August 2012

C-144 Permit Package for Polar Bear 5H Well Drying Pad (Temporary Pit) Section 11 T17S R28E Eddy County NM

Prepared for
Murchison Oil & Gas, Inc.
Plano, Texas

Prepared by
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August 11, 2012

Mr. Mike Bratcher
NMOCD District 2
811 South First Street
Artesia, New Mexico 88210
Via E-mail

RE: Polar Bear 5H, Section 11 T17S R28E

Dear Mike:

For the above-referenced temporary pit, attached are:

1. A C-144 Form
2. Supplemental information to support the C-144

Please note that this submittal:

A. Uses the term temporary pit/drying pad to signify that Murchison will
   a. use the sub-grade "pit" as a drying pad that receives only cuttings and mud from the closed loop system
   b. will not store liquids in the temporary pit/drying pad – except for up to 500 gallons of fluid that may drain to the sump
B. Proposes to close the temporary pit/drying pad "in place"

The C-144 Form is not entirely clear regarding how one uses a "pit" as a drying pad in order to allow a "closure in-place" for the dry cuttings/mud that we deliver to the pit/pad. I hope we filled out the form correctly.

As shown below, we are sending a copy of this application to the State Land Office to serve as notice to the surface owner of the intention to dispose of drilling waste on-site.

As always, thanks for your help.

Sincerely,
R.T. Hicks Consultants

Randall Hicks

Copy: Murchison Oil and Gas, Inc.
Scott Dawson, NM State Land Office

C-144 and
Site Specific Information for
Drying Pad (Temporary Pit)

R.T. Hicks Consultants, Ltd.
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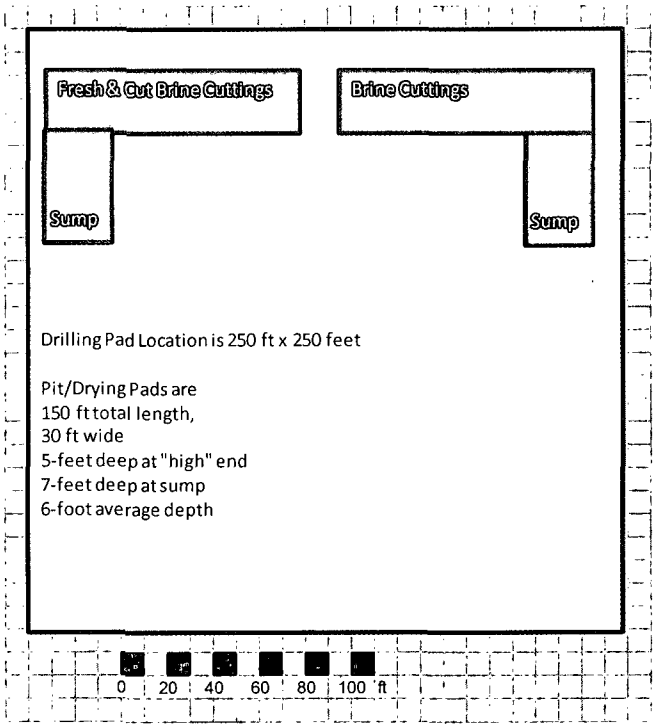
Site Specific Information

Figure 1 shows the location of the proposed temporary pit/drying pad location on a USGS topographic map. The Design and Construction Plan is included with this submission. Below is a schematic layout of the temporary pit/drying pad. .



Sketch of temporary pit/drying pad

Hydrogeologic Report Demonstrating Compliance With Depth to Water Criteria

Figure 2a, 2b and 2c and the discussion presented below demonstrates that groundwater (fresh water as defined by NMOCD Rules) at the location is greater than 50 feet beneath the temporary pit/drying pad.

Figure 2a is an area geologic map that shows:

1. The location of the temporary pit/drying pad as a red rectangle.
2. Water wells in the OSE database as blue circles with a corresponding permit number. OSE wells are often miss-located in the WATERS database as older wells are plotted in the center of the quarter, quarter, quarter, of the Section Township and Range.
3. Water wells in Open File Report 95 (OFR-95[1]) or wells with water data collected by Hicks Consultants as yellow squares and are labeled as "Misc." with wells numbers assigned in the RT Hicks GIS database.
4. Water wells from the USGS database with a red triangle.

[1] http://geoinfo.nmt.edu/publications/openfile/downloads/OFR014-99/76-99/95/ofr_95.pdf

Figure 2b is a groundwater elevation contour map showing our interpretation of the groundwater elevation data, which also appears next to each well. Groundwater data from the OSE database are not included on this map because of location errors, which are discussed below.

Figure 2c is a 1:24,000 scale map of the area near the temporary pit/dryingpad that uses the same dataset as Figure 2a.

Geology and Hydrogeology

The proposed temporary pit/drying pad is located on an outcrop of the Permian Rustler Formation that is often veiled by a thin layer of overlying Quaternary Older Alluvium (Qoa on Figure 2a, 2c). Topographically, the site is on the east-facing slope of a closed depression, approximately 10 feet above the floor of the depression to the east (Figures 3a and 3b). The Rustler is probably more than 150 feet thick at this site and consists of siltstone, gypsum, sandstone, and dolomite, which provides fresh water to wells located at the Ranch Headquarters to the west. Gypsum bedrock is exposed at and around the location. The underlying Permian Salado Formation (Psl on Figure 2a) is comprised of evaporite sequence rocks (gypsum, shale, salts) and is not considered a source for fresh water. Salado Formation rocks are exposed several miles to the west. The Permian-Artesia Group (Pat on Figure 2a) crops out approximately 5 miles to the west of the site and extends in the subsurface to the east, underlying the Salado Formation. These formations are comprised of more clastic (shelf facies) rocks that are capable of producing fresh water when located near the surface and below the water table elevation. To the east of the site the Rustler Formation is covered by a thin layer of Quaternary (older) alluvium (Qoa); and northwest of the site, the Rustler Formation is overlain by piedmont alluvium (Qp). The alluvial sediments can provide fresh groundwater locally, but in the area of the temporary pit/drying pad, the alluvium lies above the water table and is not a place of withdrawal for use.

Water Table Elevation

Ten water wells were identified in the area surrounding area to determine the water table elevation below the temporary pit (Figure 2b). They include two wells from the USGS database, and eight wells from the Open File Report No. 95 (OFR-95). A summary of the available water well data, with respect to groundwater elevation, is provided on the table below. The table also includes information on wells from the OSE WATERS database.

Well Numbers	Well Location						Well Source Information						Groundwater Elevation Data						Gauging Date
	Township (south)	Range (east)	Section	Quarter Section (64,	16,	4)	NM-OSE Database	USGS Database	Open File Rpt. 95	USGS Topo Sheet	Aerial Photograph	Field Verification	Surface Elevation (published)	Surface Elevation (Topo Sheet)	Well Total Depth (published)	Depth to Water (published)	Groundwater Elev. (published)	Groundwater Elev. (using topo elev.)	
Misc - 19	16	27	36	2	1	2			✓	✓	--	--	3,454	3,454	61.4	47.1	3,407	3,407	10/13/1977
RA 07774	17	27	11	3	2	1	✓			✓	✓	✓		3,401	100	50		3,351	12/20/1989
USGS-1344	17	27	11	2	2	1		✓		✓	✓	✓	3,390		100	56.26	3,334		2/7/2007
Misc - 20	17	27	12	3	1	4			✓				3,472		250	115	3,357		4/1/1954
RA 04554	17	27	23			1	✓												
Misc - 5	17	28	2			2	4			✓	✓	✓	--		3,574		27.6	3,560	3,546	1/1/1948
Misc - 2	17	28	14			2	2			✓	✓	✓	--		3,590		80	3,540	3,510	unkn
Misc - 16	17	28	19				2			✓	✓	✓	✓		3,591		224.3	3,380	3,367	1/2/1948
Misc - 17	17	28	22			3	2			✓	✓	✓	✓	--	3,579		45.5	3,520	3,534	1/1/1948
USGS-1222	17	28	22	4	2	4		✓		✓	✓	✓	3,578			95	78.55	3499		1/13/1999
L 07643	17	28	34	2	4	4	✓					--								
Misc - 1	17	28	24	2	2	2			✓											
Misc - 3	17	29	22	1	1	1			✓	✓	✓	✓	3,550	3,545		79.7	3,470	3,465	11/29/1948
Misc - 4	17	29	29	4	4	4			✓	✓	✓	--		3550		210		3340	12/3/1948
Misc - 0	17	29	8	2	3	1			✓	✓	✓	✓	3617	3617	92.7	90.13	3526.9		10/14/1977

✓ Indicates well was verified, (blank) indicates well not verified, and -- indicates no attempt to verify

Visual inspections of questionable wells were performed to verify the information provided by the public records and published reports. We also contacted the OSE for records on certain wells. Initially, an attempt was made to identify each well using USGS topographic maps. The surface elevations of wells identified on the maps were compared to the published surface elevation, if available. Wells that could not be verified using maps were searched on current and historic satellite photographs in an effort to identify windmills, tanks, or roads associated with the well. Locations that could not be verified by maps, photographs or an OSE records search were verified in the field. Attempts were also made to gauge wells during the field investigation, when access to the casing was permitted. The results of the field inspections are summarized as follows:

- Wells No. Misc-17 and USGS-1222 are the same well based on similar locations and surface elevations
- Well No. Misc-20 and Misc-0 could not be located by map, photograph, or field inspection; therefore the groundwater elevation data should be discounted
- Well No. RA 04554 could not be located by map, photograph, or field inspection; therefore the depth to water data should be discounted
- Well L 07643 is a well located in the Lea County Basin of the OSE and is mis-located in the WATERS database.
- Well RA 09342 is mis-located in the WATERS database and lies 3 townships west (see Appendix A)

Figures 2b and 2c were prepared with data published in OFR-95 and USGS data. RT Hicks Consultants believes that Figure 2b is the most complete interpretation of the groundwater gradient available. Based on this map the groundwater elevation at the temporary pit location was approximately 3550 feet above sea level in 1948. The well survey (Appendix B) indicates

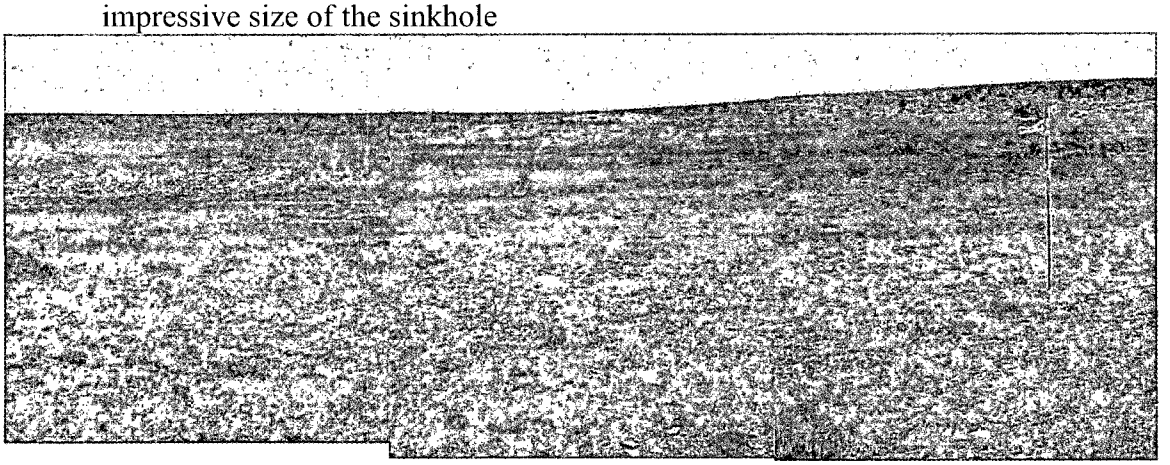
that the surface elevation of the location is 3647.8 feet above sea level; therefore the depth to groundwater was approximately 98 feet in 1948. However, water levels at the USGS 1222/Misc-17 well has dropped 21 feet between 1948 and 1999. Considering a 10-foot (maximum) depth for the temporary pit/drying pad, the distance from the bottom of the temporary pit/drying pad to the water table is 88 feet, if we use the 1948 data. The distance from the bottom of the temporary pit/drying padto the water table could be 109 feet, if water levels have dropped as suggested by the 1999 USGS data.

Additional Sitting Criteria Compliance Demonstration

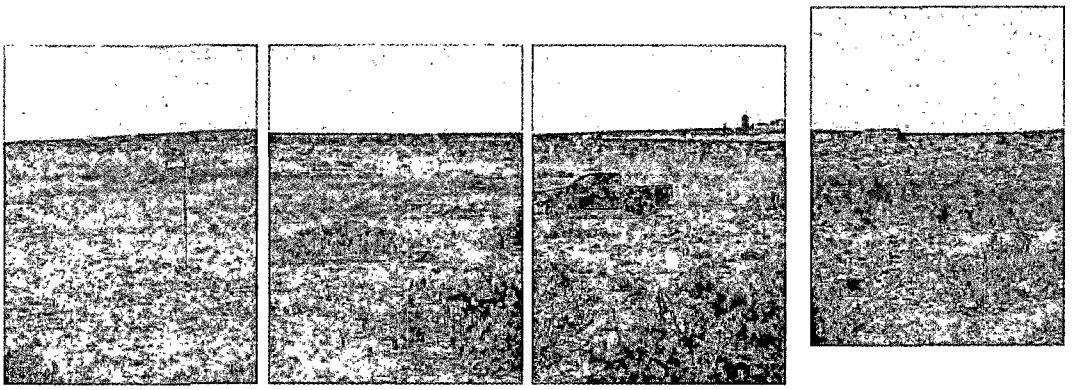
The information identified in Item 10, "Siting Criteria" of the C-144 is presented below. The descriptions below are associated with the maps presented in Figures 2-7, attached.

Figures 3a and 3b and the site visit demonstrates that the location is not within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark).

- Data from the USDA's National Hydraulic Dataset shows a dry steam drainage (shown as a light blue line) approximately 3000 feet east of the temporary pit.
- The closed depression shown on the topographic map (Figure 3b) is not a lakebed or playa lake
- No other watercourses, as defined by NMOCD Rules, or water bodies exist with 300-feet of location.
- A sinkhole does exist about 600 feet east of the location. On Figure 3a, the sinkhole is visible beneath the 300-foot radius ring. The survey (Appendix B), which is far more accurate than the GIS mapping tool, shows the western edge of the sinkhole about 600 feet from the location center. The temporary pit/drying pad is located on the west side of the location, about 700 feet from the sinkhole mapped on the survey.
- Photographs presented below show the nature of the surface at the location and the impressive size of the sinkhole



View to east-south from location, sinkhole is on left of photograph



View to north-northwest from location across portion of closed depression showing Polar Bear 4H

Figure 3a and the site visit demonstrate that the location is not within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. No nearby structures exist within 300 feet of location.

- Figure 3a shows oil and gas facilities on all sides of the location
- Our site visit identified no permanent structures within 300 feet of the site

View west of sinkhole with location in background to the right of truck

Figures 2 and 3 demonstrates that the location is not within 500 horizontal feet of a private, domestic fresh water well or spring that less than five households use for domestic or stock watering purposes, or within 1000 horizontal feet of any other fresh water well or spring, in existence at the time of initial application.

- Figure 3a shows the locations of all surface water; including springs
- No springs were identified within the mapping area during our site visit

Figure 4 demonstrates that the location is not within incorporated municipal boundaries or defined municipal fresh water well fields covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended.

- The closest municipality is Artesia, NM approximately 6 miles to the west
- The closest public well field is located approximately 12 miles to the east

Figure 5 demonstrates the location is not within 500 feet of wetlands.

Figure 6 and our general reconnaissance of the area demonstrates that the nearest mines are caliche pits

Figure 7 shows the location of the temporary pit/drying pad with respect Karst areas identified in the most recent Caves and Karst Map published by the BLM

- According to our interpretation of a recent conversation with Mr. James Goodbar of BLM, the Cave Karst Map is
  i. Based upon decades of field inspections and geologic reasoning
  ii. A work-in-progress and is continually updated as new data are reviewed
  iii. Accurate on a regional scale but site visits by trained professionals are often necessary to determine the existence/potential of karst features within small areas (e.g. a drilling pad)
- The legend for Figure 7 is explained below (personal communication with Mr. Goodbar)
  i. Critical Karst Areas: Areas that contain a high density of significant caves and karst features and/or provide important karst groundwater recharge for domestic drinking water supplies and springs.
  ii. High Karst Areas: Areas of known karst geology that contain high density of significant caves and karst features.
  iii. Medium Potential Karst Areas: Areas of known karst geology that contain dispersed caves and karst features.
  iv. Low Potential Karst Areas: Areas of questionable karst geology and few if any known caves or karst features.
- Although the site is located within a "Low Potential Karst Area" the thin-bedded gypsum at the surface (see photographs above) exhibits some solution voids. Within the closed depression lies the large sinkhole shown in photographs above. Because of the presence of solution features in the gypsum combined with a postulated water table aquifer in this area, Murchison will cause the contractor to compact the earth material that forms the foundation for the pit liners to an expected proctor density of greater than 90% by:
  i. adding water as appropriate,
  ii. compacting the earth by walking a crawler-type tractor down the sides and bottom of the pit, and
  iii. repeating this process with a second 6-inch lift of earth material if necessary.
- Murchison will
  i. employ the temporary pit/drying pad as drying pad
  ii. not store drilling fluids in the temporary pit/drying pad
  iii. will remove any fluids as they accumulate in the sumps of the temporary pit/drying pad sump
  iv. close the temporary pit/drying pad containing the relatively dry cuttings/mud "in-place" in a manner consistent with the attached closure plan
- A Professional Geologist will witness the excavation of the temporary pit/drying pad and collect additional information pertaining to Karst for possible submission to NMOCD

- Although karst features (large voids) create preferential pathways for downward saturated flow (e.g. free liquids flowing into a void from a pit/pipeline rupture), large voids represent a barrier to unsaturated flow (e.g. very slow seepage from dried cuttings/mud). This phenomenon is the reason that capillary barriers are used to prevent seepage into restored uranium tailings piles, landfills and like features (see http://www.epa.gov/superfund/accomp/news/pdfs/evapo.pdf and http://www.beg.utexas.edu/staffinfo/pdf/scanlon_vadosezj.pdf) . As the large voids in a gravel layer beneath a fine-grained layer significantly minimize seepage, solution cavities and tubes create the same effect.

Figure 8 demonstrates that the location is not within a 100-year floodplain.

- The location is within Zone X of FEMA Flood Zone Designation. Zone X is defined as an area of minimal flood hazard and above the 500-year (0.2% annual chance) flood level.