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PIT CLOSURE REPORT
WHITING OIL AND GAS CORPORATION
Pit #100035 – Terrace Gas Plant
Weld County, Colorado

Prepared For:

Whiting Petroleum Corporation
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Olsson Project No. 012-0790
Terrace Gas Plant ID # 255980
Pit ID # 100035

October 2013

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1.0 INTRODUCTION

Whiting Petroleum Corporation (Whiting) contracted Olsson Associates (Olsson) to excavate impacted soil from the produced water pit #100035 associated with the Terrace Compressor Station on the west end of the Terrace Gas Plant in Weld County, Colorado.

1.1 Site Location

The Terrace Gas Plant is located in the northwest quarter of the northeast quarter of Section 18, Township 10 North, Range 58 West, of the Sixth Principal Meridian, approximately 40 miles north of the town of Fort Morgan, CO. Pit #100035 was a produced water pit associated with the Terrace Gas Plant but located within the road right-of-way approximately 20 feet on the south side of Weld County Road 118 and 2.75 miles west of the intersection with Weld County Road 127. Pit #100035 was located approximately 800 feet west of the Terrace Gas Plant (latitude 40° 50' 44.5" North and , longitude -103° 54' 48.82" West).

There is an intermittent dry wash located to the west of the pit location. A general location map for Terrace Gas Plant is presented as Figure 1. A site map showing the location of the pit is presented as Figure 2.

1.2 Project Description

The production pit was installed in the late 1970s or early 1980s by Antelope Energy Company, LLC. The production pit was used for the collection and disposal of produced water. The pit was surrounded by an earthen berm and a metal pipe fence.

The excavation involved the removal of a vertical culvert, or "tinhorn" pit that was eight feet in diameter and buried approximately 10 feet below ground surface (bgs). Excavation was performed to remove the visually impacted soils from beneath the tin horn once the culvert had been removed. Confirmation soil samples were collected from the side walls and from the bottom of the excavation and were submitted to Summit Scientific Laboratories for the COGCC Table 910-1 petroleum hydrocarbon parameters. Impacted soils were stockpiled on the south side of the Terrace Gas Plant pending landfarming to meet the Table 910-1 standards and future reuse of the impacted materials onsite.

2.0 ENVIRONMENTAL SETTING

The former pit #100035, Terrace Compressor Station, and Terrace Gas Plant are located on privately owned land in proximity to the Pawnee National Grassland. Topography slopes south to southwest toward an unnamed dry wash and intermittent drainage to North Pawnee Creek. The pit has an approximate elevation of 4,919 feet above mean sea level. The climate for the region is semi-arid with an average annual precipitation of approximately 12 inches per year.

2.1 Site Geology

Surficial geology within the area surrounding Terrace Gas Plant and tank battery consists of Tertiary age fluvial deposits of the lower Ogallala Formation represented by the geologic map symbol 'To'. More specifically, these deposits are Miocene in age and are composed of gray to brown and semi-consolidated, ashy sand and silt beds with volcanic ash beds. The lower part of the Ogallala Formation can be as much as 150 feet thick (Scott 1978). However, thickness of the formation around the Terrace Gas Plant and Tank Battery and the depth to the underlying Arikaree Formation, geologic map symbol 'Ta', could not be determined from well completion logs of nearby water wells.

2.2 Site Hydrology

The following sections describe the site hydrology and potential sensitive receptors in proximity to the former pit #100035.

Surface Water

There are no major surface water features in the immediate area of the plant. There are springs and intermittent streams located within a three mile radius. An unnamed intermittent drainage to North Pawnee Creek is located approximately 400 feet to the southwest of the former pit. North Pawnee Creek is located approximately one mile south of the plant and trends to the southeast.

Groundwater

Groundwater was not encountered during pit excavation activities which reached a total depth of 26 feet bgs at which point siltstone bedrock was encountered.

Based on the area topography and regional surface water drainages, groundwater flow is expected to be to the south and southeast. According to the Colorado

Division of Water Resources Website, there are three groundwater wells located within 0.5 miles and three miles of the pit location. Boring logs for these wells report static water levels ranging from 80 feet to104 feet below ground surface (fbgs). Well permit# 169917 (Nelson Ranches Inc.) is the closest well at the Terrace Gas Plant and well completion log for this well report a static water level of 104 fbgs at the time of completion and a reported total depth of 240 feet. This well appears to lie cross gradient to the former pit #100035 site.

There are several springs located to the northeast and northwest of the Terrace Gas Plant. The Demoss Spring is located approximately one mile to the northwest of the site, and Elizabeth springs is located approximately 1.5 miles northeast of the plant. These springs are not in close proximity to the pit site, are at higher elevation, and are expected to lie up-gradient of the former pit site.

2.3 Surrounding Land Use

The land surrounding the Terrace Gas Plant is owned by the Nelson Ranches Inc. at 58900 County Road 382 in Grover, Colorado. The land is rangeland used for livestock grazing. There are no houses or other buildings located in close proximity to the Terrace Gas Plant. Olsson contacted Mr. Gene Nelson on October 1, 2012 and obtained verbal permission to close the pit and to landfarm impacted soils adjacent to the Terrace Gas Plant. A letter was mailed to Mr. Nelson prior to contacting him by telephone. Mr. Nelson also gave permission to obtain fill soil from a gravel pit located to the west of the site to backfill the pit excavations.

3.0 PIT EXCAVATION

On Thursday December 6, 2012 Olsson mobilized to the Terrace Gas Plant site to oversee soil excavation activities and collect confirmation soil samples from Pit #100035. K&K Oilfield Services provided the labor and equipment necessary to complete the pit closure activities**.** Confirmation soil samples were collected from the pit side walls on December 6, 2012. Confirmation soil sample locations are presented in Figure 2.

Olsson called the Utility Notification Center of Colorado at least three days prior to the excavation and utility locates were conducted and the locations of buried utilites were marked.

Pit #100035 was excavated until the extent of the trackhoe arm had been reached at approximately 17 fbgs. On December 7, 2012 K&K then benched down the side walls and continued to excavate down to 26 fbgs, at which point the extent of the excavator had been reached a second time. Bedrock consisting of a calcareous siltstone was encountered during the excavation. Staining was observed on the surface of the bedrock. Confirmation soil samples, SS5 and SS6, were collected from the bottom of the excavation. The side wall and bottom confirmation soil samples were submitted for laboratory analysis.

3.1 Pit Excavation Oversight

The equipment provided by K&K Oilfield Services for the pit remediation activities included a CAT 420E trackhoe and a CAT 316EL frontend loader. The monitoring equipment used by Olsson included a miniRAE 2000 photoionization detector (PID) . The PID was used to screen soil samples collected from the pit. The meter was calibrated using span gas consisting of 100 parts per million (ppm) isobutylene in air, prior to use at the site.

Upon arrival on-site at 9:30 a.m. K&K had excavated and stockpiled the top soil and un-impacted overburden soil and removed the tinhorn culvert from its original location in the pit. Staining and hydrocarbon odor were observed beneath the tinhorn and in the soil surrounding the excavation beneath the tinhorn. Representative soil samples were screened using the PID to determine the extent of impacted soil. After reaching a depth of approximately 13 fbgs, confirmation soil samples were collected. The confirmation soil samples collected on December 6, 2012 were designated SS1, SS2, SS3, and SS4. Samples were collected from the trackhoe bucket.

- SS1 was collected from the west wall of the pit at a depth of 13 fbgs;
- SS2 was collected from the south wall of the excavation at a depth of 13 fbgs.
- SS3 was collected from the southeast wall of the pit at a depth of 12.0 fbgs.; and
- SS4 was collected from the north wall of the pit at a depth of 11 fbgs. K&K excavated the north wall until the pit excavation was within four feet of underground utilities;

These confirmation soil samples were stored on ice in a plastic cooler and were hand delivered to the laboratory following chain-of-custody protocols. K&K services backfilled the pit with the un-impacted overburden soil to create a ramp. K&K continued to excavate the pit to the equipment's greatest depth capability.

On December 7, 2012 K&K benched the side walls down seven fbgs to enable greater depth in the excavation of the pit. K&K excavated pit #100035 to a final depth of 26 fbgs at which point bedrock was encountered and K&K was again at the limit of the excavator. Bottom confirmation soil samples were collected to assess the subsurface conditions at the bedrock interface by bringing soils up to ground surface in the trackhoe bucket.

- Confirmation sample SS5 was collected from the bottom of the northern half of the pit at a depth of 26 fbgs; and
- SS6 was collected from the bottom of the southern half of the pit at a depth of 26 fbgs.

The location of the soil samples and there characteristics are shown in Figure 2. PID readings from soil screening are summarized in Table 1. A summary of soil sample analytical results is presented in Table 2. The polycyclic aromatic hydrocarbons (PAHs) results are presented on Table 3. Photographs of the pit closure activities are included in Attachment 1. A copy of the laboratory analytical report is presented as Attachment 2.

3.2 Soil Stockpiles Landfarm

A landfarm constructed on the south side of the Terrace Gas Plant was used to contain impacted soils previously excavated from Pit #100036, from the west end of the plant, and from Pit #100035. The landfarm measured approximately 68 feet by 100 feet and had an average height of approximately seven feet, or approximately

1,763 cubic yards of materials, surrounded by an earthen berm. The soil stockpiled materials with the visually heaviest staining are located in the center of the landfarm area as shown in the site photographs. It may be possible to sample the soils that do not exhibit as much staining and that are rocky to reduce the volume requiring treatment if these materials are found to meet the COGCC Table 910-1 concentration levels.

3.3 Summary of Findings

Six confirmation samples were submitted for analysis to Summit Scientific in Golden, Colorado for benzene, toluene, ethylbenzene and total xylenes (BTEX) and Gasoline Range Organics (GRO) by EPA Method 8260B and for Diesel Range Organics (DRO) by EPA modified Method 8015.

A summary of soil sample analytical results are presented in Table 2 and Figure 2. The soil analytical results for the samples were compared to the COGCC, *900 Series Exploration and Production Waste Management, Table 910-1 Concentration Levels*, May 30, 2011. A review of the soil analytical data is provided below:

<u>Confirmation Soil Sample Analytical Results</u>

- Benzene was not detected in confirmation soil samples SS1, SS3, SS4, or SS6. Benzene was detected in soil sample SS2 and reported at 0.012 milligrams per kilogram (mg/kg). This concentration does not exceed the COGCC Table 910-1 concentration of 0.17 mg/kg benzene. Benzene was reported above the COGCC benzene soil concentration level of 0.17 mg/kg in soil sample SS5 at 0.73 mg/kg. Although benzene was not detected in the bottom confirmation soil sample SS6, the laboratory detection limit of 0.45 mg/kg is above the COGCC Table 910-1 benzene concentration level;
- Toluene was not detected in confirmation soil samples SS1, SS3, or SS4. Toluene was detected in soil samples SS2, SS5, and SS6, but was below the COGCC toluene concentration level of 85 mg/kg in any of the confirmation soil samples submitted for analysis;
- Ethylbenzene was not detected in confirmation soil samples SS1, SS3, or SS4. Ethylbenzene was detected in soil samples SS2, SS5, and SS6 but did not exceed the COGCC Table 910-1 Ethylbenzene concentration level of 100 mg/kg in any of the confirmation soil samples submitted for analysis;

- Total xylenes were not detected in soil samples SS3 or SS4. Total xylenes were reported in confirmation soil samples SS1, SS2, SS5, and SS6, but did not exceed the COGCC Table 910-1 xylenes concentration level of 175 mg/kg for any of the confirmation soil samples submitted for analysis;
- TPH-GRO were not detected in confirmation soil sample SS4. TPH-GRO were reported in soil sample SS1 at 13 mg/kg, but did not exceed the COGCC Table 910-1 TPH-GRO concentration level. TPH-GRO were reported in SS2, SS5, and SS6 above the COGCC Table 910-1 TPH soil concentration levels of 500 mg/kg in soil sample SS2 at 700 mg/kg, SS5 at 1,900 mg/kg, and SS6 at 1,500 mg/kg; and
- TPH-DRO were not detected in confirmation soil samples SS3 or SS4. The laboratory reported TPH-DRO results in side wall soil samples SS1 at 1,500 mg/kg, and SS2 at 730 mg/kg, respectively. The laboratory reported TPH-DRO results in bottom confirmation soil samples SS5 at 2,100 mg/kg and SS6 at 1,800 mg/kg. The TPH-DRO results in soil samples SS1, SS2, SS5, and SS6 exceed the COGCC TPH-DRO concentration level of 500 mg/kg.

Olsson requested that Summit Scientific analyze bottom excavation confirmation soil samples SS5 and SS6 for polynuclear aromatic hydrocarbons (PAH) by EPA Method 8270 since the TPH-DRO results for SS5 and SS6 exceeded the Table 910-1 TPH-DRO concentration level of 500 mg/kg. Sidewall samples SS1 and SS2 were each collected at a depth of 13 fbgs from the west and south walls. The sidewall soil sample SS1 was collected form the west wall and had a TPH-DRO was 1,500 mg/Kg, and sidewall soil sample SS2 was collected from the south wall had a TPH-GRO of 700 mg/Kg and a TPH-DRO of 730 mg/Kg. Sidewall samples SS1 and SS2 were not submitted for PAH analysis, since the bottom of the excavation soil samples SS5 and SS6 had higher TPH concentrations and were from below the tinhorn source.

The PAH results showed that none of the PAH concentrations reported were above the COGCC Table 910-1 concentration levels with the exception of benzo (a) pyrene which was reported at 0.111 mg/kg in confirmation soil sample SS6. The COGCC Table 910-1 concentration level for benzo (a) pyrene is 0.022 mg/kg. The PAH results for confirmation soil samples SS5 and SS6 are summarized on Table 3.

Impacted soil excavated from the pit located at Terrace Gas Plant is to be treated onsite and is being contained within an earthen berm located along the south side of the plant. The soil will be land farmed and bio-remediated until concentrations are below the COGCC Table 910-1 concentration levels. Once the laboratory analytical results show that the soil meets the Table 910-1 concentration levels, the soil may be re-used onsite.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on visual observations, field soil screening; and laboratory analytical results, it appears that the impacted soil located in the vicinity of the former produced water pit #100035 tinhorn west of the Terrace Gas Plant has been excavated to the extent possible. The pit was excavated down to the bedrock surface at a depth of approximately 26 feet bgs. The excavation was filled with clean overburden and top soil and restored back to grade to prevent it from being a safety hazard due to its proximity to County Road 118. The pit was located approximately 20 feet from the south side of the road.

The impacted soils are in the process of being land farmed on site and progress soil samples will be collected periodically to assess the progress for these soils to meet the Table 910-1 concentration levels for reuse onsite.

Olsson recommends that no further action be required for the former produced water pit #100035 tin horn located on the west side of the Terrace Gas Plant based on the following:

- The bulk of the impacted soil has been removed from the source area of the former produced water tin horn pit # 100035;
- Relatively low levels of benzene were reported in two of the five confirmation soil samples, and only the benzene reported in bottom confirmation soil sample SS5 exceeded the Table 910-1 concentration level of 0.17 mg/kg. This concentration level is based on a residential surface soil benzene concentration as a carcinogen rather than soil lying at 26 fbgs. Concentrations of toluene, ethylbenzene, and total xylenes did not exceed the Table 910-1 concentration levels in any of the six confirmation soil samples.
- TPH-GRO were reported above the Table 910-1 concentration level of 500 mg/kg in one of the side wall samples (SS2) and both of the bottom samples. TPH-DRO were reported above the Table 910-1 concentration level of 500 mg/kg in confirmation soil samples SS1, SS2, SS5, and SS6. This site is in a non-sensitive area and the cleanup standard for TPH-GRO and TPH-DRO was formerly 10,000 mg/kg.
- Olsson requested that PAH be analyzed for bottom of excavation confirmation soil samples SS5 and SS6 which had the highest TPH-DRO concentrations. With the exception of the benzo(a)pyrene concentration of 0.111 mg/kg in

SS6, none of the PAH compounds exceeded the COGCC Table 910-1 concentration level. The COGCC benzo(a)pyrene concentration level of 0.022 mg/kg is based on a residential surface soil standard as a carcinogen. Benzo (a) pyrene is relatively low, and PAH have been shown to be immobile in the environment and are not expected to leach. There is no exposure pathway for benzo(a)pyrene as an inhalation hazard since the pit was closed and has been filled with clean fill.

- Bedrock consisting of siltstone and claystone was encountered in the bottom of the pit excavation at a depth of 26 fbgs which will limit downward migration of hydrocarbons. There are no sensitive receptors in the immediate down gradient direction of the former pit # 100035.
- Groundwater was not encountered in the excavation. The reported depth to groundwater in the area is 104 fbgs based on information for the closest water well (Nelson water well) at the Terrace Gas Plant located approximately 800 feet to 1,000 feet to the east (cross gradient) to the pit #100035.
- Exposure to the air during excavation and closure of the pit with un-impacted overburden will allow the residual TPH-GRO and TPH-DRO to biodegrade over time. The Terrace Gas Plant is expected to remain in operation for the foreseeable future.
- Although the vertical extent has not been defined the bedrock in the bottom of the excavation will limit migration.

Olsson recommends Whiting request that the COGCC close pit #100035 once laboratory analytical results for the landfarm soil samples show that the impacts have been remediated to below the Table 910-1 concentration levels. It is estimated that the landfarm may require six months to a year to completely remediate these soil impacts.

TABLES

TABLE 1
Whiting Oil and Gas Corporation

Terrace Gas Plant - Pit 2 Soil Screening Results
County Road 118 - Weld County Colorado

Sample ID	Date	Time	Location	Depth (ft)	PID Reading (ppm)	Soil Screening Sample Description
	12/6/2012	10:05	South wall	9	336	
	12/6/2012	10:35	North wall	14	1927	
	12/6/2012	11:10	South wall	9	2653	
	12/6/2012	11:16	Center Bottom	16	1560	
	12/6/2012	11:25	North wall	15	1553	
	12/6/2012	11:45	South wall	17	1499	
	12/6/2012	12:15	East wall	16	1875	
SS1	12/6/2012	12:48	West wall	13	25.8	West wall confirmation soil sample
SS2	12/6/2012	13:15	South wall	13	740	South wall confirmation soil sample
	12/6/2012	13:45	East wall	10	1576	
SS3	12/6/2012	14:20	East wall	12	155	East wall confirmation soil sample
SS4	12/6/2012	14:50	North wall	11	104	North wall confirmation soil sample
	12/6/2012	15:00	North Bottom	17	1220	Extent of excavator
	12/7/2012	10:10	Center Bottom	23	1575	Ramped and benched down excavation
SS5	12/7/2012	10:40	North Center	26	1540	Extent of excavator - 2nd time
SS6	12/7/2012	10:45	South Center	26	1560	Extent of excavator - 2nd time

TABLE 2
Whiting Oil & Gas Corporation
Antelope Field Pit #2 - Tin Horn Closure

Sample ID	Date Collected	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	GRO (mg/kg)	DRO (mg/kg)
		0.17	**85**	**100**	**175**	**500**	**500**
SS1	12/6/2012	< 0.005	< 0.005	< 0.005	0.016	13	**1500**
SS2	12/6/2012	0.012	0.046	1.5	11	**700**	**730**
SS3	12/6/2012	< 0.0044	< 0.0044	< 0.0044	< 0.0044	1.2	< 50
SS4	12/6/2012	< 0.0043	< 0.0043	< 0.0043	< 0.0043	< 0.43	< 50
SS5	12/7/2012	**0.73**	17	10	69	**1900**	**2100**
SS6	12/7/2012	< 0.45	12	7.1	48	**1500**	**1800**

mg/kg - milligrams per kilogram
< - analyte not detected above the laboratory reporting limit
GRO - gasoline range organics
DRO - diesel range organics
Note: Values in **bold type** are above the COGCC Table 910-1 concentration levels

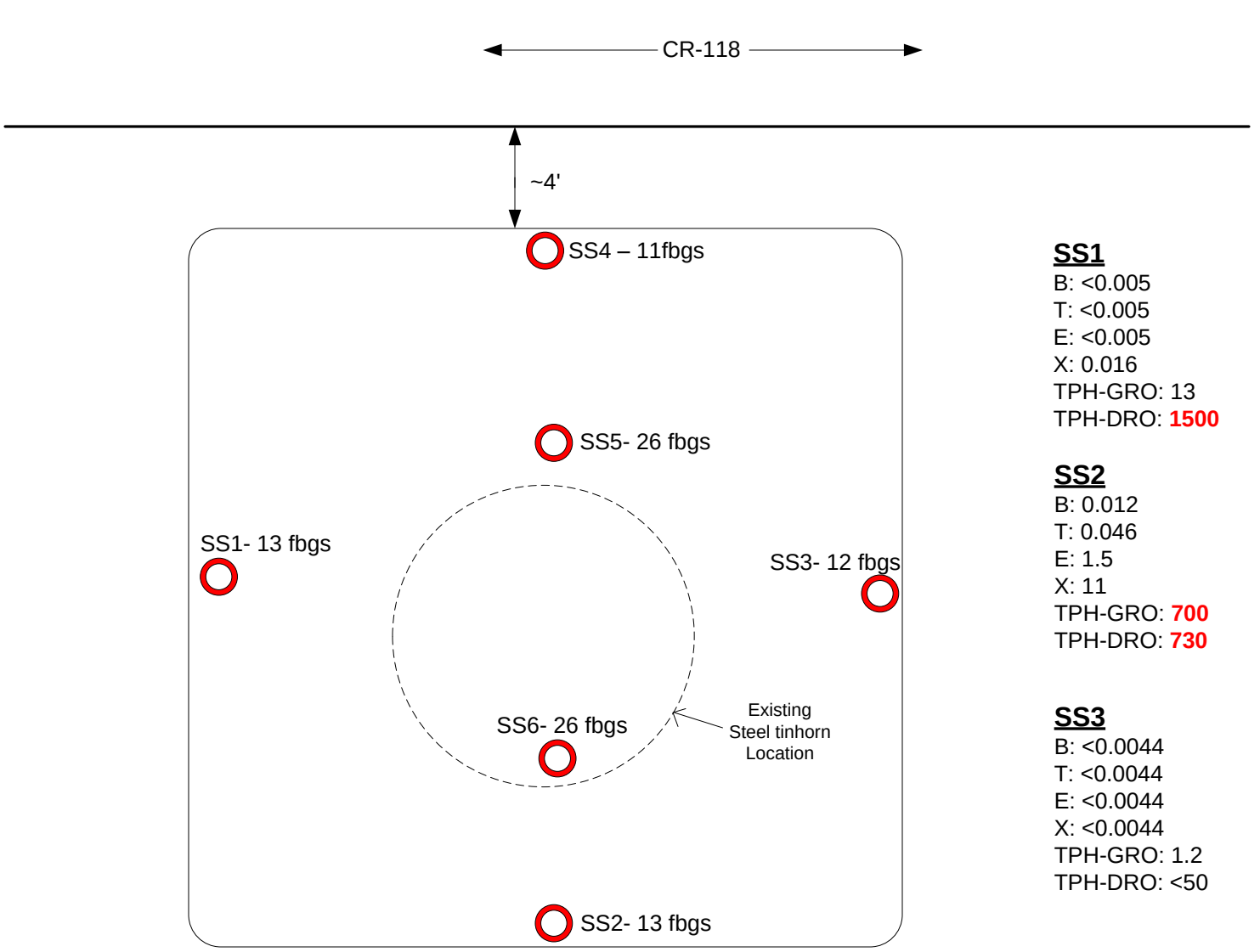
TABLE 3
Whiting Oil & Gas Corporation
Antelope Field Pit #2 - Tin Horn Closure

Sample ID	Date Collected	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a) anthracene (mg/kg)	Benzo(b) fluoranthene (mg/kg)	Benzo(k) fluoranthene (mg/kg)	Benzo (g,h,i) perylene (mg/kg)	Benzo(a) pyrene (mg/kg)	Chrysene (mg/kg)	Dibenz(a,h) anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno (1,2,3-cd) pyrene (mg/kg)	2-Methyl naphthalene (mg/kg)	Naphthalene (mg/kg)	Phenathrene (mg/kg)	Pyrene (mg/kg)
COGCC Table 910-1		1000	NE	1000	0.22	0.22	2.2	NE	0.022	22	0.022	1000	1000	0.22	NE	23	NE	1000
SS5	12/7/2012	0.0286	0.0255	0.0102	0.012	< 0.005	< 0.005	< 0.005	0.0116	0.122	< 0.01	0.0145	0.579	< 0.010	< 0.010	3.9	0.789	0.142
SS6	12/7/2012	0.0284	0.019	0.0111	0.0231	< 0.005	< 0.005	< 0.005	**0.111**	0.0899	< 0.01	0.0129	0.474	< 0.010	< 0.010	2.46	0.841	0.115

mg/kg - milligrams per kilogram
COGCC - Colorado Oil and Gas Conservation Commission (Table 910-1 E&P Waste Concentration Levels).
NE - Not Established (The COGCC Table 910-1 does not contain a concentration level for this compound).
Note: Laboratory results with values in **bold type** are above the Table 910-1 Concentrations Levels.

FIGURES

PROJECT NO: 012-0790 DRAWN BY: BB DATE: 6-14-12	General Location Map of Terrace Gas Plant Whiting Petroleum Corporation	OLSSON ASSOCIATES	4690 TABLE MOUNTAIN DRIVE, SUITE 200 GOLDEN, CO 80403 TEL 303.237.2072 FAX 303.237.2659	FIGURE 1



SS1
B: <0.005
T: <0.005
E: <0.005
X: 0.016
TPH-GRO: 13
TPH-DRO: **1500**

SS4
B: <0.0043
T: <0.0043
E: <0.0043
X: <0.0043
TPH-GRO: <0.43
TPH-DRO: <50

SS2
B: 0.012
T: 0.046
E: 1.5
X: 11
TPH-GRO: **700**
TPH-DRO: **730**

SS5
B: **0.73**
T: 17
E: 10
X: 69
TPH-GRO: **1900**
TPH-DRO: **2100**

SS3
B: <0.0044
T: <0.0044
E: <0.0044
X: <0.0044
TPH-GRO: 1.2
TPH-DRO: <50

SS6
B: <0.45
T: 12
E: 7.1
X: 48
TPH-GRO: **1500**
TPH-DRO: **1800**

PROJECT NO: 012-0790 DRAWN BY: BN DATE: 3-18-13	Soil and Tinhorn Sampling Locations for Pit 2 Terrace Gas Plant Whiting Petroleum Corporation	OLSSON ASSOCIATES 4690 TABLE MOUNTAIN DRIVE, SUITE 200 GOLDEN, CO 80403 TEL 303.237.2072 FAX 303.237.2659	LEGEND Soil sampling location- Sample Depth (feet below ground surface) *Analytical values are reported in mg/kg	B: Benzene T: Toluene E: Ethylbenzene X: Total xylenes TPH:Total Petroleum Hydrocarbons ND: Non-detect **5.9**: Above COGCC cleanup level	FIGURE 3

ATTACHMENT 1
SITE PHOTOGRAPHS

Photographic Log
Whiting Pit 2 Closure

	**PHOTO 1** **Subject:** Beginning of Pit 2 excavating. Upon arrival, K&K had removed the tin horn culvert. The bottom of the pit containing heavily stained soil and sludge. **View:** West
	**PHOTO 2** **Subject:** Excavating the East wall of the pit. Produced water lines are exposed. **View:** North

Photographic Log
Whiting Pit 2 Closure

	**PHOTO 3** **Subject:** Heavy staining is observed below 8 feet. **View:** North
	**PHOTO 4** **Subject:** Excavation of the west wall. **View:** West

Photographic Log
Whiting Pit 2 Closure

	**PHOTO 5** **Subject:** Heavily stained soil on the West wall. **View:** West
	**PHOTO 6** **Subject:** Excavation towards the North. Fiber optic line and road in proximity to pit on northern side. **View: North**

Photographic Log
Whiting Pit 2 Closure

	**PHOTO 7** **Subject:** K&K benched down 7 feet to continue to excavate the bottom of the pit. **View:** West
	**PHOTO 8** **Subject:** Calcerous siltstone was encountered at the bottom of the pit. The greatest depth 26 fbgs reached with the equipment provided by K&K. **View:** NA

Photographic Log
Whiting Pit 2 Closure

PHOTO 9

Subject: Excavation of the east side of the pit.

View: East

ATTACHMENT 2
LABORATORY REPORT

Summit Scientific

741 Corporate Circle – Suite I ♦ Golden, Colorado 80401

303.277.9310 - laboratory ♦ 303.277.9531 - fax

December 13, 2012

James Hix
Olsson Associates
4690 Table Mountain Drive, Suite 200
Golden, CO 80403

RE: Whiting Pit 2 Closure

Enclosed are the results of analyses for samples received by Summit Scientific on 12/07/12 13:34. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

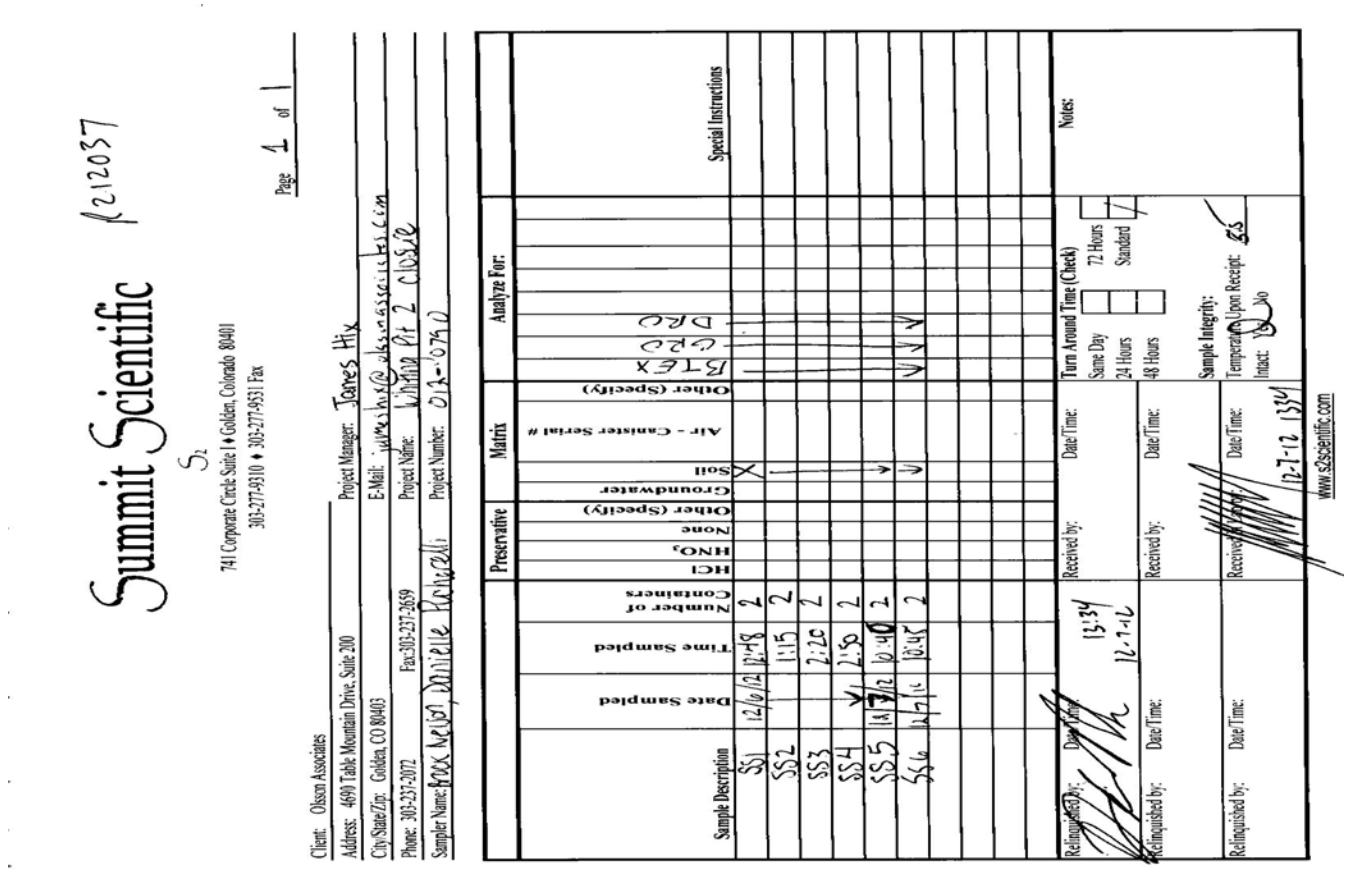
Joseph J Egry IV For Ben Shrewsbury
President / Laboratory Manager

Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SS1	R212037-01	Soil	12/06/12 12:48	12/07/12 13:34
SS2	R212037-02	Soil	12/06/12 13:15	12/07/12 13:34
SS3	R212037-03	Soil	12/06/12 14:20	12/07/12 13:34
SS4	R212037-04	Soil	12/06/12 14:50	12/07/12 13:34
SS5	R212037-05	Soil	12/07/12 10:40	12/07/12 13:34
SS6	R212037-06	Soil	12/07/12 10:45	12/07/12 13:34

Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16



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Page 1 of 1

Client: Olsson Associates
Address: 4690 Table Mountain Drive, Suite 200
City/State/Zip: Golden, CO 80403
Phone: 303-237-2072 Fax:303-237-2659
Sampler Name: Rock Nelson, Danielle Rodwell

Project Manager: James Hix
E-Mail: jmhix@olssonassociates.com
Project Name: Whiting Pit 2 Closure
Project Number: 012-0790

Sample Description	Date Sampled	Time Sampled	Number of Containers	Preservative: HCl	HNO3	None	Other (Specify)	Matrix: Groundwater	Soil	Air - Canister Serial #	Other (Specify)	Analyze For: BTEX	CPAH	Special Instructions
SS1	12/6/12	12:48	2						X			X	X	
SS2		1:15	2											
SS3		2:20	2											
SS4		2:50	2											
SS5	12/7/12	10:40	2											
SS6	12/7/12	10:45	2											

Relinquished by: Date/Time: 12-7-12 13:34
Received by: Date/Time:
Relinquished by: Date/Time:
Received by: Date/Time:
Relinquished by: Date/Time:
Received by: Date/Time:

Turn Around Time (Check): Same Day, 24 Hours, 48 Hours, 72 Hours, Standard (X)
Sample Integrity: Temperature Upon Receipt: 4°C; Intact: Yes / No

Notes:

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Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16

SS1
R212037-01 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/06/12 12:48**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**1500**	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/06/12 12:48**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*107 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/06/12 12:48**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0050	mg/kg	1	2121013	12/10/12	12/10/12	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	ND	0.0050	"	"	"	"	"	"	
Xylenes (total)	**0.016**	0.0050	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**13**	0.50	"	"	"	"	"	"	

Date Sampled: **12/06/12 12:48**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*118 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*106 %*	*30-150*		"	"	"	"	

Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16

SS2

R212037-02 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/06/12 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**730**	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/06/12 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*105 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/06/12 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.012**	0.0050	mg/kg	1	2121013	12/10/12	12/10/12	EPA 8260B	
Toluene	**0.046**	0.0050	"	"	"	"	"	"	
Ethylbenzene	**1.5**	0.50	"	100	"	"	"	"	
Xylenes (total)	**11**	0.50	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**700**	50	"	"	"	"	"	"	

Date Sampled: **12/06/12 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*97.6 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*97.8 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*98.7 %*	*30-150*		"	"	"	"	

SS3
R212037-03 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/06/12 14:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/06/12 14:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*116 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/06/12 14:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0044	mg/kg	1	2121013	12/10/12	12/10/12	EPA 8260B	
Toluene	ND	0.0044	"	"	"	"	"	"	
Ethylbenzene	ND	0.0044	"	"	"	"	"	"	
Xylenes (total)	ND	0.0044	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**1.2**	0.44	"	"	"	"	"	"	

Date Sampled: **12/06/12 14:20**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*129 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*104 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*98.6 %*	*30-150*		"	"	"	"	

Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16

SS4

R212037-04 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/06/12 14:50**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/06/12 14:50**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*101 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/06/12 14:50**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0043	mg/kg	1	2121013	12/10/12	12/10/12	EPA 8260B	
Toluene	ND	0.0043	"	"	"	"	"	"	
Ethylbenzene	ND	0.0043	"	"	"	"	"	"	
Xylenes (total)	ND	0.0043	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.43	"	"	"	"	"	"	

Date Sampled: **12/06/12 14:50**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*132 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*103 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*100 %*	*30-150*		"	"	"	"	

SS5
R212037-05 (Soil)

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Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/07/12 10:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**2100**	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/07/12 10:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*112 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/07/12 10:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	**0.73**	0.45	mg/kg	100	2121013	12/10/12	12/11/12	EPA 8260B	
Toluene	**17**	0.45	"	"	"	"	"	"	
Ethylbenzene	**10**	0.45	"	"	"	"	"	"	
Xylenes (total)	**69**	0.45	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**1900**	45	"	"	"	"	"	"	

Date Sampled: **12/07/12 10:40**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*98.3 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*96.5 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*123 %*	*30-150*		"	"	"	"	

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SS6

R212037-06 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/07/12 10:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	**1800**	50	mg/kg	1	2121012	12/10/12	12/11/12	8015 Full Carbon Chain	

Date Sampled: **12/07/12 10:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		*108 %*	*30-150*		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/07/12 10:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.45	mg/kg	100	2121013	12/10/12	12/11/12	EPA 8260B	
Toluene	**12**	0.45	"	"	"	"	"	"	
Ethylbenzene	**7.1**	0.45	"	"	"	"	"	"	
Xylenes (total)	**48**	0.45	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	**1500**	45	"	"	"	"	"	"	

Date Sampled: **12/07/12 10:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		*95.4 %*	*30-150*		"	"	"	"	
Surrogate: Toluene-d8		*95.5 %*	*30-150*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*112 %*	*30-150*		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015 - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2121012 - EPA 3550A										
Blank (2121012-BLK1)				Prepared & Analyzed: 12/10/12						
C10-C28 (DRO)	ND	50	mg/kg							
LCS (2121012-BS1)				Prepared & Analyzed: 12/10/12						
C10-C28 (DRO)	531	50	mg/kg	501		106	73-134			
LCS Dup (2121012-BSD1)				Prepared & Analyzed: 12/10/12						
C10-C28 (DRO)	548	50	mg/kg	501		109	73-134	3.14	11	
Matrix Spike (2121012-MS1)		**Source: R212035-01**		Prepared & Analyzed: 12/10/12						
C10-C28 (DRO)	2610	50	mg/kg	447		583	50-148			
Matrix Spike Dup (2121012-MSD1)		**Source: R212035-01**		Prepared & Analyzed: 12/10/12						
C10-C28 (DRO)	2820	50	mg/kg	491		574	50-148	7.82	13	

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2121013 - EPA 5030 Soil MS										
Blank (2121013-BLK1)				Prepared & Analyzed: 12/10/12						
Benzene	ND	0.0050	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.0050	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	*0.0440*		"	*0.0397*		*111*	*30-150*			
Surrogate: Toluene-d8	*0.0391*		"	*0.0400*		*97.8*	*30-150*			
Surrogate: 4-Bromofluorobenzene	*0.0390*		"	*0.0400*		*97.6*	*30-150*			
LCS (2121013-BS1)				Prepared & Analyzed: 12/10/12						
Benzene	0.0766	0.0050	mg/kg	0.100		76.6	58-130			
Toluene	0.0863	0.0050	"	0.100		86.3	61-134			
Ethylbenzene	0.117	0.0050	"	0.100		117	74-139			
m,p-Xylene	0.207	0.010	"	0.200		103	73-137			
o-Xylene	0.108	0.0050	"	0.100		108	73-141			
Surrogate: 1,2-Dichloroethane-d4	*0.0413*		"	*0.0397*		*104*	*30-150*			
Surrogate: Toluene-d8	*0.0402*		"	*0.0400*		*100*	*30-150*			
Surrogate: 4-Bromofluorobenzene	*0.0382*		"	*0.0400*		*95.5*	*30-150*			
LCS Dup (2121013-BSD1)				Prepared & Analyzed: 12/10/12						
Benzene	0.0744	0.0050	mg/kg	0.100		74.4	58-130	2.94	13	
Toluene	0.0830	0.0050	"	0.100		83.0	61-134	3.90	16	
Ethylbenzene	0.112	0.0050	"	0.100		112	74-139	4.16	12	
m,p-Xylene	0.197	0.010	"	0.200		98.3	73-137	5.12	14	
o-Xylene	0.104	0.0050	"	0.100		104	73-141	4.21	12	
Surrogate: 1,2-Dichloroethane-d4	*0.0442*		"	*0.0397*		*111*	*30-150*			
Surrogate: Toluene-d8	*0.0410*		"	*0.0400*		*102*	*30-150*			
Surrogate: 4-Bromofluorobenzene	*0.0380*		"	*0.0400*		*94.9*	*30-150*			

Olsson Associates 4690 Table Mountain Drive, Suite 200 Golden CO, 80403	Project: Whiting Pit 2 Closure Project Number: 012-0790 Project Manager: James Hix	**Reported:** 12/13/12 10:16

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2121013 - EPA 5030 Soil MS										
Matrix Spike (2121013-MS1)		**Source: R212037-01**		Prepared & Analyzed: 12/10/12						
Benzene	0.0742	0.0050	mg/kg	0.0980	0.00412	71.5	30-131			
Toluene	0.0812	0.0050	"	0.0980	0.00384	78.9	30-134			
Ethylbenzene	0.110	0.0050	"	0.0980	0.00340	109	22-153			
m,p-Xylene	0.200	0.010	"	0.196	0.00900	97.2	10-159			
o-Xylene	0.107	0.0050	"	0.0980	0.00661	103	31-151			
Surrogate: 1,2-Dichloroethane-d4	*0.0457*		*"*	*0.0389*		*117*	*30-150*			
Surrogate: Toluene-d8	*0.0400*		*"*	*0.0392*		*102*	*30-150*			
Surrogate: 4-Bromofluorobenzene	*0.0400*		*"*	*0.0392*		*102*	*30-150*			
Matrix Spike Dup (2121013-MSD1)		**Source: R212037-01**		Prepared & Analyzed: 12/10/12						
Benzene	0.0718	0.0045	mg/kg	0.0909	0.00412	74.4	30-131	3.40	34	
Toluene	0.0790	0.0045	"	0.0909	0.00384	82.7	30-134	2.74	30	
Ethylbenzene	0.108	0.0045	"	0.0909	0.00340	115	22-153	1.93	24	
m,p-Xylene	0.194	0.0091	"	0.182	0.00900	102	10-159	3.03	68	
o-Xylene	0.104	0.0045	"	0.0909	0.00661	107	31-151	3.37	38	
Surrogate: 1,2-Dichloroethane-d4	*0.0434*		*"*	*0.0361*		*120*	*30-150*			
Surrogate: Toluene-d8	*0.0371*		*"*	*0.0364*		*102*	*30-150*			
Surrogate: 4-Bromofluorobenzene	*0.0410*		*"*	*0.0364*		*113*	*30-150*			

Olsson Associates	Project: Whiting Pit 2 Closure	
4690 Table Mountain Drive, Suite 200	Project Number: 012-0790	**Reported:**
Golden CO, 80403	Project Manager: James Hix	12/13/12 10:16

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference