FORM 27 Rev 3/16

State of Colorado
Oil and Gas Conservation Commission

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Report taken by:

Site Investigation and Remediation Workplan (Supplemental Form)

This form shall be submitted to the Director for approval prior to the initiation of site investigation and remediation activities. However, this shall not preclude the Operator from taking immediate action to protect public health or safety, the environment, wildlife, or livestock.
This Form 27 describes site conditions as currently understood by the Operator; approval of this Form 27 by COGCC is based on the site conditions accurately described herein; any changes in site conditions identified during or subsequent to the performance of the approved workplan may necessitate additional investigation or remediation which shall be described on a supplemental Form 27.
This Form 27 is intended to provide basic information regarding the proposed site investigation and remediation actions, but the workplan may be more fully described in attached documentation.
Refer to Rules 340, 905, 906, 907, 908, 909, and 910

OPERATOR INFORMATON

Name of Operator: KERR MCGEE OIL & GAS ONSHORE LP Operator No: 47120

Phone Numbers

Address: P O BOX 173779 Phone: (970) 336-3500
City: DENVER State: CO Zip: 80217-3779 Mobile: ( )
Contact Person: Phil Hamlin Email: Phil.Hamlin@anadarko.com

PROJECT, PURPOSE & SITE INFORMATION

PROJECT INFORMATION

Remediation Project #: 4348 Initial Form 27 Document #: 1984410

PURPOSE INFORMATION

- [ ] 901.e. Sensitive Area Determination
- [ ] 909.c.(1), Rule 905: Pit or PW vessel closure
- [x] 909.c.(2), Rule 906: Spill/Release Remediation
- [ ] 909.c.(3), Rule 907.e.: Land treatment of oily waste
- [ ] 909.c.(4), Rule 908.g.: Centralized E&P Waste Management Facility closure
- [x] 909.c.(5), Rule 910.b.(4): Remediation of impacted ground water
- [ ] Rule 909.e.(2)A.: Notice completion of remediation in accordance with Rule 909.b.
- [ ] Rule 909.e.(2)B.: Closure of remediation project
- [ ] Rule 906.c.: Director request
- [ ] Other

SITE INFORMATION

N Multiple Facilites (in accordance with Rule 909.c.)

Facility Type: WELL Facility ID: API #: 123-08414 County Name: WELD
Facility Name: ARISTOCRAT ANGUS RANCHES 1 Latitude: 40.264612 Longitude: -104.652977
** correct Lat/Long if needed: Latitude: Longitude:
QtrQtr: SESW Sec: 34 Twp: 4N Range: 65W Meridian: 6 Sensitive Area? Yes

SITE CONDITIONS

General soil type - USCS Classifications CL
Most Sensitive Adjacent Land Use Agriculture and Wetlands
Is domestic water well within 1/4 mile? Yes
Is surface water within 1/4 mile? Yes
Is groundwater less than 20 feet below ground surface? Yes

Other Potential Receptors within 1/4 mile

Domestic water well approximately 540 feet (ft) northwest, surface water/wetlands approximately 60 ft southeast, building approximately 1,260 ft northeast, livestock/pasture approximately 100 ft north, and groundwater approximately 2 ft below ground surface (bgs).

SITE INVESTIGATION PLAN

TYPE OF WASTE:

- [x] **E&P Waste**
- [ ] **Other E&P Waste**
- [ ] **Non-E&P Waste**

- [x] Produced Water
- [x] Oil
- [ ] Condensate
- [ ] Drilling Fluids
- [ ] Drill Cuttings
- [ ] Workover Fluids
- [ ] Tank Bottoms
- [ ] Pigging Waste
- [ ] Rig Wash
- [ ] Spent Filters
- [ ] Pit Bottoms
- [ ] Other (as described by EPA)

DESCRIPTION OF IMPACT

Impacted?	Impacted Media	Extent of Impact	How Determined
Yes	GROUNDWATER	See Attached Data	Groundwater Samples/Lab Analysis
Yes	SOILS	155' N-S x 160' E-W x 8' bgs (max)	Soil Samples/Lab Analysis

INITIAL ACTION SUMMARY

Description of initial action or emergency response measures take to abate, investigate, and/or remediate impacts associated with E&P Waste.

Due to a COGCC requested investigation of former Amoco sites, Kerr-McGee undertook assessment activities at the Aristocrat Angus Ranch #1 facility to determine the magnitude and extent of potential petroleum hydrocarbon impacts to soil and/or groundwater resulting from historic operation of the site. LT Environmental, Inc. (LTE) was contracted by Kerr-McGee to perform subsurface investigation work at the site. In April 2008, LTE advanced and continuously sampled three investigation soil borings (SB01 through SB03). The soil borings were then completed as groundwater monitoring wells MW01 through MW03, respectively. Laboratory analytical results indicated exceedances to the Colorado Oil and Gas Conservation Commission (COGCC) Table 910-1 allowable levels for both the soil and groundwater samples collected from SB03/MW03. Based on the findings of the April 2008 assessment activities, excavation of source area soils with historical petroleum hydrocarbon impacts was conducted in September and October 2009.

On February 2, 2010, a surface casing release occurred while attempting to plug and abandon the Aristocrat Angus Ranch #1 well. Approximately 35 barrels (bbls) of water-based bentonitic drilling mud and 0.5 bbl of condensate were released onto the ground surface around the wellhead. The petroleum hydrocarbon impacted soil was excavated in March 2010.

PROPOSED SAMPLING PLAN

Proposed Soil Sampling

- [x] Will soil samples be collected as part of this investigation? (Number, type (grab/composite), analyses, and locations of samples):

Between September 10 and October 2, 2009, 18 soil samples were collected from the 2009 excavation for laboratory analysis of total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and total xylenes (BTEX). Laboratory analytical results indicated that TPH and BTEX concentrations were in full compliance with COGCC Table 910-1 allowable levels at the northern, western, and southern extents of the excavation. Impacted soil was left in place along the eastern sidewall.

Between March 11 and 25, 2010, 15 soil samples were collected from the 2010 excavation for TPH and BTEX analysis. Analytical results indicated that TPH and BTEX concentrations were in full compliance with COGCC Table 910-1 allowable levels at the lateral extent of the excavation. The 2010 excavation overlapped with the eastern extent (northern half) of the 2009 tank battery excavation, removing the impacted soil in place. Please refer to the Form 27 Update Report dated May 10, 2011, for additional details.

Proposed Groundwater Sampling

- [x] Will groundwater samples be collected as part of this investigation? (Number, analyses, and locations of samples):

On August 25, 2009, groundwater sample GW01 was collected from the 2009 tank battery excavation for laboratory analysis of BTEX. Laboratory analytical results indicated sample GW01 exceeded the COGCC Table 910-1 allowable level for benzene at a concentration of 410 micrograms per liter (µg/L). On March 11, 2010, groundwater sample GW01 was collected from the 2010 wellhead excavation for BTEX analysis. Laboratory analytical results indicated sample GW01 exceeded the COGCC Table 910-1 allowable level for benzene at a concentration of 1,300 µg/L. On March 16, 2010, following the removal of impacted groundwater, sample GW02 was collected from the wellhead excavation and was in full compliance with COGCC Table 910-1 allowable levels for BTEX. The excavation groundwater sample locations are depicted on Figure 1. The groundwater sample analytical results are summarized in Table 1.

Groundwater monitoring has been conducted on a quarterly basis since April 2008.

Proposed Surface Water Sampling

- [x] Will surface water samples be collected as part of this investigation? (Number, analyses, and locations of samples):

In March 2010, six surface water samples (SW01 through SW06) were collected from the wetland located south of the wellhead. Samples SW01 and SW02 exceeded the COGCC Table 910-1 allowable levels for benzene and/or toluene. Please refer to the Form 27 Update Report submitted to the COGCC on May 10, 2011, for additional details.

Surface water monitoring from locations SW03 and SW07 has been conducted on a quarterly basis since March 2010. The surface water sample locations are depicted on Figure 1. The surface water sample analytical results are summarized in Table 2.

Additional Investigative Actions

- [ ] Additional alternative investigative actions described in attached Site Investigation Plan (summary):

SITE INVESTIGATION REPORT

SAMPLE SUMMARY

Soil

Number of soil samples collected	38	--	Highest concentration of TPH (mg/kg) 2400
Number of soil samples exceeeding 910-1	17	NA	Highest concentration of SAR
Was the areal and vertical extent of soil contamination delineated?	Yes		BTEX > 910-1 Yes
Approximate areal extent (square feet)	14210		Vertical Extent > 910-1 (in feet) 7

Groundwater

Number of groundwater samples collected	387	--	Highest concentration of Benzene (µg/l) 5100
Was extent of groundwater contaminated delineated?	Yes	--	Highest concentration of Toluene (µg/l) 2100
Depth to groundwater (below ground surface, in feet)	2`	--	Highest concentration of Ethylbenzene (µg/l) 430
Number of groundwater monitoring wells installed	21	--	Highest concentration of Xylene (µg/l) 3600
Number of groundwater samples exceeding 910-1	80	NA	Highest concentration of Methane (mg/l)

Surface Water

52 Number of surface water samples collected

2 Number of surface water samples exceeding 910-1

If surface water is impacted, other agency notification may be required.

OTHER INVESTIGATION INFORMATION

☒ Were impacts to adjacent property or offsite impacts identified?

Groundwater impacts were detected in the adjoining rangeland and agricultural field north and east of the excavation. Surface water impacts were detected in two of the initial surface water samples (SW01 and SW02) in the wetland south of the wellhead.

☐ Were background samples collected as part of this site investigation?

☐ Was investigation derived waste (IDW) generated as part of this investigation?

Volume of solid waste (cubic yards) _____ Volume of liquid waste (barrels) _____

☐ Is further site investigation required?

REMEDIAL ACTION PLAN

Does this Supplemental Form 27A include changes to a previously approved Remedial Action Plan? No

SOURCE REMOVAL SUMMARY

Describe how source is to be removed.

Approximately 6,520 cubic yards of petroleum hydrocarbon impacted soil from the 2009 tank battery excavation were transported to the Kerr-McGee Land Treatment Facility in Weld County, Colorado, for recycling. Approximately 305 cubic yards of petroleum hydrocarbon impacted soil from the 2010 wellhead excavation were transported to Buffalo Ridge Landfill in Keenesburg, Colorado, for disposal. The impacted soil was excavated into the capillary and phreatic zones to address potential hydrocarbon impacts that may have been present below the current groundwater table due to seasonal fluctuations. Approximately 950 cubic yards of petroleum hydrocarbon impacted groundwater were removed from the 2010 excavation and transported to a licensed disposal facility. The general site layout and 2009 and 2010 excavation footprints are depicted on the Site Map provided as Figure 1.

REMEDIATION SUMMARY

Describe how remediation of existing impacts to soil and groundwater is to be accomplished (i.e. summarize remedial action plan). Provide a brief narrative description including: technical justification, schedule for implementation, estimated time to attain NFA status, plus plans and specifications for the selected remedial action technology.

Prior to backfilling the 2009 excavation, 20 gallons of MicroBlaze®, a concentrated solution of facultative microbes, nutrients, and surfactants designed to bioremediate petroleum hydrocarbons, were applied to the groundwater and exposed smear zone soil in the open excavation. Prior to backfilling the 2010 excavation, 10 gallons of MicroBlaze® were applied to the groundwater and exposed smear zone soil in the open excavation.

Due to persistent, elevated BTEX concentrations in multiple site monitoring wells, an air sparging (AS) system was installed at the site. The AS system was designed to introduce ambient air into the subsurface water column to promote volatilization and aerobic microbial decomposition of dissolved-phase petroleum hydrocarbons. Installation of the full-scale AS system occurred between April 2016 and November 2017.

The AS system started up in April 2016. The system is comprised of 14 AS wells connected by a combination of surface and subsurface high-density polyethylene piping to a tow-behind air compressor powered by diesel. The remediation system included valves at all of the AS wellheads to allow for uninterrupted flow control, measurement, and adjustment. AS was accomplished using a 49-horsepower-driven John Deere, rotary-screw compressor. The system was shut down on August 27, 2018, for static groundwater monitoring. The as-built layout of the full-scale AS system is depicted on the Site Map attached as Figure 1.

Soil Remediation Summary

☐ **In Situ**

- ____ Bioremediation (or enhanced bioremediation)
- ____ Chemical oxidation
- ____ Air sparge / Soil vapor extraction
- ____ Natural Attenuation
- ____ Other ____

☒ **Ex Situ**

- Yes — Excavate and offsite disposal
  - If Yes: Estimated Volume (Cubic Yards) 6825
  - Name of Licensed Disposal Facility or COGCC Facility ID # 149007
- No — Excavate and onsite remediation
  - ____ Land Treatment
  - ____ Bioremediation (or enhanced bioremediation)
  - ____ Chemical oxidation
  - ____ Other ____

Groundwater Remediation Summary

- Yes — Bioremediation (or enhanced bioremediation)
- No — Chemical oxidation
- Yes — Air sparge / Soil vapor extraction
- Yes — Natural Attenuation
- Yes — Other: Groundwater Removal and MicroBlaze® Application (2009 and 2010 Excavations)

GROUNDWATER MONITORING

If groundwater has been impacted, describe proposed monitoring plan, including # of wells or sample points, monitoring schedule, analytical methods, points of compliance. Attach a groundwater monitoring location diagram.

Groundwater monitoring wells MW03R, MW05 through MW09, MW10R2, MW11R, and MW13 through MW16 and surface water locations SW03 and SW07 are sampled on a quarterly basis and submitted for laboratory analysis of BTEX. The monitoring well and surface water locations are depicted on Figure 1. The Groundwater Elevation Contour Map generated using the February 2019 survey data is provided as Figure 2. The groundwater and surface water analytical results are summarized in Table 1 and Table 2, respectively. The laboratory analytical reports for the August 2018, November 2018, and February 2019 monitoring events are attached.

Groundwater and surface water monitoring will continue on a quarterly basis until a No Further Action status request is warranted.

REMEDIATION PROGRESS UPDATE

PERIODIC REPORTING

Frequency: ☐ Quarterly ☐ Semi-Annually ☒ Annually ☐ Other

Report Type: ☒ Groundwater Monitoring ☐ Land Treatment Progress Report ☐ O&M Report ☐ Other

WASTE DISPOSAL INFORMATION

Was E&P waste generated as part of this remediation? Yes

Describe beneficial use, if any, of E&P Waste derived from this remediation project:

Approximately 6,520 cubic yards of petroleum hydrocarbon impacted soil from the 2009 excavation were transported to the Kerr-McGee Land Treatment Facility in Weld County, Colorado, for recycling. Approximately 305 cubic yards of petroleum hydrocarbon impacted soil from the 2010 excavation were transported to Buffalo Ridge Landfill in Keenesburg, Colorado, for disposal.

Volume of E&P Waste (solid) in cubic yards: 6825

E&P waste (solid) description: Petroleum hydrocarbon impacted soil

COGCC Disposal Facility ID #, if applicable: 149007

Non-COGCC Disposal Facility: Buffalo Ridge Landfill in Keenesburg, Colorado (2010 Excavation)

Volume of E&P Waste (liquid) in barrels: 950

E&P waste (liquid) description: Petroleum hydrocarbon impacted groundwater

COGCC Disposal Facility ID #, if applicable: 159443

Non-COGCC Disposal Facility:

REMEDIATION COMPLETION REPORT

REMEDIATION COMPLETION SUMMARY

Is this a Final Closure Request for this Remediation Project? No

Do all soils meet Table 910-1 standards? Yes

Does the previous reply indicate consideration of background concentrations? No

Are the only residual soil impacts pH, SAR, or EC at depths greater than 3 feet below ground surface?

Does Groundwater meet Table 910-1 standards? Yes

Is additional groundwater monitoring to be conducted? Yes

RECLAMATION PLAN

RECLAMATION PLANNING

Describe reclamation plan. Discuss existing and new grade recontouring; method and testing of compaction alleviation; and reseeding program, including location of new seed, seed mix and noxious weed prevention. Attach diagram or drawing.

The site was restored to its pre-release grade. The site will be reclaimed in accordance with COGCC 1000 Series Reclamation Rules.

Is the described reclamation complete? No

Does the reclamation described herein constitute interim or final reclamation of the Oil and Gas Location?

☐ Interim? ☐ Final?

Did the Surface Owner approve the seed mix?

If NO, does the seed mix comply with local soil conservation district recommendations?

IMPLEMENTATION SCHEDULE

PRIOR DATES

Date of Surface Owner notification/consultation, if required.

Actual Spill or Release date, if known. 04/07/2008

SITE INVESTIGATION DATES

Date of Initial Actions described in Site Investigation Plan (start date). 04/07/2008

Date of commencement of Site Investigation. 04/07/2008

Date of completion of Site Investigation. 08/01/2014

REMEDIAL ACTION DATES

Date of commencement of Remediation. 09/04/2009

Date of completion of Remediation.

SITE RECLAMATION DATES

Date of commencement of Reclamation.

Date of completion of Reclamation.

OPERATOR COMMENT

I hereby certify all statements made in this form are to the best of my knowledge true, correct, and complete.

Signed:` Phil Hamlin

Title: Senior Environmental Rep.

Submit Date:`

Email: Phil.Hamlin@anadarko.com

Based on the information provided herein, this Application for Site Investigation and Remediation Workplan complies with COGCC Rules and applicable orders and is hereby approved.

COGCC Approved:

Date:

Remediation Project Number: 4348

COA Type	Description

Attachment Check List

Upon approval, the approved Form 27 and all listed attachments will be indexed to the Remediation Project file. Only the approved Form 27 will also be indexed to the related Facilities.

Att Doc Num	Name
401985801	ANALYTICAL RESULTS
402016575	GROUND WATER ELEVATION MAP
402016764	SITE MAP

Total Attach: 3 Files

General Comments

User Group	Comment	Comment Date
		Stamp Upon Approval

Total: 0 comment(s)