

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

For temporary pits, below-grade tanks, and multi-well fluid management pits, submit to the appropriate NMOCD District Office.
For permanent pits submit to the Santa Fe Environmental Bureau office and provide a copy to the appropriate NMOCD District Office.

Pit, Below-Grade Tank, or
Proposed Alternative Method Permit or Closure Plan Application

- Type of action: Below grade tank registration
 Permit of a pit or proposed alternative method
 Closure of a pit, below-grade tank, or proposed alternative method
 Modification to an existing permit/or registration
 Closure plan only submitted for an existing permitted or non-permitted pit, below-grade tank, or proposed alternative method

Instructions: Please submit one application (Form C-144) per individual pit, below-grade tank or alternative request

Please be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.
Operator: Lime Rock Resources II-A, L.P. (LRRII) OGRID #: 277558
Address: 1111 Bagby Street, Suite 4600, Houston, TX 77002
Facility or well name: All Thorn MWFM Pit
API Number: _____ OCD Permit Number: _____
U/L or Qtr/Qtr NE/4 of SE/4 of Section 36 Township 17S Range 27E County: Eddy
Center of Proposed Design: Latitude 32.7875766 Longitude 104.2258098 NAD: 1927 1983
Surface Owner: Federal State Private Tribal Trust or Indian Allotment

2.
 Pit: Subsection F, G or J of 19.15.17.11 NMAC
Temporary: Drilling Workover
 Permanent Emergency Cavitation P&A Multi-Well Fluid Management Low Chloride **Drilling** Fluid yes no
 Lined Unlined Liner type: Thickness 60 mil LLDPE HDPE PVC Other See Variance Request
 String-Reinforced 60 mil HDPE Primary Liner and Secondary Liner
Liner Seams: Welded Factory Other _____ Volume 160,500 bbl Dimensions: L 260 x W 260 x D 14 feet

3.
 Below-grade tank: Subsection I of 19.15.17.11 NMAC
Volume: _____ bbl Type of fluid: _____
Tank Construction material: _____
 Secondary containment with leak detection Visible sidewalls, liner, 6-inch lift and automatic overflow shut-off
 Visible sidewalls and liner Visible sidewalls only Other _____
Liner type: Thickness _____ mil HDPE PVC Other _____

4.
 Alternative Method:
Submittal of an exception request is required. Exceptions must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

5.
Fencing: Subsection D of 19.15.17.11 NMAC (*Applies to permanent pits, temporary pits, and below-grade tanks*)
 Chain link, six feet in height, two strands of barbed wire at top (*Required if located within 1000 feet of a permanent residence, school, hospital, institution or church*)
 Four foot height, four strands of barbed wire evenly spaced between one and four feet
 Alternate. Please specify _____ Game fence _____

6.

Netting: Subsection E of 19.15.17.11 NMAC (*Applies to permanent pits and permanent open top tanks*)

- Screen Netting Other_____ Operator will evaluate need for netting as described in Construction/Design Plan_____
- Monthly inspections (If netting or screening is not physically feasible)

7.

Signs: Subsection C of 19.15.17.11 NMAC

- 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers
- Signed in compliance with 19.15.16.8 NMAC

8.

Variations and Exceptions:

Justifications and/or demonstrations of equivalency are required. Please refer to 19.15.17 NMAC for guidance.

Please check a box if one or more of the following is requested, if not leave blank:

- Variance(s): Requests must be submitted to the appropriate division district for consideration of approval.
- Exception(s): Requests must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

9.

Siting Criteria (regarding permitting): 19.15.17.10 NMAC

Instructions: *The applicant must demonstrate compliance for each siting criteria below in the application. Recommendations of acceptable source material are provided below. Siting criteria does not apply to drying pads or above-grade tanks.*

General siting

Ground water is less than 25 feet below the bottom of a low chloride temporary pit or below-grade tank.

- NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells

- Yes No
- NA

Ground water is less than 50 feet below the bottom of a Temporary pit, permanent pit, or Multi-Well Fluid Management pit .

NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells **See Figures 1 & 2**

- Yes No
- NA

Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. **(Does not apply to below grade tanks) See Figure 5**

- Written confirmation or verification from the municipality; Written approval obtained from the municipality

- Yes No

Within the area overlying a subsurface mine. **(Does not apply to below grade tanks) See Figure 7**

- Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division

- Yes No

Within an unstable area. **(Does not apply to below grade tanks) See Figure 8 and discussion in application**

- Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; Topographic map

- Yes No

Within a 100-year floodplain. **(Does not apply to below grade tanks) See Figure 9**

- FEMA map

- Yes No

Below Grade Tanks

Within 100 feet of a continuously flowing watercourse, significant watercourse, lake bed, sinkhole, wetland or playa lake (measured from the ordinary high-water mark).

- Topographic map; Visual inspection (certification) of the proposed site

- Yes No

Within 200 horizontal feet of a spring or a fresh water well used for public or livestock consumption;.

- NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site

- Yes No

Temporary Pit using Low Chloride Drilling Fluid (maximum chloride content 15,000 mg/liter)

Within 100 feet of a continuously flowing watercourse, or any other significant watercourse or within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). (Applies to low chloride temporary pits.)

- Topographic map; Visual inspection (certification) of the proposed site

- Yes No

Within 300 feet from a occupied permanent residence, school, hospital, institution, or church in existence at the time of initial application.

- Visual inspection (certification) of the proposed site; Aerial photo; Satellite image

- Yes No

Within 200 horizontal feet of a spring or a private, domestic fresh water well used by less than five households for domestic or stock watering purposes, or 300feet of any other fresh water well or spring, in existence at the time of the initial application.

NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site

- Yes No

Within 100 feet of a wetland.
 - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site Yes No

Temporary Pit Non-low chloride drilling fluid

Within 300 feet of a continuously flowing watercourse, or any other significant watercourse, or within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark).
 - Topographic map; Visual inspection (certification) of the proposed site Yes No

Within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application.
 - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image. Yes No

Within 500 horizontal feet of a spring or a private, domestic fresh water well used by less than five households for domestic or stock watering purposes, or 1000 feet of any other fresh water well or spring, in the existence at the time of the initial application;
 - NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site Yes No

Within 300 feet of a wetland.
 - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site Yes No

Permanent Pit or Multi-Well Fluid Management Pit

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).
 - Topographic map; Visual inspection (certification) of the proposed site **See Figure 3** Yes No

Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application.
 - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image **See Figure 4** Yes No

Within 500 horizontal feet of a spring or a fresh water well used for domestic or stock watering purposes, in existence at the time of initial application.
 - NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site **See Figures 1 & 2** Yes No

Within 500 feet of a wetland.
 - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site **See Figure 6** Yes No

10. **Temporary Pits, Emergency Pits, and Below-grade Tanks Permit Application Attachment Checklist:** Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- Hydrogeologic Report (Below-grade Tanks) - based upon the requirements of Paragraph (4) of Subsection B of 19.15.17.9 NMAC
 - Hydrogeologic Data (Temporary and Emergency Pits) - based upon the requirements of Paragraph (2) of Subsection B of 19.15.17.9 NMAC
 - Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
 - Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
 - Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
 - Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC
- Previously Approved Design (attach copy of design) API Number: _____ or Permit Number: _____

11. **Multi-Well Fluid Management Pit Checklist:** Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC **Appendix A, B, and C**
 - Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC **Appendix D**
 - A List of wells with approved application for permit to drill associated with the pit. **Appendix E**
 - Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC **Appendix F**
 - Hydrogeologic Data - based upon the requirements of Paragraph (4) of Subsection B of 19.15.17.9 NMAC **Attached**
 - Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC **Attached**
- Previously Approved Design (attach copy of design) API Number: _____ or Permit Number: _____

12. **Permanent Pits Permit Application Checklist:** Subsection B of 19.15.17.9 NMAC

Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- Hydrogeologic Report - based upon the requirements of Paragraph (1) of Subsection B of 19.15.17.9 NMAC
- Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- Climatological Factors Assessment
- Certified Engineering Design Plans - based upon the appropriate requirements of 19.15.17.11 NMAC
- Dike Protection and Structural Integrity Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- Leak Detection Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- Liner Specifications and Compatibility Assessment - based upon the appropriate requirements of 19.15.17.11 NMAC
- Quality Control/Quality Assurance Construction and Installation Plan
- Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- Freeboard and Overtopping Prevention Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- Nuisance or Hazardous Odors, including H₂S, Prevention Plan
- Emergency Response Plan
- Oil Field Waste Stream Characterization
- Monitoring and Inspection Plan
- Erosion Control Plan
- Closure Plan - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

13. **Proposed Closure:** 19.15.17.13 NMAC

Instructions: Please complete the applicable boxes, Boxes 14 through 18, in regards to the proposed closure plan.

- Type: Drilling Workover Emergency Cavitation P&A Permanent Pit Below-grade Tank Multi-well Fluid Management Pit
 Alternative
- Proposed Closure Method: Waste Excavation and Removal
 Waste Removal (Closed-loop systems only)
 On-site Closure Method (Only for temporary pits and closed-loop systems)
 In-place Burial On-site Trench Burial
 Alternative Closure Method

14. **Waste Excavation and Removal Closure Plan Checklist:** (19.15.17.13 NMAC) **Instructions:** Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.

- Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC
- Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.13 NMAC
- Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings)
- Soil Backfill and Cover Design Specifications - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- Re-vegetation Plan - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- Site Reclamation Plan - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

15. **Siting Criteria (regarding on-site closure methods only):** 19.15.17.10 NMAC

Instructions: Each siting criteria requires a demonstration of compliance in the closure plan. Recommendations of acceptable source material are provided below. Requests regarding changes to certain siting criteria require justifications and/or demonstrations of equivalency. Please refer to 19.15.17.10 NMAC for guidance.

Ground water is less than 25 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Ground water is between 25-50 feet below the bottom of the buried waste - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Ground water is more than 100 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Within 100 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse, lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; Visual inspection (certification) of the proposed site	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within 300 horizontal feet of a private, domestic fresh water well or spring used for domestic or stock watering purposes, in existence at the time of initial application. - NM Office of the State Engineer - iWATERS database; Visual inspection (certification) of the proposed site	<input type="checkbox"/> Yes <input type="checkbox"/> No
Written confirmation or verification from the municipality; Written approval obtained from the municipality	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within 300 feet of a wetland. US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance	<input type="checkbox"/> Yes <input type="checkbox"/> No

adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; Written approval obtained from the municipality	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; Topographic map	<input type="checkbox"/> Yes <input type="checkbox"/> No
Within a 100-year floodplain. - FEMA map	<input type="checkbox"/> Yes <input type="checkbox"/> No

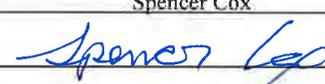
16. **On-Site Closure Plan Checklist:** (19.15.17.13 NMAC) *Instructions: Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.*

- Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- Proof of Surface Owner Notice - based upon the appropriate requirements of Subsection E of 19.15.17.13 NMAC
- Construction/Design Plan of Burial Trench (if applicable) based upon the appropriate requirements of Subsection K of 19.15.17.11 NMAC
- Construction/Design Plan of Temporary Pit (for in-place burial of a drying pad) - based upon the appropriate requirements of 19.15.17.11 NMAC
- Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC
- Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of 19.15.17.13 NMAC
- Waste Material Sampling Plan - based upon the appropriate requirements of 19.15.17.13 NMAC
- Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings or in case on-site closure standards cannot be achieved)
- Soil Cover Design - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- Re-vegetation Plan - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- Site Reclamation Plan - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

17. **Operator Application Certification:**

I hereby certify that the information submitted with this application is true, accurate and complete to the best of my knowledge and belief.

Name (Print): Spencer Cox Title: Production Engineer

Signature:  Date: 5/7/14

e-mail address: scox@limerockresources.com Telephone: 713-292-9528

18. **OCD Approval:** Permit Application (including closure plan) Closure Plan (only) OCD Conditions (see attachment)

OCD Representative Signature: **DENIED 8/17/14 Past 60 day review and 40 day extension-Requested documentation not received.** Approval Date: _____

Title: _____ OCD Permit Number: _____

19. **Closure Report (required within 60 days of closure completion):** 19.15.17.13 NMAC

Instructions: Operators are required to obtain an approved closure plan prior to implementing any closure activities and submitting the closure report. The closure report is required to be submitted to the division within 60 days of the completion of the closure activities. Please do not complete this section of the form until an approved closure plan has been obtained and the closure activities have been completed.

Closure Completion Date: _____

20. **Closure Method:**

Waste Excavation and Removal On-Site Closure Method Alternative Closure Method Waste Removal (Closed-loop systems only)

If different from approved plan, please explain.

21. **Closure Report Attachment Checklist:** *Instructions: Each of the following items must be attached to the closure report. Please indicate, by a check mark in the box, that the documents are attached.*

- Proof of Closure Notice (surface owner and division)
- Proof of Deed Notice (required for on-site closure for private land only)
- Plot Plan (for on-site closures and temporary pits)
- Confirmation Sampling Analytical Results (if applicable)
- Waste Material Sampling Analytical Results (required for on-site closure)
- Disposal Facility Name and Permit Number
- Soil Backfilling and Cover Installation
- Re-vegetation Application Rates and Seeding Technique
- Site Reclamation (Photo Documentation)

On-site Closure Location: Latitude _____ Longitude _____ NAD: 1927 1983

Operator Closure Certification:

I hereby certify that the information and attachments submitted with this closure report is true, accurate and complete to the best of my knowledge and belief. I also certify that the closure complies with all applicable closure requirements and conditions specified in the approved closure plan.

Name (Print): _____ Title: _____

Signature: _____ Date: _____

e-mail address: _____ Telephone: _____

**C-144 Permit Package for
All Thorn
Multi-Well Fluid Management Pit
Section 36 of T17S, R27E, Eddy County**

**Transmittal Letter
C-144
Appendices 8-;**



View southwest from northeast corner of proposed site showing All Thorn trees

**Prepared for:
Lime Rock Resources II-A, LP (LRRII)
Artesia, New Mexico**

Prepared by:

**Huitt-Zollars, Inc
333 Rio Rancho Blvd
Suite 101
Rio Rancho, New Mexico**

**R.T. Hicks Consultants, Ltd.
901 Rio Grande NW
F-142
Albuquerque, New Mexico**

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

May 7, 2014

Mr. Mike Bratcher
NMOCD District 2
811 S. First Street
Artesia, New Mexico 88210
Via E-mail and US Mail

RE: Lime Rock Resources II-A, L.P. (LRR-II)
All Thorn MWFM Pit for Treated Produced Water

Dear Mike:

Enclosed is a C-144 permit application for a Multi Well Fluids Management Pit located at Section 36 T17S R27E in Eddy County. The purpose of this pit is to facilitate the reuse of produced water for well stimulation and well drilling in lieu of using fresh water.

A site inspection and literature review conducted by a professional geologist with decades of field experience concludes that unstable ground does not exist within 1000 feet of the location. Although OCD may not share this opinion, the design of the pit has incorporated engineering measures to ensure that the pit's integrity is not compromised. These engineering measures include, but are not limited to the following work elements which will be overseen by a Registered Professional Engineer at Pettigrew and Associates:

- A geotechnical investigation consisting of site specific testing of materials and an evaluation of construction methods
- Development of a set of construction recommendations and a standard of performance that will be submitted to OCD prior to construction.
- Inspection and testing during construction to verify that the protocols are delivering the standards of performance
- A final report summarizing the results of the construction inspection and testing program

Perhaps the most important work element proposed in this application is a conference call between the Professional Engineers of this project and the Professional Engineers from OCD/EMNRD assigned to the evaluation of these engineering design measures. The purpose of this call is to present this submission, discuss any comments/concerns of the OCD Engineers and then provide a response to fill in any gaps identified in the phone conference (see Design Plan).

Please note the following:

1. The application requests one variance from the prescriptive mandates of OCD Rules. OCD has approved the use of the Hypernet drainage system in lieu of 2-feet of compacted earth for part of the leak detection system for the Mack Round Tank Permanent Pit.

May 7, 2014

Page 2

2. Note that the design drawings specify the secondary liner as “in accordance with permit”. As stated in the Construction Plan, 60-mil HDPE material will be used as the secondary liner in accordance with the Rule.
3. Attached is a description of the produced water treatment system. We understand that OCD is interested in making a determination regarding the disposition of any wastes generated by the treatment system with respect to compliance with OCD Rules Part 36 and Part 34.

We believe this application is consistent with a recently approved application for the Yates Dagger Draw MWFM pit. Therefore, we hope it can be approved without significant delay. Lime Rock Resources will submit two additional variance requests in the near future in an effort to improve the economics associated with the construction of this pit and the subsequent conservation of fresh water resources. The two forthcoming variance requests are associated with this application, but should be considered separately from this permit application.

Please contact me if you have any questions regarding this submittal.

Sincerely,
R.T. Hicks Consultants

A handwritten signature in black ink, appearing to read "Randall Hicks", written in a cursive style.

Randall Hicks

Copy: Lime Rock Resources
State Land Office (surface owner)

Project: All Thorn Multi-Well Fluid Management Pit
Eddy County, New Mexico

Date: May 1, 2014

A site review was conducted on April 3, 2014 to determine the acceptability of existing site soil conditions for construction of the All Thorn MWFM Pit in accordance with NMAC 19.15.17.

The generalized subsurface conditions based upon visual classifications are comprised of silty clayey sands, < 10" depth, underlain by caliche.

These findings are consistent with previous Soils Investigations performed by this firm in the area, observations at the nearby Eddy County caliche pit

(Figure 2) as well as trench backfill on location (Figure 1).

Based upon our experience with similar conditions and our site observations, we are confident that we will be able to provide sound foundation recommendations for the proposed pit that meet the needs of the project.



Figure 1



Figure 2

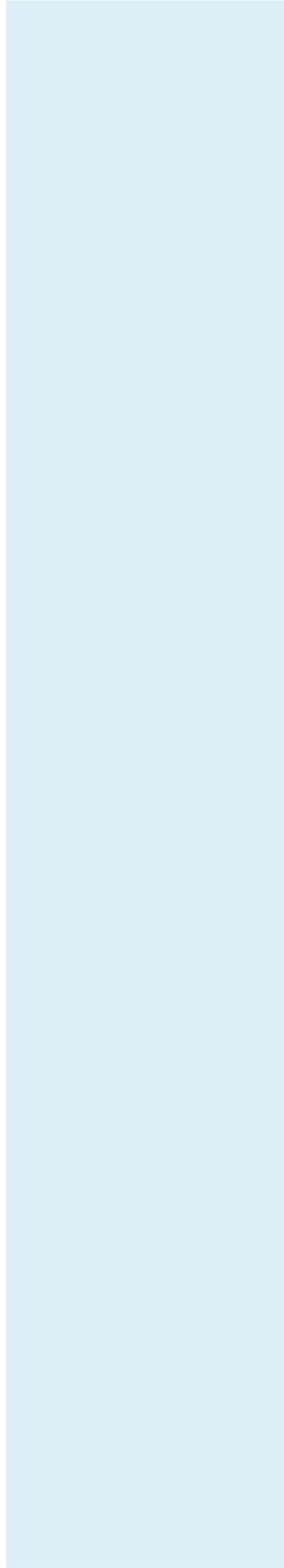


Upon completion of geotechnical field investigation and laboratory testing, final recommendations will be based upon additional site-specific data collected by Pettigrew.



Debra P. Hicks





C-144 and Site Specific Information for Temporary Pit

R.T. Hicks Consultants, Ltd.

901 Rio Grande Blvd. NW, Suite F-142
Albuquerque, NM 87104

Distance to Groundwater

Figure 1, Figure 2, and the discussion presented below demonstrates that groundwater (fresh water as defined by NMOCD Rules) at the location is greater than 270 feet beneath the Multi Wells Fluid Management (MWFM) Pit.

Figure 1 is an area geologic base map that depicts regional topography (metric contour units) and includes the water wells located nearest to the MWFM pit site for which information is available, regardless of how comprehensive or useful. It also shows:

1. The location of the MWFM pit as a solid blue rectangle
2. Water wells from the USGS database as a green triangle
3. Water wells from the New Mexico Office of the State Engineer (OSE) database as a small blue triangle inside a colored circle that indicates the well depth (see Legend). Please note, 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. Topographic maps and/or aerial photographs verified all of the OSE well locations included on this map.
4. Water wells, which are not documented in the public databases but were identified by field inspection or other published reports are shown as a dot inside a color-coded (depth) square. These wells are our internal Miscellaneous (Misc) database.
5. Depth to water and gauging dates from the most recent and reliable measurement for each well is provided adjacent to the well symbol. It should be noted that in most cases the depth to water provided by the OSE database are from drillers log notes estimated at the time of completion, rather than actual field measurements.

Figure 2 is a regional topographic base map (metric contour units) that depicts the potentiometric surface contours of the shallow-most aquifer at the MWFM pit site, labeled in feet above sea level (ASL). The water wells plotted include the USGS database water wells from Figure 1 and additional Misc database wells for which a reliable depth to water measurement has been recorded for the regional aquifer/water-bearing zone (Permian Rustler, Salado Formation and Artesia Group). Figure 2 also shows:

1. The location of the MWFM pit as a solid blue rectangle.
2. Groundwater elevations and gauging dates from the most recent available static water level measurement for each well.

Hydrologic and Geologic Report

The proposed MWFM Pit is located in the Great Plains physiographic province. The Plains are considered a Cenozoic depositional feature composed of erosional materials derived from the eastern front of the Rocky Mountains and similarly aligned Basin and Range mountains to the south including the Sacramento and Guadalupe Mountains.

Much of the Plains material that comprises the surface was deposited between 40 and 50 million years ago (ma). With some uplift of the Plains, depositional rates slowed or ceased from 40 to 30 ma. Beginning 30 ma, additional deposition spreading from the north to the south and reworking of the earlier materials resulted in the deposition of the Ogallala formation. The later formation of the Pecos Valley by headward erosion due to either uplift to the west or solution/subsidence of the valley resulted in partial stripping of material from the fronts of the mountains (Reeves, 1972). This action has left the Great Plains isolated from the mountain fronts.

Siting Criteria (19.15.17.10 NMAC)
All Thorn MWFM Pit, Section 36, T17S, R27E

The MWFM Pit location is between the Mescalero rim, the western edge of the Great Plains (Ogallala Formation), and the Pecos River. The above mentioned development of the Pecos Drainage removed and reworked the remnants of the Ogallala formation between the Mescalero rim and the Pecos River. This surface is called the Mescalero Plain and is composed of relatively thin pediment deposits and alluvium of fluvial and eolian origins deposited on top of weathered Triassic and Permian formations.

The MWFM Pit location is mapped as Permian Salado Formation (Psl on Figure 1, see Graphic 1). About 200 feet south of the location is the mapped east-west contact between the Salado formation and Quaternary older alluvium (Qoa on Figure 1). Just west of the pit location, the mapped contact swings to the southwest. Hence, east to south of the location is Quaternary alluvium overlying the Salado Formation.

At the location and north and west of the location, at least several feet of caliche and soil exist on top of both the Permian Salado Formation and the underlying Artesia Group (Psl and Pat on Figure 1, see Graphic 2). The underlying Permian Artesia Group is exposed about 0.7 miles west-southwest of the pit location by the topography which slopes downwards to the Pecos River. The Permian Rustler Formation, overlying the Salado Formation, is a regional aquifer that is exposed to the north-northeast of the site and provides water to wells east of the site. The Rustler is not present at the proposed MWFM pit location.

Graphic 1: Looking south at wall of caliche pit about 0.4 miles southwest of MWFM Pit location. Three to four feet of caliche and alluvium (Qoa) is above the black contact line and thickens to the east (left). The western side of this caliche pit is mapped as Permian Salado Formation (Psl). The Salado Formation is below the black line. The dashed red contact is between the Salado formation and the Artesia Group. Some weathered limestone is exposed in the "red" layer on the lower pit walls and floor on the western side of the caliche pit. The proposed MWFM Pit will be excavated within this cross section.



Siting Criteria (19.15.17.10 NMAC)
All Thorn MWFM Pit, Section 36, T17S, R27E

Graphic 2: Looking west at wall of caliche pit about 0.8 miles west-southwest of MWFM Pit location. Three to four feet of caliche and soil exist on top of the Artesia Group (Pat).



The site location is in the southeast corner of Section 36 along a topographic high at an elevation of about 3670 feet above sea level (asl). The western half of Section 36 is drained to the northwest by Logan Draw with a gradient of about 290 feet/mile (0.05 foot/foot). The western side of Section 1 (immediately south of Section 36 and the site location) is drained by Scoggin Draw to the southwest with a gradient of about 310 feet/mile (0.06 foot/foot). Both Draws are tributaries of the Pecos River approximately six miles to the west

On the topographic high are several small, shallow depressions that are not sufficiently deep to register as closed topographic contours in Figure 3. These features are formed by the same mechanism proposed for similar depressions observed east of the Mescalero Rim, on the Ogallala Formation. According to Smith, (2003), small depressions initially form due to ancient collapse of solution voids, such as within the soluble evaporite beds in the underlying Permian Formations that lay deep below the Ogallala or, in the area of the MWFM Pit, within the Salado Formation and Artesia Group. As these surface irregularities/depressions collect surface water during precipitation events, infiltration is obviously greater than for the adjacent slopes or hilltops. Higher infiltration can result in dissolution of soluble material within the underlying material and resultant slumping of the overlying soils – increasing the depth of the depression

and widening the area of impact. This deepening and enlarging process is limited by amount of rainfall and sediment inflow to the depression. Outside of these closed depressions, infiltration and subsequent solution of caliche or other soluble materials is negligible (Sabin, 1995).

Hydrogeology of the Pit Location

Figure 2 shows a potentiometric surface of the area. The western edge of the Mescalero Plain is a ground water divide between groundwater flowing west-southwest to the Pecos River and ground water flowing south and southeast beneath the Mescalero Plain. Due to locally complicated geology, groundwater gradients can vary. Groundwater does not exist everywhere beneath the Mescalero Plain or everywhere within the Permian Formations exposed on the western edge of the Mescalero Plain. At the location of the MWFM Pit, the groundwater data suggests flow moves from east to west, toward the Pecos River. If groundwater exists at the site, it would occur in the Artesia Group evaporites.

Depth to Water

Data from the wells closest to the MWFM pit location are explained below:

- At the Empire Abo Gas Plant, 2.1 miles west of the MWFM Pit location (see Figure 2), groundwater monitoring wells at the Plant document a shallow, perched water body within the Artesia Group that is clearly a result of Plant Activities (known leakage of water lines). To the south of the Plant, shallow groundwater also exists in alluvium, within Scoggins Draw. A monitoring well immediately north of the plant was a dry hole to a depth of 200 feet.
- About 3 miles north of the site is Misc-21, a plugged and abandoned well observed in the field and probably completed within the Artesia Group. Figure 1 shows a measured depth to water of 115 feet and Figure 2 shows the water table elevation of 3357 (in 1954).
- About one mile west of Misc-21 is USGS-1520, an active windmill. This well is also probably completed in the Artesia Group, was monitored by the USGS in 2013 and shows a water table elevation of 3329.3. The data suggest a 28-foot decline in the water table over the 60-year time between the 1954 measurement of the nearby Misc-21. Adjacent to USGS-1520 is OSE well RA 07774 (Figure 1) with a depth to water of 50 feet in 1989. This suggests a 10-foot decline in the 24 year from 1989 to 2013, consistent with rate of decline noted above.
- The closest well to the north of the site is Misc.-17 about 2.25 miles to the northeast. Depth to water at Misc.-17 is recorded as more than 224.3 feet (ground water elevation of 3366.7). Misc.-17 is no longer a well as we field verified on our site visit of March 4, 2014. The windmill and some of the stock tank and plumbing are still present. The casing could not be located. Misc-17 is on an exposure of Rustler Formation and could have drawn water from this unit or from the underlying Artesia Group. We believe it unlikely that this well draws water from the poor-quality Salado Formation.
- About 4.35 miles to the northeast and 4.0 miles to the southeast are two USGS wells, USGS-1393 and USGS-1108. Ground water elevation at these two sites is 3499 asl (1999) and 3355 asl (1999). Both of these wells draw water from the Rustler and are up gradient of the MWFM Pit location as shown on the water table surface on Figure 1. Resultant depths to water are 78.55 feet and 225.24 feet respectively.

Siting Criteria (19.15.17.10 NMAC)
All Thorn MWFM Pit, Section 36, T17S, R27E

- Misc-18 is mapped as being slightly east of USGS-1393. We believe this well is the same well as USGS-1393. If this is true, the data record a 33 foot decline in the water table elevation – which is consistent with the estimated water table decline near Misc-21 to the northwest.
- Closest wells to the south are Misc.-59 and Misc.-60 located just east and west of the Pecos Diamond Gas Plant, and are 2.35 miles and 1.95 miles away respectively. Ground water elevation at Misc-59 is reported as 3517 with a depth to water of 81 feet (1948). Ground water elevation at Misc-60 is reported as 3550 (1989) with a depth to water of 55 feet. These wells are pumped by windmills. Due to the pump construction, it was not possible to obtain a measurement from these wells during our site visit of March 4, 2014. We believe these wells are most likely completed in the Rustler Formation, like the nearby USGS 1108 well.

As explained above, much of the data employed to create Figure 2 relies upon wells completed in the Rustler Formation. The only documented wells with reasonable depth to water measurements within the Artesia Group are at the Empire Abo Gas Plant, Misc-21 and USGS-1520. We found no wells completed within the Salado Formation, which underlies the MWFM Pit location. Although the projection of the water table elevation from these wells to the Salado Formation beneath the MWFM Pit would benefit from more data, the available data do suggest that the water table elevation map of Figure 2 is relatively accurate at the proposed pit site.

The MWFM Pit location is at an altitude of 3670 feet and is on a topographic high area along the western rim of the Mescalero Plain. The water table surface shown in Figure 2 suggests a water table elevation of about 3380, resulting in a calculated depth to water of 290 feet at the MWFM Pit location.

Distance to Surface Water

Figure 3 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).

- The nearest stream (intermittent) is a branch of Hart Canyon, more than 2000 feet north-northeast of the pit location. Logan Draw is more than 2200 feet west of the pit location. Other nearest streams (intermittent) include Logan Draw, and various tributaries. All are at greater distances from the pit location (see Figure 2).
- There are no water bodies within 1.5 miles of the pit location.

Distance to Permanent Residence or Structures

Figure 4 and the site visit demonstrates that the location is not within 300 feet from a permanent residence, school, hospital, institution, church, or other structure in existence at the time of initial application.

- There is a gas pipeline facility more than 750 feet southwest of the pit location.
- All structures in the area are oil field infrastructure.

Distance to Non-Public Water Supply

Figures 1 and Figure 2 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 1 and 2 show the locations of all area water wells, active or plugged/abandoned
- The nearest active well is Misc.-59 located more than 2 miles southeast of the location.
- There are no known domestic water wells located within 1000 feet of the location.
- No springs were identified within the mapping area (see Figure 3).

Distance to Municipal Boundaries and Fresh Water Fields

Figure 5 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 10.5 miles to the northwest.
- The City of Carlsbad's Double Eagle Wellfield is more than 23 miles to the northeast.

Distance to Wetlands

Figure 6 demonstrates the location is not within 500 feet of wetlands. This also qualifies the location for in-place closure.

- The nearest designated wetland is a "freshwater pond" located 1.7 miles southeast of the pit location.

Distance to Subsurface Mines

Figure 7 and our general reconnaissance of the area demonstrate that the nearest mines are caliche pits. The location is not within an area overlying a subsurface mine.

- The nearest mapped caliche pit is located about 1.0 miles to the northeast.
- There is an active caliche pit whose northeastern corner is about 1600 feet to the southwest of the pit location and is not part of the government database of mines.
- There are no subsurface mines in the area.

Distance to High or Critical Karst (Unstable) Areas

Figure 8a shows the location of the MWFM Pit with respect to BLM Karst areas using the 2013 map. A revised map will be available in July, 2014.

- The proposed MWFM pit location is currently mapped in a "High Potential" karst area.
- A north-south running boundary between "High Potential" karst and "Low Potential" karst is located about 1.2 miles east of the site. The "Low Potential" karst is mapped on the east side of County Road 206 (Illinois Camp road). Obviously, this boundary is not based on strict geologic evidence.
- East of the junction of County Road 206 and US 82 (Lovington Highway), the boundary between high and low karst potential is US 82. North of the highway the karst potential is high and south of the highway the potential is low. This "highway" karst boundary is not based upon strict geologic evidence.

Siting Criteria (19.15.17.10 NMAC)
All Thorn MWFM Pit, Section 36, T17S, R27E

- About 3 miles east of the junction of US 82 and County Road 206, the high potential-low potential karst boundary runs north-south. Unlike the highway boundaries, this mapped boundary is sub-parallel to the geologic contact between the exposed bedrock of the Rustler Formation and the alluvial material. Refer to Figure 1 to see this geologic contact in a regional view and examine Figure 8b, which plots karst potential and geology on the same map.
- An examination of Figure 8b allows one to discern that the “highway boundaries” also roughly correspond to the contact between alluvial material and underlying Salado (south of US 82) or the lower Rustler (north of US 82).
- No evidence of solution voids were observed within the chosen pit location during the field inspection.
- No evidence of unstable ground was observed within the chosen pit location.
- Solution slump features are observed near the proposed pit location where stormwater temporarily flows or accumulates.

The BLM’s Cave Karst Potential Map of 2013 uses surveyed boundaries and highways to separate karst potential area. These boundaries roughly correspond to the geologic contact between exposed bedrock and alluvial material. Our examination of the area permit a conclusion that low karst is mapped, in general, where the alluvial cover (especially caliche) is sufficiently thick to substantially reduce the potential of unstable ground. We also know from our work north of US 82 in areas mapped as low karst that solution collapse occurs where the alluvial cover is relatively thin and precipitation accumulates in small depressions. Geology, not highways, determines the potential for unstable ground. Field surveys by trained professionals, not relatively coarse mapping tools, are required to determine if a location meets the criteria in the Pit Rule for unstable ground.

The southern side of the proposed pit location is 500 feet north of a depression feature. This feature temporarily collects overland flow during large precipitation events. Soils are finer grained within this depression as these materials are carried into the depression during overland flow events. There exist some small-scale, recent solution features within the deepest areas of this depression (depth is 3 to 4 feet). The topographically high area selected for the pit location does not contain such features. We consider this feature to be an example of a depression feature as exist east of the Mescalero Rim and described earlier in the Geologic section.

Graphic 1 (see Page 2) is a photograph of the caliche pit wall located 0.4 miles southwest of the MWFM Pit location. The proposed MWFM Pit will be excavated into material equivalent to the upper eight feet of the caliche pit wall in Graphic 1.

At both caliche pits, we examined the pit floors. The closer pit (Graphic 1) is actively being worked, and therefore the floor surface is covered with freshly, loosened material. At the more distant caliche pit to the west (Graphic 2), vegetation is present on the pit floor indicating that it has not been worked since before the mesquite and grass began growing. At neither location was there evidence of subsidence features or instability.

Siting Criteria (19.15.17.10 NMAC)
All Thorn MWFM Pit, Section 36, T17S, R27E

As mentioned above, a geotechnical study comprised of 3-4 borings will be conducted at the site. Pettigrew and Associates will use the data from these borings and observations of the nearby caliche pit to create a series of recommendations for the foundation of the pit. These recommendations will be stamped by a New Mexico Professional Engineer and will address any concerns regarding unstable ground.

Distance to 100-Year Floodplain

Figure 9 demonstrates that the location is within an area that has not yet been mapped by the Federal Emergency Management Agency with respect to the Flood Insurance Rate 100-Year Floodplain.

- Areas that are not mapped are generally considered minimal flood risk
- Our field inspection and examination of the topography permits a conclusion that the location is not within any floodplain

References

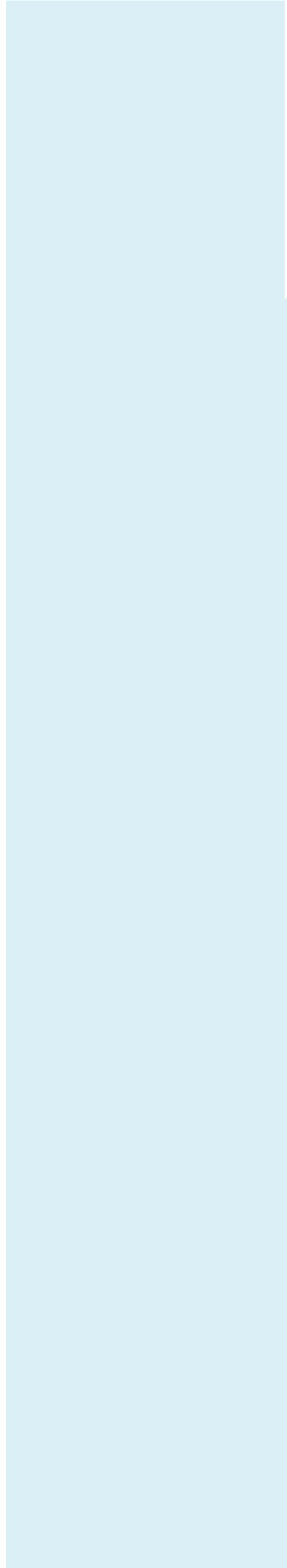
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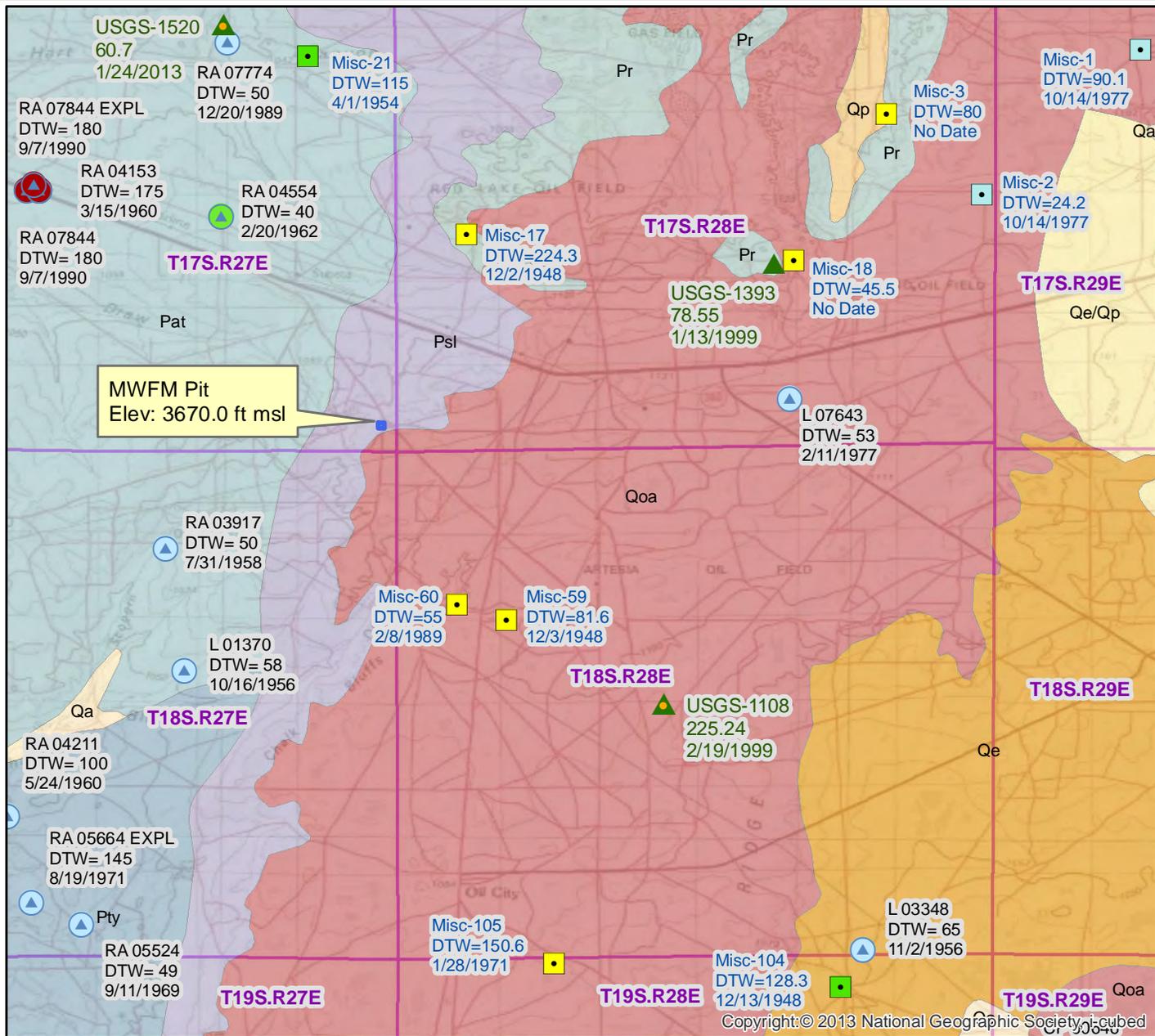
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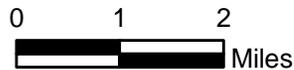
Site Specific Information Figures

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Depth To Water and Geology

Lime Rock Resources: All Thorn MWFM Pit

Figure 1

April 2014

Legend

 MWFM Pit

USGS Gauging Station (DTW, Date)

Aquifer Code, Well Status

-  Alluvium/Bolsom
-  Artesia Group

Misc. Water Wells (Well ID, DTW)

Well Depth (ft)

-  No Data
-  <=150
-  151 - 350

OSE Water Wells

Well Depth (ft)

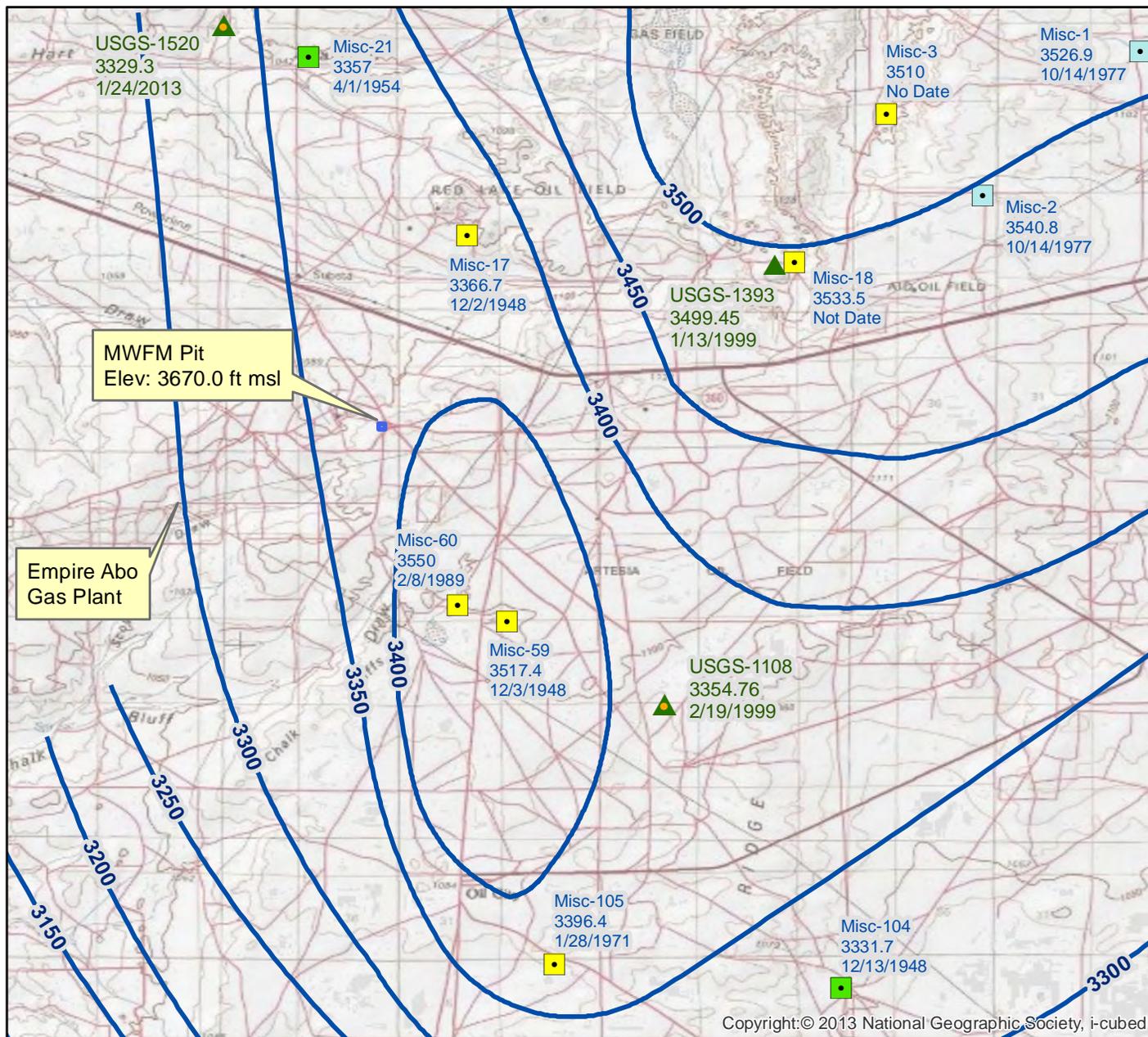
-  <= 150
-  151 - 350
-  > 1000

NM Geology

Map Unit, Description

-  Pat, Permian-Artesia Group; shelf facies forming south-southeast trending outcrop
-  Pr, Paleozoic-Ruster Formation; siltstone, gypsum, sandstone, and dolomite; Upper Permian
-  Psl, Paleozoic-Salado Formation; evaporite sequence; Upper Permian
-  Pty, Paleozoic-Yates and Tansill Formations; sandstones, siltstones, limestone, dolomite, and anhydrite
-  Qa, Quaternary Alluvium
-  Qe, Quaternary-Eolian Deposits
-  Qe/Qp, Quaternary-Eolian Piedmont Deposits
-  Qoa, Quaternary-Older Alluvial Deposits
-  Qp, Quaternary-Piedmont Alluvial Deposits

<p>R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004</p>	<p>Legend for Figure 1</p>	<p>Figure 1 Legend</p>
	<p>Lime Rock Resources: All Thorn MWFM Pit</p>	<p>April 2014</p>



Legend

USGS Gauging Station (GW Elev, Date)

Aquifer Code, Well Status

- ▲ Alluvium/Bolsom
- ▲ Artesia Group

Misc. Water Wells (Well ID, GW Elev)

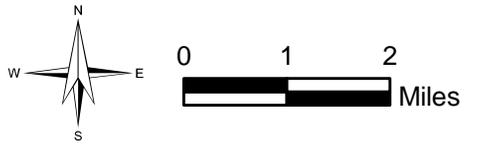
Well Depth (ft)

- No Data
- <=150
- 151 - 350

Potentiometric Surface (ft msl)

Type

- Isocontour



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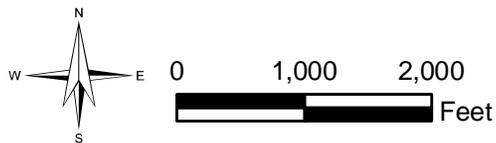
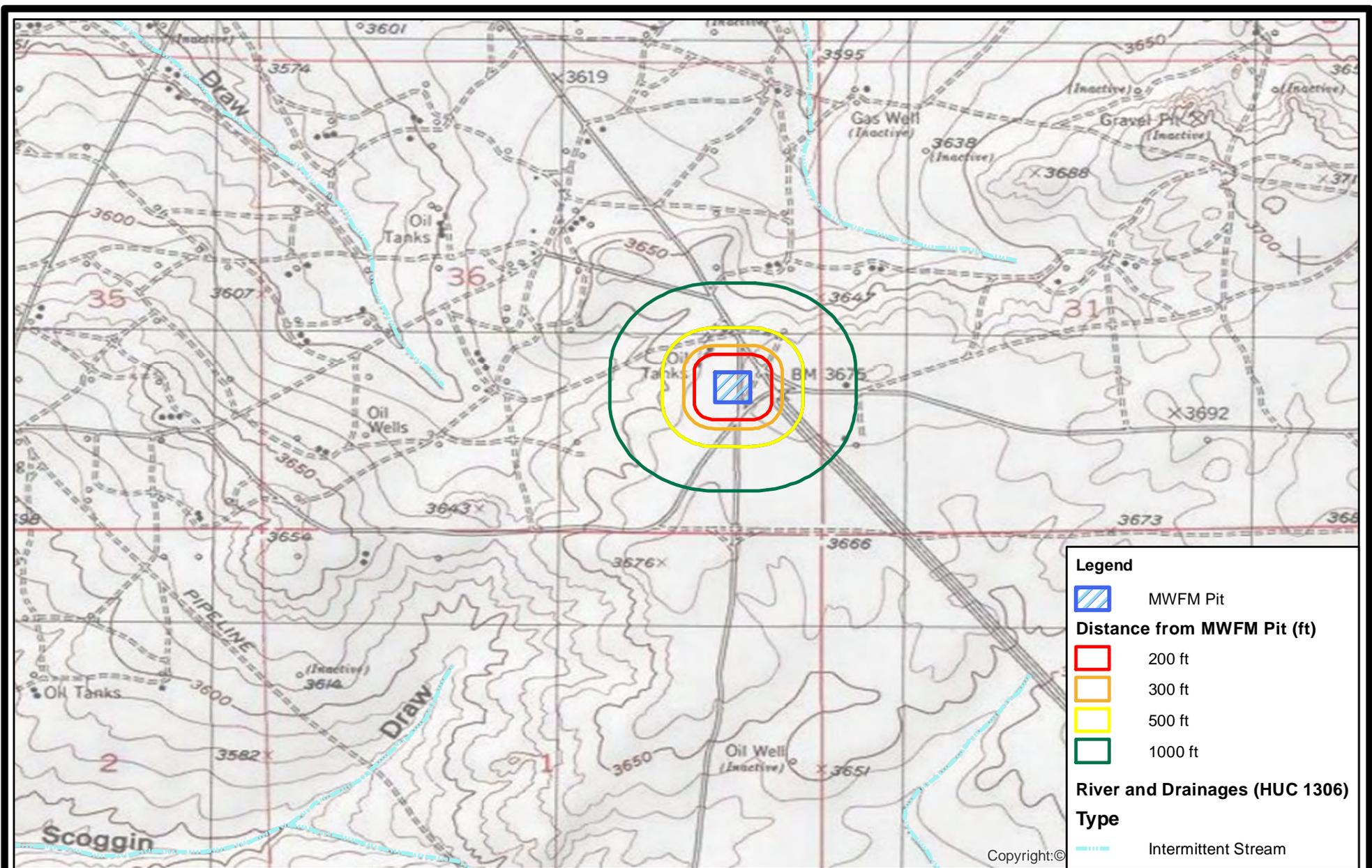
Potentiometric Surface and Groundwater Elevation
 at Nearby Water Wells

Lime Rock Resources: All Thorn MWFM Pit

Figure 2

April 2014

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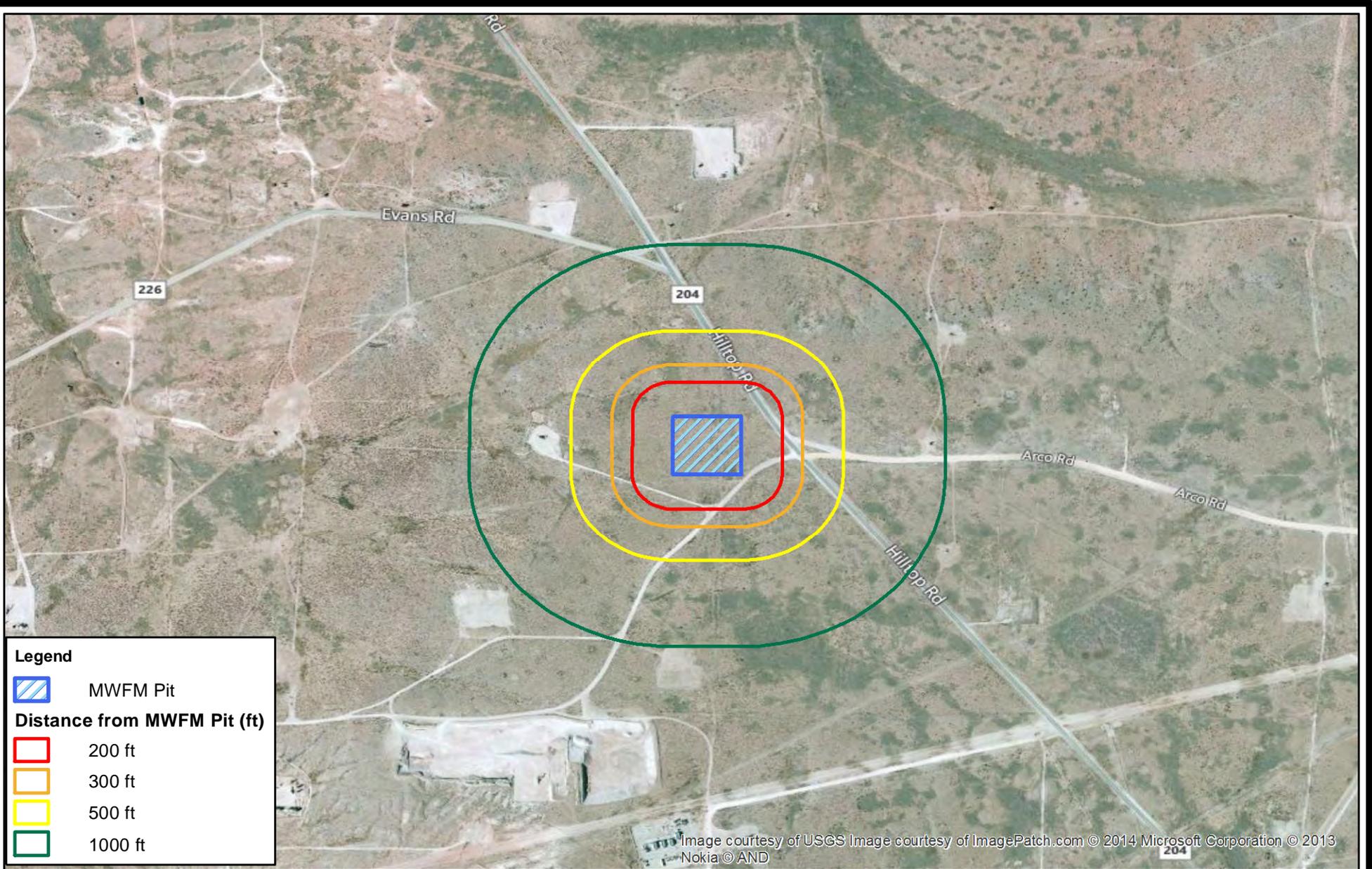
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Surface Water and Topography

Lime Rock Resources: All Thorn MWFM Pit

Figure 3

April 2014



Legend

 MWFM Pit

Distance from MWFM Pit (ft)

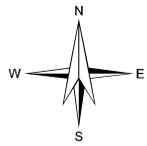
 200 ft

 300 ft

 500 ft

 1000 ft

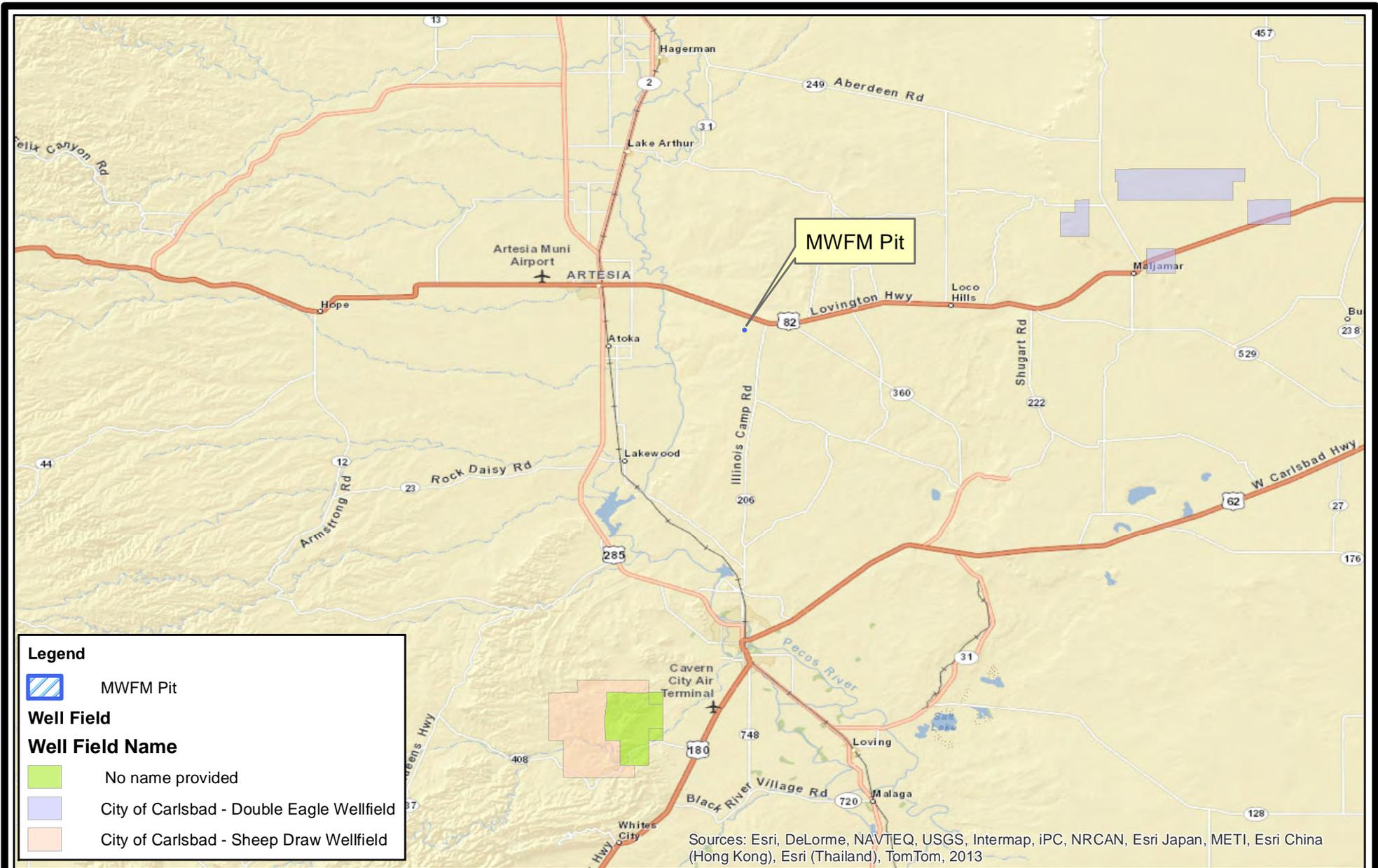
(aerial image c.2013)



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Nearby Structures
Lime Rock Resources: All Thorn MWFM Pit

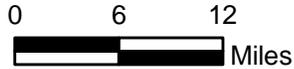
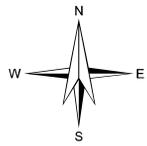
Figure 4
 April 2014



Legend

-  MWFM Pit
- Well Field**
- Well Field Name**
-  No name provided
-  City of Carlsbad - Double Eagle Wellfield
-  City of Carlsbad - Sheep Draw Wellfield

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013



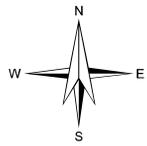
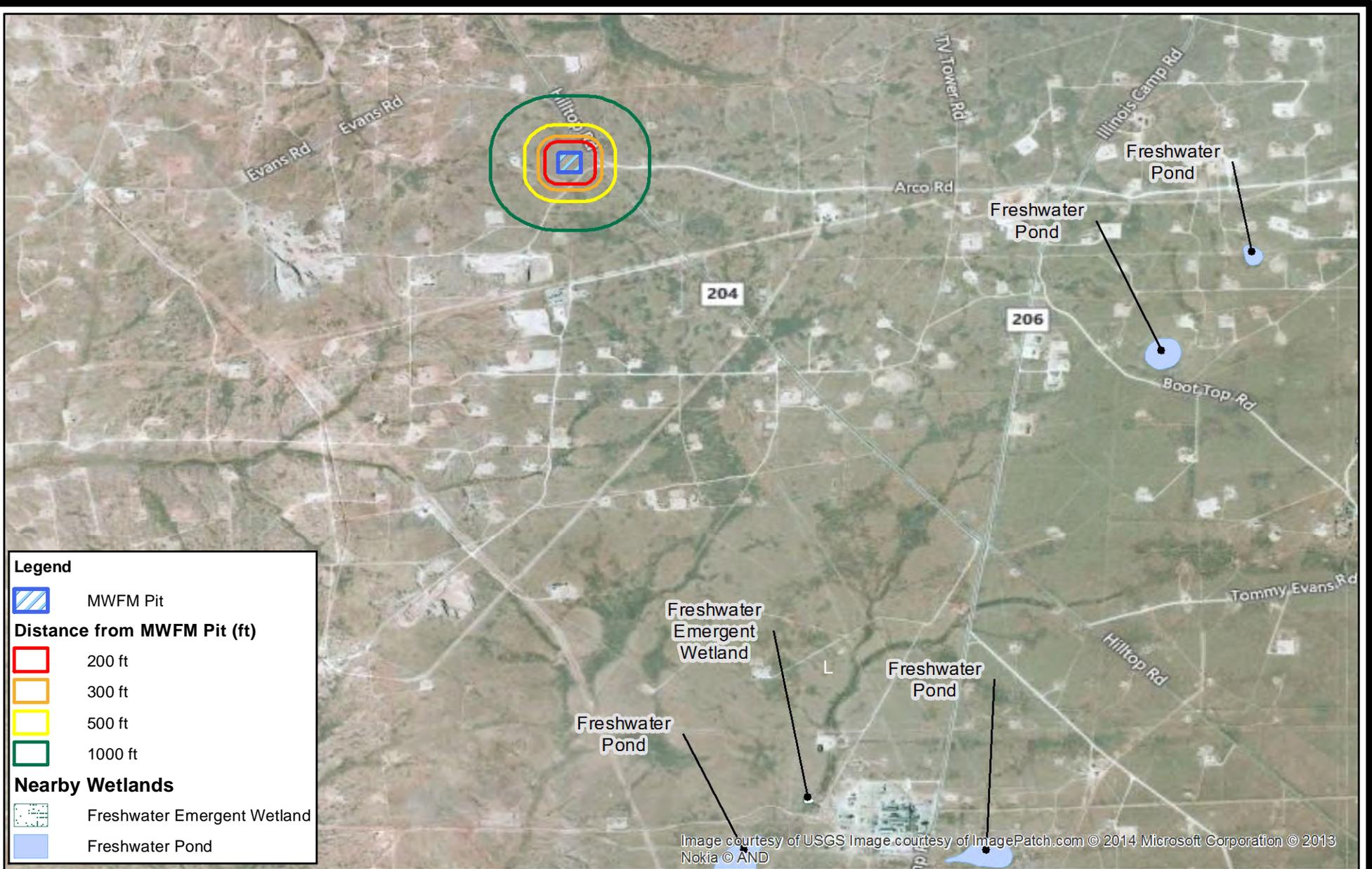
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Nearby Municipalities and Well Fields

Lime Rock Resources: All Thorn MWFM Pit

Figure 5

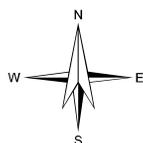
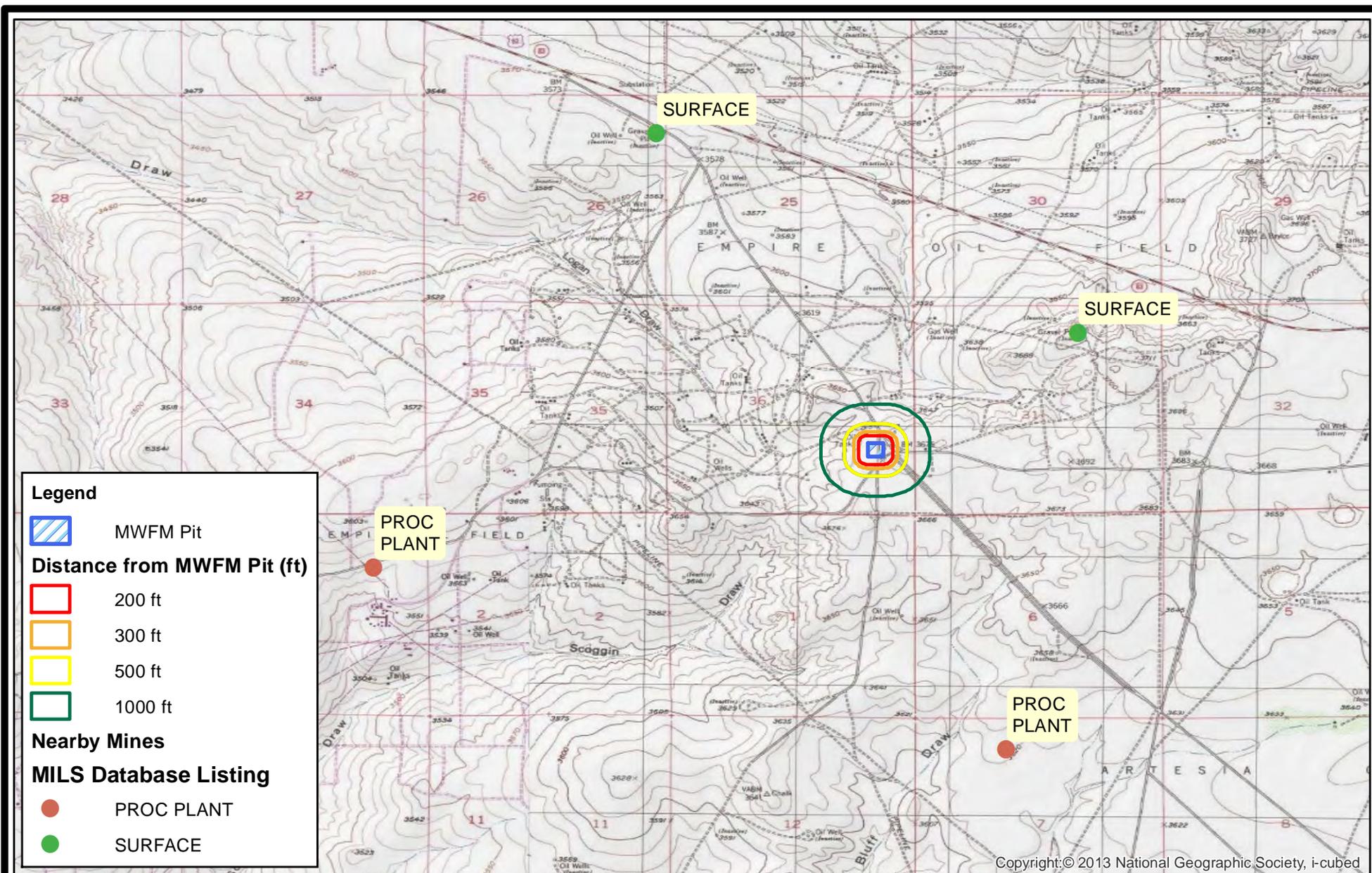
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Nearby Wetlands
Lime Rock Resources: All Thorn MWFM Pit

Figure 6
 April 2014



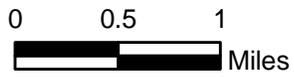
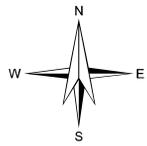
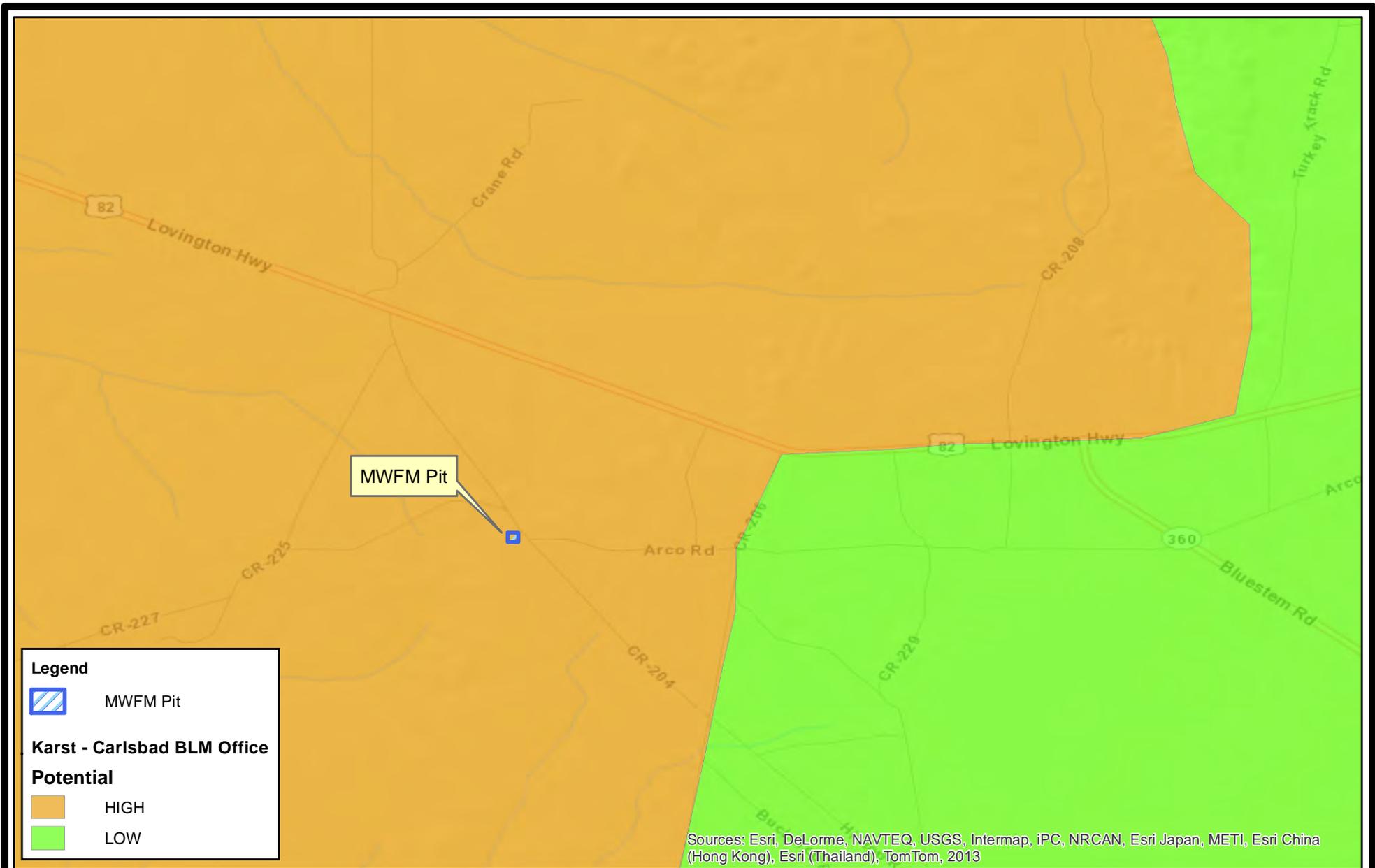
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Nearby Mines and Minerals

Lime Rock Resources: All Thorn MWFM Pit

Figure 7

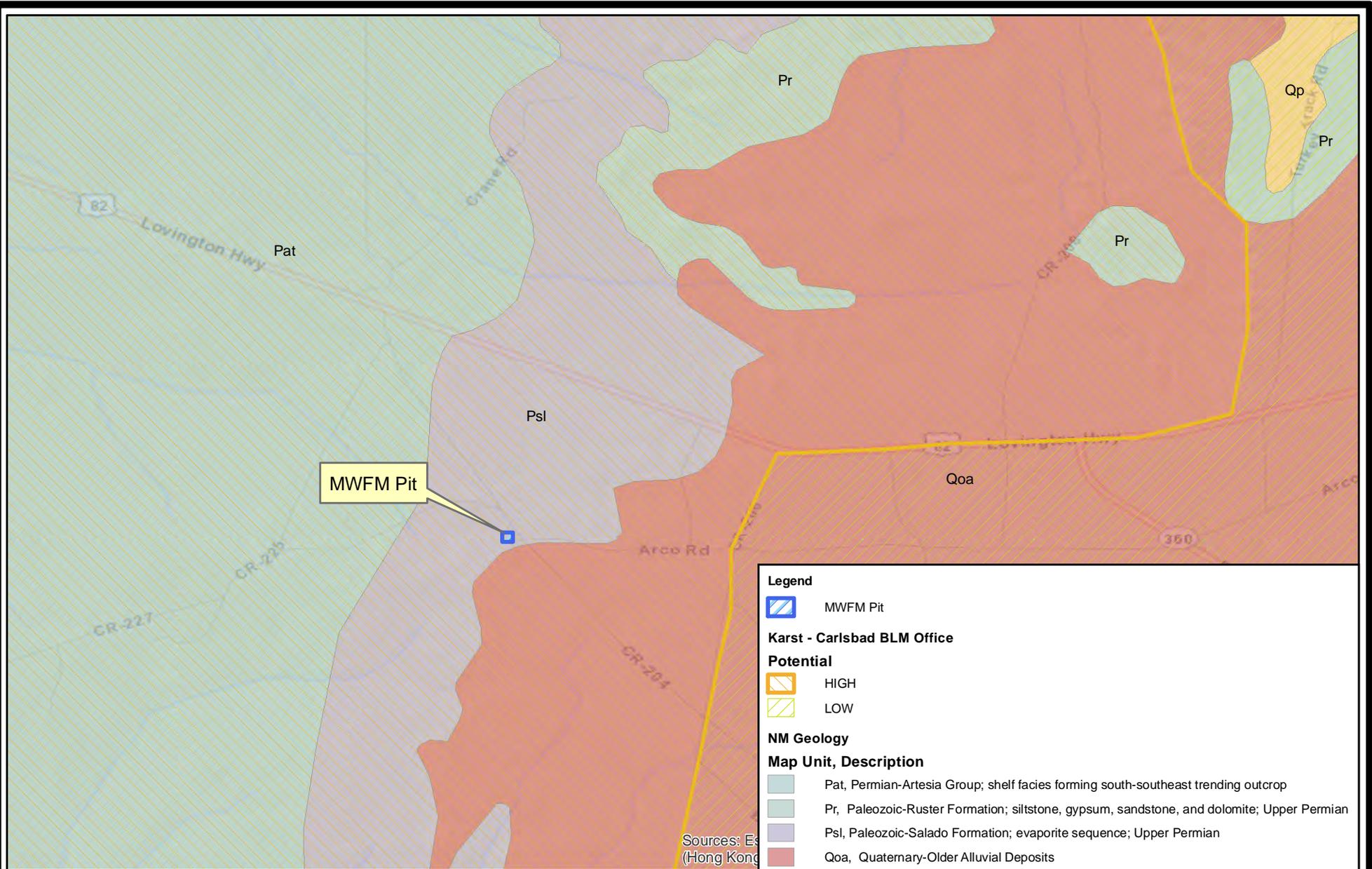
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Karst Potential
Lime Rock Resources: All Thorn MWFM Pit

Figure 8a
 April 2014



Legend

MWFM Pit

Karst - Carlsbad BLM Office

Potential

HIGH

LOW

NM Geology

Map Unit, Description

Pat, Permian-Artesia Group; shelf facies forming south-southeast trending outcrop

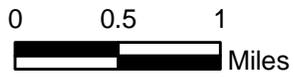
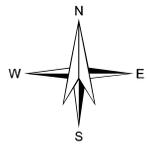
Pr, Paleozoic-Ruster Formation; siltstone, gypsum, sandstone, and dolomite; Upper Permian

Psl, Paleozoic-Salado Formation; evaporite sequence; Upper Permian

Qoa, Quaternary-Older Alluvial Deposits

Qp, Quaternary-Piedmont Alluvial Deposits

Sources: Es
(Hong Kong



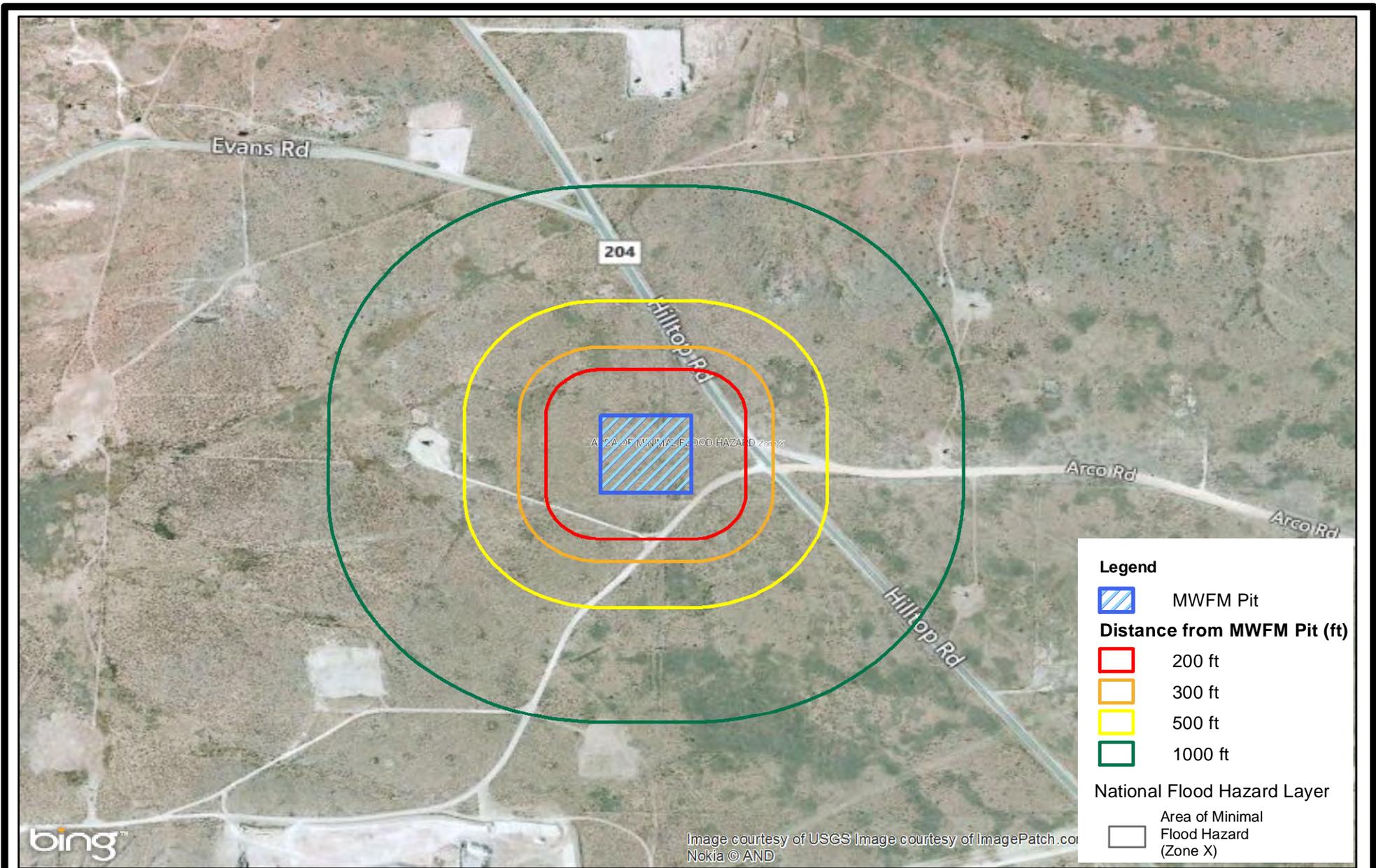
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Karst Potential and Geology

Lime Rock Resources: All Thorn MWFM Pit

Figure 8b

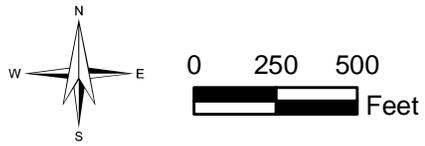
April 2014



Legend

-  MWFM Pit
- Distance from MWFM Pit (ft)**
-  200 ft
-  300 ft
-  500 ft
-  1000 ft
- National Flood Hazard Layer**
-  Area of Minimal Flood Hazard (Zone X)

FEMA Source: <https://hazards.fema.gov/gis/nfhl/services/public/NFHLWMS/MapServer/WMSServer>



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FEMA Flood Map
 Lime Rock Resources: All Thorn MWFM Pit

Figure 9
 April 2014

Appendix D

Operating and Maintenance Plan

C-144 Supplemental Information: Operation and Maintenance Plan Multi-Well Fluid Management Pit

Operating and Maintenance Procedures

Lime Rock Resources II-A, L.P. (Lime Rock) will operate and maintain the MWFM Pit to contain liquids and solids (blow sand and minimal precipitates from the treated produced water) and maintain the integrity of the liner system in a manner that prevents contamination of fresh water and protects public health and the environment as described below. The purpose of the MWFM pit is to facilitate recycling, reuse and reclamation of produced water derived from nearby oil and gas wells listed in Appendix E. During periods when water for E&P operations is not needed, produced water will discharge to one of the injection wells in the Lime Rock SWD system, which is also listed in Appendix E.

The operation of the MWFM pit is summarized below.

- A. Via pipeline, produced water generated from nearby oil and gas wells is delivered to a treatment system located within the perimeter fence on the north side of the MWFM pit. The treatment capacity of the proposed unit is about 8,000 bbls/day.
- B. After initial treatment, the produced water flows into frac tanks which provide the required residence time after treatment to remove H₂S and certain other constituents, then discharges into the pit
- C. When required, treated produced water is removed from the pit for E&P operations. At this time, treated produced water will be used for drilling beneath the fresh water zones (beneath surface casing), for well stimulation (e.g. hydraulic fracturing) and other E&P uses as approved by OCD.
- D. Typically, one well will be stimulated during the same contractor mobilization event. Each stimulation requires about 120,000 bbls and each stimulation event occurs over a several day period (set up-fracturing-demobilization). Because the pit cannot be 100% evacuated of fluid and the treated produced water serves other E&P uses (e.g. drilling), the pit must hold more than 120,000 bbls prior to each stimulation event.
- E. A treatment rate of 8,000 bbl/day allows stimulation of two wells per month.
- F. Whenever the maximum fluid capacity of the pit is reached, treatment and discharge to the pit ceases (see Freeboard and Overtopping Plan, below)

The operation of the MWFM pit will follow the mandates listed below:

1. The operator will not discharge into or store any hazardous waste (as defined by 40CFR 261 and NMAC 19.15.2.7.H.3) in the pits.
2. If the pit liner's integrity is compromised above the water line, then the operator will repair the damage within 48 hours of discovery.
3. If any penetration of the pit liner is visually identified below the normal high water mark of the pit, then The operator will suspend operations of the pit, remove all liquid above the damage or leak within 48 hours, notify the district office within 48 hours (phone or email) of the discovery and repair the damage or replace the pit liner.
4. If any penetration of the pit liner is confirmed by sampling of fluid in the leak detection system (see Inspection and monitoring plan), The operator will
 - a. Begin and maintain fluid removal from the leak detection/pump-back system
 - b. notify the district office within 48 hours (phone or email) of the discovery
 - c. Schedule a shut-down of produced water treatment/re-use, then
 - i. remove all liquids
 - ii. identify the location of the leak and
 - iii. repair the damage or replace the pit liner prior to continuing operation
5. The operator will report releases of fluid to the subsurface in a manner consistent with NMAC 19.15.29

C-144 Supplemental Information: Operation and Maintenance Plan Multi-Well Fluid Management Pit

6. As shown in the engineering drawings (Appendix A), the injection and withdrawal or treated and untreated produced water is accomplished through a piping system to prevent liner damage.
7. Appendix A also demonstrates that the elevation and slopes of the pit prevent the collection of surface water run-on.
8. No oil or floating hydrocarbon shall be present in the MWFM pit. In the on-site storage building, the operator will maintain an oil absorbent boom to contain and remove oil from the pit's surface.
9. The operator will maintain the pit free of miscellaneous solid waste or debris.
10. The operator will maintain at least three feet of freeboard for the permanent pit and will use a free-standing staff gauge to allow easy determination of the required 3-foot of freeboard.
11. The operator will ensure that all gates associated with the fence are closed and locked when responsible personnel are not on-site.

Monitoring, Inspection, and Reporting Plan

When the pit holds fluid, the operator will inspect the pit daily and document such inspections until the pit is closed. Daily inspections consist of

- a. reading and recording the fluid height of staff gauges
- b. recording any evidence that the pond surface shows visible oil
- c. visually inspecting the pit's exposed liners.

If a liner's integrity is compromised, or if any penetration of the liner occurs above the water surface, then the operator will notify the Artesia district office within 48 hours (phone or email).

After back-to-back stimulation of two wells, the fluid level in the pit should be relatively low and the nature (e.g. jetting) of water that is actively leaving and/or entering the pit should be visible. At this time, the daily inspection includes:

1. a thorough examination of the liner (e.g. with binoculars) for any possible loss of integrity.
2. Watching the movement of fluid into and/or out of the pit to monitor any liner damage due to fluid jets, vibration or other problems with the manifold system (see Design and Construction Plan for data relating to this equipment).

Monthly, the operator will

- A. Inspect diversion ditches and berms around the pit to check for erosion and collection of surface water run-on.
- B. For the first year, measure H₂S concentrations on the down-wind side of the pit.
- C. Inspect the leak detection system for evidence of damage or malfunction and monitor for leakage (see Design and Construction Plan for data relating to this system).
- D. inspect the pit for dead migratory birds and other wildlife. Within 30 days of discovery, the operator will report such findings to the USFWS and to the Artesia Division district office in order to facilitate assessment and implementation of measures to prevent incidents from reoccurring.

The operator will maintain a log of all inspections and make the log available for the appropriate Division district office's review upon request. An example of the log is attached to this section of the permit application.

- On a quarterly basis the operator will report the following information:
- Any reports of bird or wildlife mortality
- The location (UL, S, T, R), identifier (e.g. well/ API number and volume of treated produced water used for each hydraulic fracturing event

C-144 Supplemental Information: Operation and Maintenance Plan Multi-Well Fluid Management Pit

- The volume of fresh water, if any, used for hydraulic fracturing
- The total volume of treated produced water and fresh water used in the quarter.

Freeboard and Overtopping Prevention Plan

The method of operation of the pit allows for maintaining freeboard with very few potential problems. When the capacity of the pit is reached (3-feet of freeboard), the discharge of treated produced water ceases and the produced water generated by nearby oil and gas wells is managed by one of the injection wells identified in Appendix E.

If rising water levels suggest that 3-feet of freeboard will not be maintained, the operator will implement one or more of the following options

- I. Cease discharging produced water scheduled for recycling to the pit
- II. Accelerate re-use of the treated produced water for purposes approved by the Division
- III. Transfer treated produced water from the pit to one of the injection wells listed in Appendix E

The reading of the staff gauge occurs daily. In order for the MWFM Pit to rise 1-foot above the required 3-feet of freeboard (thus creating only 2-feet of freeboard) a total volume of at least 15,000 bbls of treated must enter the pit. At a treatment rate of 8,000 bbls/day, this 1-foot rise requires 2 days of discharge. Overtopping the pit would require six days of inattention, which is essentially impossible, given the need to maintain the treatment unit.

Protocol for Leak Detection Monitoring, Fluid Removal and Reporting

As shown in Appendix A, the leak detection system includes a monitoring system. Any fluid released from the primary liner will flow to the collection sump where fluid level monitoring is possible at the monitoring riser pipe associated with the leak detection system (see Appendix A). Lime Rock personnel will employ a portable electronic water level meter to determine if fluid exists in the monitoring riser pipe. Obtaining accurate readings of water levels in a sloped pipe beneath a pit can be a challenge. An electrician's wire snake may be required to push the probe to the bottom of the port and the probe may be fixed in a 2-inch PVC pipe "dry housing" to avoid false readings due to water condensation on the pipe. There are many techniques to determine the existence of water in the sumps – including low flow pumps.

If seepage from the pit into the leak detection system is suspected by a positive fluid level measurement, the operator will

1. Re-measure fluid levels in the monitoring riser pipe on a daily basis for one week to determine the rate of seepage.
2. Collect a water sample from the monitoring riser pipe to confirm the seepage is treated produced water from the pit via field conductivity and chloride measurements.
3. Notify NMOCD of a confirmed positive detection in the system within 48-hours of sampling (initial notification).
4. Install a pump into the monitoring riser pipe sump to continually (manually on a daily basis or via automatic timers) remove fluids from the leak detection system into the pit until the liner is repaired or replaced.
5. Dispatch a liner professional to inspect the portion of the pit suspected of leakage during a "low water" monitoring event.
6. Provide NMOCD a second report describing the inspection and/or repair within 20 days of the initial notification

C-144 Supplemental Information: Operation and Maintenance Plan Multi-Well Fluid Management Pit

If the point of release is obvious from the low water inspection, the liner professional will repair the loss of integrity. If the point of release cannot be determined by the inspection, the liner professional will develop a more robust plan to identify the point(s) of release. The inspection plan and schedule will be submitted to OCD with the second report. The operator will implement the plan upon OCD approval.

Pit Inspection Form All Thorn MWFM Pit

Month **Oct-14**

Day	Weekly	Low Water	Activity	Monthly	Staff Gauge	Comments
1 - Wed						
2	x				8.75	Gate unlocked upon arrival - notified Jerry Smith, no birds in pit
3					10	
4					12	
5			x			Water transfer to frac - pipes are good
6			x			Water transfer to frac - pipes are good
7		x			2.5	No visible liner problems
8					3	
9	x				4	All OK - no oil on surface, no birds in pit
10					5	
11					5	
12					6	
13					7	
14					7.5	
15				x	8	No fluid in leak detection, outer berm and stormwater diversion OK, H2S - no alarm,
16					9	
17					9	
18					9.5	
19	x				10	All OK
20					11	
21					12	
22			x			Water transfer to frac - no problems
23			x			Water transfer to frac - no problems
24		x			1.75	No visible liner problems
25					2.25	
26	x				3.75	High wind -liner is good, no birds
27					4.75	
28					5.5	
29					6.75	
30					7.75	
31					8.5	

Appendix E

List of Wells with Approved APDs

List of Wells with Approved APD's.

Well Name	API #	
EAGLE 34F FEDERAL #69	30-015	41287
EAGLE 34I FEDERAL #62	30-015	41285
EAGLE 34J FEDERAL #63	30-015	41446
EAGLE 35 H FEDERAL #25	30-015	41697
EAGLE 35F FEDERAL #24	30-015	41751
COMPTON 5 P FEDERAL #4	30-015	41439
HONDO 4 K FEDERAL #50	30-015-	41510
SIMON A 5 M FEDERAL #2	30-015	41640
EAGLE 35L FEDERAL #23	30-015	41441
EAGLE 26 N FEDERAL #6	30-015	39564
EAGLE 33G FEDERAL #27	30-015	41226
EAGLE 34N FEDERAL #64	30-015	41213
EAGLE 35 A FEDERAL #21	30-015	40810
EAGLE 35E FEDERAL #20	30-015	40809
LOGAN 2C STATE #4	30-015	40783
SIMON A 5 N FEDERAL #3	30-015	41436
EAGLE 34G FEDERAL #67	30-015	41432
EAGLE 34K FEDERAL #65	30-015	41433
KITE 5I FEDERAL #4	30-015	41718
EAGLE 34D FEDERAL #72	30-015	41216
LOGAN 35I FEDERAL #17	30-015	41370
LOGAN B 35O FEDERAL #10	30-015	41435
MATTHEWS 25 FEDERAL #2	30-015	41712
EAGLE 33N FEDERAL #31	30-015	42263
EAGLE 35E FEDERAL #29	30-015	42302
LOGAN 35J FEDERAL #20	30-015	42247
EAGLE 26I FEDERAL #7	30-015	42301
EAGLE 33J FEDERAL #25	30-015	41264
CHALK BLUFF FEDERAL #4	30-015	41509
MALCO B 6 P FEDERAL #11	30-015	42319
MATTHEWS 25 FEDERAL #3	30-015	41698
FALCON 3G FEDERAL #32	30-015	41466
EAGLE 33O FEDERAL #19	30-015	39459
FALCON 3K FEDERAL #28	30-015	39948
RESTLER STATE #1	30-015	31283
RESTLER STATE #2	30-015	35973
RESTLER STATE #3	30-015	37313
RESTLER STATE #4	30-015	38514
RESTLER STATE #5	30-015	40308
JEFFERS 36 STATE #3	30-015	31541
JEFFERS 36 STATE #4	30-015	34626

ENRON STATE #4	30-015	32162
ENRON STATE #15	30-015	36978
ENRON STATE #16	30-015	38512
ANTHONEY STATE #2	30-015	38234
STALEY STATE #2	30-015	31285
STALEY STATE #4	30-015	31287
STALEY STATE #9	30-015	36564
STALEY STATE #12	30-015	37673
STALEY STATE #16	30-015	40338
STALEY STATE #17	30-015	40026
STALEY STATE #20	30-015	40983
STALEY STATE #24	30-015	41065
KERSEY STATE #7	30-015	42612
KERSEY STATE #8	30-015	42613
ENRON STATE #21	30-015	42156
NO BLUFF STATE COM #1	30-015	30907
ANTHONEY STATE #1	30-015	37691

Appendix F

Closure Plan

C-144 Supplemental Information: Closure Plan MWFM Pit & Caliche Mining Lease

The MWFM pit is expected to contain a small volume of solids, the majority of which will be windblown sand and dust with some mineral precipitates from the water.

Closure Notice

Lime Rock Resources II-A, L.P. (Lime Rock) will not commence closure without first obtaining approval of the closure plan submitted with the C-144 application. To allow for review time and site inspection, Lime Rock will notify the Division's Santa Fe office at least 60 days prior to cessation of operations and provide a proposed schedule for closure. Lime Rock will close the permitted MWFM pit within 60 days of cessation of operation of the pit in accordance with an approved closure plan.

At least 72 hours, but not more than one week, prior to any closure activities, Lime Rock will notify the surface owner (State Land Office) by certified mail, return receipt requested. This notice will include the project name and location description.

Excavation and Removal Closure Plan – Protocols and Procedures

1. Lime Rock will remove all liquids from the pits and either:
 - a. Dispose of the liquids in a division-approved facility (e.g. Round Tank SWD #1),
or
 - b. Recycle, reuse or reclaim the water for reuse in drilling and stimulation.
2. Lime Rock will remove all solid pit contents and synthetic pit liners and transfer those materials to the following division-approved facility:
Disposal Facility Name: R360 Permit Number NM 01-0006
3. After the removal of the pit contents and liners, soils beneath the MWFM pit will be tested as follows
 - a. Collect a five-point (minimum) composite from beneath the pit liner sample to include any obviously stained or wet soils, or any other evidence of impact from the pits for laboratory analyses for the constituents listed in Table I of 19.15.17.13 NMAC.
 - b. If any concentration is higher than the parameters listed in Table I, additional delineation may be required and closure activities will not proceed without Division approval.
4. If all constituents' concentrations are less than or equal to the parameters listed in Table I, then Lime Rock will proceed to backfill the former pit location in accordance with the **Soil Cover Design** (below) with non-waste containing, uncontaminated, earthen material blended to the surrounding topography and arranged in a manner that prevents surface erosion.
5. Re-vegetation as outlined below

Soil Cover Design

If required by the surface owner, Lime Rock will backfill the former pit locations and the soil cover will consist of

1. At least 3-feet of compacted, uncontaminated, non-waste containing earthen fill with chloride concentrations less than 600 mg/kg as analyzed by EPA Method 300.0.
2. Either the background thickness of topsoil or one foot of suitable material to establish vegetation at the site, whichever is greater, over the 3-foot earth material.
3. Contours to blend with the surrounding topography and to prevent erosion of the cover and ponding over the cover.

C-144 Supplemental Information: Closure Plan MWFM Pit & Caliche Mining Lease

Closure Documentation

1. Within 60 days of closure completion, Lime Rock will submit a closure report on form C-144, with necessary attachments to document all closure activities including sampling results; information required by 19.15.17 NMAC; a plot plan; and details on back-filling, capping and covering, where applicable.
2. In the closure report, Lime Rock will certify that all information in the report and attachments is correct and that Lime Rock has complied with all applicable closure requirements and conditions specified in the approved closure plan.

Reclamation and Re-vegetation

As required by the surface owner, Lime Rock will reclaim to a safe and stable condition that existed prior to oil and gas operations and that blends with the surrounding undisturbed area

Areas not reclaimed as described herein due to their use in production or drilling operations will be stabilized and maintained to minimize dust and erosion.

For all areas disturbed by the closure process that will not be used for production operations or future drilling, the Lime Rock will

1. Replace topsoils and subsoils to their original relative positions
2. Grade so as to achieve erosion control, long-term stability and preservation of surface water flow patterns
3. Reseed in the first favorable growing season following closure

Re-vegetation and reclamation plans imposed by the surface owner will be outlined in communications with the OCD.

Lime Rock will notify the Division when the surface grading work element of reclamation is complete.

Lime Rock will notify the Division when the site meets the surface owner's requirements or exhibits a uniform vegetative cover that reflects a life-form ratio of plus or minus fifty percent (50%) of pre-disturbance levels and a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels, excluding noxious weeds.

Appendix G

Variance Request

Statement Explaining Why the Applicant Seeks a Variance

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of 19.15.17.11.J:

(8) The operator shall place a leak detection system between the upper and lower geomembrane liners that consists of two feet of compacted soil with a saturated hydraulic conductivity of 1×10^{-5} cm/sec or greater to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection. The operator may install alternative methods that the appropriate division's district office approves.

With respect to the leak detection system, the current standard of care for lagoon leak detection is synthetic drainage material (not compacted soil), similar to the 200-mil GSE Hypernet which is proposed in this application. The Hypernet is easier to install and is less expensive than the prescribed method of the Rule. This request was recently approved by OCD for the Mack Energy Round Tank Permanent Pit.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment.

With respect to the use of the 200-mil Hypernet drainage system in lieu of 2-feet of compacted soil, we believe the table below that contrasts the two systems provides ample demonstration.

Geonet Hypernet	Compacted Soil
Installation does not put strain on secondary liner	Equipment and compaction can stress secondary liner
Hydraulic conductivity is homogeneous and isotropic	Hydraulic conductivity can vary based upon the nature of the compaction and percent fines in a given load of placed soil
Fluid transmissivity is 2×10^{-3} m ² /sec	Mandated transmissivity is 6×10^{-8} m ² /sec
Settling after loading/unloading pit with fluid should be minimal	Settling after loading/unloading pit with fluid could be measureable, creating liner strain and changes in flow patterns to the detection system

The variance request to use the Hypernet drainage system in lieu of 2-feet of compacted soil is exactly the same as the recently-approved exception request by Mack Energy for the Round Tank Permanent Pit.

**C-144 Permit Package for
All Thorn
Multi-Well Fluid Management Pit
Section 36 T17S R27E Eddy County**

Appendices A-C



View southwest from northeast corner of proposed site showing All Thorn trees

**Prepared for
LRE Operating LLC
Artesia, New Mexico**

**Prepared by
Huitt-Zollars, Inc
333 Rio Rancho Blvd
Suite 101
Rio Rancho, New Mexico**

**R.T. Hicks Consultants, Ltd.
901 Rio Grande NW
F-142
Albuquerque, New Mexico**

Appendix A

Certified Engineering Drawings

All Thorn MWFM Pit

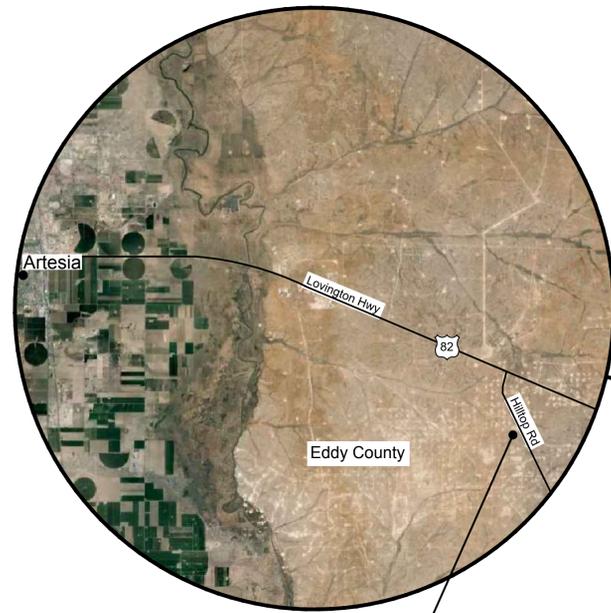
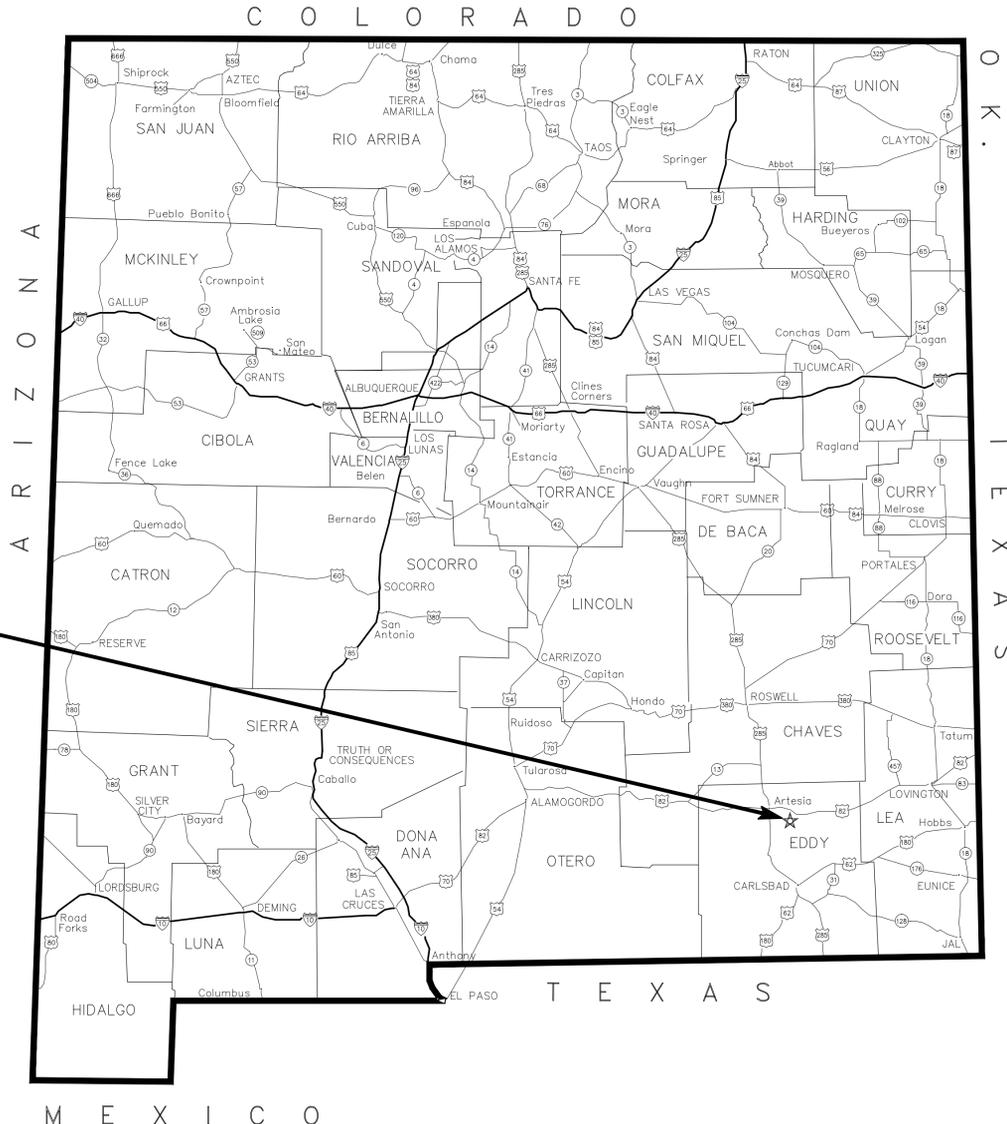
Section 36 T17S R27E
Eddy County, New Mexico



Permit Plans

100% Submittal
MAY 7, 2014

NO.	DESCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			



All Thorn MWFM Pit
Eddy County, NM

SHEET	SHEET TITLE
C001	PROJECT COVER SHEET
C101	SITE PLAN
C300	DETAILS
C301	DETAILS
C400	SWPPP NOTES
C401	SWPPP

APPROVALS

State of New Mexico Oil Conservation Division _____ DATE _____

Designed By: **HUIT-ZOLIARS**
Huit-Zoliars, Inc. 5000 Camino Del Rio NE, Suite 200
San Diego, CA 92108
Phone (619) 882-5141 Fax (619) 882-3259

Designed For: **LIME ROCK RESOURCES**

PROJECT COVER SHEET

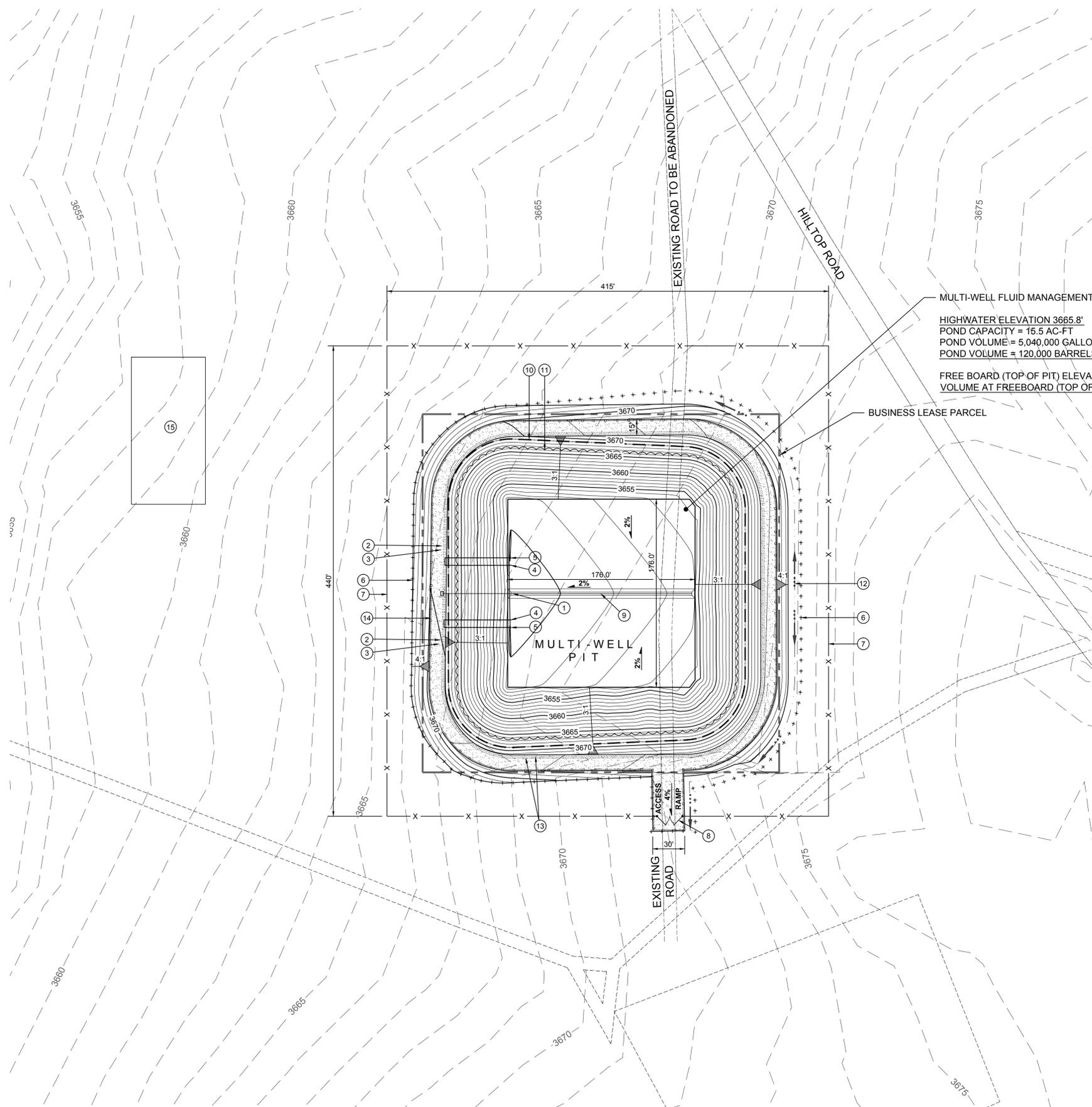
ALL THORN MWFM PIT
SECTION 36 T17S R27E
EDDY COUNTY, NM



PROJECT NO.	R170976.03
DESIGNED BY:	SAE
DRAWN BY:	LRT
CHECKED BY:	SAE
DATE:	MAY 7, 2014
DPW CHK:	-
SHEET:	C001

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SITE PLAN

GENERAL NOTES

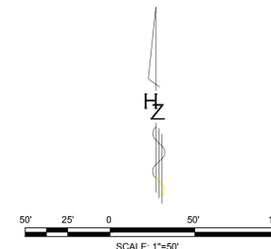
1. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH THE PROJECT CONSTRUCTION PLANS, SPECIFICATIONS, AND THE LATEST EDITION OF THE NEW MEXICO STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION.
2. OWNER AND CONTRACTOR ARE RESPONSIBLE TO DEVELOP, PERMIT, IMPLEMENT AND MAINTAIN THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IN ACCORDANCE WITH FEDERAL AND STATE REQUIREMENTS. SWPPP IS INCIDENTAL TO THE PROJECT.
3. BOTTOM OF PIT SHALL BE SLOPED AT 2% AS SHOWN.
4. PERIMETER OF THE PIT SHALL BE ENCLOSED WITH A BARBED WIRE FENCE.
5. STRIP AND STOCKPILE TOPSOIL FOR FUTURE CLOSURE USE. OWNER SHALL DIRECT LOCATION OF STOCKPILE.
6. EARTHWORK SHALL BE WETTED TO OPTIMUM MOISTURE CONTENT AND COMPACTED TO A MINIMUM OF 95% ASTM D-1557.

○ SHEET KEYNOTES

1. 3'x3' SUMP. SEE DETAIL A, SHEET C300.
2. 3'x4.5' SUMP ACCESS. SEE DETAIL B, SHEET C301.
3. BOLLARDS. SEE DETAIL C, SHEET C300.
4. PIPE SUCTION & DISCHARGE PIT INFLOW SIDE. SEE DETAIL G, SHEET C301.
5. PIPE SUCTION & DISCHARGE PIT OUTFLOW SIDE. SEE DETAIL H, SHEET C301.
6. LIMITS OF DISTURBANCE.
7. 4 STRAND BARBED WIRE FENCE. SEE DETAIL I, SHEET C301.
8. 12-FOOT SWING GATE (FENCE HEIGHT AND GUARD TO MATCH), TWO EACH.
9. LEAK DETECTION SYSTEM PIPING - 4" SCHEDULE 80 PVC.
10. 3' FREEBOARD DEPTH.
11. HIGH WATER ELEVATION.
12. EROSION PROTECTION DITCH: 3' WIDTH AND 6" DEPTH.
13. ANCHOR TRENCH. SEE DETAIL A, SHEET C301.
14. GAME FENCE W/36" HIGH "CHICKEN WIRE" FIRMLY ATTACHED TO BOTTOM.
15. STOCKPILE AREA.

LEGEND

- 3740 --- EXISTING MAJOR CONTOUR
- 3745 --- EXISTING MINOR CONTOUR
- 3745 --- PROPOSED MAJOR CONTOUR
- 3745 --- PROPOSED MINOR CONTOUR
- 3745 --- PROPOSED BARBED WIRE FENCE
- 3745 --- LEAK DETECTION PIPING
- 3745 --- LIMITS OF DISTURBANCE
- 3745 --- HIGH WATER ELEVATION
- 3745 --- DITCH & FLOW DIRECTION



NO.	DESCRIPTION	DATE	BY
7			
6			
5			
4			
3			
2			
1			

Designed By: **HUIT-ZOLIARS**
 Huit-Zoliars, Inc.
 10000 Camino Del Rio NE, Suite 101
 San Diego, CA 92124
 Phone: (619) 882-5141 Fax: (619) 882-3259

Designed For: **LIME ROCK RESOURCES**

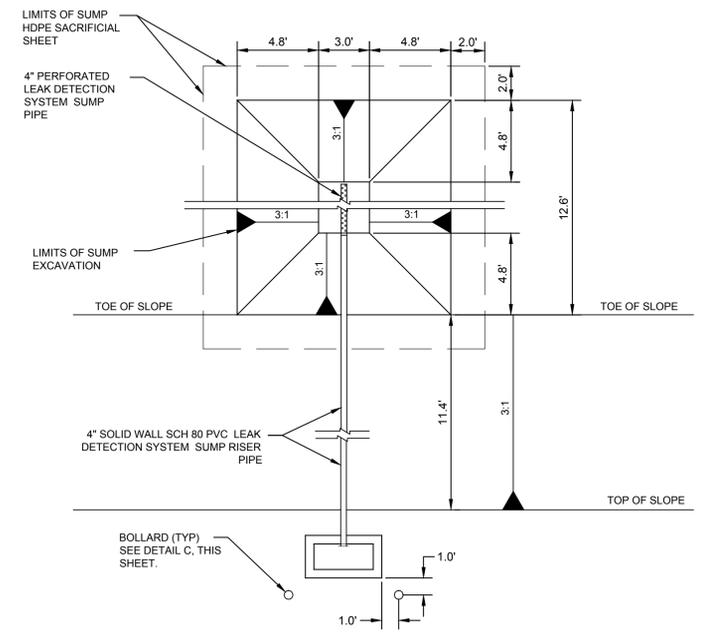
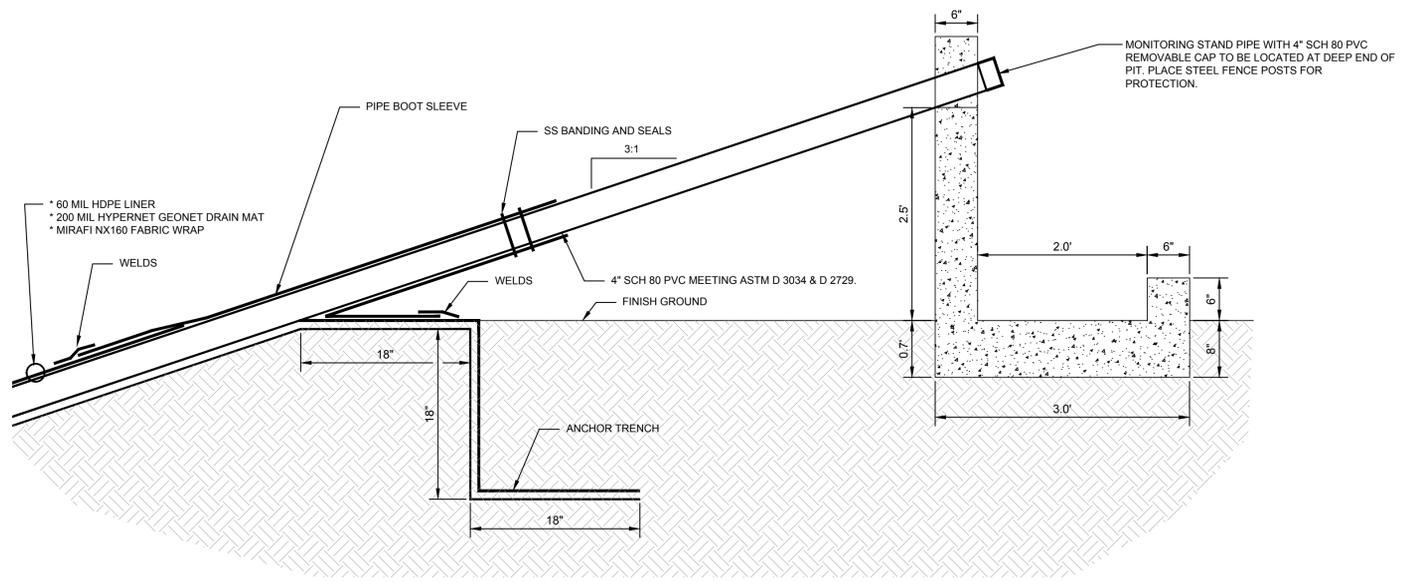
SITE PLAN

**ALL THORN MWFM PIT
 SECTION 36 T17S R27E
 EDDY COUNTY, NM**

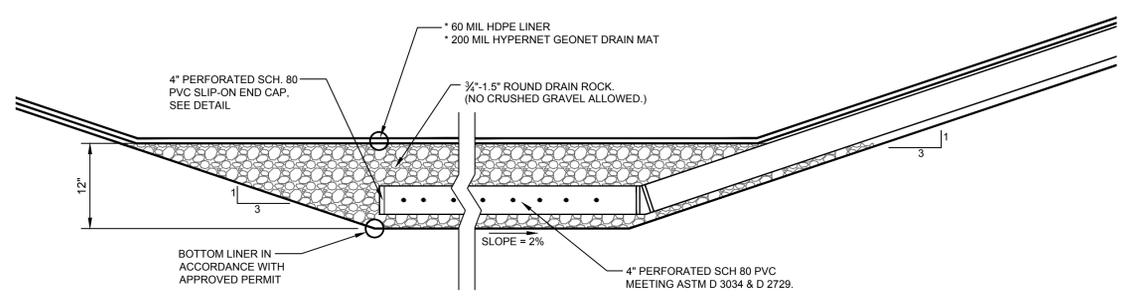
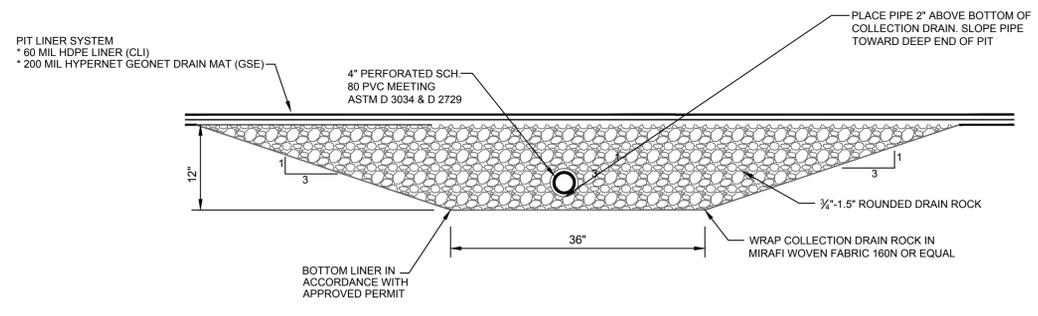


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 DRAWN BY: **LRT**
 CHECKED BY: **SAE**
 DATE: **MAY 7, 2014**
 DPW CHK: **-**

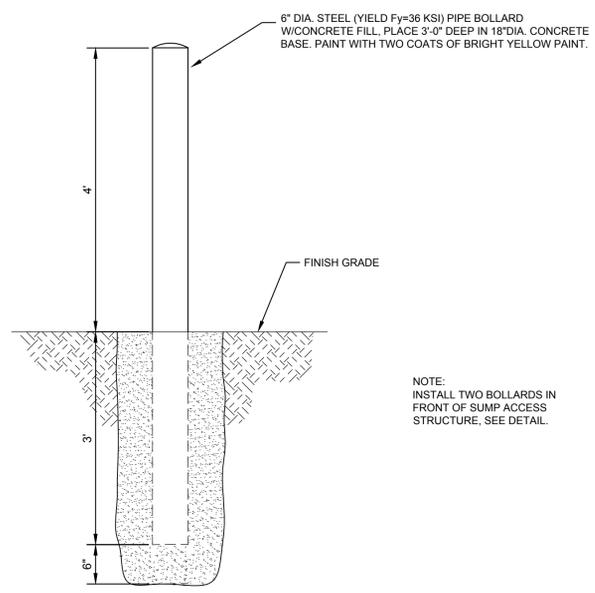
SHEET: **C101**



SUMP DETAIL Scale: 1"=5' **B**



LINER & LEAK DETECTION SYSTEM Scale: 1"=1' **A**



BOLLARD DETAIL (TYP) Scale: N.T.S. **C**



REVISIONS (OR CHANGE NOTICES)	
NO.	DESCRIPTION
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1	

Designed By: **HUIT-ZOLIARS**
 Huit-Zoliars, Inc.
 10000 Camino Del Rio NE, Suite 101
 San Diego, CA 92126
 Phone: (619) 592-5141 Fax: (619) 592-3259

Designed For: **LIME ROCK RESOURCES**

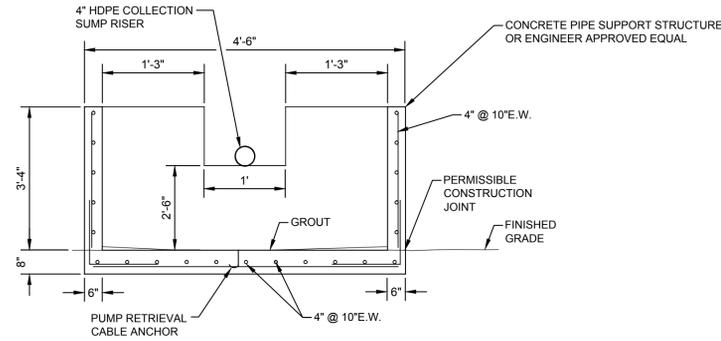
DETAILS

ALL THORN MWFM PIT
SECTION 36 T17S R27E
EDDY COUNTY, NM

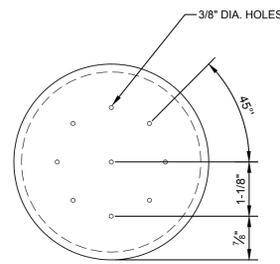


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DRAWN BY:	LRT
CHECKED BY:	SAE
DATE:	MAY 7, 2014
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SHEET:	C300

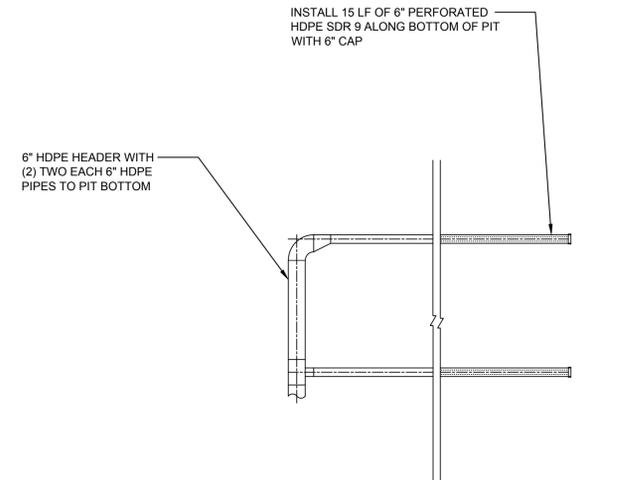
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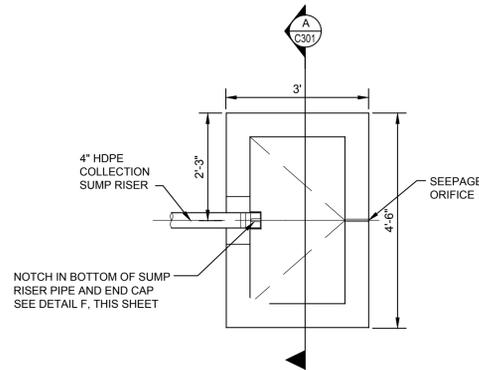
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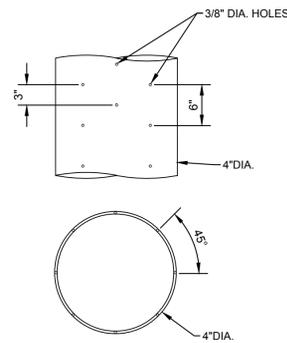
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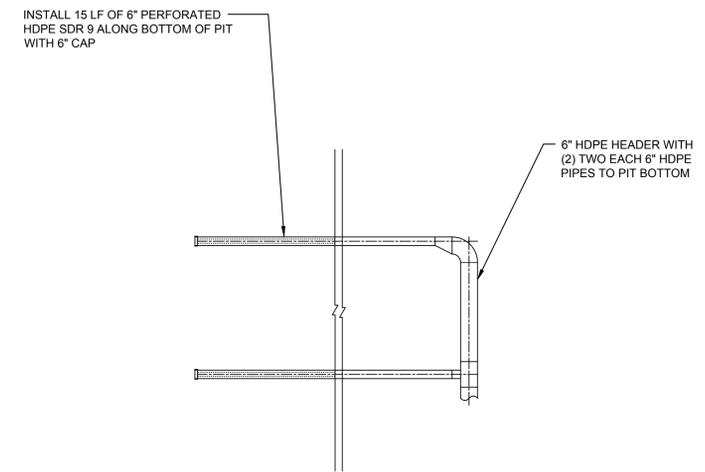
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Scale: N.T.S. **G**



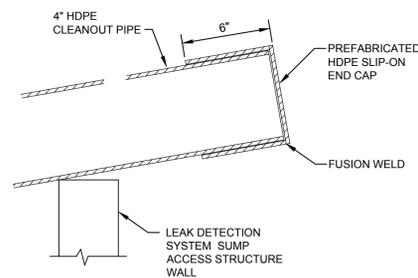
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Scale: N.T.S. **C**



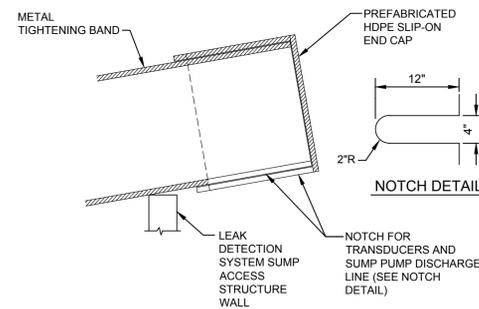
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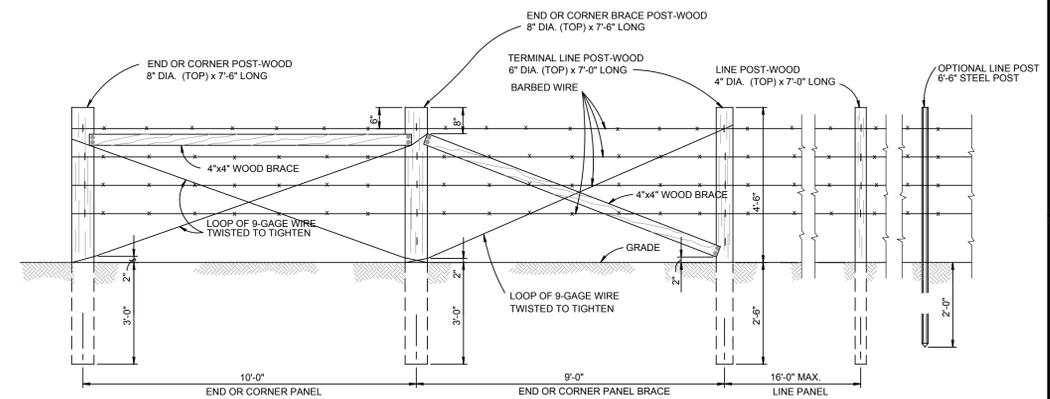
PIPE SUCTION & DISCHARGE OUTFLOW SIDE
Scale: N.T.S. **H**



CLEANOUT RISER END
Scale: N.T.S. **E**



SUMP RISER END CAP
Scale: N.T.S. **F**



4 STRAND BARBED-WIRE FENCE
Scale: N.T.S. **I**



NO.	DESCRIPTION	DATE	BY
7			
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Designed By: **HUIT-ZOLIARS**
 Huit-Zoliars, Inc. The Ranchos
 10000 Camino Del Rio NE, Suite 101
 San Diego, CA 92121
 Phone: (619) 892-5141 Fax: (619) 892-3259

Designed For: **LIME ROCK RESOURCES**

DETAILS

ALL THORN MWFM PIT SECTION 36 T17S R27E EDDY COUNTY, NM



PROJECT NO. **R170976.03**

DESIGNED BY: **SAE**

DRAWN BY: **LRT**

CHECKED BY: **SAE**

DATE: **MAY 7, 2014**

DPW CHK: **-**

SHEET: **C301**

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EROSION AND SEDIMENT CONTROL

SITE DESCRIPTION

PROJECT NAME AND LIMITS: ALL THORN MWFM PIT
PROJECT IS LOCATED IN PORTIONS OF SECTION 36 T17S R27E

PROJECT DESCRIPTION: CONSTRUCTION OF A PERMANENT PIT.

EXISTING CONDITIONS: THE SITE IS UNDEVELOPED RANGELAND.

MAJOR SOIL DISTURBING ACTIVITIES: CONSTRUCTION ACTIVITIES INCLUDE HEAVY DIRT MOVING AND LINER CONSTRUCTION.

TOTAL PROJECT AREA: 2.6 ARES

TOTAL AREA TO BE DISTURBED: 2.9 ACRES

WEIGHTED RUNOFF COEFFICIENT (AFTER CONSTRUCTION): 0.33

EXISTING CONDITION OF SOIL AND VEGETATIVE COVER AND % OF EXISTING VEGETATIVE COVER:

NAME OF RECEIVING WATERS: THE SITE IS GENTLY SLOPING TO THE WEST; SURFACE SOILS ON THIS PORTION OF THE SITE ARE BROWN LOAMY FINE SANDS. SITE SOILS ARE OF A POOR QUALITY FOR VEGETATION PRODUCTION. SITE VEGETATION CONSISTS OF SPARSE DESERT SHRUBS. THE SOILS ARE MODERATELY TO VERY PERMEABLE AND SUSCEPTIBLE TO BLOWING.

OWNER CERTIFICATION

I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHERED AND EVALUATED THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM, OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS, TO THE BEST OF MY KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS.

OWNER: SIGNED DATE

OWNER: NAME DATE

TITLE DATE

SOIL STABILIZATION PRACTICES

- TEMPORARY SEEDING
PERMANENT PLANTING, SODDING, OR SEEDING
MULCHING
SOIL RETENTION BLANKET
[X] BUFFER ZONES
[X] PRESERVATION OF NATURAL RESOURCES

OTHER:

STRUCTURAL PRACTICES:

- [X] SILT FENCES
HAY BALES
ROCK BERMS
DIVERSION, INTERCEPTOR, OR PERIMETER DIKES
[X] DIVERSION, INTERCEPTOR, OR PERIMETER SWALES
DIVERSION DIKE AND SWALE COMBINATION
PIPE SLOPE DRAINS
CONCRETE FLUMES
ROCK BEDDING AT CONSTRUCTION EXIT
TIMBER MATTING AT CONSTRUCTION EXIT
CHANNEL LINERS
SEDIMENT TRAPS
SEDIMENT BASINS
STORM INLET SEDIMENT TRAP
STONE OUTLET STRUCTURES
CURBS AND GUTTERS
STORM DRAINS
VELOCITY CONTROL DEVICES
VEGETATED SWALES & NATURAL DEPRESSIONS

OTHER: NEW EARTHEN SWALE

NARRATIVE - SEQUENCE OF CONSTRUCTION (STORM WATER MANAGEMENT) ACTIVITIES:

- 1. CONSTRUCT TEMPORARY EROSION CONTROLS INCLUDING DITCHES AND FILTER FENCES.
2. STRIP AND STOCKPILE TOPSOIL IN DESIGNATED AREAS. CONSTRUCT APPROPRIATE EROSION CONTROLS TO MAINTAIN NATURAL DRAINAGE PATTERNS TO THE EXTENT POSSIBLE.
3. EXCAVATE TO THE ELEVATIONS SHOWN ON THE ENCLOSED GRADING PLAN AND STOCKPILE SOIL IN DESIGNATED AREAS.
4. CONSTRUCT A COMPOSITE LINER IN ACCORDANCE WITH THE SOIL LINER QUALITY CONTROL PLAN

GENERAL CONTRACTOR CERTIFICATION

I CERTIFY UNDER PENALTY OF LAW THAT I UNDERSTAND THE TERMS AND CONDITIONS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) GENERAL PERMIT THAT AUTHORIZES STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY FROM THE CONSTRUCTION SITE IDENTIFIED AS PART OF THIS CERTIFICATION.

SIGNED: COMPANY:
NAME: ADDRESS:
TITLE: TELEPHONE:
DATE:

SUB - CONTRACTOR CERTIFICATION

I CERTIFY UNDER PENALTY OF LAW THAT I WILL COORDINATE, EITHER THROUGH THE GENERAL CONTRACTOR, OWNER, OR DIRECTLY, WITH THE CONTRACTOR(S) AND/OR SUBCONTRACTOR(S) IDENTIFIED IN THE POLLUTION PREVENTION PLAN HAVING RESPONSIBILITY FOR IMPLEMENTING STORM WATER CONTROL MEASURES TO MINIMIZE ANY IMPACT MY ACTIONS MAY HAVE ON THE EFFECTIVENESS OF THESE STORM WATER CONTROL MEASURES.

SIGNED: COMPANY:
NAME: ADDRESS:
TITLE: TELEPHONE:
DATE:

BEST MANAGEMENT PRACTICES CONTROLS

- I. WASTE MATERIALS: ALL WASTE MATERIALS, INCLUDING CONSTRUCTION DEBRIS, SHALL BE COLLECTED AND STORED IN A SECURELY LIDDED METAL DUMPSTER. NO CONSTRUCTION WASTE MATERIAL SHALL BE BURIED ON SITE. THE TRANSIT DUMPSTER SHALL COMPLY WITH ORDINANCE 18.52.010 (ENCLOSURE AND REMOVAL OF WASTE MATERIALS DURING CONSTRUCTION), THE DUMPSTER SHALL BE EMPTIED AS NECESSARY OR AS REQUIRED BY ORDINANCE 9.04 (SOLID WASTE MANAGEMENT) AND THE TRASH SHALL BE HAULED TO A LICENSED LANDFILL.
II. HAZARDOUS WASTE: AT A MINIMUM, ANY PRODUCTS IN THE FOLLOWING CATEGORIES SHALL BE CONSIDERED HAZARDOUS: PAINT, ACIDS FOR CLEANING MASONRY SURFACES, CLEANING SOLVENTS, ASPHALT PRODUCTS, CHEMICAL ADDITIVES FOR SPILL STABILIZATION, CURING COMPOUNDS AND ADDITIVES. IN THE EVENT OF A SPILL WHICH MAY BE HAZARDOUS, THE CONTRACTOR SHALL TAKE IMMEDIATE ACTION AND CONTACT THE FIRE DEPT. AND NMED.
III. SANITARY WASTE: ALL SANITARY WASTE SHALL BE COLLECTED FROM THE CONSTRUCTION PORTABLE UNITS AS NECESSARY OR AS REQUIRED, CHAPTER 18.08 (BUILDING CODE), BY A LICENSED SANITARY WASTE MANAGEMENT CONTRACTOR. ALL WASTE MATERIAL SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
IV. SPILL PREVENTION: THE FOLLOWING PRACTICES SHALL BE USED TO REDUCE THE RISK OF SPILLS OR OTHER ACCIDENTAL EXPOSURES OF MATERIALS TO STORM WATER RUNOFF.
V. GOOD HOUSEKEEPING: A. STORE ONLY ENOUGH PRODUCTS REQUIRED TO DO THE JOB B. NEATLY STORE MATERIALS ON-SITE IN AN ORDERLY MANNER C. KEEP PRODUCTS IN THEIR ORIGINAL CONTAINER D. DO NOT MIX SUBSTANCES WITH ONE ANOTHER, UNLESS OTHERWISE RECOMMENDED BY THE MANUFACTURER E. USE ENTIRE CONTENTS OF A PRODUCT BEFORE DISPOSING THE CONTAINER F. FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR PROPER USE AND DISPOSAL
VI. HAZARDOUS PRODUCTS: PRACTICES USED TO REDUCE RISKS: A. KEEP PRODUCTS IN THEIR ORIGINAL CONTAINER IF AT ALL POSSIBLE B. RETAIN ORIGINAL LABELS, PRODUCT INFORMATION AND MATERIAL SAFETY DATA SHEETS (MSDS) C. DISPOSE SURPLUS PRODUCT IN ACCORDANCE WITH MANUFACTURER'S OR LOCAL & STATE RECOMMENDED METHODS
VII. PETROLEUM PRODUCTS: ALL ON-SITE VEHICLES SHALL BE MONITORED FOR LEAKS AND RECEIVE REGULAR PREVENTIVE MAINTENANCE TO REDUCE THE CHANCE OF LEAKAGE. PETROLEUM PRODUCTS SHALL BE STORED IN TIGHTLY SEALED CONTAINERS WHICH ARE CLEARLY LABELED. ANY ASPHALT SUBSTANCES USED ON-SITE SHALL BE APPLIED ACCORDING TO THE MANUFACTURER'S RECOMMENDATION.
VIII. SPILL CONTROL PRACTICES: A. MANUFACTURER'S RECOMMENDED METHODS FOR SPILL CLEANUP SHALL BE CLEARLY POSTED AND SITE PERSONNEL SHALL BE MADE AWARE OF THE PROCEDURES: B. MATERIALS AND EQUIPMENT NECESSARY FOR CLEANUP SHALL BE KEPT IN THE MATERIAL STORAGE AREA ON-SITE: C. ALL SPILLS SHALL BE CLEANED UP IMMEDIATELY AFTER DISCOVERY D. SPILL AREA SHALL BE WELL VENTILATED AND APPROPRIATE CLOTHING WILL BE WORN: E. ANY SPILL SHALL BE REPORTED TO THE APPROPRIATE GOVERNMENTAL AGENCY F. MEASURES SHALL BE TAKEN TO PREVENT A SPILL FROM REOCCURRING
IX. MAINTENANCE AND INSPECTION PROCEDURES: ALL POLLUTION PREVENTION MEASURES SHALL BE INSPECTED AT LEAST ONCE A MONTH OR WITHIN 24-HOURS PRIOR TO ANTICIPATED STORM EVENT AND FOLLOWING A STORM EVENT OF 0.5 INCHES OR MORE. INSPECTION IN FINAL STABILIZED AREAS OR DURING ARID PERIODS WILL BE CONDUCTED MONTHLY, BEST MANAGEMENT PRACTICES AND POLLUTION CONTROL PROCEDURES SHALL BE INSPECTED FOR ADEQUACY.
X. REMARKS: DISPOSAL AREAS, STOCKPILES, AND HAUL ROADS SHALL BE CONSTRUCTED IN A MANNER THAT WILL MINIMIZE AND CONTROL THE AMOUNT OF SEDIMENT THAT MAY ENTER RECEIVING WATERS. DISPOSAL AREAS SHALL NOT BE LOCATED IN ANY WETLAND, WATERBODY OR STREAMBED. CONSTRUCTION STAGING AREAS AND VEHICLE MAINTENANCE AREAS SHALL BE CONSTRUCTED BY THE CONTRACTOR IN A MANNER TO MINIMIZE THE RUNOFF OF POLLUTANTS. ALL WATERWAYS SHALL BE CLEANED AS SOON AS PRACTICABLE OF TEMPORARY EMBANKMENT, TEMPORARY BRIDGES, MATTING, FALSEWORK, PILING DEBRIS OR OTHER OBSTRUCTIONS PLACED DURING CONSTRUCTION OPERATIONS THAT ARE NOT A PART OF THE FINISHED WORK.
XI. OFFSITE VEHICLE TRACKING: IN ADDITION TO THE STABILIZED CONSTRUCTION ENTRANCES, THE FOLLOWING MEASURES SHALL BE OBSERVED DURING CONSTRUCTION: -HAUL ROADS SHALL BE DAMPENED FOR DUST CONTROL - LOADED HAUL TRUCKS SHALL BE COVERED WITH TARPAULIN - EXCESS DIRT ON ROAD SHALL BE REMOVED IMMEDIATELY - STABILIZED CONSTRUCTION ENTRANCE - OTHER:

MISCELLANEOUS

- [X] NO BATCH PLANT
[X] NO ENDANGERED SPECIES



Table with 7 columns: NO., DATE, REVISIONS (OR CHANGE NOTICES), BY

HUIT-ZOLIARS logo and contact information for Lime Rock Resources

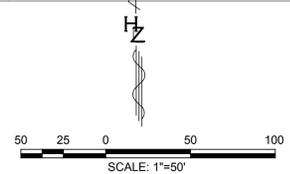
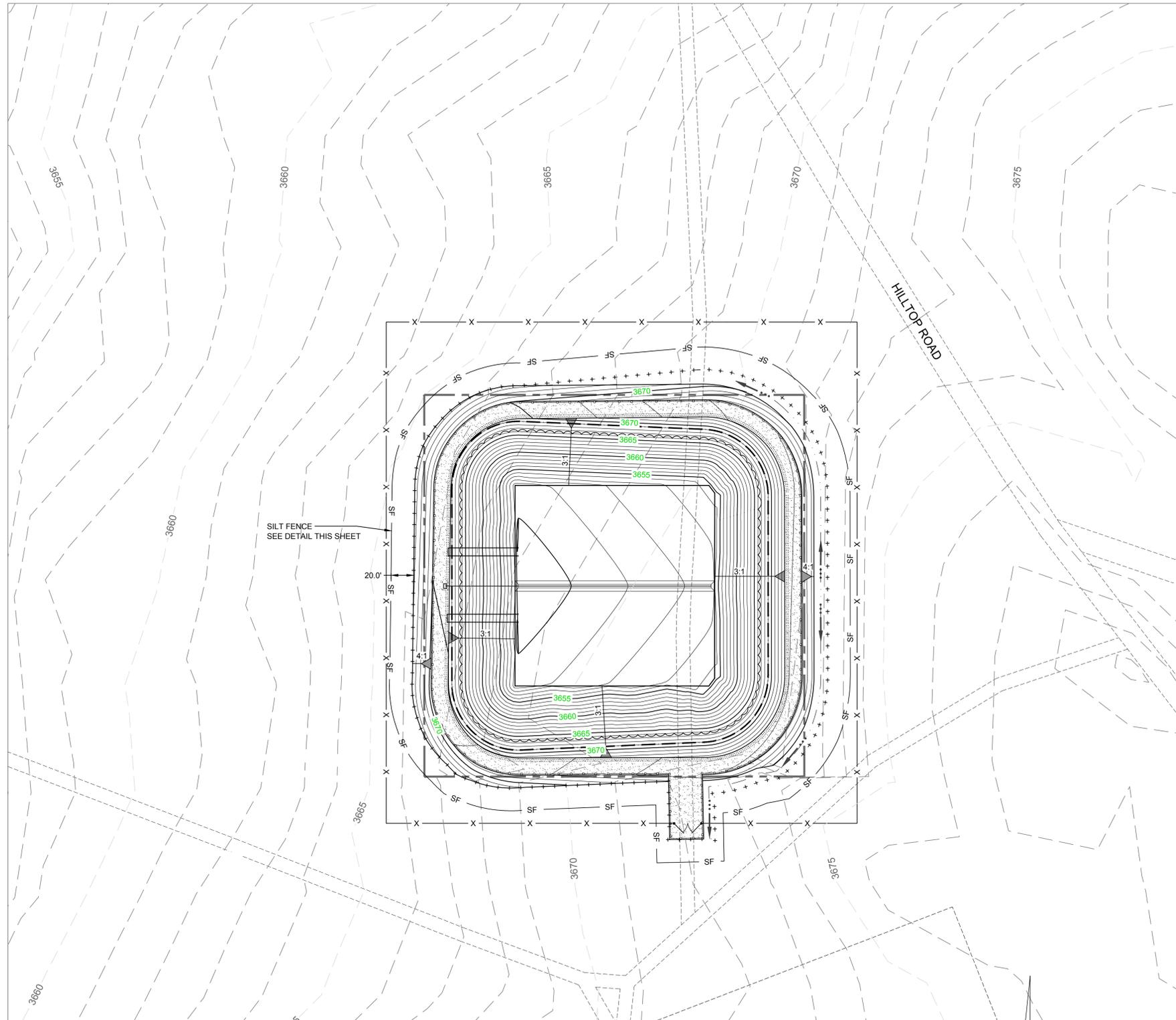
SWPPP NOTES
ALL THORN MWFM PIT
SECTION 36 T17S R27E
EDDY COUNTY, NM



PROJECT NO. R170976.03
DESIGNED BY: SAE
DRAWN BY: LRT
CHECKED BY: SAE
DATE: MAY 7, 2014
DPW CHK: -
SHEET: C400

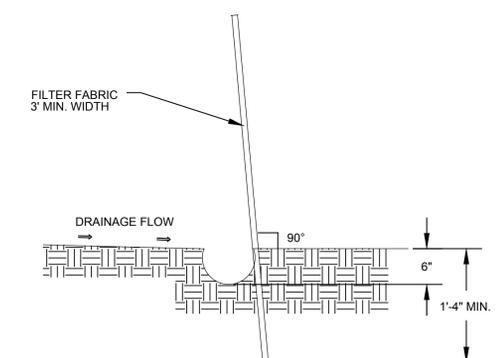
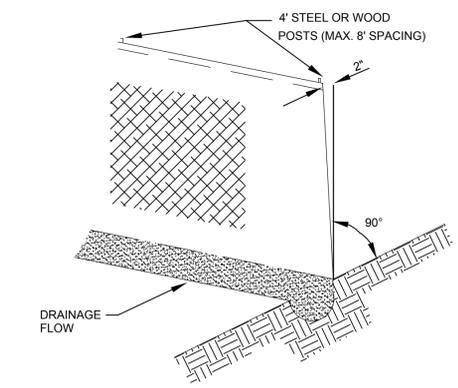
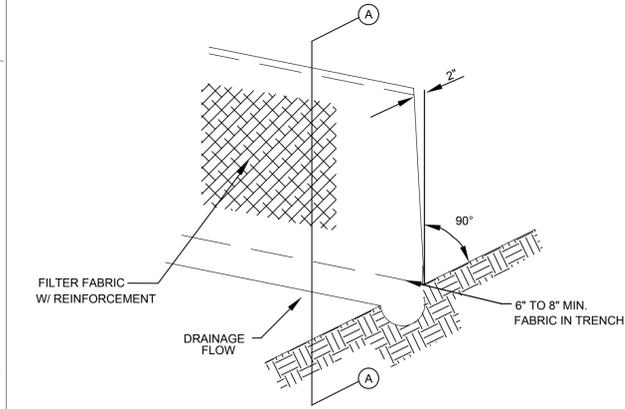
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EROSION CONTROL

1. PIT SHALL BE SITED OUTSIDE OF ANY POSSIBILITY TO BE IMPACTED BY CONCENTRATED STORM WATER FLOWS.
2. STORM WATER SHEET FLOWS SHALL BE ROUTED AROUND PERIMETER OF PIT WITHIN AN EARTHEN SWALE. THE SWALE SHALL BE INSTALLED FROM THE HIGH POINT AND EXTEND TO THE LOW POINT. GRADES WITHIN SWALE SHALL NOT EXCEED 2% WITHOUT ADDITIONAL ARMORING OF FLOWLINE AND SIDE SLOPES.
3. STOCKPILE TOPSOIL ALONG FENCE LINE. WINDROW STOCKPILED SOIL TO MINIMIZE STORMWATER RUN ON.
4. SEDIMENT SHALL BE FILTERED FROM SWALE IN ACCORDANCE WITH THE STORM WATER POLLUTION PREVENTION PLAN.
5. EXPOSED SLOPES SHALL BE STABILIZED WITH CALICHE MATERIAL.
6. ALL DISTURBED AREAS SHALL BE SEEDED WITH NATIVE SEEDS AND STRAW CRIMPED UNLESS NOTED OTHERWISE.



REINFORCEMENT AND FILTER FABRIC TO BE DIRECTED BY THE ENGINEER

**SEDIMENT CONTROL FENCE
 STRUCTURE SECTION**

Scale: N.T.S. **A**

NOTE: POULTRY NETTING SHALL NOT BE ALLOWED AS A REINFORCEMENT MATERIAL. CONTRACTOR SHALL POST NOTICE OF INTENT AT SITE ENTRANCE.



NO.	DESCRIPTION	DATE	BY
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Designed By: **HUIT-ZOLIARS**
 Huit-Zoliars, Inc.
 10000 Camino Del Rio NE, Suite 200
 San Diego, CA 92128
 Phone: (619) 592-5141 Fax: (619) 592-3259

Designed For: **LIME ROCK RESOURCES**

SWPPP

**ALL THORN MWFM PIT
 SECTION 36 T17S R27E
 EDDY COUNTY, NM**



PROJECT NO. **R170976.03**
 DESIGNED BY: **SAE**
 DRAWN BY: **LRT**
 CHECKED BY: **SAE**
 DATE: **MAY 7, 2014**
 DPW CHK: **-**

SHEET: **C401**

Appendix B

Design/Construction Plan

C-144 Supplemental Information: Design and Construction Plan Multi-Well Fluid Management Pit

This plan addresses construction of MWFM pits. Appendix A presents Certified Engineering Design Plans. Also included in Appendix A is an erosion control plan that is not required by NMOCD Rules, and the leak detection design, which is the subject of the Variance Request of Appendix G. Separate from this application are additional documents relating to the design/construction. These are available for examination by OCD if desired. One of these documents is the Quality Plan for the construction of the pit that calls for conducting a geotechnical investigation to provide foundation design/construction recommendations that are specific to this site and this pit.

Appendix C provides liner and geotextile specifications.

Field conditions may create the need for minor modification of the pit design (e.g. changing the length, width or depth). If field conditions dictate the need to modify the design, the operator will notify NMOCD of the proposed changes and provide justification. Any design change that does not conform to the prescriptive mandates of NMOCD Rules or the approved permit will be the subject of a modification request submitted to the OCD for review and approval.

Dike Protection and Structural Integrity

As part of the Quality Plan, these design elements will be specifically addressed in the foundation recommendations prepared by a New Mexico Registered Professional Engineer (Pettigrew and Associates). The recommendations will be based on site-specific data. The operator and the project P.E. will review the recommendations prior to beginning the earthwork and will adhere to the specific recommendations of the foundation study. Neither the Quality Plan nor the geotechnical study is a permit requirement for Multi-Well Fluid Management Pits. However, as unstable ground has been observed in the general area, we believe the geotechnical study and construction recommendations are important.

To underscore the importance of the engineering measures incorporated into the design to ensure that the pit's integrity is not compromised, we propose a conference call between the Professional Engineers of this project and the Professional Engineers from OCD/EMNRD assigned to the evaluation of this engineering design measures. The purpose of this call is to

- present this results of the geotechnical investigation,
- discuss the pit design and proposed construction methods
- identify any comments/concerns of the OCD Engineers and
- schedule a written response to fill in any gaps identified in the phone conference.

Construction of the pit foundation will not commence until OCD provides written concurrence with the written response after the phone conference.

Stockpile Topsoil

Prior to constructing the pit the qualified contractor will strip and stockpile the topsoil for use as the final cover or fill at the time of closure. The topsoil will be stockpiled adjacent to the west side of the perimeter fence surrounding the pit. Until vegetation is established

C-144 Supplemental Information: Design and Construction Plan Multi-Well Fluid Management Pit

on the stockpile, the topsoil will be protected from wind erosion by placement of silt fences on the stockpile.

Signage

The operator shall post an upright sign not less than 12 inches by 24 inches with lettering not less than two inches in height on the fence at the entrance(s) to the pit. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name; the location of the site by quarter-quarter or unit letter, section, township and range; and emergency telephone numbers.

Fencing:

As the pit is not located within 1000 feet of a permanent residence, school, hospital, institution or church, a chain-link fence is not required. The design plan shows a game fence around the pit to exclude wildlife. This fence is significantly more robust than the required barbed wire fence with four strands evenly spaced in the interval between one foot and four feet above ground level. A perimeter fence of 4-strand barbed wire is also proposed to exclude stock from the working area around the pit.

Netting and Protection of Wildlife

The proposed game fence on the upper edge of the pit levee will be effective in excluding antelope, coyotes and most other terrestrial wildlife. Stock is excluded from the working area of the site by the 4-strand barbed wire perimeter fence.

As the size of the proposed MWFM pit is about 300 feet by 300 feet, an effective net over the pit would be difficult to manage and problematic to install. Of greater importance than logistics is the fact that such netting may not be necessary. The pit will contain treated produced water that will not pose a threat to birds due to hydrogen sulfide gas or floating, free-phase hydrocarbons. With respect to protection of birds, Lime Rock Resources will regularly inspect the MWFM pit and report, within 30 days of discovery, any migratory or wildlife death to the appropriate wildlife agency as required by NMAC 19.15.17.11 E.

If the monthly reports present mortality data that show an obvious need to exclude birds from the stored water, the operator will consult with the District Office regarding mitigation options. If the monitoring data suggest that netting is not acutely necessary, the operator will submit annual reports to OCD that discuss the results of the monitoring program and provide an evaluation of the need to exclude avian species from the pit via netting.

Earthwork

As part of the QA/QC plan, a professional engineer registered in New Mexico (Pettigrew and Associates) will provide recommendations regarding the foundation for the pit liner. The pit will have a properly constructed foundation and interior slopes consisting of a firm, unyielding base that is smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear.

C-144 Supplemental Information: Design and Construction Plan Multi-Well Fluid Management Pit

Appendix A shows the

- a. inside grade of the levee is no steeper than two horizontal feet to one vertical foot (3H:1V).
- b. levee has an outside grade no steeper than three horizontal feet to one vertical foot (4H:1V).
- c. levee's top is wide enough to install an anchor trench that is at least 18-inches deep
- d. the 10-foot wide top of the levee provides adequate room for inspection of the liner and maintenance of the pit.
- e. pit contains a primary (upper) liner and a secondary (lower) liner with a leak detection system between the upper and lower geomembrane liners that is appropriate to the site's conditions and is equivalent to the liner material prescribed in the Rule (see Appendix F). The primary and secondary liner are 60-mil HDPE as specified in the Rule.
- f. caliche gravel placed on the levee (see sheet C-400) provides additional erosion control.

As always, field conditions may create the need for changes to the design. Any changes to the construction or grade requirements due to unforeseen conditions will be reviewed and approved by the PE then reported to OCD at least 10-days prior to initiating installation of the secondary liner and leak-detection system.

Liner Installation

The liners will be installed in a manner consistent with the Manufacture's specifications, which are found in Appendix F. As outlined in Appendix F, protocols for liner installation include measures to:

- i. minimize liner seams and orient them up and down, not across a slope (Section 2.3.1 In-Line).
- ii. use factory welded seams where possible (as identified in Appendix A notes)
- iii. overlap liners four to six inches and orient seams parallel to the line of maximum slope, i.e., oriented along, not across, the slope, prior to any field seaming (as identified in Appendix A notes)
- iv. minimize the number of welded field seams in comers and irregularly shaped areas (2.3.1 In-Line 60-mil HDPE)
- v. utilize only qualified personnel to weld field seams (as identified in Appendix A notes)
- vi. avoid excessive stress-strain on the liner (as identified in Appendix A notes)
- vii. place geotextile under the liner where directed by the independent field inspector (Pettigrew Engineers) to reduce localized stress-strain or protuberances that may otherwise compromise the liner's integrity (as identified in Appendix A notes)
- viii. anchor the edges of all liners in the bottom of a compacted earth-filled trench that is at least 18 inches deep (as identified in Appendix A notes)

At points of discharge into or suction from the lined MWFM pit the pipe configuration (see Appendix A) effectively protects the liner from excessive hydrostatic force or mechanical damage during filling or evacuation of fluids. Note that the single 6-inch inflow (and
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C-144 Supplemental Information: Design and Construction Plan Multi-Well Fluid Management Pit

outflow) pipe shown in the design drawings moves from a manifold at the top of the levee into two 6-inch solid pipes that transfer fluid to (or from) the bottom of the pit. Along the bottom of the pit, 6-inch perforated pipe distributes the liquid flow to minimize the hydraulic force on the liner.

External discharge or suction lines do not penetrate the liner.

Leak Detection and Fluid Removal Installation

The leak detection system, which is the subject of a variance request, contains the following design elements

- a. The 200-mil Hypernet drainage material between the primary and secondary liner that is sufficiently permeable to allow the transport of fluids to the drainage pipes and observation ports (Appendices A and F).
- b. The pit floor is sloped towards the center perforated pipe/swale to facilitate the earliest possible leak detection of the pit bottom. A pump may be placed in an observation port to provide for fluid removal.
- c. Piping will withstand chemical attack from any seepage; structural loading from stresses and disturbances from overlying water, cover materials, equipment operation or expansion or contraction (see Appendix A).
- d. The slope of the interior sub-grade and of drainage lines and laterals is at least a two percent grade, i.e., two feet vertical drop per 100 horizontal feet.
- e. The piping collection system is comprised of solid and perforated PVC pipe having a minimum diameter of four inches and a minimum wall thickness of schedule 80 (Appendix A).

Appendix C

Material Specifications

Herculine

Smooth Geomembranes

Herculine^{Sigma} Smooth HDPE Product Specifications

Properties	Test Method	Minimum Average Values				
		12 mil	20 mil	30 mil	40 mil	60 mil
Thickness*, mil		12	20	30	40	60
Lowest individual reading	ASTM D 5199	10	18	27	36	54
Density, g/cm ³	ASTM D 1505	.940	.940	.940	.940	.940
Tensile Properties (Each Direction)	ASTM D 6693, Type IV					
Strength at Break, lb/in width (N/mm)		42 (7)	76 (13)	114 (20)	152 (27)	228 (40)
Strength at Yield, lb/in width (N/mm)		23 (4)	42 (7)	63 (11)	84 (15)	126 (22)
Elongation at Break, %		700	700	700	700	700
Elongation at Yield, %		12	12	12	12	12
Tear Resistance, lb. (N)	ASTM D 1004	7 (33)	13 (59)	21 (93)	28 (125)	42 (187)
Puncture Resistance, lb. (N)	ASTM D 4833	19 (86)	34 (152)	54 (240)	72 (320)	108 (480)
Carbon Black Content, % (minimum)	ASTM D 1603	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾

⁽¹⁾ 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

*Custom material thicknesses also available.

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GSE HyperNet Geonet

GSE HyperNet geonet is a synthetic drainage material manufactured from a premium grade high density polyethylene (HDPE) resin. The structure of the GSE HyperNet geonet is formed specifically to transmit fluids uniformly under a variety of field conditions. The geonet is formulated to be resistant to ultraviolet light for a period of time necessary to complete the installation.



AT THE CORE:
A synthetic geonet engineered specifically to transmit fluids consistently under a variety of field conditions.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value			
			HyperNet	HyperNet HF	HyperNet HS	HyperNet UF
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	9.66 (2 x 10 ⁻³)	14.49 (3 x 10 ⁻³)	28.98 (6 x 10 ⁻³)	38.64 (8 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 5035/7179	1/50,000 ft ²	45	55	65	75
Carbon Black Content, %	ASTM D 1603 ⁽³⁾ /4218	1/50,000 ft ²	2.0	2.0	2.0	2.0
NOMINAL ROLL DIMENSIONS						
Geonet Thickness, mil	ASTM D 5199	1/50,000 ft ²	200	250	275	300
Roll Width ⁽²⁾ , ft			15	15	15	15
Roll Length ⁽²⁾ , ft			330	290	270	250
Roll Area, ft ²			4,950	4,350	4,050	3,750

NOTES:

- ⁽¹⁾Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Roll widths and lengths have a tolerance of ±1%.
- ⁽³⁾Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.



[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

Mirafi® 160N



Mirafi® 160N is a needlepunched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 160N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Mirafi® 160N meets AASHTO M288-06 Class 2 for Elongation > 50%.

TenCate Geosynthetics Americas Laboratories are accredited by [a2La](#) (The American Association for Laboratory Accreditation) and Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP). NTPEP Number: GTX-2012-01-003

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	160 (712)	160 (712)
Grab Tensile Elongation	ASTM D4632	%	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	60 (267)	60 (267)
CBR Puncture Strength	ASTM D6241	lbs (N)	410 (1825)	
Apparent Opening Size (AOS) ¹	ASTM D4751	U.S. Sieve (mm)	70 (0.212)	
Permittivity	ASTM D4491	sec ⁻¹	1.5	
Flow Rate	ASTM D4491	gal/min/ft ² (l/min/m ²)	110 (4481)	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70	

¹ ASTM D4751: AOS is a Maximum Opening Diameter Value

Physical Properties	Unit	Typical Value ²
Roll Dimensions (width x length)	ft (m)	15 x 300 (4.5 x 91)
Roll Area	yd ² (m ²)	500 (418)
Estimated Roll Weight	lb (kg)	199 (90)

² ASTM D4439 Standard Terminology for Geosynthetics: typical value, *n*—for geosynthetics, the mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with on specific property.

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Testing Lab 1291.01 & 1291.02