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Project 4361
Revised scope of work
Document 2315673

ATTACHMENT A
ON-SITE SOIL TREATMENT SCOPE OF WORK



August 27, 2015

Mr. Phillip Hamlin
Senior HSE Representative
Kerr-McGee Oil & Gas Onshore LP
1099 18th Street, Suite 1800
Denver, Colorado 80202

**Re: On-Site Soil Treatment Scope of Work
Smith Elsie GU #1 Tank Battery
Weld County, Colorado
SENE 33-T2N-R65W**

Dear Mr. Hamlin:

Tasman Geosciences, Inc. (Tasman) has prepared the following scope of work (SOW) for the proposed soil treatment activities at the Smith Elsie GU #1 tank battery (Site – Figure 1). The SOW describes post-assessment on-Site chemical oxidant (chemox) soil mixing activities intended to destroy petroleum hydrocarbons in soil resulting from historical oil and gas production operations at the Site. The soil treatment SOW has been prepared based on the results of the subsurface soil and groundwater assessment conducted by LT Environmental, Inc. (LTE) in August 2014. The subsurface assessment was conducted per the *Revised Subsurface Assessment and Excavation SOW* (LTE, August 4, 2014). The field activities and analytical results for the subsurface assessment are briefly summarized below.

Subsurface Soil and Groundwater Assessment Summary

On August 6, 2014, thirteen soil borings (SB01 through SB13) were advanced at the Site using a track-mounted GeoProbe[®] rig. The soil borings were advanced to 18 feet to 20 feet below ground surface (bgs). Two to three soil samples were collected from each soil boring from directly above the shallow groundwater table (where apparent), at total depth, and/or at the soil interval exhibiting the highest photoionization detector (PID) headspace reading. Soil samples were submitted for laboratory analysis of total petroleum hydrocarbons (TPH) by United States Environmental Protection Agency (EPA) Methods 8015 and 8260, and benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA Method 8260. The TPH analysis included gasoline range organics (GRO), diesel range organics (DRO), and oil range organics (ORO). The locations of the soil borings installed during the August 2014 assessment activities are displayed on Figure 2. The soil sample analytical results are summarized in Table 1 and presented on Figure 2.

Soil borings SB01 through SB13 were completed as temporary groundwater monitoring wells MW01 through MW13, respectively. The temporary monitoring wells were constructed with 1-inch diameter polyvinyl chloride risers and slotted screens. A sand filter pack (10-20 silica) was placed around the well screen followed by a hydrated bentonite seal to the surface.

On August 8, 2014, the temporary groundwater monitoring wells were gauged with a water level meter to assess the presence of groundwater. Groundwater was not encountered in monitoring wells MW01, MW04 through MW08, and MW10. Groundwater was gauged in monitoring wells MW02, MW03, MW09, MW11, MW12, and MW13 at depths ranging from 11.23 feet to 19.22 feet bgs. Grab groundwater samples were collected from these six monitoring wells in volatile organic analysis (VOA) vials preserved with hydrochloric acid. After collecting the grab samples, LTE then attempted to develop and purge the monitoring wells with a disposable bailer. However, each well was bailed dry while purging and did not recharge prior to LTE leaving the Site. The grab groundwater samples were submitted for laboratory analysis of BTEX by EPA Method 8260.

On August 11, 2014, LTE returned to the Site and the temporary monitoring wells were gauged a second time to assess the presence of groundwater. Groundwater was not encountered in monitoring wells MW01, MW05 through MW08, and MW10. Groundwater was gauged in monitoring wells MW02, MW03, MW04, MW09, MW11, MW12, and MW13 at depths ranging from 11.28 feet to 19.20 feet bgs. Groundwater samples were collected from these wells in the same manner described above and submitted for laboratory analysis of BTEX by EPA Method 8260. The groundwater analytical results are summarized in Table 2 and displayed on Figure 3. The laboratory analytical reports were presented in the *Excavation Scope of Work – Smith Elsie GU #1 – Tank Battery* (LTE, September 15, 2014).

Proposed On-Site Chemox Soil Mixing

Prior to initiating soil treatment activities, the landowner and their designated consultant, Tom Glibota, will be provided with 48-hour notice. A 3-strand perimeter fence with gated access will be installed around the proposed treatment area to prevent livestock from entering the Site. The gates will be manned during remediation activities.

Based on the soil assessment activities conducted by LTE in August 2014, the lateral extent of the treatment area will include an area approximately 90 feet by 90 feet, centered on the former tank battery. Benching and/or sloping of the excavation may be necessary due to the Site geology. It is expected that the treatment area will be extended to a depth of approximately 20 feet bgs. The estimated volume of soil to be treated is approximately 6,000 cubic yards (yd³). The estimated extent of the treatment area is presented on Figure 2. The lateral and vertical extent of the treatment area may increase or decrease based on impacts observed during soil treatment activities, as well as the laboratory analytical results from the confirmation soil samples. Temporary monitoring wells located within the proposed treatment area footprint will be properly abandoned per Colorado Division of Water Resources requirements.

Tasman has developed a proven, cost-effective, and minimal footprint method of on-Site chemox soil mixing that is ideally suited to addressing soil impacts in the treatment area. This soil remedial methodology will address both soil impacts above and below the groundwater table (if encountered). This technology is designed to be implemented with minimal disturbance to areas outside the excavation and staging areas.

Topsoil will be removed from the work area and stockpiled on-Site for use during reclamation activities. Clean overburden, if present, will be removed from the excavation area and stockpiled separately on-Site for use as backfill. This material will also be used to create a berm around the

perimeter of the excavation area for surface water runoff control, visual shielding, and noise reduction.

Impacted soil will be treated on-Site using a dilute solution of hydrogen peroxide (H_2O_2 – 7 to 34%) and physical soil mixing using an appropriately-sized excavator. This methodology has been proven to provide excellent contact and destruction of hydrocarbon impacts in similar geologic settings, and with impacts in similar (and much greater) concentrations than those present at the Site.

Treated soil confirmation samples will be collected and submitted for laboratory analysis of TPH (GRO, DRO, and ORO) by EPA Methods 8015 and 8260 and BTEX by EPA Method 8260, at a frequency of approximately one per 100 yd^3 of the treated soils. The samples will be run on a quick (i.e. overnight) turnaround time. Impacted soil will be treated until laboratory analytical results confirm TPH concentrations are below 500 milligrams per kilogram (mg/kg) and BTEX concentrations are below 0.17 mg/kg, 85 mg/kg, 100 mg/kg, and 175 mg/kg, respectively.

Throughout soil treatment activities, Tasman field personnel will make visual observations and screen soil using a PID and/or PetroFlag[®] field analyzer to guide excavation and treatment activities. Prior to backfilling, sidewall and base samples will be collected from the final extent of the excavation at the following frequencies and locations:

- Soil samples will be collected along each excavation sidewall at a frequency of one per 25 linear feet, at a minimum.
- The excavation base will be divided into 4 quadrants, and one discrete soil sample will be collected from each quadrant (4 soil samples).

Sidewall and base confirmation soil samples will be submitted for laboratory analysis of TPH (GRO, DRO, and ORO) by EPA Methods 8015 and 8260 and BTEX by EPA Method 8260. The samples will be run on a quick (i.e. overnight) turnaround time and the analytical results will be used to guide the excavation and treatment activities, as necessary. Excavation and soil treatment activities will be continued until laboratory analytical results confirm TPH concentrations are below 500 milligrams per kilogram (mg/kg) and BTEX concentrations are below 0.17 mg/kg, 85 mg/kg, 100 mg/kg, and 175 mg/kg, respectively along the sidewalls and at the base of the excavation.

Subsequent to successful completion of soil mixing activities and receipt of confirmation soil analytical data, the excavation area will be backfilled and compacted using a combination of bucket and vibratory roller compaction to eliminate settling caused by truck and equipment traffic.

If groundwater enters and accumulates in the excavation, soil excavation and treatment will proceed a minimum of 2 feet into the water table. A vacuum truck will be utilized to remove impacted groundwater during the excavation activities. Excavation groundwater samples will be collected before and after groundwater removal and submitted for BTEX analysis. After removing any visibly impacted groundwater, a groundwater amendment (i.e., activated carbon, etc.) will be applied to groundwater in the excavation to enhance petroleum hydrocarbon degradation. The excavation will be backfilled with confirmed treated soil, clean overburden, and topsoil, and the excavation area will be contoured to match the surrounding land.



Once the excavation has been backfilled, a minimum of two source area monitoring wells will be installed inside the excavation footprint and the temporary groundwater monitoring wells will be converted to permanent wells with the addition of locking steel protective casings with cemented footers. At a minimum, the final post-soil treatment groundwater monitoring network will include one upgradient monitoring well, two source area monitoring wells, and three hydraulically downgradient monitoring wells. Temporary groundwater monitoring wells will be surveyed so that groundwater flow direction and gradient can be established and monitored.

A Site Investigation Report (SIR) will be prepared following completion of the soil treatment activities outlined in this SOW. The SIR will present the subsurface assessment findings, soil treatment activities, and confirmation sampling results. A separate, draft Site Closure Plan (SCP), outlining a proposed path to Site closure, will also be prepared and submitted to Kerr-McGee and the landowner for review and comment following the soil treatment activities outlined in this SOW.

Please call me at 970.927.0393 if you have any questions regarding this proposed excavation SOW.

Sincerely,



A handwritten signature in blue ink that reads 'Robert M. Cornez'.

Robert M. Cornez
Principal – Environmental

Attachments

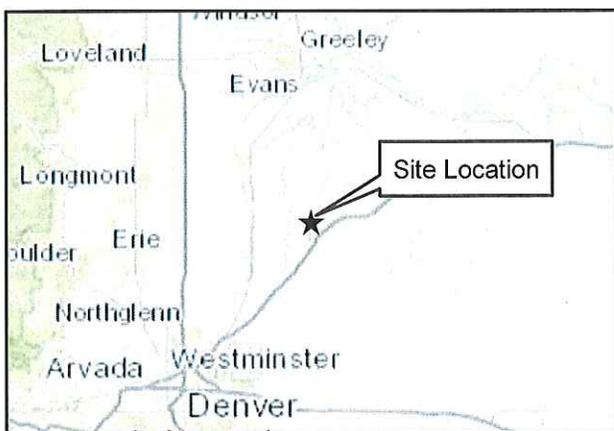
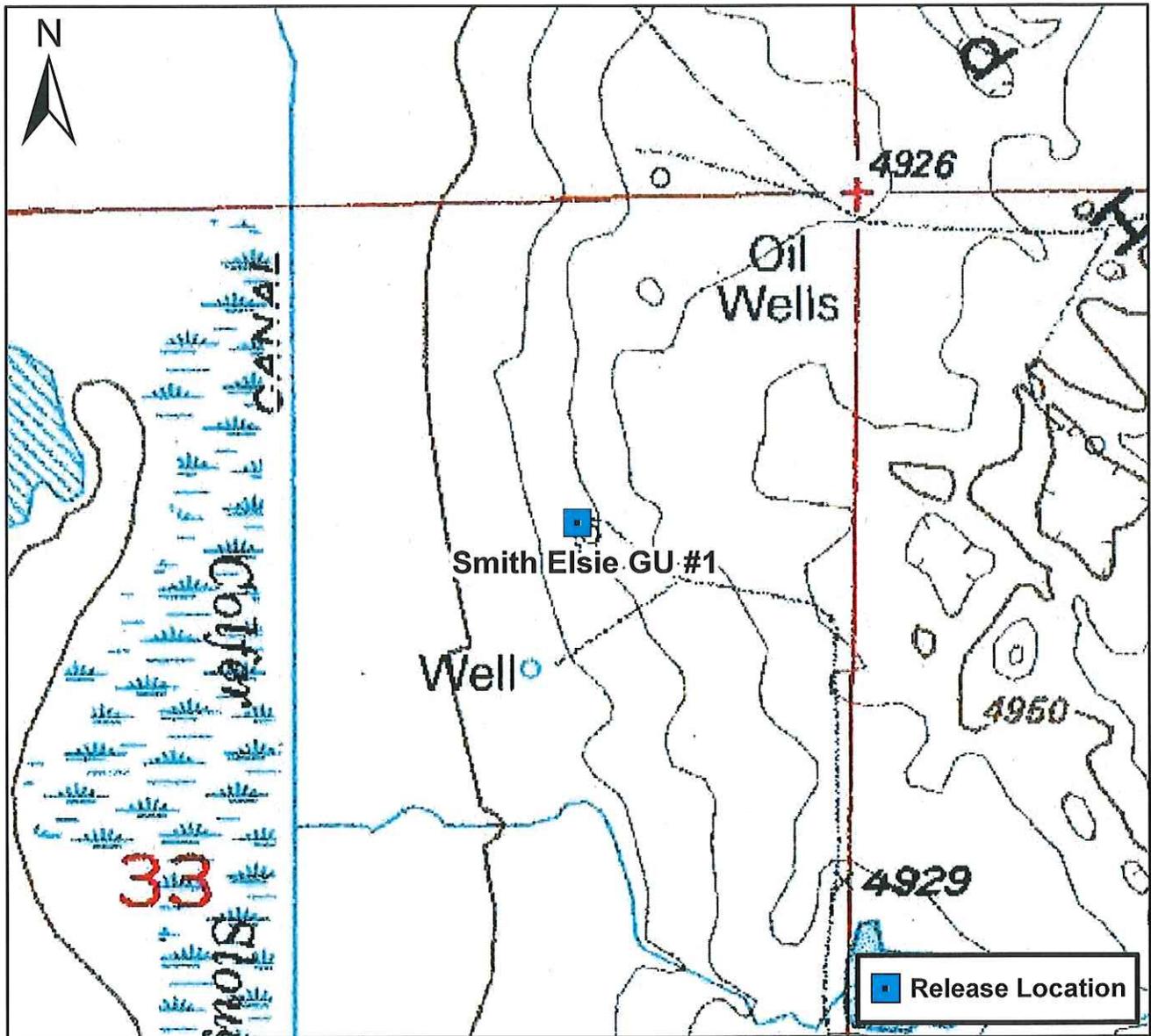
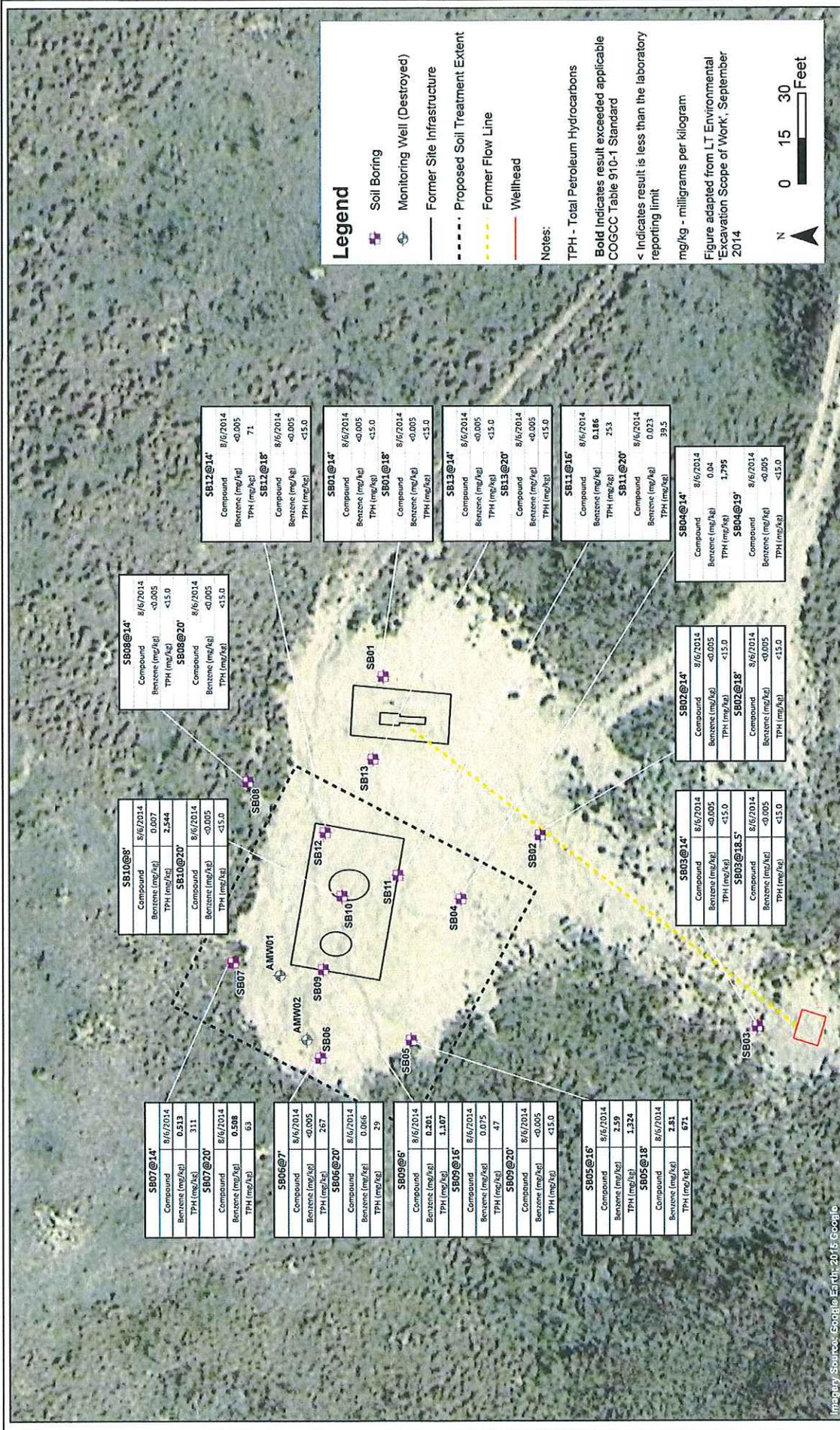
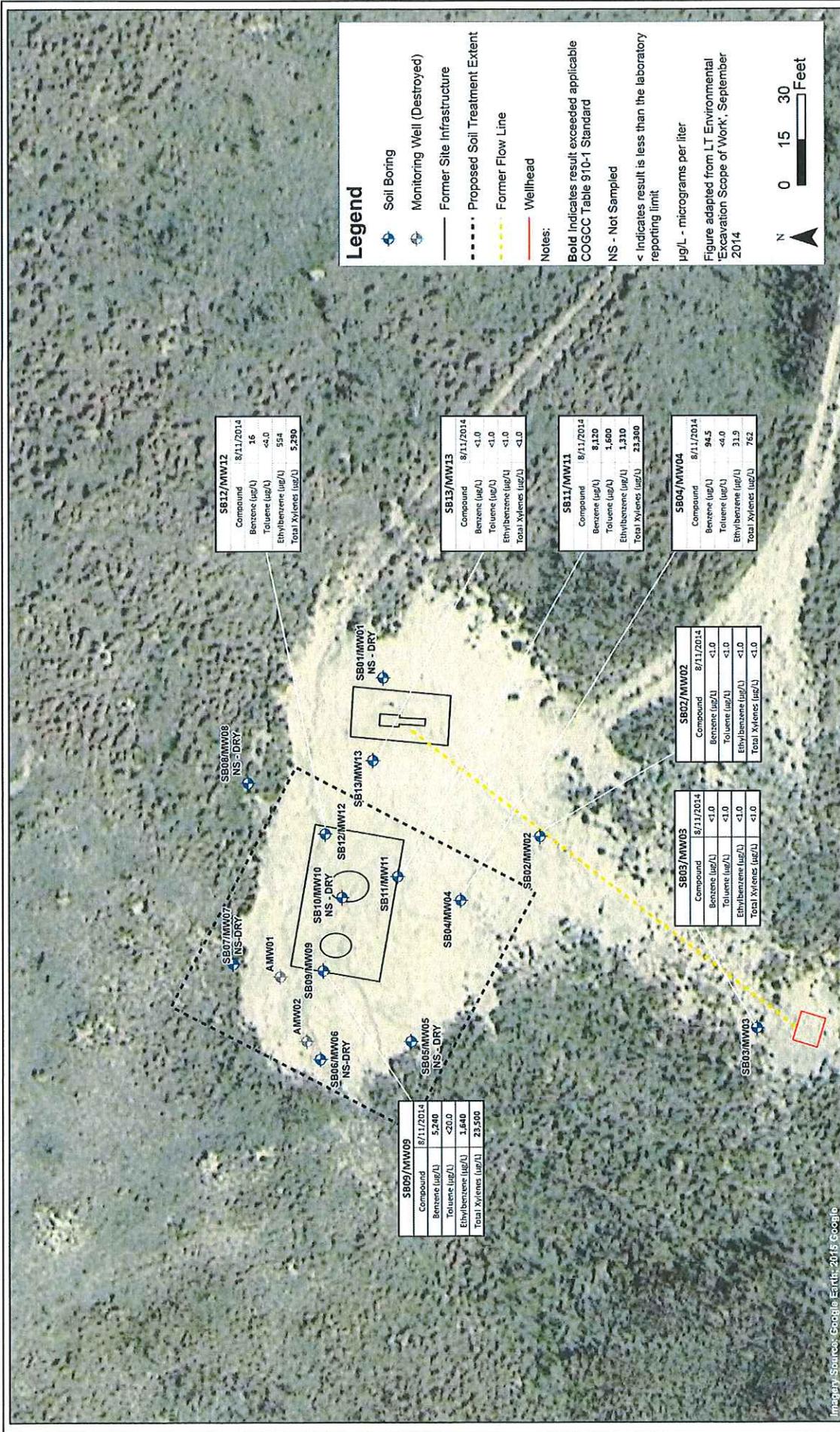


Figure 1
 Site Location Map
 Smith Elsie GU #1
 SENE S33 T2N R65W
 Weld County, Colorado



Drawn By: DBA
 Date: 6/29/2015



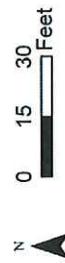


Legend

- Soil Boring
- Monitoring Well (Destroyed)
- Former Site Infrastructure
- Proposed Soil Treatment Extent
- Former Flow Line
- Wellhead

Notes:
 Bold indicates result exceeded applicable COGCC Table 910-1 Standard
 NS - Not Sampled
 < Indicates result is less than the laboratory reporting limit
 µg/L - micrograms per liter

Figure adapted from LT Environmental 'Excavation Scope of Work', September 2014



SB12/MW12		8/11/2014	
Compound			
Benzene (µg/L)		16	
Toluene (µg/L)		<4.0	
Ethylbenzene (µg/L)		554	
Total Xylenes (µg/L)		5,290	

SB13/MW13		8/11/2014	
Compound			
Benzene (µg/L)		<1.0	
Toluene (µg/L)		<1.0	
Ethylbenzene (µg/L)		<1.0	
Total Xylenes (µg/L)		<1.0	

SB11/MW11		8/11/2014	
Compound			
Benzene (µg/L)		8,120	
Toluene (µg/L)		1,600	
Ethylbenzene (µg/L)		1,310	
Total Xylenes (µg/L)		23,000	

SB04/MW04		8/11/2014	
Compound			
Benzene (µg/L)		94.5	
Toluene (µg/L)		<4.0	
Ethylbenzene (µg/L)		31.9	
Total Xylenes (µg/L)		762	

SB02/MW02		8/11/2014	
Compound			
Benzene (µg/L)		<1.0	
Toluene (µg/L)		<1.0	
Ethylbenzene (µg/L)		<1.0	
Total Xylenes (µg/L)		<1.0	

SB03/MW03		8/11/2014	
Compound			
Benzene (µg/L)		<1.0	
Toluene (µg/L)		<1.0	
Ethylbenzene (µg/L)		<1.0	
Total Xylenes (µg/L)		<1.0	

SB09/MW09		8/11/2014	
Compound			
Benzene (µg/L)		5,240	
Toluene (µg/L)		<30.0	
Ethylbenzene (µg/L)		1,640	
Total Xylenes (µg/L)		23,500	

DATE: June 2015
 DESIGNED BY: B. Carnez
 DRAWN BY: D. Arnold

TASMAN
 GEOSCIENCES

Tasman Geosciences, Inc.
 6899 Pecos Street - Unit C
 Denver, CO 80221

Kerr-McGee Oil & Gas Onshore LP
 Former Smith Eisie GU #1
 SENE Section 33, Township 2 North, Range 65 West
 Weld County, Colorado

Groundwater Analytical Results
 Map
 (August 11, 2014)

Figure
3

Imagery Sources: Google Earth: 2015

TABLE 1
SMITH ELSIE GU #1
SOIL SAMPLE RESULTS SUMMARY TABLE
KERR-McGEE OIL AND GAS ONSHORE LP

Sample ID	Date Sampled	Depth (feet bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	TVPH - GRO (mg/kg)	TEPH - DRO + ORO (mg/kg)
COGCC standards for soil (mg/kg)			0.17	85	100	175	500	
SB01@14'	08/06/2014	14'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB01@18'	08/06/2014	18'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB02@14'	08/06/2014	14'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB02@18'	08/06/2014	18'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB03@14'	08/06/2014	14'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB03@18.5'	08/06/2014	18.5'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB04@14'	08/06/2014	14'	0.04	0.104	5.09	62.5	1,147	648
SB04@19'	08/06/2014	19'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB05@16'	08/06/2014	16'	2.59	2.21	5.74	79.2	1,135	189
SB05@18'	08/06/2014	18'	2.81	0.697	4.34	47.8	620	50.7
SB06@7'	08/06/2014	7'	< 0.005	0.03	0.281	6.6	167	100
SB06@20'	08/06/2014	20'	0.066	< 0.01	0.427	0.795	29.4	< 5.0
SB07@14'	08/06/2014	14'	0.513	7.05	1.76	28.7	274	37.4
SB07@20'	08/06/2014	20'	0.508	0.184	0.347	4.73	63.4	< 5.0
SB08@14'	08/06/2014	14'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB08@20'	08/06/2014	20'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB09@6'	08/06/2014	6'	0.201	0.048	3.1	54	887	220
SB09@16'	08/06/2014	16'	0.075	< 0.01	0.186	2.49	36.3	10.8
SB09@20'	08/06/2014	20'	< 0.005	< 0.01	< 0.01	0.026	< 5.0	< 5.0
SB10@8'	08/06/2014	8'	0.007	3.97	11.2	169	2,311	233
SB10@20'	08/06/2014	20'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB11@16'	08/06/2014	16'	0.186	0.404	1.03	14.6	210	43.4
SB11@20'	08/06/2014	20'	0.023	0.037	0.206	2.73	39.5	< 5.0
SB12@14'	08/06/2014	14'	< 0.005	< 0.01	0.264	2.47	62.9	8.04
SB12@18'	08/06/2014	18'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB13@14'	08/06/2014	14'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0
SB13@20'	08/06/2014	20'	< 0.005	< 0.01	< 0.01	< 0.01	< 5.0	< 5.0

Notes:

Standards for soil are taken from 2 CCR 404-1, Table 910-1, effective February 1, 2014.

COGCC = Colorado Oil and Gas Conservation Commission

(<) = Analytical result is less than the indicated laboratory reporting limit.

TVPH - GRO = Total volatile petroleum hydrocarbons - gasoline range organics

TEPH - DRO = Total extractable petroleum hydrocarbons - diesel range organics

TEPH - ORO = Total extractable petroleum hydrocarbons - oil range organics

mg/kg = Milligrams per kilogram.

bgs = Below ground surface.

Bold = Analytical result is in exceedance of COGCC Table 910-1 soil standards.

* Data source: LT Environmental, *Excavation Scope of Work, Smith Elsie GU #1 - Tank Battery*, 15-Sept-14

TABLE 2
SMITH ELSIE GU #1
GROUNDWATER SAMPLE RESULTS SUMMARY TABLE
KERR-McGEE OIL AND GAS ONSHORE LP

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water (feet bgs)
COGCC Table 910-1 Groundwater Standard (µg/L)		5	560	700	1,400	
AMW01	05/27/2008	8,800	7,900	890	18,000	14.31
AMW01	07/01/2008	8,300	6,700	680	12,000	14.30
AMW01	01/13/2009	2,100	26	750	7,800	PVC Bent
AMW01	AMW01 destroyed as of 4/20/2009					
AMW02	05/27/2008	Dry - Not Sampled				Dry
AMW02	07/01/2008	Dry - Not Sampled				Dry
AMW02	01/13/2009	Dry - Not Sampled				Dry
AMW02	AMW02 destroyed as of 4/20/2009					
MW01	08/08/2014	Dry - Not Sampled				Dry
MW01	08/11/2014	Dry - Not Sampled				Dry
MW02	08/08/2014	< 1.0	< 1.0	< 1.0	< 1.0	13.95
MW02	08/11/2014	< 1.0	< 1.0	< 1.0	< 1.0	15.98
MW03	08/08/2014	< 1.0	< 1.0	< 1.0	< 1.0	19.22
MW03	08/11/2014	< 1.0	< 1.0	< 1.0	< 1.0	17.55
MW04	08/08/2014	Dry - Not Sampled				Dry
MW04	08/11/2014	94.5	< 4.0	31.9	762	19.20
MW05	08/08/2014	Dry - Not Sampled				Dry
MW05	08/11/2014	Dry - Not Sampled				Dry
MW06	08/08/2014	Dry - Not Sampled				Dry
MW06	08/11/2014	Dry - Not Sampled				Dry
MW07	08/08/2014	Dry - Not Sampled				Dry
MW07	08/11/2014	Dry - Not Sampled				Dry
MW08	08/08/2014	Dry - Not Sampled				Dry
MW08	08/11/2014	Dry - Not Sampled				Dry
MW09	08/08/2014	6,280	7.3	1,940	26,500	11.23
MW09	08/11/2014	5,240	< 20.0	1,640	23,500	11.28
MW10	08/08/2014	Dry - Not Sampled				Dry
MW10	08/11/2014	Dry - Not Sampled				Dry
MW11	08/08/2014	7,920	2,060	1,620	23,900	12.75
MW11	08/11/2014	8,120	1,600	1,310	23,300	12.77
MW12	08/08/2014	5.5	< 1.0	145	2,930	12.92
MW12	08/11/2014	16.0	< 4.0	554	5,290	12.85
MW13	08/08/2014	< 1.0	< 1.0	< 1.0	4.8	14.04
MW13	08/11/2014	< 1.0	< 1.0	< 1.0	< 1.0	14.07

Notes:

Groundwater standards referenced from 2 CCR 404-1, Table 910-1, effective February 1, 2014.

COGCC = Colorado Oil and Gas Conservation Commission

µg/L = Micrograms per liter

(<) = Analytical result is less than the indicated laboratory reporting limit.

Bold = Analytical result is in exceedance of COGCC groundwater standards.

* Data source: LT Environmental, *Excavation Scope of Work, Smith Elsie GU #1 - Tank Battery*, 15-Sept-14