



Remediation #4316

October 4, 2013

Mr. Howard Urband
United States Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, Colorado 80202-1129

**RE: Remediation Injection Rule Authorization Application
Chesnut G 22-6 Tank Battery Site
Noble Energy, Inc.
County Road 44 and County Road 43, Weld County, La Salle, Colorado
80645**

Dear Mr. Urband:

Please find the enclosed Remediation Injection Rule Authorization Application for your review regarding the above-referenced site. If you have any questions or require additional information, please do not hesitate to contact us at (303) 433-9788.

Sincerely,

LT ENVIRONMENTAL, INC.

A handwritten signature in black ink, appearing to read "William Baldwin".

William Baldwin
Staff Scientist

A handwritten signature in black ink, appearing to read "Rob Rebel".

Rob Rebel, P.E.
Project Engineer

Attachment

cc: Mr. Todd Cullum, Noble Energy, Inc., Greeley, CO
Mr. Jacob Evans, Noble Energy, Inc., Denver, CO
Mr. Bob Chesson, Colorado Oil and Gas Conservation Commission, Denver, CO

**REMEDATION INJECTION RULE
AUTHORIZATION APPLICATION**

**NOBLE ENERGY, INC.
CHESNUT G 22-6
TANK BATTERY SITE
COUNTY ROAD 44 AND COUNTY ROAD 43
WELD COUNTY, COLORADO**

OCTOBER 2013

Prepared for:

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, Colorado 80202-1129**

**REMEDATION INJECTION RULE
AUTHORIZATION APPLICATION**

**NOBLE ENERGY, INC.
CHESNUT G 22-6
TANK BATTERY SITE
COUNTY ROAD 44 AND COUNTY ROAD 43
WELD COUNTY, COLORADO**

OCTOBER 2013

Prepared for:

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION 8
1595 Wynkoop Street
Denver, Colorado 80202-1129**

Prepared by:

**LT ENVIRONMENTAL, INC.
4600 West 60th Avenue
Arvada, Colorado 80003
(303) 433-9788**

UNDERGROUND INJECTION RULE AUTHORIZATION APPLICATION

**NOBLE ENERGY, INC. – COUNTY ROAD 44 AND COUNTY ROAD 43,
WELD COUNTY, COLORADO 80645**

October 2013

1. Property owner of facility including a physical and mailing address; phone and fax numbers.

Physical address of facility:

No physical address on east side of County Road 43 (0.5 miles south of CR44)
Weld County, Colorado 80645
Weld County Parcel: 105522000032
SENW; Sec22, T4N, R65W, 6th meridian

Mailing address:

C/O Tax Service - Jack Chesnut
12457 Manchester Avenue
Grandview, MO 64030

2. Operator of facility including a physical and mailing address; phone and fax numbers.

Noble Energy, Inc.
2115 117th Avenue
Greeley, Colorado 80634
(970) 304-5097 telephone
(970) 304-5099 fax
Contact: Mr. Todd Cullum

3. Responsible party for the operation, maintenance, and closure of the injection system including a physical and mailing address and phone number.

LT Environmental, Inc. (LTE)
4600 West 60th Avenue
Arvada, Colorado 80003
(303) 433-9788 telephone
(303) 433-1432 fax
Contact: Mr. Rob Rebel

4. Contact persons representing any other regulatory agencies that have an interest in the site; include a physical and mailing address and phone number.

Mr. Bob Chesson

Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, Colorado 80203
(303) 894-2100 telephone
(303) 894-2109 fax

5. Briefly outline the type of contamination and when it occurred.

Petroleum-impacted soil and groundwater caused via an equipment failure that was discovered on August 22, 2008. An unknown quantity of condensate was released.

6. Map of the site location (1:24,000 topographic map or similar)

See attached Figure 1.

7. Analysis of groundwater from the receiving formation (up gradient from the contamination) and from the contaminated formation (near the source) include tabular data and a map of the contamination plume with the local groundwater flow direction shown.

See Table 1 and Figure 2 for analytical results.

See Figure 4 for groundwater flow direction information.

8. Analysis of contaminants. Include BTEX and MTBE if fuel spill related.

See Table 1 for BTEX concentrations. The release was of unrefined product, thus MTBE is not a potential contaminant.

9. Type of proposed injection well. (example: water well, trench, injection gallery, etc.)

Each injection point will involve 1.25-inch, outside-diameter (OD) steel rods driven to a specified depth by a direct-push drill rig. A steel injection/drive point is used to install the injectate. After placing the injectate, the rods will be pulled, and each 1.25-inch injection hole will be plugged with bentonite and hydrated.

10. Analysis of the proposed injectate.

The injections will consist of COGAC[®] with potable water. COGAC[®] is manufactured by Remington Technologies, LLC and is designed for in-situ biological remediation of petroleum hydrocarbons under aerobic conditions. Attachment 1 contains a material safety data sheets (MSDS) for COGAC[®].

The injection area is shown on Figure 3. The depths of injections will be between 5 feet and 20 feet below ground surface (bgs), which will be confirmed

periodically during the injections by collecting a vertical core from the surface to 20 feet bgs. The source soils were previously excavated and the site was remediated via an air sparge/soil vapor extraction system.

The injection design consists of 10 injection points on 7-foot centers in the source area, and 31 points on 10-foot centers for the remaining impacted area. In the 10 source area injection points, a 12% slurry of COGAC® in 50 gallons of potable water will be injected a three different intervals per point, which results in 150 gallons total per well. In the remaining 31 points, a 12% slurry of COGAC® in 75 gallons of potable water will be injected in one interval per well. This results in a total of 3,825 pounds of COGAC®.

11. Hydrogeologic description, location, depth, and current use (if any) of the receiving formations. Include hydrological studies if available.

The depth to the observed water table is approximately 5 feet to 19 feet bgs (varies seasonally). The general direction of groundwater flow at the site is to the northeast. Soil identified at the site consists of brown, medium-grained sand from the ground surface to a depth of approximately 12 feet bgs, and clay from approximately 12 feet to 20 feet bgs. A soil boring log is included as Attachment 2.

12. Location of existing monitoring wells (if any) and the location of proposed monitoring wells.

See Figure 2 for monitoring well locations.

13. Explain how the monitoring system proposed will be able to track contaminant migration and how the proposed remediation system will minimize further migration.

The existing monitoring wells will be sampled on a quarterly basis to ensure a stable and decreasing contaminant plume. The quarterly monitoring will be conducted until four quarters of groundwater concentrations are in compliance with applicable regulations.

The remediation product, COGAC®, is composed mainly of activated carbon. The activated carbon will ‘trap’ and co-locate the contaminant and bacteria within the carbon matrix. The contaminant will not migrate because it will be trapped within the carbon where it will be biologically degraded. As a result, plume reduction should begin to occur within a short period of time, mitigating any potential for further plume migration.

14. If injection is into an alluvial aquifer, provide locations of surface water bodies, i.e. rivers, streams, and lakes, within one mile of injection site (may substitute topographic map).

A topographic map of the area around the site is provided as Figure 1. An unnamed pond is located approximately 105 feet west-northwest, Evans #2 Ditch is approximately 336 feet west, Platte Valley Canal is located approximately 855 feet west, and Chesnut Reservoir is located approximately 3,535 feet southeast.

15. Provide location and description of any drinking water wells within ¼ mile that may be impacted by the proposed injection.

There are no drinking water wells within ¼ mile of the site.

16. Description of the remediation system including operational procedures.

Description of the Remediation System

LTE's approach is designed to reach cleanup goals using COGAC®. COGAC is a blend of selected nutrients, oxidizers or oxygen releasing compounds and activated carbon.

The product is injected into the formation which causes flow outward from the injection point along thin fractures or fissures that are generally oriented horizontally with respect to the ground surface. Once a fracture is initiated, fluid will always follow along the path of least resistance. As a result, it is difficult, if not impossible, to control how fissures propagate throughout the formation. Experience has demonstrated, however, that these seams tend to extend out horizontally (typically in a radial fashion) away from the injection point, then tend to migrate vertically toward the ground surface. So if enough fluid is pumped into the ground, it may eventually break through to the ground surface.

The objective of LTE's injection program will be to create a three-dimensional network of material interlaced throughout the affected formation, such that it is unlikely that a significant volume of contaminants will move through the installation without contacting the product. Injection points will be located fairly close to one another, and targeted injection depths are located in the zone where impact is observed.

Once installed, COGAC® reduces contaminant concentrations in soil and groundwater. Hydrocarbon molecules are removed from these media via adsorption by the activated carbon and are co-located with bacteria in the activated carbon pore network. As a result, the hydrocarbon contaminant concentration within the carbon matrix is substantially higher than that which existed in the soil or groundwater prior to treatment. Rates of degradation within the carbon matrix will be significantly faster than rates commonly observed using conventional in-situ bioremediation technology due to this concentration effect. As adsorbed contaminants are degraded, active sites within the carbon become

available to adsorb fresh contaminant, and the cycle is repeated until the microcosm runs out of food, i.e. petroleum hydrocarbons.

Equipment and Operational Procedure

Equipment

Injection trailer includes:

Gasoline motor-driven medium-pressure injection pump (1,200 psi);
Various centrifugal transfer pumps;
Mixers;
Polyethylene mixing tanks (300 to 750 gallons); and
High-pressure injection hose.

A hydraulically-powered, truck-mounted, direct-push drill rig including all the ancillary tooling, push rods, expendable points, injection heads, etc. is normally needed for operation.

The injection trailer is equipped with a diaphragm pump capable of delivering up to 6 gallons per minute at a pressure of 150 psi. Process tanks located on the trailer include six 300-gallon slurry-mixing tanks or one 750-gallon slurry-mixing tank. Pump suction is directly connected to the slurry-mixing tank, and fresh water is transferred to this tank from the potable water tank using a gas-driven, high-volume centrifugal pump.

Operational Procedure

A volume of water is transferred into the slurry-mixing tank, a measured amount of the injection product is slowly added to the tank, and the mixer is started. A small diameter (1.25-inch OD) push rod is driven to the targeted depth, and an injection head is threaded securely onto the rod. The injection head is configured with a valve and quick-connect coupling to facilitate rapid connection to the injection pump discharge hose. Once the product is mixed, the pump is engaged, the injection head valve is opened, and the discharge line is pressurized. Pressure is allowed to build until a fracture or fissure is created in the formation and slurry begins to flow outward.

After injection of the product, fresh water is transferred into the product tank, mixed, and then injected to flush the system of residual product. The pump is subsequently disengaged, and the injection-head valve is closed. A fresh batch of product is then prepared, a new injection rod is installed, and the process is repeated.

After product is injected into the formation, back-pressure is present that dissipates over a period of time. Therefore, the injection rod is not immediately removed after the injection of product. Instead, the injection rods remain in the ground until the transient pressure dissipates. Residual pressure in the formation is checked by opening the injection head valve. Once residual pressure has

dissipated, the rods are safely removed, and the borehole is sealed with hydrated bentonite.

17. If injectate is treated water, is it expected to meet current drinking water standards? If not, what exceedences are expected?

The injectate water will be supplied by a potable water source.

18. Describe effect of injectate on groundwater: reaction products or by-products that are anticipated.

The design radius of influence of the injectate is seven to ten feet. The injectate footprint will not extend more than ten feet beyond the contaminant plume.

The byproducts of the aerobic degradation process include water and carbon dioxide.

19. Bench scale-testing results if available.

A bench scale-test will not be performed.

20. A specific closure plan for the removal, closure, or plugging of the injections system, including an estimate of closing costs.

All monitoring and injection holes will be closed following state guidelines.

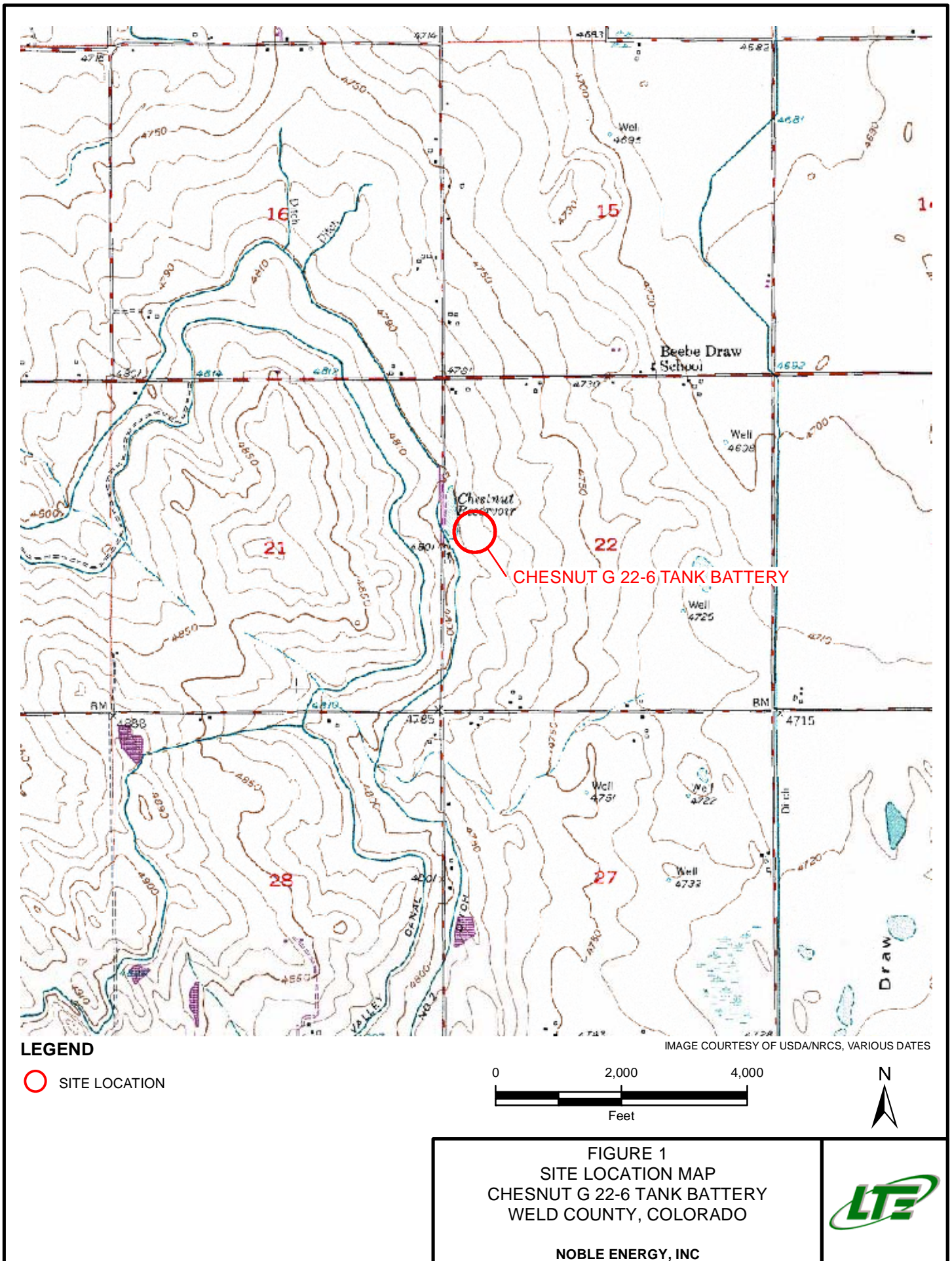
21. An executive summary of the approved Corrective Action Plan.

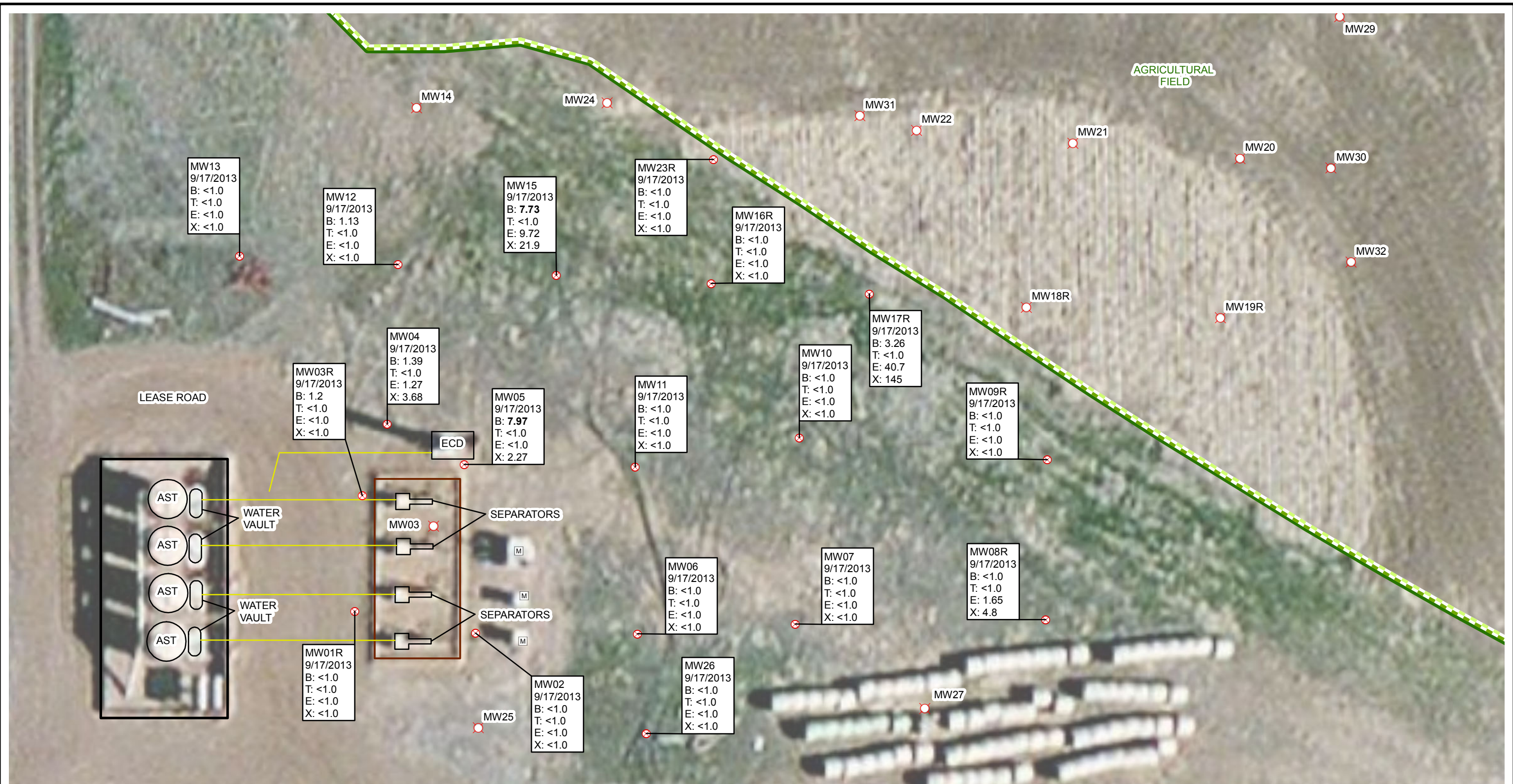
LTE conducted a site assessment to determine the extent of impact. Per the Colorado Oil and Gas Conservation Commission (COGCC), hydrocarbon impacts must be remediated to meet the current Maximum Contaminant Levels (MCLs) in groundwater. Thus, LTE is initiating an injection program to achieve remediation goals. Remediation goals are to meet the MCLs with an activated carbon slurry designed to remove petroleum hydrocarbons from impacted media.

22. Estimate the time period required to complete the task covered in this Rule authorization request.

It is estimated that all injection activities will be completed in approximately 60 days.

FIGURES





LEGEND

	MONITORING WELL		METAL BERM
	ABANDONED/DESTROYED MONITORING WELL		DIRT BERM
	METER HOUSE	AST: ABOVEGROUND STORAGE TANK	
	UNDERGROUND UTILITY	ECD: EMISSIONS CONTROL DEVICE	
	AGRICULTURAL FIELD BOUNDARY		

SAMPLE ID
SAMPLE DATE
B: BENZENE IN MICROGRAMS PER LITER (µg/L)
T: TOLUENE (µg/L)
E: ETHYLBENZENE (µg/L)
X: TOTAL XYLENES (µg/L)
<: LESS THAN LABORATORY METHOD DETECTION LIMIT
BOLD INDICATES RESULT EQUALS OR EXCEEDS COLORADO
DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT - WATER
QUALITY CONTROL COMMISSION REGULATION 41 COVERING
BASIC STANDARDS FOR GROUND WATER

0 30 60
Feet

FIGURE 2
GROUNDWATER ANALYTICAL RESULTS
AUGUST 17, 2013
CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.



LEGEND

- PROPOSED COGAC INJECTION LOCATION
- ⊗ MONITORING WELL
- ⊗ ABANDONED/DESTROYED MONITORING WELL
- Ⓜ METER HOUSE
- UNDERGROUND UTILITY
- AGRICULTURAL FIELD BOUNDARY
- 2009 PRE-AS/SVE SYSTEM BENZENE ISOCONCENTRATION CONTOUR (5 µg/L)
- - - DASHED WHERE INFERRED
- JUNE BENZENE ISOCONCENTRATION CONTOUR (5 µg/L)
- ▭ METAL BERM
- ▭ DIRT BERM

AST: ABOVEGROUND STORAGE TANK
ECD: EMISSIONS CONTROL DEVICE

SAMPLE ID
B: BENZENE IN MICROGRAMS PER LITER (µg/L)
<: LESS THAN LABORATORY METHOD DETECTION LIMIT
BOLD INDICATES RESULT EQUALS OR EXCEEDS COLORADO
DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT - WATER
QUALITY CONTROL COMMISSION REGULATION 41 COVERING
BASIC STANDARDS FOR GROUND WATER
NS-DRY: NOT SAMPLED-DRY

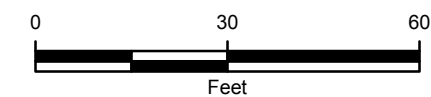


FIGURE 3
PROPOSED COGAC INJECTION LOCATIONS
CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO

NOBLE ENERGY, INC.





LEGEND

- | | | |
|--------------------------------------|---|-------------------------------|
| MONITORING WELL | UNDERGROUND UTILITY | METAL BERM |
| ABANDONED/DESTROYED MONITORING WELL | AGRICULTURAL FIELD BOUNDARY | DIRT BERM |
| METER HOUSE | RELATIVE GROUNDWATER ELEVATION CONTOUR IN FEET
CONTOUR INTERVAL = 2 FEET
GRADIENT = 0.057 FEET/FOOT
NM: NOT MEASURED | AST: ABOVEGROUND STORAGE TANK |
| ESTIMATED GROUNDWATER FLOW DIRECTION | | ECD: EMISSIONS CONTROL DEVICE |

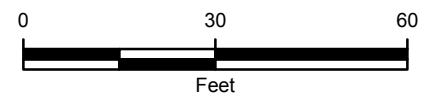


FIGURE 4
RELATIVE GROUNDWATER ELEVATION MAP
JUNE 18, 2013
CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.



TABLE

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW01	1/13/2009	15.11	NM	26,400	8,320	536	8,800
	3/5/2010	14.60	NM	26,100	6,270	666	11,090
	9/20/2010	NM	NM	Could Not Locate Well			
MW01R	12/2/2010	8.68	88.25	5,600	161	37.1	1,550
	3/14/2011	15.33	81.60	1,010	<1.00	<1.00	12.8
	6/2/2011	9.89	87.04	1,080	<1.0	13.5	1,400
	9/12/2011	2.96	93.97	1,560	<1.0	84.5	1,510
	12/9/2011	7.80	89.13	427	<1.0	34.5	945
	3/22/2012	13.50	83.43	<1.0	4.17	<1.0	<1.0
	6/8/2012	4.56	92.37	5.8	<1	<1	19.3
	9/18/2012	4.04	92.89	7.1	<1.0	3.1	100
	12/3/2012	6.53	90.40	<1.0	<1.0	<1.0	<1.0
	3/22/2013	13.78	83.15	<1.0	<1.0	<1.0	2.89
	6/18/2013	5.35	91.58	<1.0	<1.0	<1.0	<1.0
	9/17/2013	1.60	95.33	<1.0	<1.0	<1.0	<1.0
MW02	1/13/2009	15.12	83.02	3,460	1,420	199	6,120
	3/5/2010	15.95	82.19	857	3.61	151	1,448.61
	9/20/2010	6.00	92.14	338	<1.0	104	2,256.14
	12/2/2010	10.04	88.10	125	<1.0	147	1,590
	3/14/2011	16.40	81.74	37.4	<1.00	22.0	266
	6/2/2011	13.02	85.12	<1.0	<1.0	<1.0	<3.0
	9/12/2011	5.38	92.76	4.9	<1.0	2.4	9.5
	12/9/2011	10.00	88.14	<1.0	<1.0	2.17	20.4
	3/22/2012	16.19	81.95	1	2.36	9.88	47.2
	6/8/2012	7.45	90.69	<1	<1	<1	<1
	9/18/2012	6.97	91.17	<1.0	<1.0	<1.0	2.1
	12/3/2012	8.49	89.65	<1.0	<1.0	<1.0	<1.0
	3/18/2013	15.99	82.15	<1.0	<1.0	14.8	60.3
	6/18/2013	7.62	90.52	<1.0	<1.0	<1.0	<1.0
	9/17/2013	3.46	94.68	<1.0	<1.0	<1.0	<1.0
MW03	1/13/2009	15.06	NM	11,700	7,860	195	5,950
				Destroyed			
MW03R	3/18/2013	17.72	NM	<2.0	<2.0	1.98	27.5
	6/18/2013	10.33	87.92	<1.0	<1.0	<1.0	<1.0
	9/17/2013	5.84	92.41	1.2	<1.0	<1.0	<1.0
MW04	1/13/2009	13.13	84.15	19,700	7,460	555	9,990
	3/5/2010	15.71 *sheen	81.57	Sample not collected			
	9/20/2010	3.70	93.58	563	<10.0	<10.0	6,027
	12/2/2010	9.33	87.95	664	42	19.1	4,710
	3/14/2011	14.94	82.34	713	<10.0	113	6,510
	6/2/2011	9.10	88.18	233	<1.0	31.8	457
	9/12/2011	3.40	93.88	23.8	<1.0	6.8	124
	12/9/2011	9.60	87.68	57.2	<1.0	3.62	90.3
	3/22/2012	14.21	83.07	295	5.33	5.99	53.7
	6/8/2012	4.57	92.40	14.3	<1	<1	14.4
	9/18/2012	3.32	93.96	3.5	<1.0	1.3	59.0
	12/3/2012	8.80	88.48	<1.0	<1.0	<1.0	<1.0

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW04	3/18/2013	13.83	83.45	10.2	<1.0	1.49	6.27
	6/18/2013	5.54	91.74	27.7	<1.0	<1.0	<1.0
	9/17/2013	1.07	96.21	1.39	<1.0	1.27	3.68
MW05	1/13/2009	14.58	82.39	15,500	14,900	412	6,860
	3/5/2010	16.06 * sheen	80.91	Sample not collected			
	9/20/2010	6.60	90.37	12,700	1,500	522	8,190
	12/2/2010	10.48	86.49	14,700	185	122	5,650
	3/14/2011	16.16	80.81	67.9	<1.00	<1.00	112
	6/2/2011	13.25	83.72	143	<1.0	<1.0	13.0
	9/12/2011	5.96	91.01	5,050	22.5	59.1	2,680
	12/9/2011	10.70	86.27	8,790	10.6	<10.0	659
	3/22/2012	NM	NM	Not Sampled - Dry			
	6/8/2012	8.36	88.61	337	<1	<1	4.4
	9/18/2012	7.68	89.29	1,249	1.1	3.8	59.3
	12/3/2012	10.08	86.89	<1.0	<1.0	<1.0	<1.0
	3/18/2013	16.25	80.72	<1.3	<1.3	<1.3	<4.0
	6/18/2013	9.58	87.39	2.44	<1.0	<1.0	1.88
	9/17/2013	4.21	92.76	7.97	<1.0	<1.0	2.27
MW06	2/19/2009	17.24	79.73	305	15.8	167	2,476
	3/5/2010	16.47	80.87	1.27	<1.0	8.77	9.60
	9/20/2010	6.95	90.39	<1.0	<1.0	3.51	13.0
	12/2/2010	11.01	86.33	<1.0	<1.0	28.8	205
	3/14/2011	16.91	80.43	<1.00	<1.00	42.8	317
	6/2/2011	14.30	83.04	<1.0	<1.0	2.1	4.9
	9/12/2011	6.51	90.83	<1.0	<1.0	<1.0	<3.0
	12/9/2011	10.80	86.54	<1.0	<1.0	<1.0	<3.0
	3/22/2012	17.08	80.26	<1.0	<1.0	1.46	4.9
	6/8/2012	9.22	88.12	<1	<1	<1	<1
	9/18/2012	8.21	89.13	<1.0	<1.0	<1.0	<1.0
	12/3/2012	9.50	87.84	<1.0	<1.0	<1.0	<1.0
	3/18/2013	16.70	80.64	<1.0	<1.0	2.84	8.79
	6/18/2013	8.89	88.45	<1.0	<1.0	<1.0	<1.0
	9/17/2013	4.23	93.11	<1.0	<1.0	<1.0	<1.0
MW07	2/19/2009	19.18	75.41	3.99	7.09	64.1	288.67
	3/5/2010	15.93	78.66	5.47	<1.0	4.11	55.02
	9/20/2010	7.35	87.24	<1.0	<1.0	<1.0	<3.0
	12/2/2010	10.32	84.27	<1.0	<1.0	<1.0	<1.0
	3/14/2011	16.12	78.47	<1.00	<1.00	<1.00	<3.00
	6/2/2011	14.59	80.00	<1.0	<1.0	<1.0	<3.0
	9/12/2011	6.25	88.34	<1.0	<1.0	<1.0	<3.0
	12/9/2011	NM	NM	Could Not Locate Well			
	3/22/2012	16.42	78.17	<1.0	<1.0	<1.0	<1.0
	6/8/2012	8.65	85.94	<1	<1	<1	<1
	9/18/2012	8.12	86.47	<1.0	<1.0	<1.0	<1.0
	12/3/2012	9.14	85.45	<1.0	<1.0	<1.0	<1.0
	3/18/2013	16.13	78.46	<1.0	<1.0	<1.0	<3.0
	6/18/2013	8.72	85.87	<1.0	<1.0	<1.0	<1.0
	9/17/2013	3.62	90.97	<1.0	<1.0	<1.0	<1.0
MW08	2/19/2009	18.03	NM	34.3	2,000	202	4,213
MW08R	9/20/2010	10.90	83.61	1.21	<1.0	118	657.4

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW08R	12/2/2010	12.94	81.57	<1.0	<1.0	<1.0	119
	3/14/2011	18.61	75.90	<1.00	<1.00	<1.00	1,070
	6/2/2011	17.80	76.71	<1.0	<1.0	207	587
	9/12/2011	9.66	84.85	<1.0	<1.0	44.6	241
	12/9/2011	12.67	81.84	<1.0	<1.0	9.99	68.6
	3/22/2012	18.67	75.84	<1.0	8.37	16.3	109
	6/8/2012	11.99	82.52	<1	<1	1.7	26.1
	9/18/2012	11.34	83.17	<1.0	<1.0	1.5	4.5
	12/3/2012	11.88	82.63	<1.0	<1.0	2.65	20.2
	3/22/2013	18.68	75.83	<1.0	<1.0	8.47	103
	6/18/2013	12.10	82.41	<1.0	<1.0	1.98	6.85
	9/17/2013	7.41	87.10	<1.0	<1.0	1.65	4.80
MW09 MW09R	2/19/2009	18.96	NM	1,250	23.0	19.0	25.28
	9/20/2010	10.75	82.99	3,350	<1.0	368	1,891.7
	12/2/2010	12.79	80.95	10.2	<10.0	85.2	392
	3/14/2011	17.67	76.07	422	<1.0	200	644
	6/2/2011	17.02	76.72	902	<1.0	303	1,490
	9/12/2011	9.57	84.17	1.1	<1.0	128	609
	12/9/2011	12.50	81.24	1.79	<1.0	13.7	28.5
	3/22/2012	17.81	75.93	1.64	8	14.5	43.4
	6/8/2012	12.34	81.40	<1	<1	5.9	8.9
	9/18/2012	11.43	82.31	<1.0	<1.0	<1.0	<1.0
	12/3/2012	12.00	81.74	<1.0	<1.0	<1.0	<1.0
	3/22/2013	17.92	75.82	<1.0	<1.0	<1.0	<1.0
	6/18/2013	12.70	81.04	<1.0	<1.0	12.7	16
	9/17/2013	7.32	86.42	<1.0	<1.0	<1.0	<1.0
MW10	2/19/2009	17.34	76.83	10,300	374	412	2,435
	3/5/2010	16.46	77.71	9,790	581	452	3,707
	9/20/2010	7.70	86.47	4,130	50.0	434	4,280
	12/2/2010	10.83	83.34	1,560	<10.0	33.5	1,100
	3/14/2011	12.25	81.92	1,070	<1.00	12.6	476
	6/2/2011	12.35	81.82	<1.0	<1.0	<1.0	<3.0
	9/12/2011	7.01	87.16	310	<1.0	107	250
	12/9/2011	10.62	83.55	243	<1.0	53.2	279
	3/22/2012	16.37	77.80	30.3	1.75	<1.0	<1.0
	6/8/2012	9.60	84.57	18.2	<1	<1	<1
	9/18/2012	8.78	85.39	<1.0	<1.0	<1.0	<1.0
	12/3/2012	10.02	84.15	<1.0	<1.0	<1.0	<1.0
	3/18/2013	16.30	77.87	<1.0	<1.0	<1.0	<3.0
	6/18/2013	10.34	83.83	28.8	<1.0	<1.0	<1.0
	9/17/2013	4.09	90.08	<1.0	<1.0	<1.0	<1.0
MW11	2/19/2009	17.67	78.49	6,130	48.5	43.4	818.6
	3/5/2010	16.38	79.78	10,500	<1.0	10.1	497
	9/20/2010	7.20	88.96	2,670	<1.0	<1.0	235.88
	12/2/2010	11.55	84.61	835	<10.0	<10.0	57.1
	3/14/2011	16.27	79.89	180	<1.00	<1.00	<3.00
	6/2/2011	13.82	82.34	<1.0	<1.0	<1.0	<3.0
	9/12/2011	7.11	89.05	<1.0	<1.0	<1.0	<3.0

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW11	12/9/2011	11.31	84.85	<1.0	<1.0	<1.0	<3.0
	3/22/2012	16.85	79.31	<1.0	2	<1.0	<1.0
	6/8/2012	9.76	86.40	<1	<1	<1	<1
	9/18/2012	8.87	87.29	<1.0	<1.0	<1.0	<1.0
	12/3/2012	10.78	85.38	<1.0	<1.0	<1.0	<1.0
	3/18/2013	16.98	79.18	<1.0	<1.0	<1.0	<3.0
	6/18/2013	10.55	85.61	<1.0	<1.0	<1.0	<1.0
	9/17/2013	4.61	91.55	<1.0	<1.0	<1.0	<1.0
MW12	2/19/2009	14.81	81.95	1,970	257	138	423
	3/5/2010	14.63	82.13	465	24.5	42.7	199.9
	9/20/2010	4.10	92.66	9.92	<1.0	<1.0	171.07
	12/2/2010	13.41	83.35	<1.0	<1.0	<1.0	<1.0
	3/14/2011	14.91	81.85	2.35	<1.00	13.5	250
	6/2/2011	10.42	86.34	<1.0	<1.0	<1.0	<3.0
	9/12/2011	3.47	93.29	58.7	<1.0	<1.0	6.4
	12/9/2011	10.35	86.41	<1.0	<1.0	<1.0	<3.0
	3/22/2012	15.25	81.51	<1.0	2	1.4	4.98
	6/8/2012	5.76	91.00	12.8	<1	3.7	13.7
	9/18/2012	4.41	92.35	<1.0	<1.0	<1.0	1.4
	12/3/2012	10.34	86.42	<1.0	<1.0	<1.0	<1.0
	3/18/2013	15.33	81.43	<1.0	<1.0	1.41	<3.0
	6/18/2013	8.31	88.45	19.8	<1.0	<1.0	<1.0
	9/17/2013	2.40	94.36	1.13	<1.0	<1.0	<1.0
MW13	2/19/2009	15.13	83.32	<1.0	<1.0	<1.0	<3.0
	3/5/2010	15.11	83.34	<1.0	<1.0	<1.0	<3.0
	9/20/2010	3.80	94.65	<1.0	<1.0	<1.0	<3.0
	12/2/2010	10.60	87.85	<1.0	<1.0	<1.0	<1.0
	3/14/2011	15.21	83.24	<1.00	<1.00	<1.00	<3.00
	6/2/2011	7.41	91.04	<1.0	<1.0	<1.0	<3.0
	9/12/2011	2.94	95.51	<1.0	<1.0	<1.0	<3.0
	12/9/2011	11.04	87.41	<1.0	<1.0	<1.0	<3.0
	3/22/2012	15.73	82.72	<1.0	1.87	<1.0	<1.0
	6/8/2012	5.01	93.44	<1	<1	<1	<1
	9/18/2012	3.77	94.68	<1.0	<1.0	<1.0	<1.0
	12/3/2012	10.90	87.55	<1.0	<1.0	<1.0	<1.0
	3/18/2013	15.76	82.69	<1.0	<1.0	<1.0	<3.0
	6/18/2013	7.36	91.09	<1.0	<1.0	<1.0	<1.0
	9/17/2013	2.48	95.97	<1.0	<1.0	<1.0	<1.0
MW14	2/19/2009	14.32	NM	<1.0	<1.0	<1.0	<3.0
	3/5/2012	NM	NM	Destroyed			
MW15	2/19/2009	14.95	78.55	2,490	3,380	150	1,732
	3/5/2010	13.00	80.50	998	1,890	141	2,026
	9/20/2010	2.80	90.70	107	<1.0	<1.0	417.3
	12/2/2010	8.24	85.26	133	<1.0	<1.0	470
	3/14/2011	12.96	80.54	181	<1.00	135	1,580
	6/2/2011	7.44	86.06	35.4	<1.0	15.6	308
	9/12/2011	2.44	91.06	15.2	<1.0	29.1	249
	12/9/2011	10.30	83.20	<1.0	<1.0	<1.0	<3.0

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW15	3/22/2012	15.31	78.19	<1.0	2.09	<1.0	<1.0
	6/8/2012	5.40	88.10	<1	<1	<1	<1
	9/18/2012	6.38	87.12	<1.0	<1.0	<1.0	<1.0
	12/3/2012	10.06	83.44	<1.0	<1.0	<1.0	<1.0
	3/18/2013	13.81	79.69	36.9	<1.0	60.5	84.6
	6/18/2013	9.20	84.30	<1.0	<1.0	<1.0	<1.0
	9/17/2013	1.02	92.48	7.73	<1.0	9.72	21.9
MW16 MW16R	2/19/2009	15.25	NM	1,060	16.2	156	37.5
	3/22/2012	15.58	NM	<1.0	<1.0	<1.0	<1.0
	6/8/2012	8.59	NM	1.1	<1	4.2	<1
	9/18/2012	6.78	NM	3.1	<1.0	2.8	<1.0
	12/3/2012	10.71	NM	<1.0	<1.0	<1.0	<1.0
	3/19/2013	15.91	NM	2.52	<1.0	<1.0	<3.0
	6/18/2013	10.81	NM	19.7	<1.0	<1.0	<1.0
MW17 MW17R	9/17/2013	3.37	NM	<1.0	<1.0	<1.0	<1.0
	2/19/2009	15.93 <15.91>	NM	3,680	9,940	775	1,075
	9/20/2010	7.92	84.99	<1.0	<1.0	46.1	256.31
	12/2/2010	11.10	81.81	3.10	<1.0	112	570
	3/14/2011	15.62	77.29	9.19	<1.00	52.6	470
	6/2/2011	13.53	79.38	3.4	<1.0	16.5	448
	9/12/2011	6.93	85.98	<1.0	<1.0	45.1	275
	12/9/2011	11.11	81.80	9.28	<1.0	141	1,090
	3/22/2012	15.89	77.02	5.4	2.59	85.3	616
	6/8/2012	10.44	82.47	4.1	<1	117	668
	9/18/2012	9.07	83.84	5.2	<1.0	95.1	522
	12/3/2012	10.98	81.93	24.8	<1.0	97.5	684
	3/22/2013	16.16	76.75	51.4	<1.0	158	1,460
MW18 MW18R	6/18/2013	11.84	81.07	3.23	<1.0	82.1	474
	9/17/2013	4.61	88.30	3.26	<1.0	40.7	145
	2/19/2009	16.22	NM	1,410	80.9	51.0	229.6
	3/14/2011	16.25	75.85	<1.00	<1.00	<1.00	<3.00
	6/2/2011	15.24	76.86	<1.0	<1.0	<1.0	<3.0
MW19 MW19R	9/12/2011	8.76	83.34	<1.0	<1.0	<1.0	<3.0
	2/28/2012	NM	NM	Abandoned per COGCC approval			
	2/25/2009	16.67	NM	329	<1.0	1.45	6.65
	3/14/2011	17.44	74.27	<1.00	<1.00	<1.00	<3.00
	6/2/2011	16.96	74.75	<1.0	<1.0	<1.0	<3.0
MW20	9/12/2011	10.61	81.10	<1.0	<1.0	<1.0	<3.0
	2/28/2012	NM	NM	Abandoned per COGCC approval			
	2/25/2009	17.55	NM	2.13	2.34	16.0	3.27
	Destroyed						
	2/25/2009	16.87	NM	2.00	<1.0	<1.0	11.9
MW21	Destroyed						
	2/25/2009	16.70	NM	8.70	40.7	3.78	22.65
	Destroyed						
MW22	2/25/2009	15.25	NM	32.9	5.29	9.01	38.36
	3/22/2012	16.20	NM	<1.0	2.33	<1.0	<1.0
	6/8/2012	9.38	NM	<1	<1	<1	<1

TABLE 1

GROUNDWATER ANALYTICAL RESULTS

**CHESNUT G 22-6 TANK BATTERY
WELD COUNTY, COLORADO
NOBLE ENERGY, INC.**

Well ID	Date	Depth to Water/<Product> (feet btoc)	Relative Groundwater Elevation (feet)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW23R	9/18/2012	7.33	NM	<1.0	<1.0	<1.0	1.3
	12/3/2012	11.88	NM	<1.0	<1.0	<1.0	<1.0
	3/19/2013	16.67	NM	<1.0	<1.0	<1.0	<3.0
	6/18/2013	11.73	NM	<1.0	<1.0	<1.0	<1.0
	9/17/2013	4.33	NM	<1.0	<1.0	<1.0	<1.0
MW24	2/25/2009	14.87	NM	1.02	<1.0	<1.0	<3.0
MW25	2/25/2009	18.20	NM	<1.0	<1.0	<1.0	4.01
	3/5/2010	17.46	NM	<1.0	<1.0	<1.0	<3.0
MW26	2/25/2009	18.02	78.14	<1.0	<1.0	<1.0	<3.0
	3/5/2010	17.36	78.80	<1.0	<1.0	<1.0	<3.0
	9/20/2010	5.10	91.06	<1.0	<1.0	<1.0	<3.0
	12/2/2010	8.78	87.38	<1.0	<1.0	<1.0	<1.0
	3/14/2011	15.63	80.53	<1.00	<1.00	<1.00	<3.00
	6/2/2011	11.67	84.49	<1.0	<1.0	<1.0	<3.0
	9/12/2011	4.02	92.14	<1.0	<1.0	<1.0	<3.0
	12/9/2011	NM	NM	<1.0	<1.0	<1.0	<3.0
	3/22/2012	NM	NM	Not Sampled - Dry			
	6/8/2012	5.99	90.17	<1	<1	<1	<1
	9/18/2012	5.69	90.47	<1.0	<1.0	<1.0	<1.0
	12/3/2012	7.26	88.90	<1.0	<1.0	<1.0	<1.0
	3/18/2013	NM	NM	Not Sampled - Dry			
	6/18/2013	5.91	90.25	<1.0	<1.0	<1.0	<1.0
	9/17/2013	2.20	93.96	<1.0	<1.0	<1.0	<1.0
MW27	2/25/2009	19.98	NM	<1.0	<1.0	<1.0	<3.0
MW28	2/25/2009	15.82	NM	<1.0	<1.0	<1.0	<3.0
				Destroyed			
MW29	2/25/2009	16.77	NM	<1.0	<1.0	<1.0	<3.0
				Destroyed			
MW30	2/25/2009	16.86	NM	<1.0	<1.0	<1.0	<3.0
				Destroyed			
MW31	3/14/2011	14.83	76.86	<1.00	<1.00	<1.00	<3.00
	6/2/2011	11.11	80.58	<1.0	<1.0	<1.0	<3.0
	9/12/2011			Destroyed			
MW32	3/14/2011	18.47	72.41	<1.00	<1.00	<1.00	<3.00
	6/2/2011	18.27	72.61	<1.0	<1.0	<1.0	<3.0
	9/12/2011	12.92	77.96	<1.0	<1.0	<1.0	<3.0
	2/28/2012	NM	NM	Abandoned per COGCC approval			
CDPHE WQCC Reg 41				5.0	560	700	1,400

NOTES:

btoc - below top of casing

µg/L - micrograms per liter

NM - not measured

< indicates result is less than the stated laboratory reporting limit

Bold indicates concentration exceeds CDPHE WQCC Reg 41.

CDPHE WQCC Reg 41 - Colorado Department of Public Health and Environment - Water Quality Control

Commission Regulation 41 covering The Basic Standards for Ground Water

Benzene, toluene, ethylbenzene, and total xylenes analyzed by EPA Method 8260B or 8260C

COGCC - Colorado Oil and Gas Conservation Commission

ATTACHMENT 1
MATERIAL SAFETY DATA SHEETS



Material Safety Data Sheet

Section 1 – Product Identification and Use

Product Identifier: **Chemically Oxygenated Granular Activated Carbon
(COGAC)**

Description: Fine Black Powder

Product Use: Water Treatment

Manufacturer's /Suppliers Name:

Remington Technologies, LLC

8100 Arkins Court

Loveland, Colorado (80538)

Emergency Phone: (970) 278-1646

Section 2 – Hazardous Ingredients

80% of this material is composed of powdered activated carbon. The remaining 20% includes oxidizers and nutrients. These additives are neutralized by the carbon in solid form. Once the package is opened, dust will be present and an adequate dust mask or respirator is required for handling.

LD50 – Oral:	N/A	C.A.S. #:	7440-44-0
LC50:	N/A	Range % (w/w)	60-100
LC50 – Dermal	N/A	T.L.V.	3.5 mg/cu. M

Section 3 – Physical Data

Boiling Point:	2150C	Incompatibility:	Strong catalysts
Solubility in H ₂ O:	Not Soluble	Flash Point	N/A
Specific Gravity:	0.35	Stability:	Stable
Appearance and Odor:	Odorless black powder		

Section 4 – Fire and Explosion Data

Flash Point: N/A

Extinguishing Media: Water, foam, CO₂

Fire & Explosion Hazards: Contact with strong oxidizing catalysts may result in heat generation

Fire Fighting Procedures: None. Does not support a flame but may generate heat as above

Section 5 – Reactivity Data

Stability: Stable

Incompatibility: Oxidizing catalysts, metals, nitric acid, hydrogen peroxide

Hazardous Polymerization: N/A

Hazardous decomposition: N/A

Section 6 – Toxicological Data

Effects of Overexposure:

Inhalation:	Irritation of respiratory system
Skin:	Not a primary irritant
Ingestion:	Non-toxic through ingestion
Eyes:	Irritation

First Aid:

Inhalation:	Remove from source; dust mask, respirator
Skin:	Wash with soap and water
Ingestion:	Consult a physician
Eyes:	Flush with water; consult a physician

Section 7 – Preventive Measures

Spilled or released material may be swept up and discarded at a landfill or reused

Waste disposal at a landfill as non-toxic, non-hazardous material

Handling/Storage: Keep dry with packaging intact

Note: Wet material can remove oxygen from the air; generate hydrogen and CO₂ in a confined space. Confined space entry when wet prohibited

Section 8 – First Aid

Respiratory:	Wear approved dust mask or respirator (NIOSH/OHSA)
Eyes:	Wear approved safety glasses with side shields
Gloves:	Nitrile
Ventilation:	Advised
Clothing:	OSHA Level D
Hygiene:	Maintain clean environment

Section 9 – Preparation Date

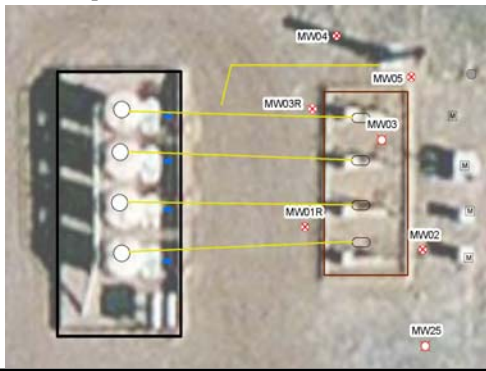
Prepared by Remington Technologies, LLC on January 4, 2013

Address: 8100 Arkins Court, Loveland, CO 80538

Telephone: (970) 278-1646

ATTACHMENT 2
SOIL BORING LOG

Location Map



Compliance • Engineering • Remediation

LT Environmental, Inc.
4600 W. 60th Avenue
Arvada, Colorado 80003

BORING LOG/MONITORING WELL COMPLETION DIAGRAM

BORING/WELL NO.: MW03R
DATE: 3-4-2013
LOGGED BY: Chris Roy
DRILL MTHD: Geoprobe 7000

PROJECT: Chesnut G 22-6
PROJECT NO.: NEP0839
DRILLED BY: ACI Services
SAMPLE MTHD: Continuous

DETECTOR: MiniRae3000

GRAVEL PACK: 10-20 Silica Sand

CASING TYPE: SCH. 40 PVC

SCREEN TYPE: SCH. 40 PVC

HOLE DIA.: 2.25"

SEAL: Bent. Chips

CASING DIA.: 1"

SCREEN SLOT: 0.010"

TD: 20' **DTW:** 16'

GROUT: NA

CASING LENGTH: 5'

SCREEN LENGTH: 15'

Penetration Resistance	Moisture Content	Vapor (ppm)	Staining	Sample	Sample Run	Depth (ft. bgs.)	USCS	Soil Type	Lithology Description	Well Construction
	Dry					0			0'-5'- Hand augered, not logged	
	Moist	0.0				5	SC		SC: Sand - 5'-12' - medium grained, clayey, some silt, brown, moist, low cohesion, low plasticity, no odor	
		0.0				10				
		715.2			MW03R @ 12'	12	CL		CL: Clay - 12'-15' - sandy, some gravel, gray stained, moist, low cohesion, low plasticity, moderate odor	
		492.9				15				
	Wet	248.0				16			CL: Clay - 15'-20' - sandy, some gravel, gray stained from 15'-19', wet @ 16', low-moderate cohesion, low plasticity, moderate odor from 15'-19'	
		22.35				18				
		0.9				20				