10-C16 Hydrocarbons)	2017/06/17	106	60 - 130	107	70 - 130	<10	mg/kg	24	40		
8666514	F3 (C16-C34 Hydrocarbons)	2017/06/17	105	60 - 130	105	70 - 130	<50	mg/kg	26	40		
8666514	F4 (C34-C50 Hydrocarbons)	2017/06/17	104	60 - 130	103	70 - 130	<50	mg/kg	NC	40		
8666534	1-Methylnaphthalene	2017/06/17	89	50 - 130	91	50 - 130	<0.0050	mg/kg	34	50		
8666534	2-Methylnaphthalene	2017/06/17	93	50 - 130	94	50 - 130	<0.0050	mg/kg	35	50		
8666534	Acenaphthene	2017/06/17	89	50 - 130	93	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Acenaphthylene	2017/06/17	87	50 - 130	90	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Acridine	2017/06/17	61	50 - 130	69	50 - 130	<0.010	mg/kg	NC	50		
8666534	Anthracene	2017/06/17	81	50 - 130	94	50 - 130	<0.0040	mg/kg	NC	50		
8666534	Benzo(a)anthracene	2017/06/17	92	50 - 130	92	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Benzo(a)pyrene	2017/06/17	82	50 - 130	90	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Benzo(b&j)fluoranthene	2017/06/17	87	50 - 130	92	50 - 130	<0.0050	mg/kg	17	50		
8666534	Benzo(c)phenanthrene	2017/06/17	94	50 - 130	93	50 - 130	<0.0050	mg/kg	NC	50		



Maxxam Job #: B747875 Report Date: 2017/06/21

QUALITY ASSURANCE REPORT(CONT'D)

MPE ENGINEERING LTD. Client Project #: 123511754

Site Location: TURNER VALLEY RESERVOIR PROJECT Sampler Initials: MW

			Matrix	Spike	Spiked	Blank	Method	Blank	RP	D	QC Sta	indard
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8666534	Benzo(g,h,i)perylene	2017/06/17	74	50 - 130	92	50 - 130	<0.0050	mg/kg	16	50		
8666534	Benzo(k)fluoranthene	2017/06/17	82	50 - 130	96	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Benzo[e]pyrene	2017/06/17	84	50 - 130	91	50 - 130	<0.0050	mg/kg	18	50		
8666534	Chrysene	2017/06/17	92	50 - 130	94	50 - 130	<0.0050	mg/kg	17	50		
8666534	Dibenz(a,h)anthracene	2017/06/17	84	50 - 130	94	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Fluoranthene	2017/06/17	92	50 - 130	93	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Fluorene	2017/06/17	90	50 - 130	93	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Indeno(1,2,3-cd)pyrene	2017/06/17	75	50 - 130	89	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Naphthalene	2017/06/17	84	50 - 130	88	50 - 130	<0.0050	mg/kg	25	50		
8666534	Perylene	2017/06/17	79	50 - 130	92	50 - 130	<0.0050	mg/kg	NC	50		
8666534	Phenanthrene	2017/06/17	89	50 - 130	91	50 - 130	<0.0050	mg/kg	23	50		
8666534	Pyrene	2017/06/17	92	50 - 130	93	50 - 130	<0.0050	mg/kg	31	50		
8666534	Quinoline	2017/06/17	98	50 - 130	97	50 - 130	<0.010	mg/kg	NC	50		
8668881	Saturation %	2017/06/20							1.5	12	103	75 - 125
8668897	Soluble (CaCl2) pH	2017/06/20			100	97 - 103			0.14	N/A	99	98 - 102
8669490	Total Antimony (Sb)	2017/06/21	108	75 - 125	111	80 - 120	<0.50	mg/kg	7.3	30		
8669490	Total Arsenic (As)	2017/06/21	102	75 - 125	104	80 - 120	<1.0	mg/kg	4.0	30	114	53 - 147
8669490	Total Barium (Ba)	2017/06/21	NC	75 - 125	101	80 - 120	<1.0	mg/kg	0.52	35	106	80 - 119
8669490	Total Beryllium (Be)	2017/06/21	108	75 - 125	106	80 - 120	<0.40	mg/kg	0.070	30		
8669490	Total Cadmium (Cd)	2017/06/21	101	75 - 125	102	80 - 120	<0.050	mg/kg	4.3	30		
8669490	Total Chromium (Cr)	2017/06/21	108	75 - 125	102	80 - 120	<1.0	mg/kg	3.2	30	100	59 - 141
8669490	Total Cobalt (Co)	2017/06/21	94	75 - 125	101	80 - 120	<0.50	mg/kg	0.010	30	102	58 - 142
8669490	Total Copper (Cu)	2017/06/21	86	75 - 125	101	80 - 120	<1.0	mg/kg	5.1	30	108	83 - 117
8669490	Total Lead (Pb)	2017/06/21	92	75 - 125	100	80 - 120	<0.50	mg/kg	5.5	35	110	79 - 121
8669490	Total Mercury (Hg)	2017/06/21	107	75 - 125	113	80 - 120	<0.050	mg/kg	6.0	35		
8669490	Total Molybdenum (Mo)	2017/06/21	106	75 - 125	98	80 - 120	<0.40	mg/kg	3.2	35		
8669490	Total Nickel (Ni)	2017/06/21	93	75 - 125	102	80 - 120	<1.0	mg/kg	1.8	30	109	79 - 121
8669490	Total Selenium (Se)	2017/06/21	96	75 - 125	100	80 - 120	<0.50	mg/kg	6.8	30		
8669490	Total Silver (Ag)	2017/06/21	96	75 - 125	100	80 - 120	<0.20	mg/kg	NC	35		
8669490	Total Thallium (TI)	2017/06/21	90	75 - 125	100	80 - 120	<0.10	mg/kg	7.6	30		
8669490	Total Tin (Sn)	2017/06/21	105	75 - 125	100	80 - 120	<1.0	mg/kg	NC	35		



Maxxam Job #: B747875 Report Date: 2017/06/21

QUALITY ASSURANCE REPORT(CONT'D)

Success Through Science®

MPE ENGINEERING LTD. Client Project #: 123511754

Site Location: TURNER VALLEY RESERVOIR PROJECT Sampler Initials: MW

			Matrix	Spike	Spiked	Blank	Method E	Blank	RP	D	QC Sta	indard
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8669490	Total Uranium (U)	2017/06/21	95	75 - 125	103	80 - 120	<0.20	mg/kg	1.9	30		
8669490	Total Vanadium (V)	2017/06/21	114	75 - 125	102	80 - 120	<1.0	mg/kg	5.3	30	111	79 - 121
8669490	Total Zinc (Zn)	2017/06/21	NC	75 - 125	104	80 - 120	<10	mg/kg	1.1	30	107	79 - 121
8669805	Soluble Conductivity	2017/06/20			100	90 - 110	<0.020	dS/m	0.88	20	107	75 - 125
8669808	Hex. Chromium (Cr 6+)	2017/06/20	106	75 - 125	105	80 - 120	<0.080	mg/kg	NC	35		
8670121	Soluble Boron (B)	2017/06/20	96	75 - 125	94	80 - 120	<0.10	mg/L	NC	30		
8670121	Soluble Calcium (Ca)	2017/06/20	91	75 - 125	93	80 - 120	<1.5	mg/L	15	30	84	75 - 125
8670121	Soluble Magnesium (Mg)	2017/06/20	94	75 - 125	93	80 - 120	<1.0	mg/L	12	30	87	75 - 125
8670121	Soluble Potassium (K)	2017/06/20	90	75 - 125	89	80 - 120	<1.3	mg/L	12	30	101	75 - 125
8670121	Soluble Sodium (Na)	2017/06/20	90	75 - 125	89	80 - 120	<2.5	mg/L	7.4	30	84	75 - 125
8670121	Soluble Sulphate (SO4)	2017/06/20					<5.0	mg/L	5.0	30	85	75 - 125
8670342	Soluble Chloride (Cl)	2017/06/21	108	75 - 125	106	80 - 120	<5.0	mg/L	6.1	30	86	75 - 125

N/A = Not Applicable

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.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

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 spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 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 (absolute difference <= 2x RDL).



VALIDATION SIGNATURE PAGE

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

Harry (Peng) Liang, Senior Analyst

1/ennicatelk

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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 Analytics International Corporation o/a Maxxam	n Analytics				-	-			ETODY			N.	1	1				
INVO	4000 19th Street NE, Calgary, Alberta Canada 12E 6Pt DICE INFORMATION:	1 Tet: (403) 291-3077, Fax: (403) 735-2240, Toil free: (800) 385- REPORT INFORM	247 ITION (if differs	from invoice):			PRO	LECT INFORMA	TION:	RECORD		Laboratory Use	Page , of Only	PDEP #				
ompany Name: TURNER VALL ontact Name: Andy Pfeifer	LEY c/o Jill Hardy (jnardy@mpe.ca)	Company Name: Stantec Consulting Ltd. Contact Name: Lincoln Weller					Quotation #:	8309	37			MAAAAM JOB		BUTTLE U	NUCK 9:			0	1
ddress: BOX 330, 514 TURNER VAL	Windsor Ave NW	Address: 200, 325 25 ST NE		T2A 7H8			Project #:	1235	11754		CT	CHAIN OF CUSTO	DY # :	PROJECT M	ANAGER:				
hone: (403) 933-4944	Fax: (403) 933-50	377 Phone: (403) 451-4416		Fax:	(403) 716	-8039	Site Location:	TUR	NER VALLE	10		TV-1		Wendy	Sears				
REGULATORY CRITERI	ley.ca A:	Email: lincoln.weller@stantec.com SPECIAL INSTRUCTIONS:				A	Sampled By: VALYSIS REQU	ESTED	wr	MIK	TUR	AROUND TIME (TAT)	REQUIRED						
AB HER 1	Repor	rt Distribution		-		13		19				PLEASE PROVIDE ADVA	NCE NOTICE FO	OR RUSH PROJEC	TS	61.6			
AB Surface Water Quality	Guidelines	weller@stantec.com ilberti@stantec.com @mpe.ca mdurand@mpe.ca	1	B	F	ヨ				See. 1.	Regular (S (will be appl Standard TA	tandard) TAT: ed if Rush TAT is not specified T = 5-7 Working days for most	() L tests		×		12.1		
	dennisk darrellv	@turnervalley.ca dennisleis@gmail.com v@turnervalley.ca darrellfv@gmail.com		亡	n -	273		-			Please note details.	Standard TAT for certain tes	ts such as > 5 day	rs - contact your Proj	ject Manager for				
	caogru	umervalley.ca <u>terrynkgtumervalley.ca</u>		X	I.	2.	10			11	Date Requ	red:	entire submis	sion)					8.0
SAMPLES MUST	BE KEPT COOL (< 10 °C) FROM TIME OF SAT	MPLING UNTIL DELIVERY TO MAXXAM		E	X i	5	卫士		100		Rush Conf	rmation Number:	(call lab for #)	- 24 - 22	<u> </u>				
Sample Barcode Label	Sample (Location) Identification	Date Sampled & Time Sampled M	itrix La								Bottles	-	Comments						
N/A	THT-SA-03	June 15/17 0915 5	21	X	XX	X					5				<u></u>				
N/A	QC-01	June 15/17 5	1	X	XX	-X	3/- 7	•	1240	1.1	5				201				
N/A	TH8-5A-05	June 15/17 1000 So	1	X	XX	X		1			5								
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MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: TH7-SA-03

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



Gasoline: C4 C12 Diesel: C8 C22 Varsol: C8 C12 Lubricating Oils: C20 C40 Kerosene: C7 C16 Crude Oils: C3 C60+

MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: QC-01

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



Gasoline: C4 C12 Diesel: C8 C22 Varsol: C8 C12 Lubricating Oils: C20 C40 Kerosene: C7 C16 Crude Oils: C3 C60+

MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: TH8-SA-05

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	÷	C12	Diesel:	c8 -	C22
Varsol:	C8	-	C12	Lubricating Oils:	C20 -	C40
Kerosene:	c7	-	C16	Crude Oils:	C3 -	C60+

MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: TH9-SA-01

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	-	C12	Diesel:	c8 -	C22
Varsol:	C8	-	C12	Lubricating Oils:	c20 -	C40
Kerosene:	C7	10	C16	Crude Oils:	C3 -	C60+

MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: TH10-SA-01

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	-	C12	Diesel:	c8 -	C22
Varsol:	C8	1	C12	Lubricating Oils:	C20 -	C40
Kerosene:	c7	5	C16	Crude Oils:	C3 -	C60+

MPE ENGINEERING LTD. Client Project #: 123511754 Site Reference: TURNER VALLEY RESERVOIR PROJECT Client ID: TH10-SA-01

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	-	C12	Diesel:	c8 -	C22
Varsol:	C8	-	C12	Lubricating Oils:	c20 -	C40
Kerosene:	c7	1	C16	Crude Oils:	C3 -	C60+