

**3R-469**

**Mudge LS 6**

**Soil Remediation  
&  
Ground Water  
Investigation  
Work Plan**

**Date 5/17/16**

## Smith, Cory, EMNRD

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**From:** Smith, Cory, EMNRD  
**Sent:** Tuesday, May 17, 2016 1:58 PM  
**To:** 'Moskal, Steven'  
**Cc:** kdiemer@blm.gov; VonGonten, Glenn, EMNRD; Griswold, Jim, EMNRD; Fields, Vanessa, EMNRD  
**Subject:** RE: Mudge LS 6 Revised Scope of Work

Steve,

OCD has approved BP Soil and Ground Water Investigation work plan for the Mudge LS6 3RP-469.

The approved plan can be found scanned into the OCD online Data Base.

Cory Smith  
Environmental Specialist  
Oil Conservation Division  
Energy, Minerals, & Natural Resources  
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[cory.smith@state.nm.us](mailto:cory.smith@state.nm.us)

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**From:** Moskal, Steven [mailto:Steven.Moskal@bp.com]  
**Sent:** Monday, April 11, 2016 4:37 PM  
**To:** Smith, Cory, EMNRD  
**Cc:** kdiemer@blm.gov  
**Subject:** RE: Mudge LS 6 Revised Scope of Work

Cory,

Attached is a revised scope of work to include the timeline as discussed. It basically provides a 90 day window to execute the plan and another 90 days to design a follow up remediation plan following the review from the regulatory agencies (last paragraph).

Please let me know what you think.

Steve Moskal  
BP Lower 48 – San Juan – Farmington  
Field Environmental Coordinator  
Office: (505) 326-9497  
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**From:** Smith, Cory, EMNRD [<mailto:Cory.Smith@state.nm.us>]  
**Sent:** Friday, April 08, 2016 11:54 AM  
**To:** Moskal, Steven  
**Subject:** RE: Mudge LS 6 Revised Scope of Work

Steve,

As we discussed can you add in the further soil investigations and time lines etc.

Thanks.

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**From:** Moskal, Steven [<mailto:Steven.Moskal@bp.com>]  
**Sent:** Wednesday, April 06, 2016 2:17 PM  
**To:** Smith, Cory, EMNRD; [kdiemer@blm.gov](mailto:kdiemer@blm.gov)  
**Cc:** Ritchie, John; Fields, Vanessa, EMNRD  
**Subject:** Mudge LS 6 Revised Scope of Work

Katherina and Cory,

Attached is a revised scope of work for the Mudge LS 006 remediation site. The revised scope is a reduction includes a reduction in the number of soil borings and laboratory analysis. Please review and let me know if you have any questions or feedback. I will be sending this scope out to bid and expect to execute in the next 90 days.

Thank you,

**Steve Moskal**  
BP Lower 48 – San Juan – Farmington  
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Office: (505) 326-9497  
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## BP Remediation Management

To: Cory Smith (NMOCD) ; Katherina Diemer (BLM)  
From: Steve Moskal (BP)  
CC: John Ritchie (BP)  
Date: 4/6/2016  
Re: Mudge LS 6 – **REVISED** - Additional soil and groundwater characterization for remedial alternative selection

Dear Mr. Smith and Ms. Diemer,

The Mudge LS 6 site is an active natural gas production pad within the San Juan Basin Gas Field in San Juan County, New Mexico. The site is located on Bureau of Land Management (BLM) land at the head of a small ephemeral stream draining a very steep slope, covered with well-established sage brush.

A release of condensate from production equipment was identified in August 2014. Since the discovery of the condensate release BP has excavated approximately 184,680 cubic feet (ft<sup>3</sup>) of impacted soil to depths of 25 feet below ground surface (fbgs); collected numerous soil confirmation samples; conducted an off-site investigation of the sage slope and wash and installed three groundwater monitoring wells within the pad area.

The site soils consist of a wedge of loose brown sands and silts that overlie a thick sequence of dense and cemented bluish gray sands (herein referred to as blue sandstone). The thickness of the brown sands range from seven feet in the northern section of the production pad; 22 ft in the central section of the pad, and 10 feet in the wash at the bottom of the slope. Observations from the excavation identified localized thin (less than 3 feet) lenses of loose sand and silts near the surface of the blue sandstone sequence.

After the majority of impacted soil was removed from the production pad area in October of 2014, laboratory analysis of eight composite and 14 discrete soil confirmation samples revealed that remaining total petroleum hydrocarbons (TPH) concentrations were below detection limits except in five locations in the central area of the pad. The analytical results of these five discrete samples ranged between 44.1 and 146 mg/kg of TPH. A single soil sample collected from a sand lens within the blue sandstone showed concentrations of 0.38 milligrams per kilogram (mg/kg) of benzene and 903 mg/kg of TPH.

Off-site investigations performed between December 2014 and March 2015 determined the extent of hydrocarbon impacts to soils underlying the sage slope and the wash (refer to Figure 1 for the confirmed extent of soil impacts to-date). Fourteen geoprobe soil borings and two hand augered borings were advanced in the area between the production pad and the wash at the bottom of the slope. Laboratory analysis of soil samples revealed concentrations of TPH (DRO and GRO) that ranged from non-detect to 1,206 mg/kg with less than 8 mg/kg of benzene, toluene, ethyl benzene and xylenes (BTEX). A soil sample collected from one of the hand augered soil borings at the wash at the bottom of the slope revealed maximum concentrations of 7.95 mg/kg of BTEX, 375 mg/kg of TPH (DRO and GRO) at depths between 9 and 10 fbgs.

In June 2015, three groundwater monitoring wells (MW-1 through MW-3) were installed within the pad area at locations where water was previously observed to accumulate in low areas of the 2014

excavation. Groundwater samples were collected on June 18<sup>th</sup> and analyzed for BTEX and basic ions and cations. These wells confirmed the presence of groundwater within the silt and sand lenses of the blue sandstone sequence within the production pad area. All three wells were screened in both the brown sand and the blue sandstone and were sampled shortly after rain was reported in the area, noting that there are no impervious surfaces in the vicinity of the site. Laboratory analysis of groundwater samples collected on June 18, 2015 revealed up to 2,000 µg/L of benzene (MW-2 and MW-3), 4,900 µg/L of Toluene (MW-3), 680 µg/L of ethyl-benzene (MW-3) and 5,500 µg/L of total xylenes (MW-3). No free product has been observed in any of the wells. As the wells were initially reported to be dry and were sampled after a period of intense precipitation, we have determined that an additional investigation is necessary to determine whether there is a continuous aquifer or perched water underlying the site, aquifer parameters (if applicable) and the delineation of the impact.

The objectives of this investigation are:

- Obtain enough information to prepare a detailed geological model and map the extent and thickness of water bearing units.
- Determine whether the identified water bearing units constitute a continuous aquifer(s) or are isolated perched water.
- If applicable, determine aquifer parameters such as groundwater flow direction, gradient, hydraulic conductivity and transmissivity.
- Define the extent of the impact of TPH (BTEX, GRO and DRO concentration levels) in soil and groundwater.

In order to attain these objectives BP will perform an additional site investigation that will include the following activities (refer to Figure 1 for the location of the different proposed investigation elements):

- MW-3 will be plugged and abandoned by tremie cement grout injection and removal of the top five feet of casing.
- Four shallow soil borings (MW-3S, MW-4S, MW-5S, MW-7) will be advanced to a depth of 17-20 fbgs for geological logging, soil sampling and the installation of groundwater monitoring wells that will be screened in the brown sands if saturated soil is encountered. One of these wells (MW-3S) will replace the abandoned MW-3.
- Four deep soil borings (MW-3D, MW-4D, MW-5D and MW-6D) will be advanced to at least 30 fbgs (35 fbgs max) for geological logging, soil sampling and the installation of groundwater monitoring wells that will be screened in loose sand lenses within the blue sandstone sequence if saturated soil is encountered. MW-6D will be monitored for groundwater infiltration. If groundwater is encountered, a monitoring well will be completed in the blue sandstone formation. If groundwater is not observed, the boring will be abandoned to the base of the brown sand formation and completed as a shallow monitoring well.
- Soil samples will be analyzed by a U.S. EPA accredited laboratory for TPH fractions and BTEX. Selected soil samples will also be analyzed to obtain ISCO and soil venting design parameters.
- Wells will be purged and sampled by low-flow or bailing methods and analyzed for TPH fractions and BTEX. Selected groundwater samples will also be analyzed to obtain geochemical, ISCO and SVE design parameters.
- Slug testing will be performed on selected locations.
- Geological information will be analyzed in order to characterize the hydrogeological setting with respect to extent, thickness and continuity of water bearing units, groundwater flow direction and gradients and, if applicable, hydrogeological parameters such as hydraulic conductivity and transmissivity.

BP anticipates the installation, development, completion and associated testing of the wells to be executed within 90 days of approval from all regulatory agencies. Upon completion of the field activities, analytical data evaluation and geological model interpretation BP will submit to the BLM

and NMOCD a report of the limited soil and groundwater investigation activities for the Mudge LS 6 site. A remediation plan based on the findings will be submitted for approval within 90 days of the agencies documented review of results of this site investigation.

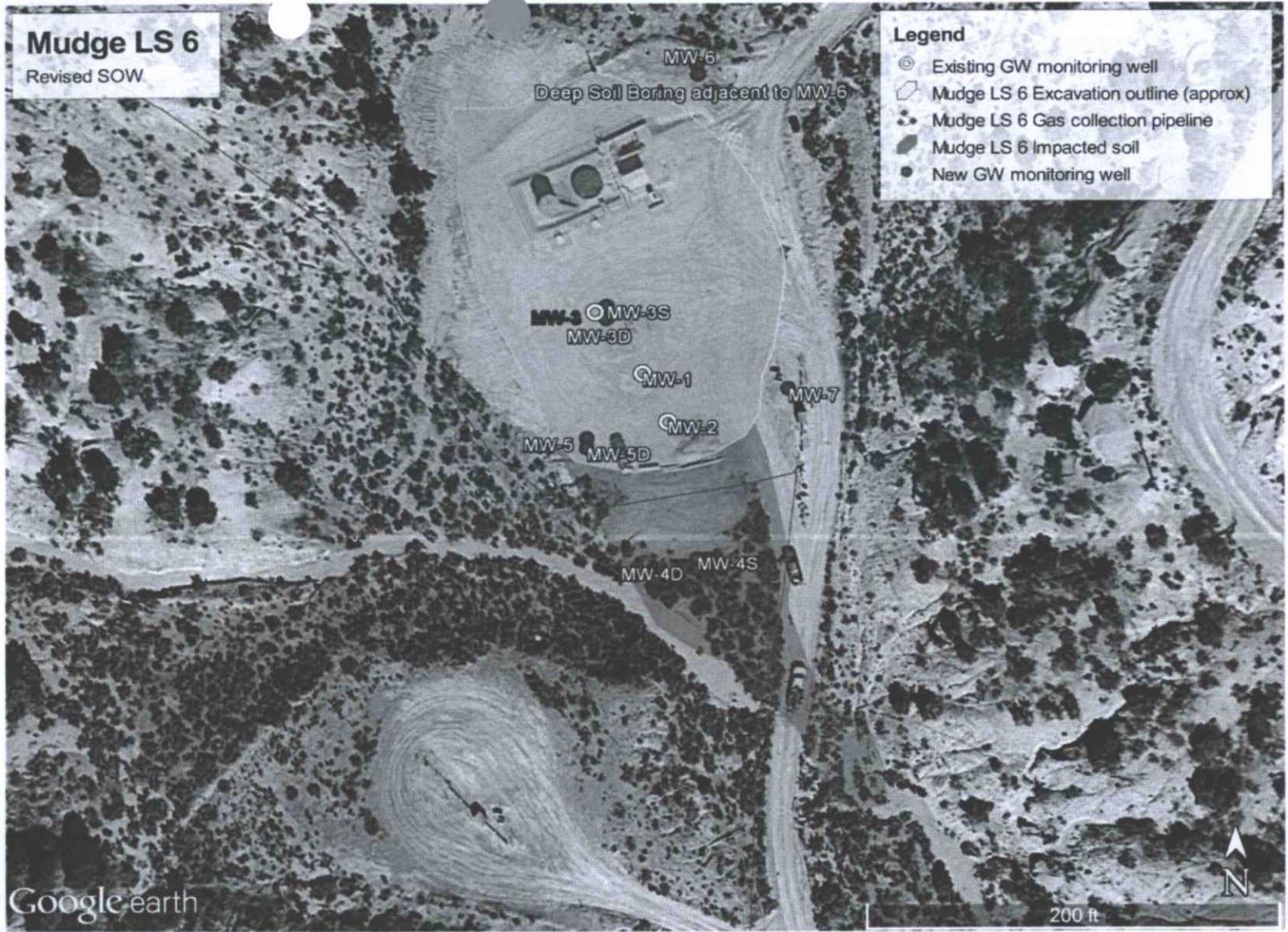


Figure 1. Location of proposed site investigation elements