Bratcher, Mike, EMNRD

From: Dale Littlejohn [dale.littlejohn@suddenlink.net]
Sent: Thursday, September 10, 2009 9:14 AM
To: Bratcher, Mike, EMNRD
Cc: qwelborn@valornet.com; 'Randall Hicks'
Subject: Mark and Garner Loco Hills Sites OCD 2RP-304-310
Attachments: M & G Loco Hills 9-10-09 Response to OCD.pdf

Mike,

Please find the attached Report for the above referenced sites. I will also send you a hard copy. Please call me if you have any questions or need any additional information.

Thanks,

Dale T Littlejohn, PG
(432) 528-3878
(432) 689-4578 (fax)

R. T. HICKS CONSULTANTS, LTD.

PO Box 7624 ▲ Midland, TX 79708 ▲ 432.528-3878 ▲ Fax: 432.689-4578

September 10, 2009

Mr. Mike Bratcher
New Mexico Oil and Conservation Division
District II - Artesia Field Office
1301 West Grand Avenue
Artesia, NM 88210

VIA EMAIL AND USPS

RE: Seven Produced Fluid Releases at sites operated by Marks and Garner Production Ltd, Company in Eddy County, NM as follows:

Site Name (type)	Location (T-R-Sec.-Unit)	OCD Reference No.
Levers Fed. No. 7 (battery)	T-16-S, R-29-E, Sec 33 (J)	2RP-304
Levers No. 3Y (well)	T-16-S, R-29-E, Sec 33 (N)	2RP-305
Red 12 Fed. No. 1 (battery)	T-16-S, R-29-E, Sec 33 (O)	2RP-306
Cave State No. 4 (well)	T-17-S, R-29-E, Sec 4 (F)	2RP-307
Red 12 State No. 2 (battery)	T-17-S, R-29-E, Sec 4 (H)	2RP-308
Red 12 State No. 3 (battery)	T-17-S, R-29-E, Sec 5 (J)	2RP-309
Red 12 State No. 4 (battery)	T-17-S, R-29-E, Sec 5 (O)	2RP-310

Dear Mr. Bratcher:

R.T. Hicks Consultants is pleased to submit this response to your August 19, 2009 directive letter concerning the characterization activities on the behalf of Marks and Garner Production Ltd. Because this letter proposes collection of additional data, we request that NMOCD consider this letter an interim response. Plate 1a shows the location of the sites.

Determination of Remediation Action Levels Ranking Score

The ranking criteria of each site is presented below in accordance with the NMOCD August 13, 1993 *Guidance for Remediation of Leaks, Spills and Releases*.

Depth to Ground Water and Ground Water Quality
Plate 1b shows the location of the Marks & Garner sites (red circles) that are the subject of investigations in support of gaining compliance with Part 29 of the NMOCD Rules. Also shown on Plate 1b are:

- The geology of the area from the on-line geologic map of New Mexico (NM Bureau of Mines and Mineral Resources)
- The Loco Hills Gas Storage Facility (south blue circle), which provides information about the nature of ground water in and around Bear Grass Draw (see Appendix A)

- A stock well (RA-8233) completed within the alluvium of Bear Grass Draw (Office of the State Engineer Database)
- A domestic well located in the older alluvium (RA 9342) from the OSE database
- Three sample locations from the PTTC database
- A well identified on the USGS topographic map in Section 10 (north blue circle)

The geologic map shows that Quaternary Alluvium fills the valley of Bear Grass Draw. Quaternary eolian and pediment deposits dominate the southern portion of the area shown in Plate 1b and Quaternary Older Alluvium comprises the majority of the northern portion.

Data obtained from drilling several monitoring wells at the Loco Hills Gas Storage Facility (Appendix A) provide the following data:

1. The alluvium in and adjacent to Bear Creek, which is composed of clay, sand and caliche deposits; is less than 15 feet thick.
2. Underlying the alluvium in Bear Grass Draw are claystone, sandstone and limestone of the Triassic Dockam Group
3. Ground water beneath Bear Grass Draw occurs in permeable units associated with the Dockum Group that are about 80 feet deep.
4. Ground water in these units is confined and exhibit 10-20 feet of artesian head

Although no driller's log is available data for RA-8233, records from the OSE in Appendix B show:

A. Total depth of well RA-9342 is 220 feet with a depth to water upon completion of 110 feet. The driller's log indicates that the top of the redbeds are at 90 feet and the water bearing strata is from 143 to 204 feet. These data suggest the well is completed below the alluvium and within one of the confined aquifers (Chinle or Rustler)

B. Total depth of well RA-8233 is 87 feet with a reported depth to water of 80 feet. The depth of this well is similar to those at the Loco Hills Gas Storage Facility where artesian conditions exist. We measured a depth to water of about 60 feet during our investigation of the gas storage facility.

Although the sample #7992 from the PTTC database plots due east of the Loco Hills Gas Storage Facility, careful examination of the database shows that this plotted point consists of eight samples from three wells. Two of these three wells are at the same location as well RA 8233 from the OSE database –and we field verified that two wells exist at this location. The PTTC database describes one well of these wells at RA 8233 as an alluvial well and the other as a Triassic Santa Rosa well. The third well in the PTTC database is a supply well for the Loco Hills Gas Facility. The PTTC data from the RA 8233 location show relatively high quality water in the Santa Rosa and alluvium (less than 50 ppm chloride). At the Loco Hills Gas Storage Facility supply well, chloride concentration exceeds 50,000 ppm. As described in Appendix A; evidence suggests that leakage from a storage pit migrated through a water well bore into the underlying aquifer.

From these data we can conclude that the quality of ground water beneath Bear Grass Draw in the area of the Marks & Garner sites is probably similar to that observed at RA 8233. No evidence from the PTTC data suggests that ground water in the area of the Marks & Garner sites is not confined.

Plate 1b shows two other wells from the PTTC database south of the Loco Hills Gas Storage Facility. According to the PTTC database, both of these wells are screened below the alluvial cover in the Triassic Dockham group or the Rustler. These two aquifers are confined in this area.

Because all evidence shows that ground water in the area is confined, we have assigned a "Depth to Ground Water" ranking score of zero (0).

Wellhead Protection Area
Since nearest published water well is located approximately 2 miles northwest of the most northwest site, we have assigned a "Wellhead Protection Area" ranking score of zero (0).

Distance to Surface Water Body
The 1993 guidance document defines surface water as being a perennial river, stream, creek irrigation canal (ditch), lake, pond, or playa. Two of the sites (Levers 3Y and Red-12 Federal No. 1) are located adjacent to Bear Grass Draw, but it is not a perennial stream. No other qualifying surface water is present within 1,000 feet; therefore we have assigned a "Distance to Nearest Surface Water Body" ranking score of zero (0).

Application of these criteria to all of the Marks and Garner Loco Hills sites is demonstrated below resulting in RRALs of 10 ppm benzene, 50 ppm BTEX, and 5,000 ppm TPH.

General Site Characteristics	Ranking Score
Depth to ground water not relevant (confined aquifer)	0
Wellhead greater than 1,000 feet from water source	0
Distance to down gradient surface water greater than 1,000 feet	0
Total Ranking Score	**0**

Horizontal Delineation of Chlorides

Following receipt of the NMOCD August 19, 2009 directive letter, laboratory analysis of chloride was performed on the deepest samples recovered from each site during the June 2009 investigation. This information provided confirmation that all of the sites contain chloride concentrations that exceed the remediation levels defined in the NMOCD May 28, 2004, *Interim Pit and Below-Grade Tank Guidelines.*

On August 27 and 28, 2009, RT Hicks Consultants returned to the Loco Hills sites in order to recover near surface soil samples used to delineate the horizontal extent of the chloride-impacted soil and provide guidance for future vertical delineation.

Analysis of Field and Laboratory Soil Samples

The following tables have been prepared as a summary of the hydrocarbon and chloride results from the soil samples recovered to date. Bold text indicates those samples that exceed NMOCD guideline RRALs. Field chloride verification and nutrient evaluation samples have been shipped to an agricultural laboratory for analyses. These results will be included in the tables with the final report.

In addition to the tables below, site maps for each site (Plate 2A – 2G) have been prepared to indicate the location of the soil samples recovered; the depth and chloride concentrations of the samples; and the proposed location of vertical delineation soil borings.

Marks & Garner - Levers Federal No. 7 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Center Oil Spill	0.5	6/23/09	--	--	10	<0.0011	<0.0022	0.0015	<0.0011	<0.006	<16.4	461	61.6
	1.0	6/23/09	--	--	0	--	--	--	--	--	--	--	--
	3.0	6/23/09	--	3,520	0	<0.0011	<0.0022	<0.0011	<0.0011	<0.006	<16.7	20.9	<16.7
10-Ft North	2-3	8/27/09	**1,802**	--	0	--	--	--	--	--	--	--	--
20-Ft North	2-3	8/27/09	**1,428**	--	0	--	--	--	--	--	--	--	--
10-Ft South	2-3	8/27/09	**948**	--	0	--	--	--	--	--	--	--	--
20-Ft South	2-3	8/27/09	**964**	--	0	--	--	--	--	--	--	--	--
30-Ft South	2-3	8/27/09	**3,971**		0	--	--	--	--	--	--	--	--
10-Ft East	2-3	8/27/09	**2,907**	--	0	--	--	--	--	--	--	--	--
20-Ft East	2	8/27/09	202	--	0	--	--	--	--	--	--	--	--
50-Ft Northeast	0-1	8/28/09	176	--	0	--	--	--	--	--	--	--	--
70-Ft Southeast	0-1	8/28/09	161	--	0	--	--	--	--	--	--	--	--
100-Ft Southeast	0-1	8/28/09	**404**	--	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Levers No. 3Y Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Center Oil Spill	Surf	6/22/09	--	--	85	0.013	0.537	1.3850	3.5	5.47	1,340	**44,500**	3,150
	2.0	6/22/09	--	--	39	--	--	--	--	--	--	--	--
	3.0	6/22/09	--	--	64	--	--	--	--	--	--	--	--
	4.0	6/22/09	--	--	127	--	--	--	--	--	--	--	--
	5.0	6/22/09	--	--	210	--	--	--	--	--	--	--	--
	6.0	6/22/09	--	6,820	334	<0.0107	0.212	0.6995	6.553	7.47	1,690	**6,640.0**	581
15-Ft East	2-3	8/27/09	**455**	--	0	--	--	--	--	--	--	--	--
20-Ft West	2-3	8/27/09	**897**	--	0	--	--	--	--	--	--	--	--
25-Ft North	2	8/27/09	**1,114**		0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Red-12 Federal No. 1 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Oil Spill Area	0.5	6/23/09	--	--	0	<0.0011	<0.0022	<0.0011	<0.0011	<0.006	<335	**23,600**	2,280
	1.0	6/23/09	--	--	0	--	--	--	--	--	--	--	--
	3.0	6/23/09	--	3,030	0	<0.0011	<0.0022	<0.0011	<0.0011	<0.006	<16.9	61.3	<16.9
25-Ft WSW	2-3	8/27/09	**6,712**	--	0	--	--	--	--	--	--	--	--
35-Ft WSW	2-3	8/27/09	**7,615**	--	0	--	--	--	--	--	--	--	--
45-Ft WSW	2-3	8/27/09	**8,192**		0	--	--	--	--	--	--	--	--
20-Ft NNW	2-3	8/27/09	**1,388**	--	0	--	--	--	--	--	--	--	--
45-Ft SSE	2-3	8/27/09	**1,332**	--	0	--	--	--	--	--	--	--	--
120-Ft Southeast	0-1	8/28/09	**392**	--	0	--	--	--	--	--	--	--	--
50-Ft Northeast	0-1	8/28/09	179	--	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Cave State No. 4 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Stockpile Soil	--	6/22/09	--	--	185	0.0519	1.22	4.45	9.264	15.0	2,050	**38,400**	2,820
Oil Spill Area	2.0	6/22/09	--	--	0	--	--	--	--	--	--	--	--
	4.0	6/22/09	--	**1,460**	0	<0.0012	<0.0024	<0.0012	<0.0024	<0.008	<17.8	18.7	<17.8
55-Ft Southeast	2-3	8/28/09	**469**		0	--	--	--	--	--	--	--	--
85-Ft Northeast	2-3	8/28/09	**800**	--	0	--	--	--	--	--	--	--	--
75-Ft Southwest	2-3	8/28/09	66	--	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Red-12 State No. 2 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Center Oil Spill	0.5	6/23/09	--	--	10	<0.0011	<0.0023	0.0099	0.0186	0.032	340	**20,500**	1,360
	1.0	6/23/09	--	--	6	--	--	--	--	--	--	--	--
	3.0	6/23/09	--	**10,300**	0	<0.0011	<0.0022	<0.0011	<0.0011	<0.006	<16.2	58.6	<16.2
10-Ft West	2-3	8/27/09	**2,518**	--	0	--	--	--	--	--	--	--	--
20-Ft West	2-3	8/27/09	**5,846**		0	--	--	--	--	--	--	--	--
30-FT West	2-3	8/27/09	**2,358**	--	0	--	--	--	--	--	--	--	--
20-Ft North	2-3	8/27/09	**2,784**	--	0	--	--	--	--	--	--	--	--
40-Ft South	2-3	8/27/09	**6,500**	--	0	--	--	--	--	--	--	--	--
100-Ft South	0-1	8/28/09	221	--	0	--	--	--	--	--	--	--	--
100-Ft North	2-3	8/28/09	**2,760**		0	--	--	--	--	--	--	--	--
160-Ft North	0-1	8/28/09	**526**	--	0	--	--	--	--	--	--	--	--
70-Ft West	0-2	8/28/09	**817**		0	--	--	--	--	--	--	--	--
160-Ft West	0-1	8/28/09	229	--	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Red-12 State No. 3 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Composite	Surf	6/22/09	**8,068**	--	0	0.0016	<0.0022	0.0015	0.0054	0.011	1,780	**57,000**	**5,510**
Oil Spill West	1.0	6/22/09	**2,408**	--	0	<0.0011	<0.0022	<0.0011	<0.0022	<0.007	<16.7	24.7	<16.7
Oil Spill East	2.0	6/22/09	**2,887**	**2,600**	0	<0.0011	<0.0023	<0.0011	<0.0011	<0.006	<16.9	35.8	<16.9
Cl Spill East	2.0	8/27/09	**4,156**	--	0	--	--	--	--	--	--	--	--
Cl Spill Center	2.0	8/27/09	**4,805**	--	0	--	--	--	--	--	--	--	--
Cl Spill West	1.0	8/27/09	**6,514**	--	0	--	--	--	--	--	--	--	--
60-Ft North	0-1	8/28/09	175	--	0	--	--	--	--	--	--	--	--
35-Ft West	0-1	8/28/09	137	--	0	--	--	--	--	--	--	--	--
100-Ft Southeast	0-1	8/28/09	**857**	--	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Marks & Garner - Red-12 State No. 4 Site
Field and Laboratory Data - Soil Samples

Sample Location	Depth (feet)	Sample Date	Field Cl (mg/kg)	Lab Cl (mg/kg)	PID (ppm)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	BTEX (mg/kg)	C_{6-12} (mg/kg)	C_{12-28} (mg/kg)	C_{28-35} (mg/kg)
Composite	Surf	6/22/09	**8,068**	--	10	0.0024	0.0040	0.0153	0.0411	0.060	<308	**18,400**	3,030
180-Ft South	1.0	6/22/09	--	193	0	--	--	--	--	--	--	--	--
	3.0	6/22/09	--	**257**	0	--	--	--	--	--	--	--	--
440-Ft Southwest	*0.5*	*6/22/09*	--	***19,200***	*0*	--	--	--	--	--	--	--	--
180-Ft North	1.0	6/22/09	**6,085**	**5,340**	0	--	--	--	--	--	--	--	--
	3	6/22/09	**6,227**	**5,830**	0	--	--	--	--	--	--	--	--
NMOCD 1993 Guideline RRALs			**250***	--		**10**	--	--	--	**50**		**5,000**	

* Chloride RRAL is based on the NMOCD May 28, 2004 Interim Pit and Below-Grade Tank Guidelines

Recommendations for Additional Corrective Actions

In mid to late August 2009 a roust-a-bout contractor was hired by Marks and Garner to remove the visible oil-stained soil and backfill the areas with clean soil and gravel. All of the hydrocarbon-impacted soil was disposed of off-site. Photographic documentation of the site clean-up results and waste soil manifests will be provided with the final report.

Hicks Consultants recommends that a hollow-stem auger be used to complete the vertical delineation of hydrocarbon- and chloride-impacted soil at each site according to the attached plates. We anticipate that a drilling rig will be available in mid to late October 2009 and a final report for each site, including recommendations for remedial actions, will be submitted to the NMOCD by the end of 2009. In the final report we will provide remediation action levels for soil and underlying sediment based upon criteria in NMOCD Rules, science-based evaluation of the sampling data and physical setting.

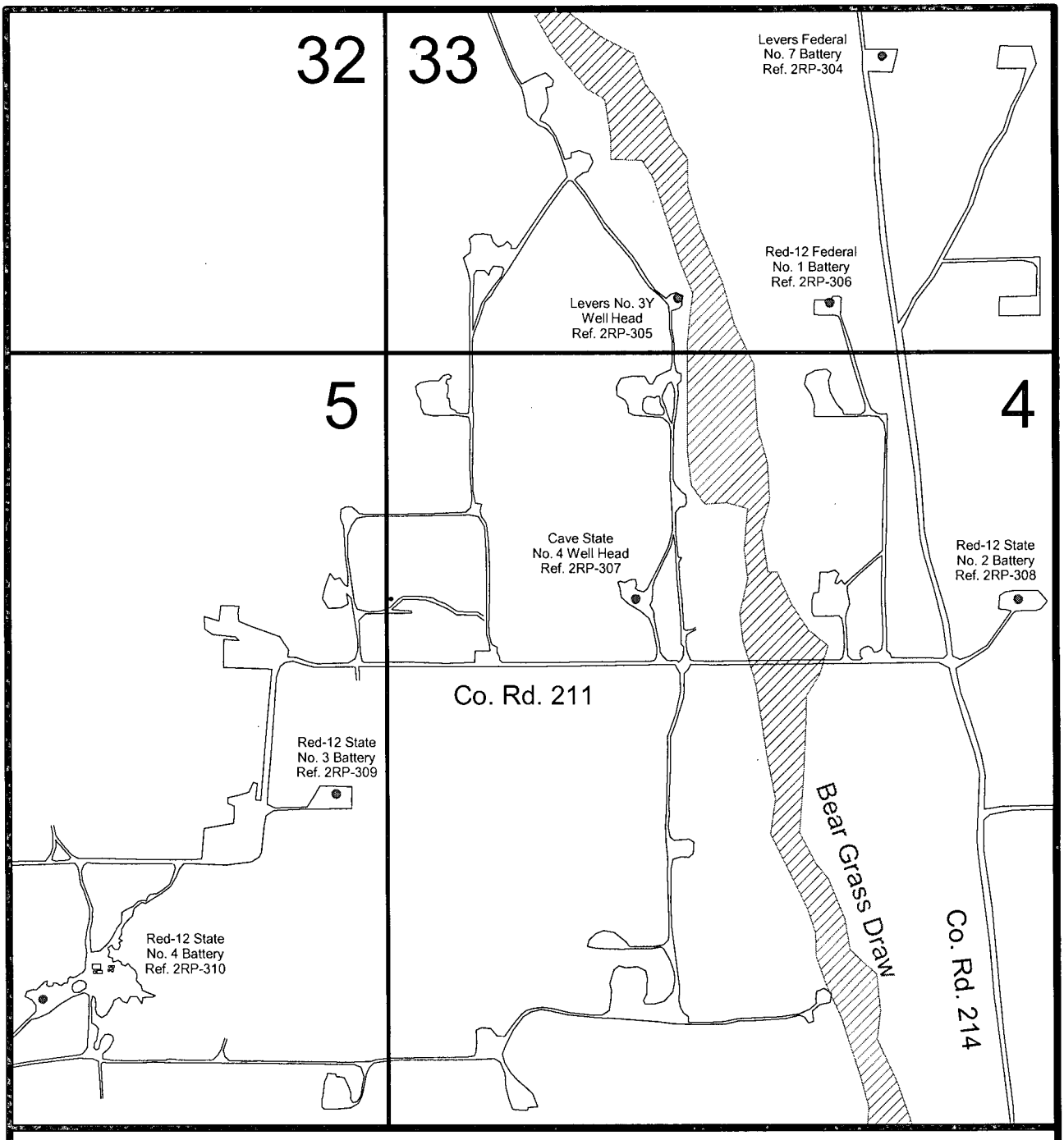
Please contact me if you have any questions, comments or require additional information prior to completion of the final report.

Sincerely,
R.T. Hicks Consultants, Ltd.

Dale T. Littlejohn

Dale T. Littlejohn
Project Manager
(432) 528-3878

Copy: Quinton Welborn, Marks and Garner Production Ltd, Co.



Marks and Garner Production Ltd Co.

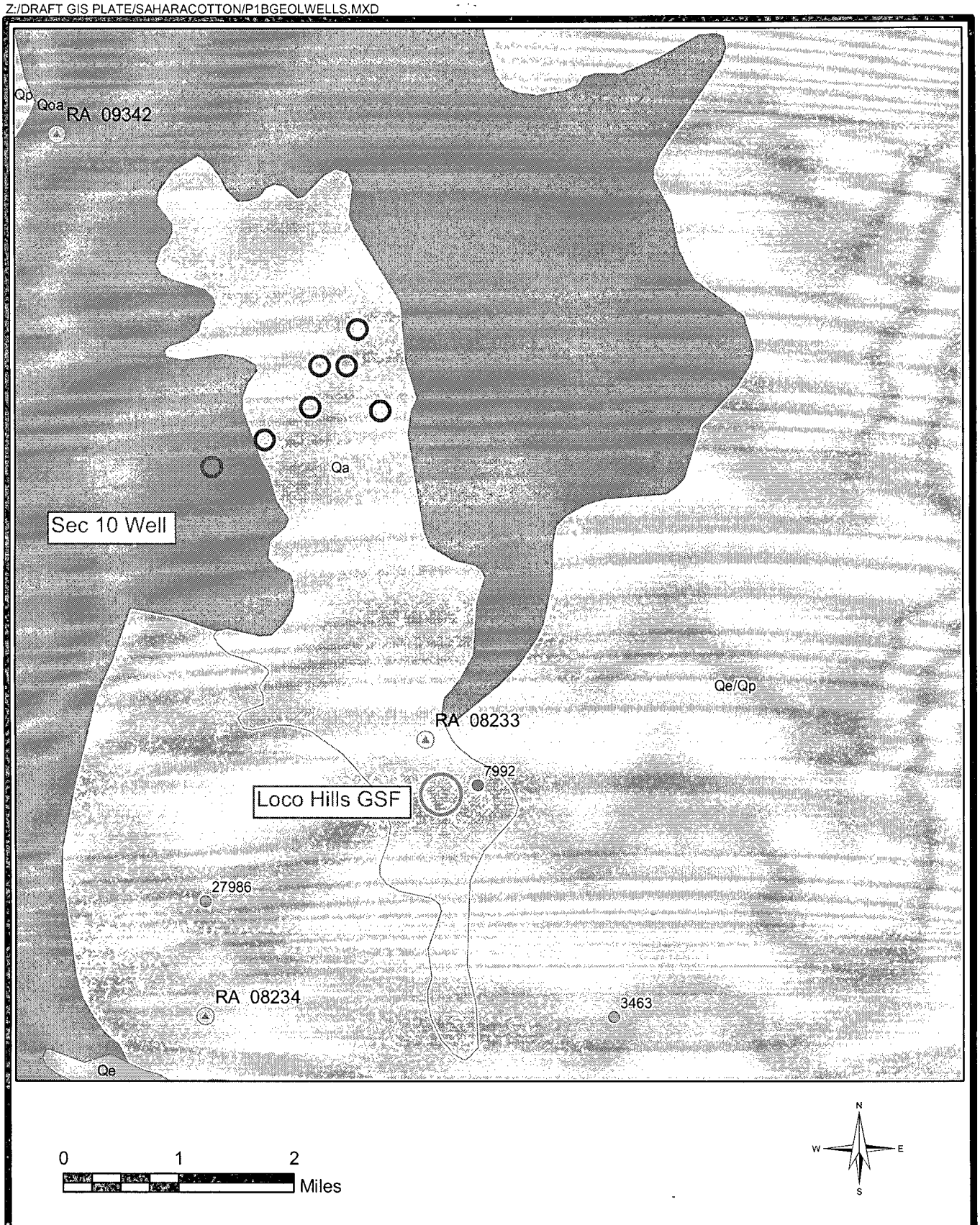
T-16-S, R-29-E, Section 33
T-17-S, R-29-E, Sec. 4 &5
Eddy County, New Mexico

Plate 1a
Site VicinityMap

0 1,000 2,000

Feet

Z:/DRAFT GIS PLATE/SAHARACOTTON/P1BGEOLWELLS.MXD



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Geologic Map Showing Nearby Wells	Plate 1b
	Marks and Garner	Sept 2009

8/31/2009

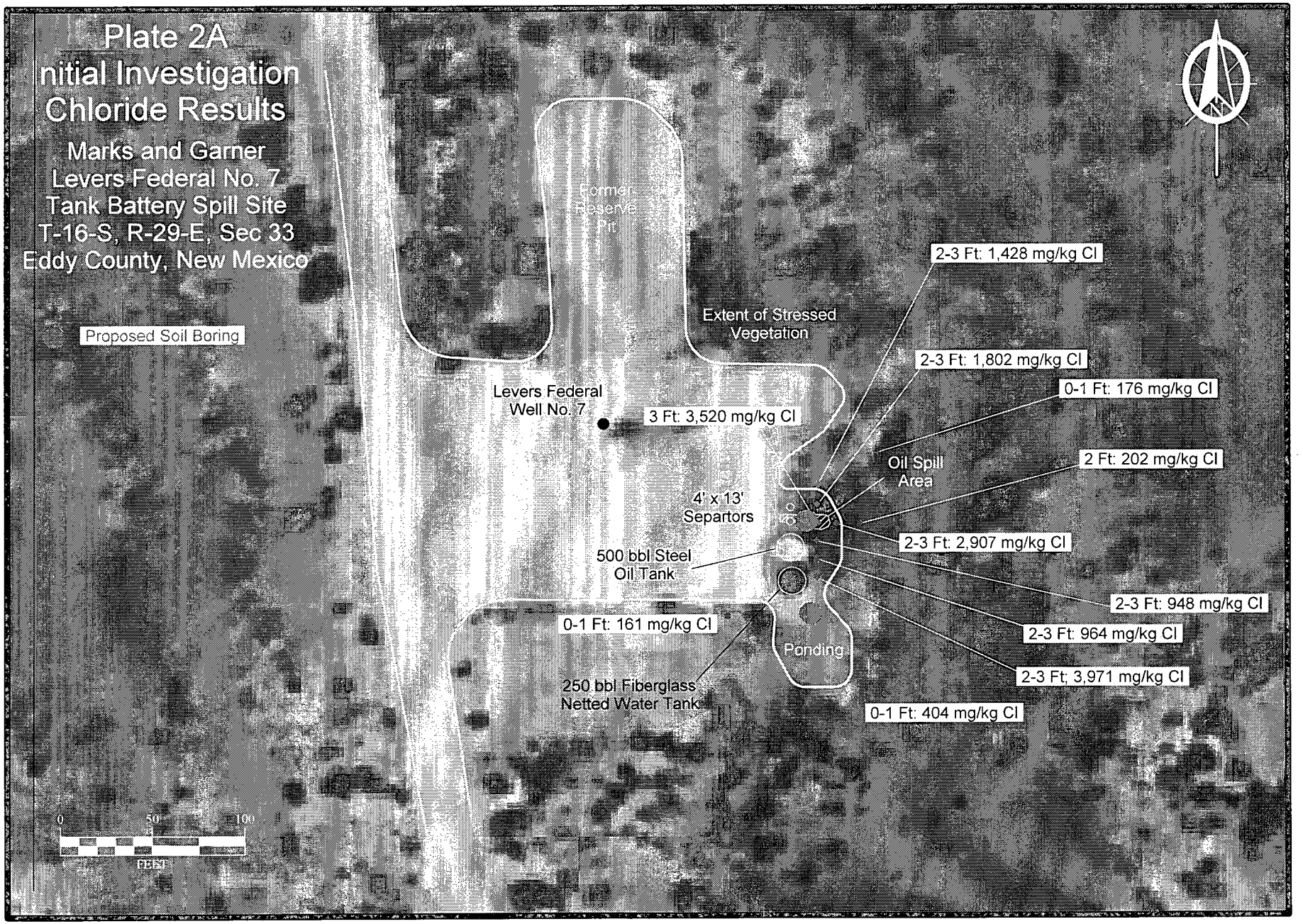
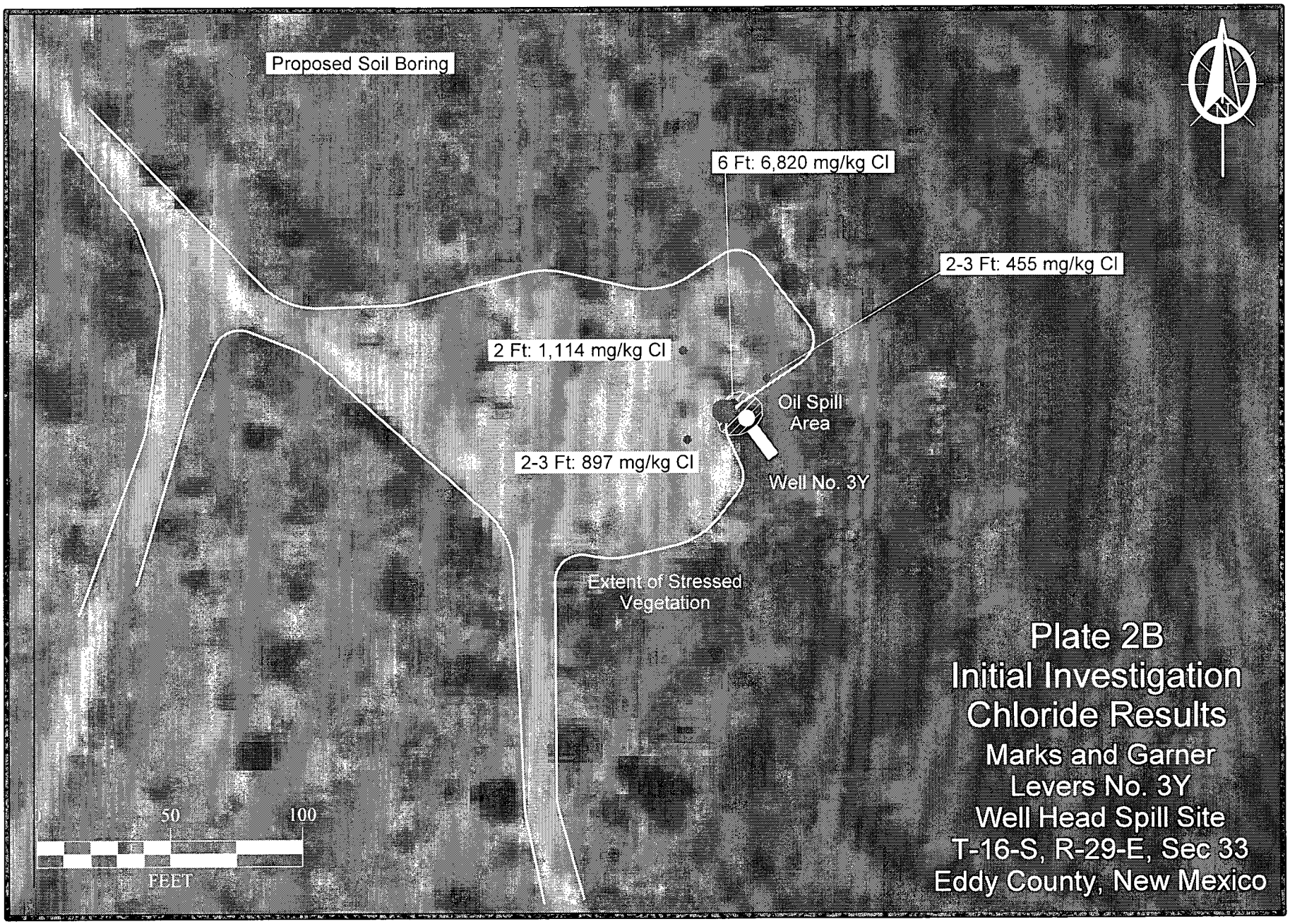


Plate 2A
nitial Investigation
Chloride Results
Marks and Garner
Levers Federal No. 7
Tank Battery Spill Site
T-16-S, R-29-E, Sec 33
Eddy County, New Mexico
Proposed Soil Boring
Former Reserve Pit
Extent of Stressed Vegetation
Levers Federal Well No. 7
3 Ft: 3,520 mg/kg Cl
2-3 Ft: 1,428 mg/kg Cl
2-3 Ft: 1,802 mg/kg Cl
0-1 Ft: 176 mg/kg Cl
2 Ft: 202 mg/kg Cl
Oil Spill Area
4' x 13' Separtors
2-3 Ft: 2,907 mg/kg Cl
500 bbl Steel Oil Tank
2-3 Ft: 948 mg/kg Cl
0-1 Ft: 161 mg/kg Cl
2-3 Ft: 964 mg/kg Cl
Ponding
2-3 Ft; 3,971 mg/kg Cl
250 bbl Fiberglass Netted Water Tank
0-1 Ft: 404 mg/kg Cl
0
50
100
FEET


Proposed Soil Boring
6 Ft: 6,820 mg/kg Cl
2-3 Ft: 455 mg/kg Cl
2 Ft: 1,114 mg/kg Cl
Oil Spill Area
2-3 Ft: 897 mg/kg Cl
Well No. 3Y
Extent of Stressed Vegetation
0
50
100
FEET
Plate 2B
Initial Investigation
Chloride Results
Marks and Garner
Levers No. 3Y
Well Head Spill Site
T-16-S, R-29-E, Sec 33
Eddy County, New Mexico

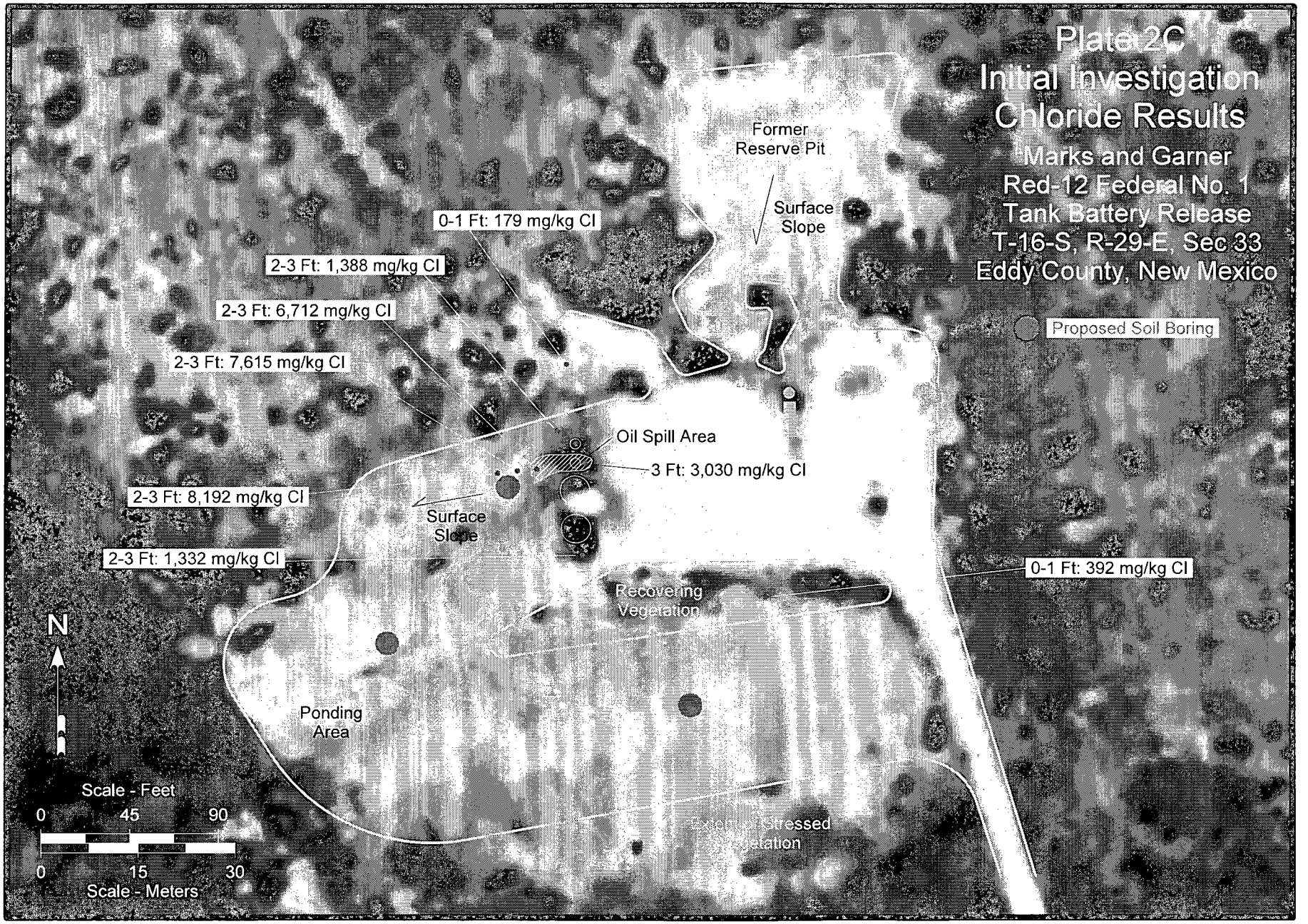
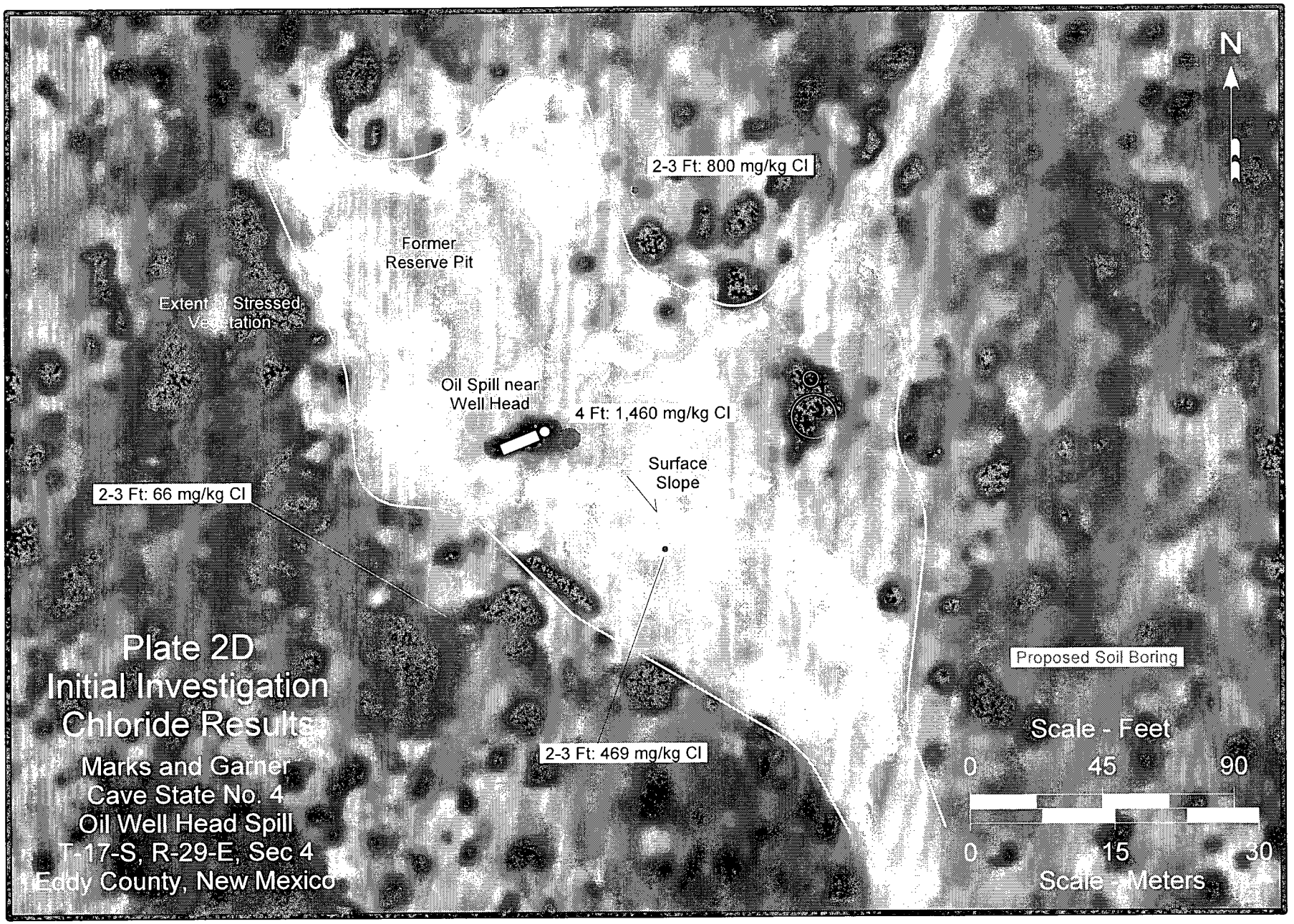
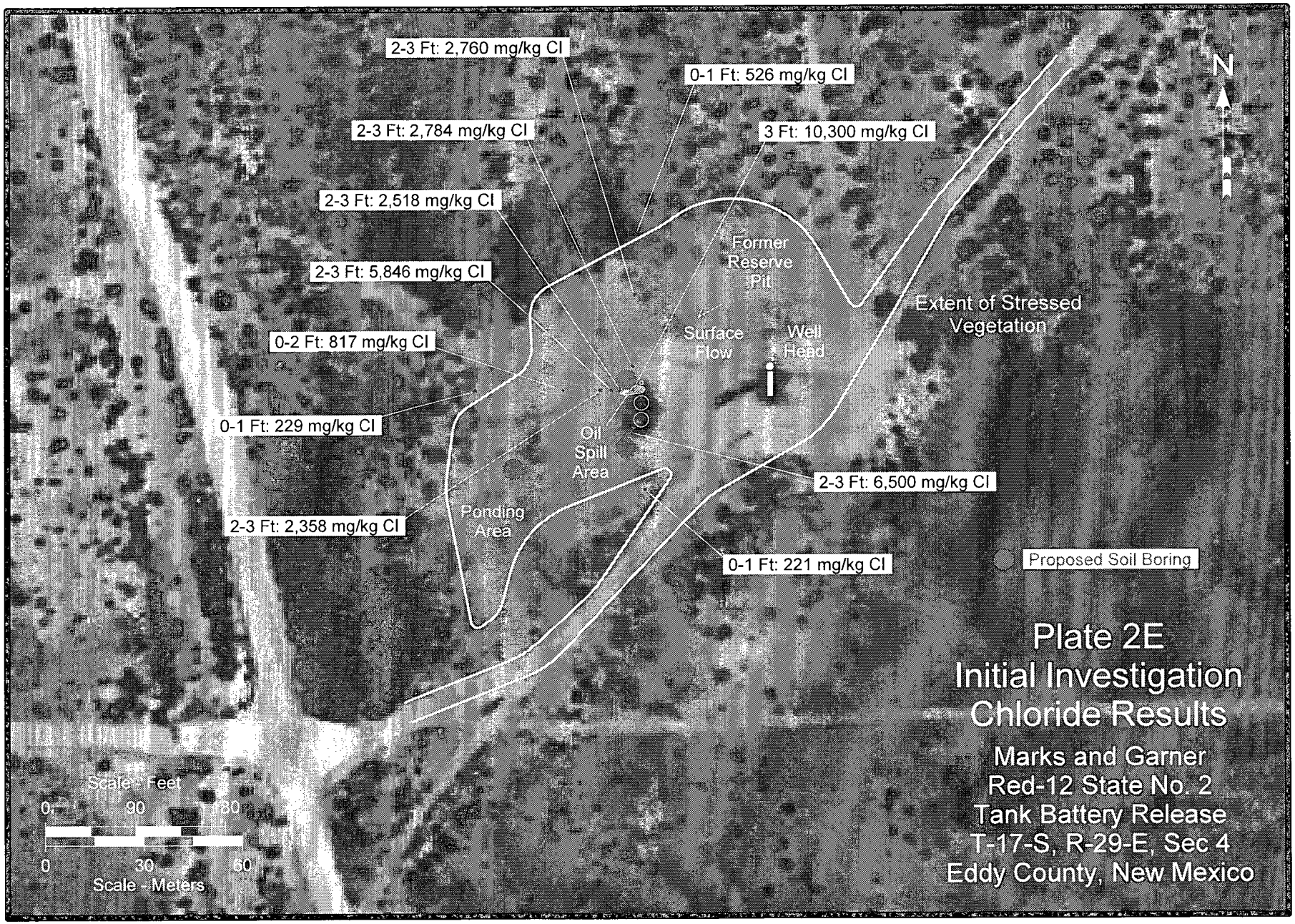
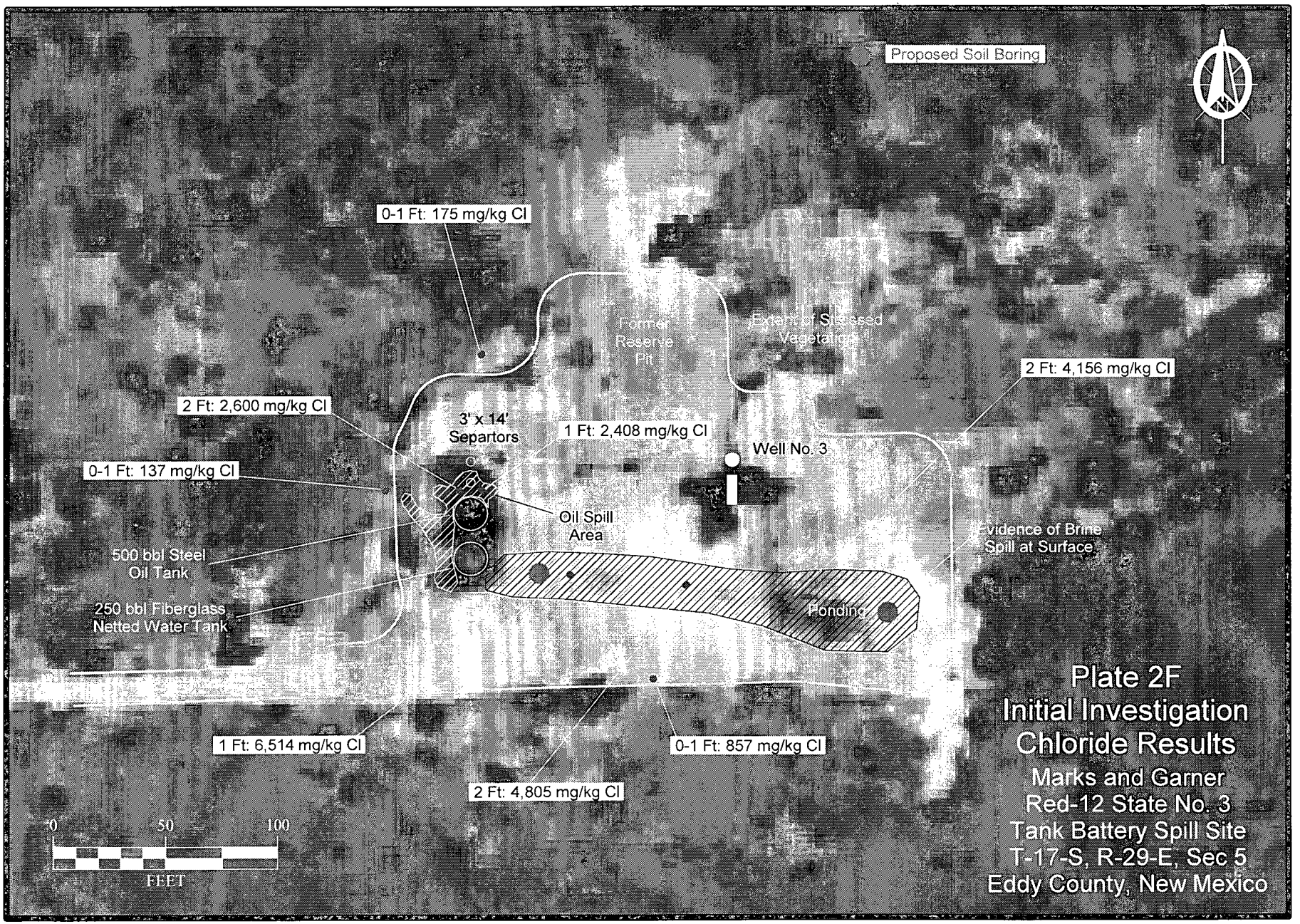


Plate 2C
Initial Investigation
Chloride Results
Marks and Garner
Red-12 Federal No. 1
Tank Battery Release
T-16-S, R-29-E, Sec 33
Eddy County, New Mexico
Proposed Soil Boring
Former
Reserve Pit
Surface
Slope
0-1 Ft: 179 mg/kg Cl
2-3 Ft: 1,388 mg/kg Cl
2-3 Ft: 6,712 mg/kg Cl
2-3 Ft: 7,615 mg/kg Cl
Oil Spill Area
3 Ft: 3,030 mg/kg Cl
2-3 Ft: 8,192 mg/kg Cl
Surface
Slope
2-3 Ft: 1,332 mg/kg Cl
0-1 Ft: 392 mg/kg Cl
Recovering
Vegetation
N
Ponding
Area
Scale - Feet
0
45
90
0
15
30
Scale - Meters


N
2-3 Ft: 800 mg/kg Cl
Former
Reserve Pit
Extent of Stressed
Vegetation
Oil Spill near
Well Head
4 Ft: 1,460 mg/kg Cl
Surface
Slope
2-3 Ft: 66 mg/kg Cl
2-3 Ft: 469 mg/kg Cl
Proposed Soil Boring
Plate 2D
Initial Investigation
Chloride Results
Marks and Garner
Cave State No. 4
Oil Well Head Spill
T-17-S, R-29-E, Sec 4
Eddy County, New Mexico
Scale - Feet
0
45
90
0
15
30
Scale - Meters


2-3 Ft: 2,760 mg/kg Cl
0-1 Ft: 526 mg/kg Cl
2-3 Ft: 2,784 mg/kg Cl
3 Ft: 10,300 mg/kg Cl
2-3 Ft: 2,518 mg/kg Cl
Former Reserve Pit
2-3 Ft: 5,846 mg/kg Cl
Extent of Stressed Vegetation
0-2 Ft: 817 mg/kg Cl
Surface Flow
Well Head
0-1 Ft: 229 mg/kg Cl
Oil Spill Area
2-3 Ft: 6,500 mg/kg Cl
Ponding Area
2-3 Ft: 2,358 mg/kg Cl
0-1 Ft: 221 mg/kg Cl
Proposed Soil Boring
N
Scale - Feet
0
90
180
0
30
60
Scale - Meters
Plate 2E
Initial Investigation
Chloride Results
Marks and Garner
Red-12 State No. 2
Tank Battery Release
T-17-S, R-29-E, Sec 4
Eddy County, New Mexico


Proposed Soil Boring
0-1 Ft: 175 mg/kg Cl
Former Reserve Pit
Extent of Stressed Vegetation
2 Ft: 4,156 mg/kg Cl
2 Ft: 2,600 mg/kg Cl
3' x 14' Separtors
1 Ft: 2,408 mg/kg Cl
Well No. 3
0-1 Ft: 137 mg/kg Cl
Oil Spill Area
Evidence of Brine Spill at Surface
500 bbl Steel Oil Tank
250 bbl Fiberglass Netted Water Tank
Ponding
1 Ft: 6,514 mg/kg Cl
0-1 Ft: 857 mg/kg Cl
2 Ft: 4,805 mg/kg Cl
0
50
100
FEET
Plate 2F
Initial Investigation
Chloride Results
Marks and Garner
Red-12 State No. 3
Tank Battery Spill Site
T-17-S, R-29-E, Sec 5
Eddy County, New Mexico

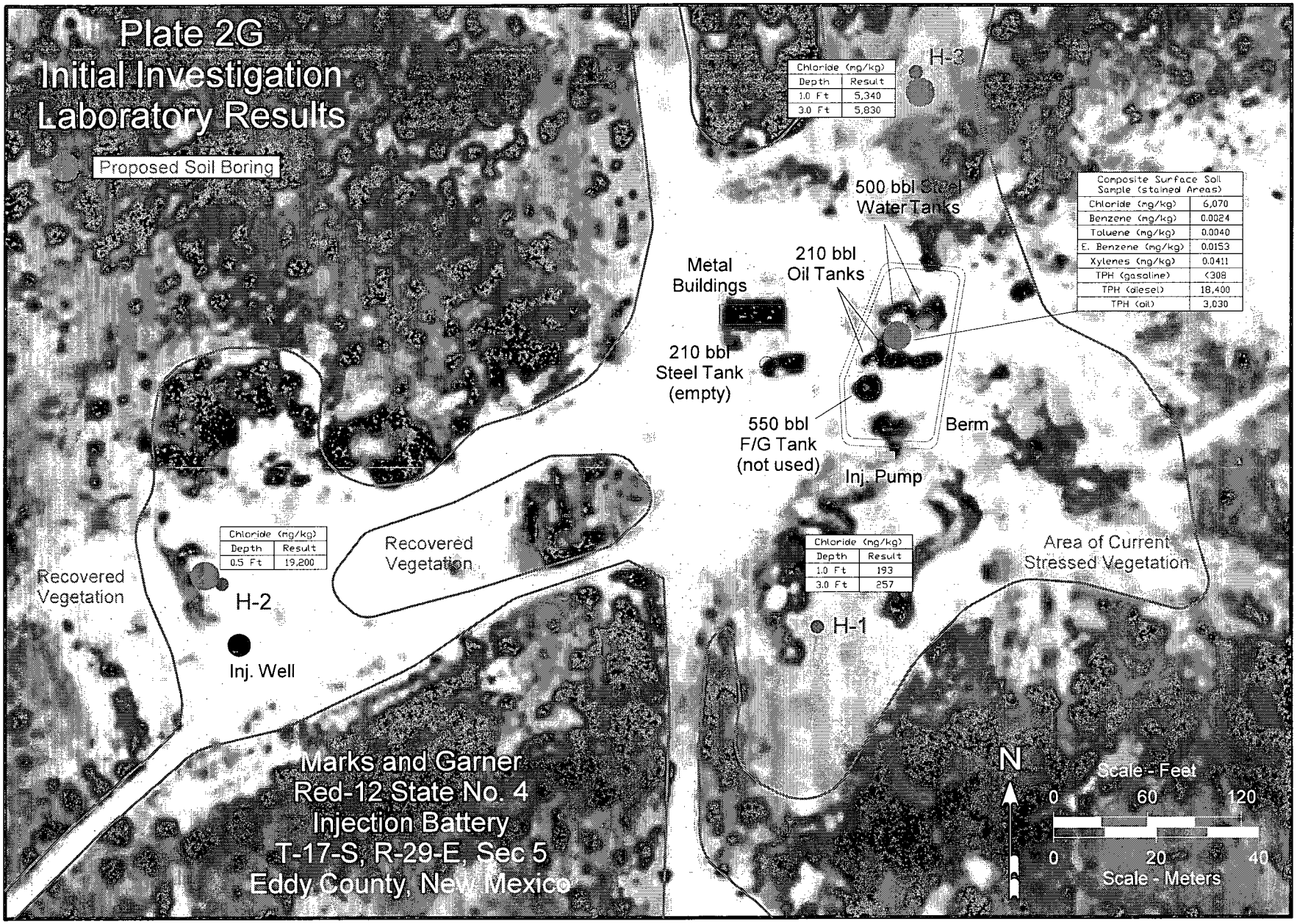


Plate 2G
Initial Investigation
Laboratory Results
Proposed Soil Boring
Chloride (mg/kg)
Depth | Result
1.0 Ft | 5,340
3.0 Ft | 5,830
H-3
500 bbl Steel Water Tanks
Composite Surface Soil Sample (stained Areas)
Chloride (mg/kg) | 6,070
Benzene (mg/kg) | 0.0024
Toluene (mg/kg) | 0.0040
E. Benzene (mg/kg) | 0.0153
Xylenes (mg/kg) | 0.0411
TPH (gasoline) | <308
TPH (diesel) | 18,400
TPH (oil) | 3,030
Metal Buildings
210 bbl Oil Tanks
210 bbl Steel Tank (empty)
550 bbl F/G Tank (not used)
Berm
Inj. Pump
Chloride (mg/kg)
Depth | Result
0.5 Ft | 19,200
Recovered Vegetation
Recovered Vegetation
H-2
Inj. Well
Chloride (mg/kg)
Depth | Result
1.0 Ft | 193
3.0 Ft | 257
H-1
Area of Current Stressed Vegetation
Marks and Garner
Red-12 State No. 4
Injection Battery
T-17-S, R-29-E, Sec 5
Eddy County, New Mexico
N
Scale - Feet
0 60 120
0 20 40
Scale - Meters

APPENDIX A

Hydrogeological Study of the Loco Hills Gas Storage Facility

TABLES

PLATES

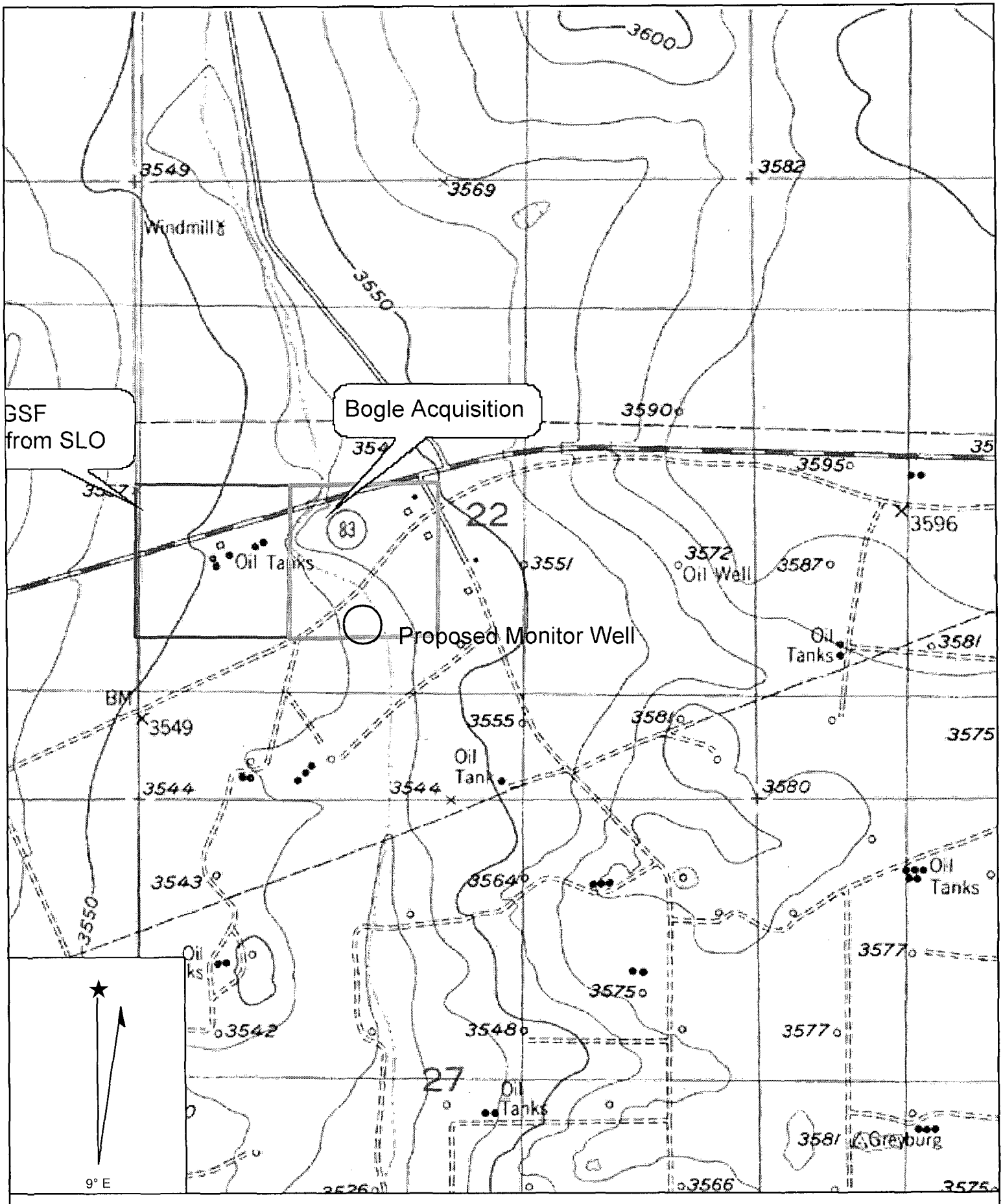
APPENDICES

ABATEMENT PLAN TABLE 1

Table 1. Loco Hills Historicity

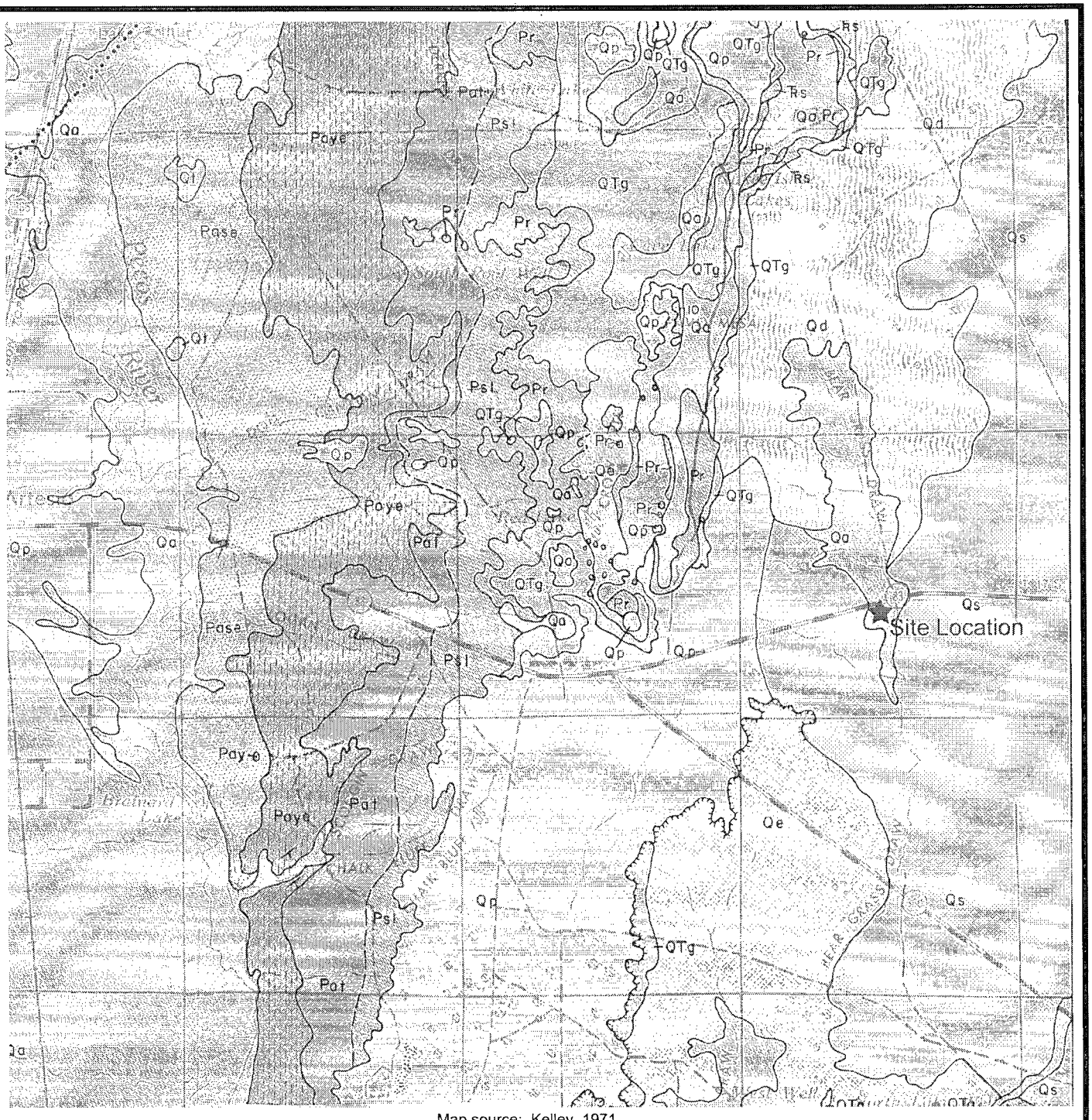
Date	Event
1952	The salt caverns and water supply wells now used by Loco Hills GSF, Ltd. were created by Sacra Brothers, a propane distributor. Sacra Brothers probably employed an unlined seepage pit to dispose of more than 30,000,000 gallons of brine generated during the construction of the caverns
1959	Ownership changed from Sacra Brothers to Arrow Gas Company, presumably due to the acquisition of Sacra Brothers Propane by Arrow Gas Company.
1981	Arrow Gas reported to NMOCD that ground water quality below facility was at least 60,680 ppm, presumably due to facility operation actions.
1995	Arrow Gas sold to National Propane and the facility changed hands.
2000	Ownership changed from National Propane to Columbia Propane, and the facility changed hands
2001	Operator Name Change from Columbia Propane to AmeriGas Eagle Propane
Jul-04	AmeriGas sold property to current owners Loco Hills GSF, Ltd.
Apr-04	Loco Hills GSF, Ltd. begins process to install a new storage pond at the facility
Jul-04	NMOCD issues a Public Notice of the proposed Discharge Permit as required by the WQCC Regulations
Aug-04	NMOCD approves the WQCC Discharge Permit of Loco Hills GSF
Oct-04	Loco Hills GSF proposes to modify their approved WQCC Discharge Plan by adding a ground water quality restoration program and proposing a clay lined pond after soil samples suggest that a clay lined pond could be approved under WQCC Regulations.
Nov-04	The new clay lined pond was completed and tested for compaction.
Dec-04	NMOCD and Loco Hills agree that a clay liner with a demonstrated low permeability should be sufficient to meet WQCC requirements, but NMOCD notes that Loco Hills GSF does not own the land. The WQCC Regulations would prohibit a clay-lined pond in the absence of surface ownership of the site.
Jan-04	Loco Hills GSF, Ltd. takes action to acquire land from Bogle Farms and the State of New Mexico.
Jun-04	In a meeting with NMOCD, Loco Hills GSF, Ltd. was notified that the facility would no longer be governed by WQCC Regulations, but would be under NMOCD Rule 50. Loco Hills GSF, Ltd. was notified that this facility would fall under the new Rule 50, which does not allow for a single lined pond without an exemption petition. Rule 50 allowed "grandfathering" of certain single-lined ponds if the operator petitioned NMOCD for continued use before May 2004.
Aug-04	Loco Hills GSF, Ltd. submits Stage I & II Abatement Plan and a Best Management Practices Plan for approval to NMOCD, requesting exemption from Rule 50 and outlining how facility operation is meeting NMOCD goals of preventing ground water impact, and protecting human health and the environment with the current facility design.

ABATEMENT PLAN PLATES



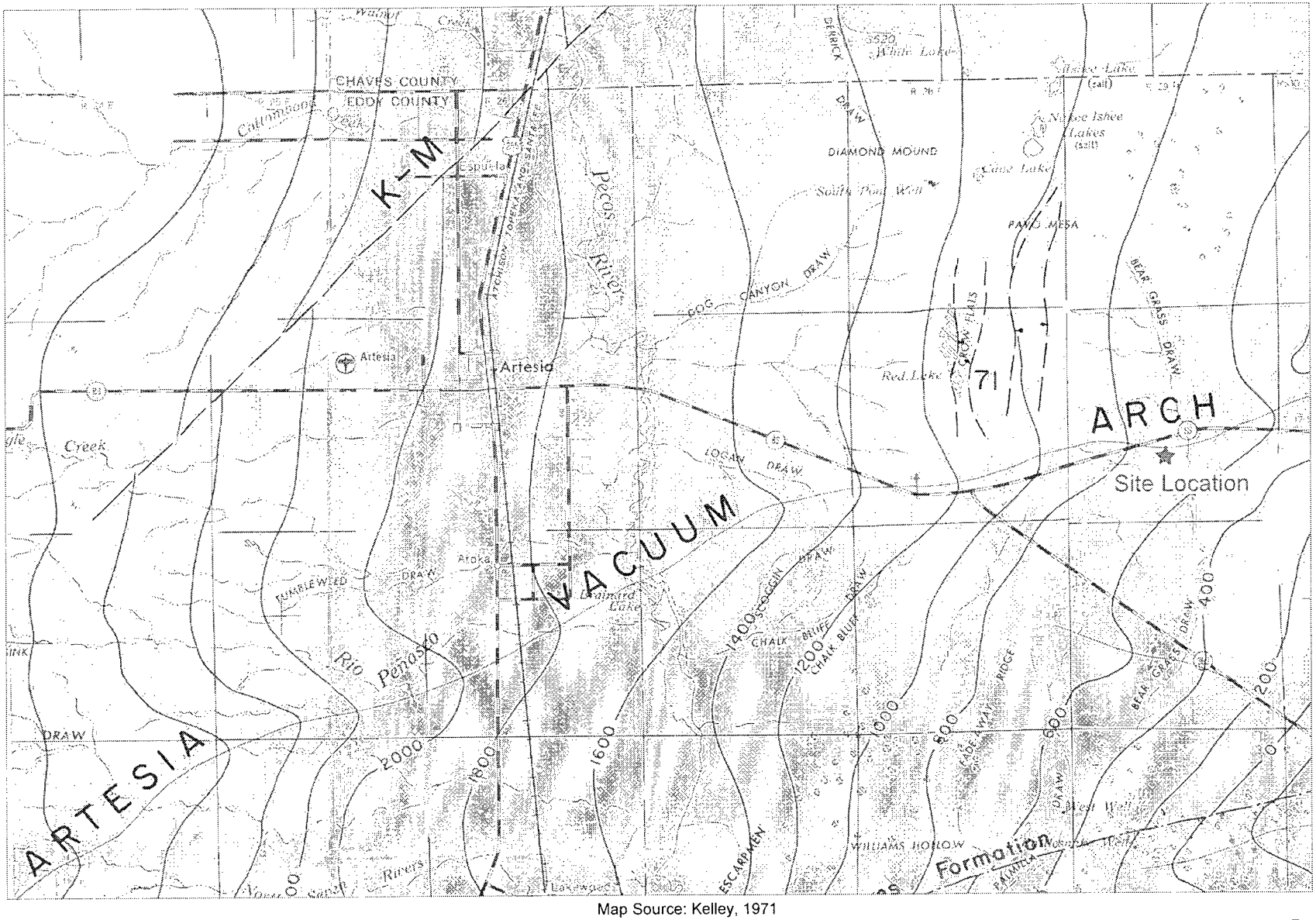
Name: RED LAKE SE
Date: 5/11/2004
Scale: 1 inch equals 1000 feet

Location: 032.8174199° N 104.0605926° W
Caption: Plate 1: Parcel Map

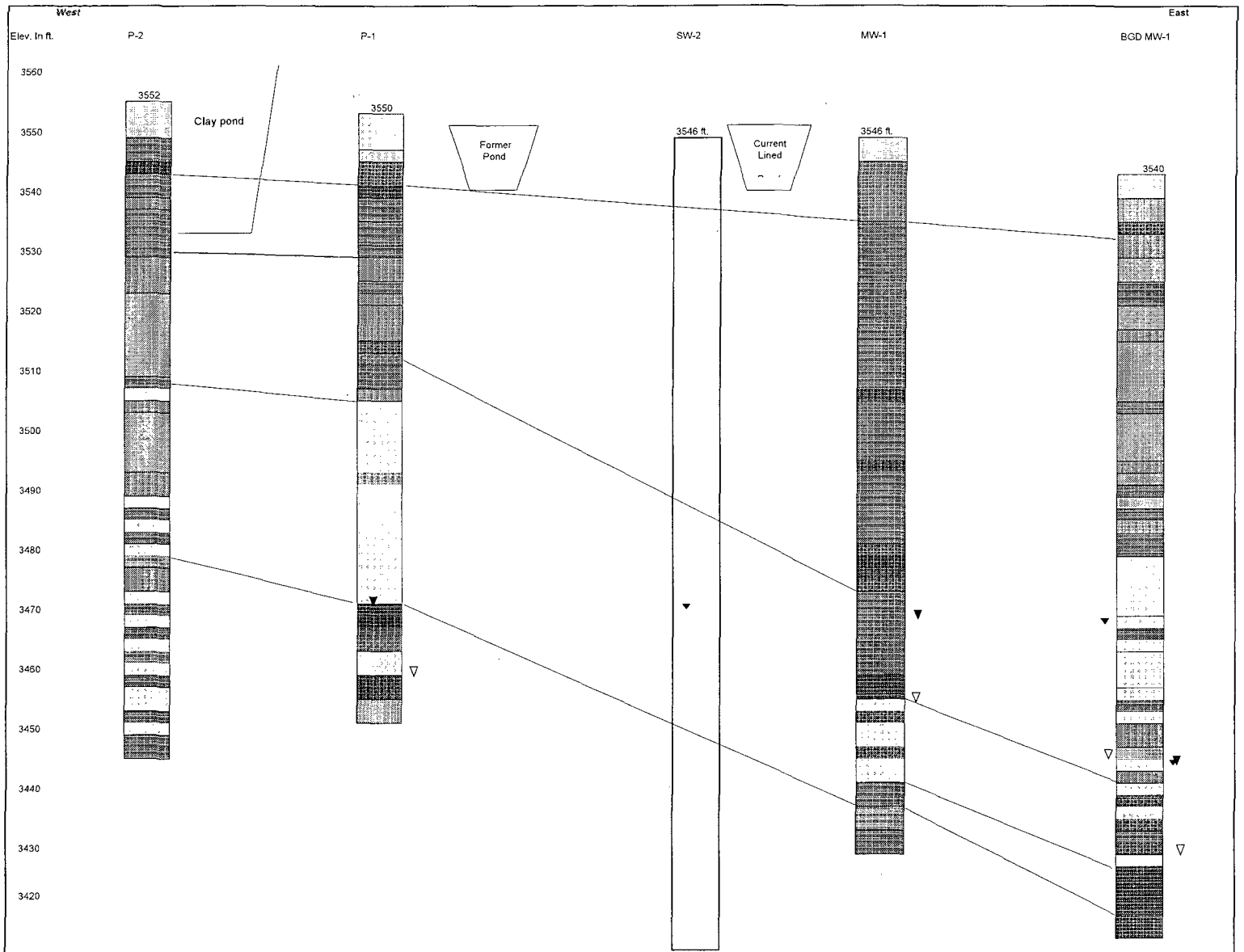


Map source: Kelley, 1971

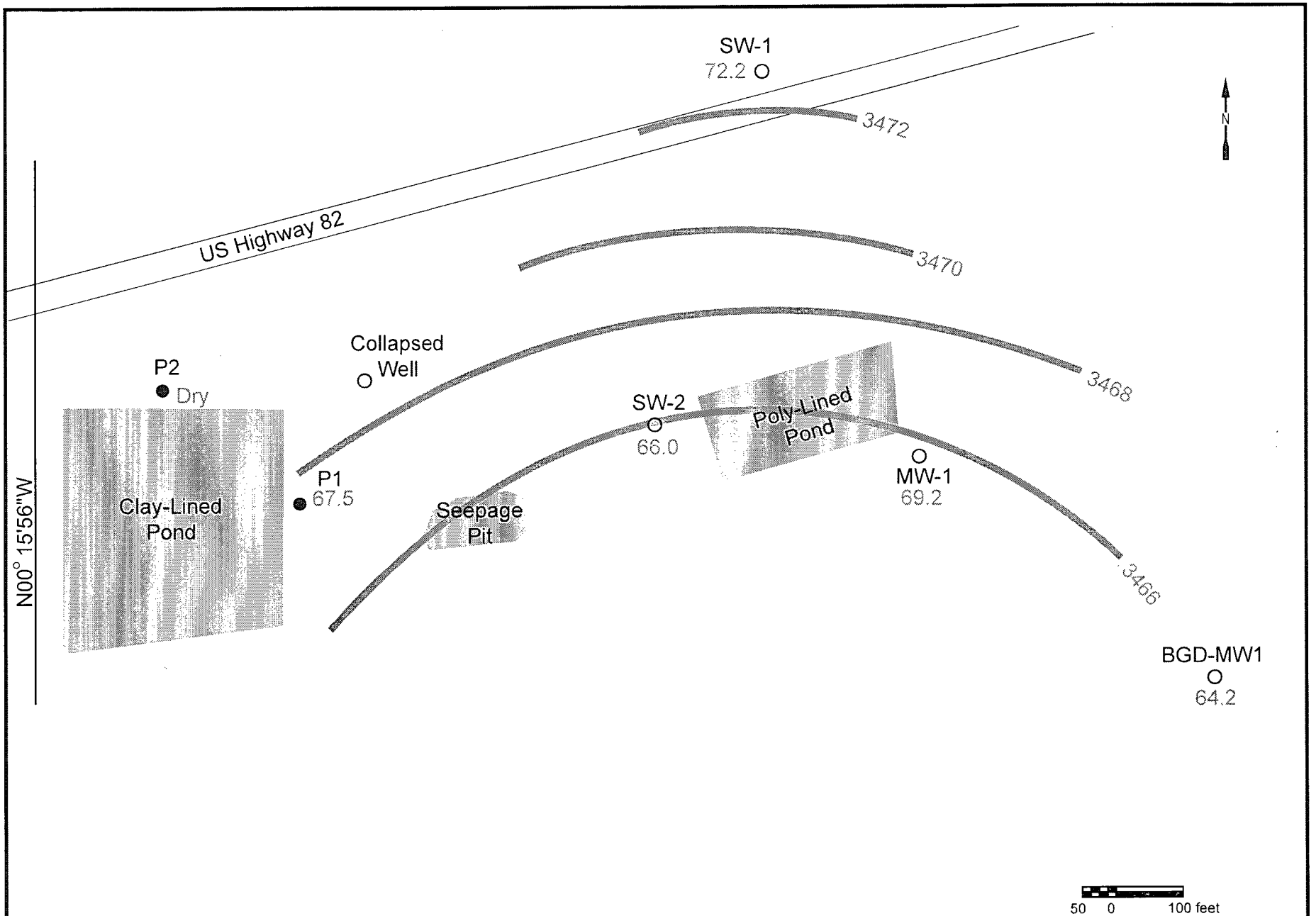
R.T. HICKS CONSULTANTS, LTD. 901 Rio Grande Blvd. NW Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.266.0745	Loco Hills GSF	Plate 2
	Surface Geologic Map	August 2004



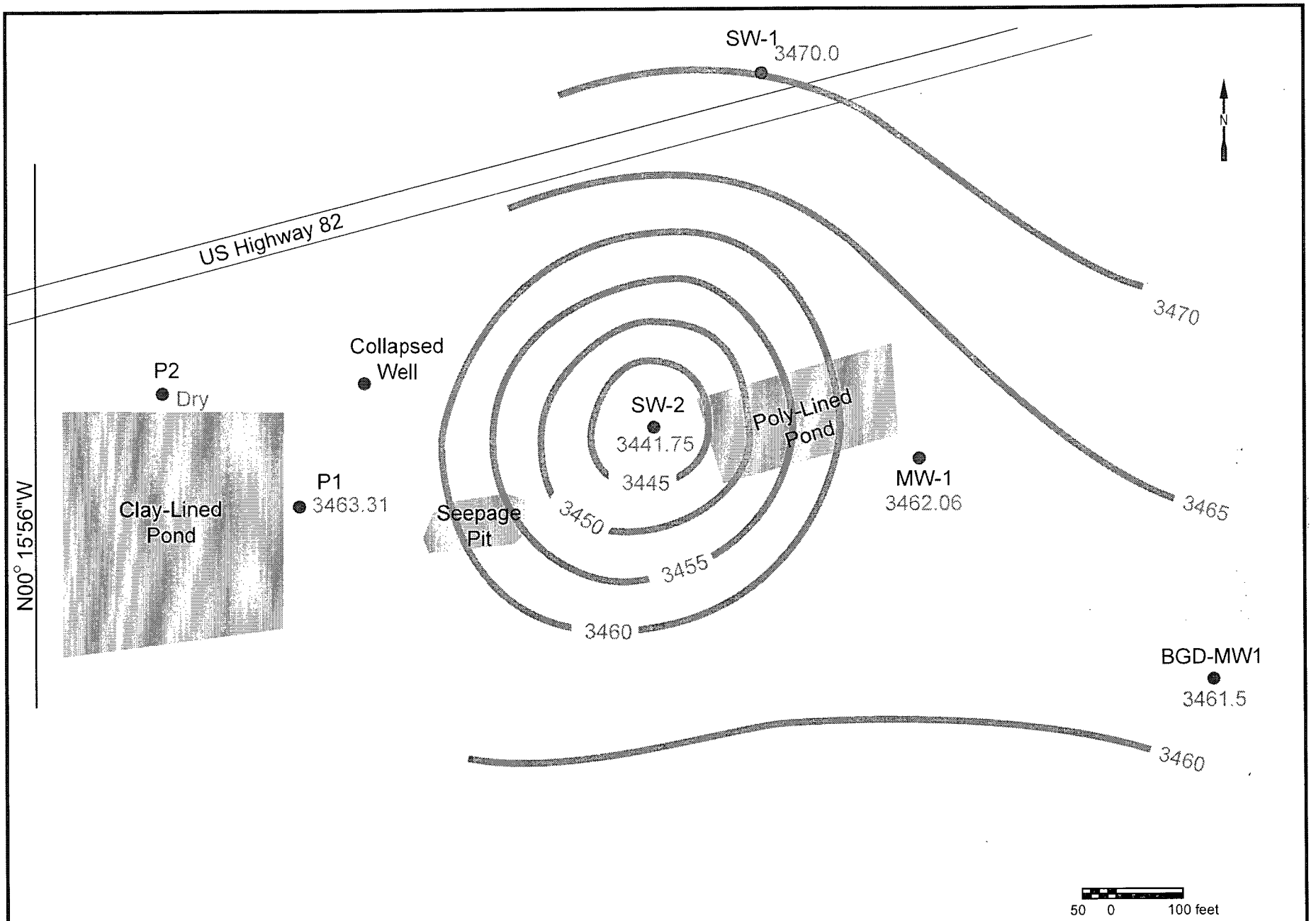
R.T. HICKS CONSULTANTS, LTD. 901 Rio Grande Blvd. NW Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.246.1818	Loco Hills GSF	Plate 3
	Structure Contour Map	August 2004



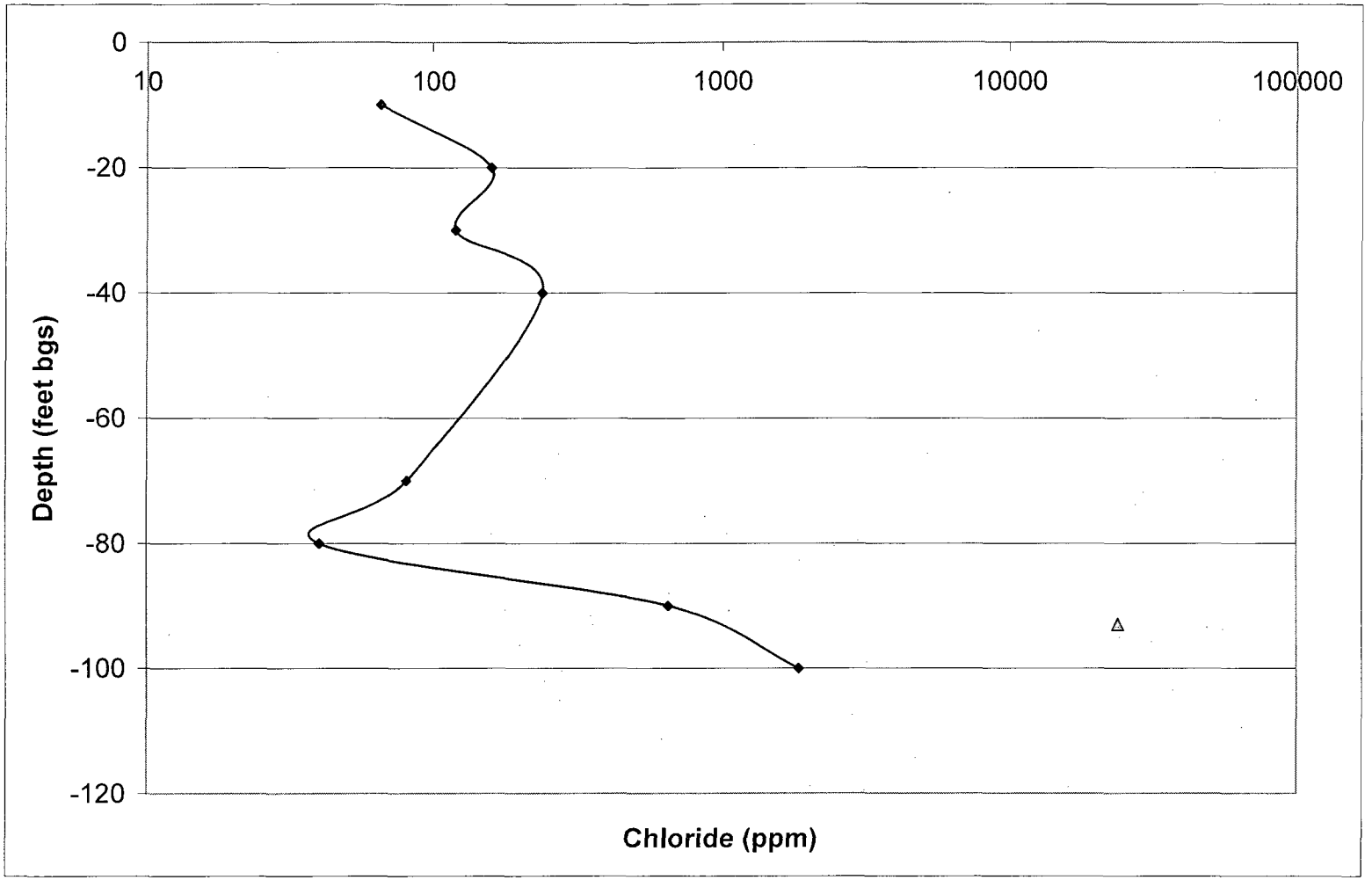
R.T. Hicks Consultants, Ltd. 901 Rio Grande Blvd. NW, Suite F-142 Albuquerque, New Mexico 87104	Hydrogeologic Cross Section	Plate 4
	Loco Hills GSF	August 2004



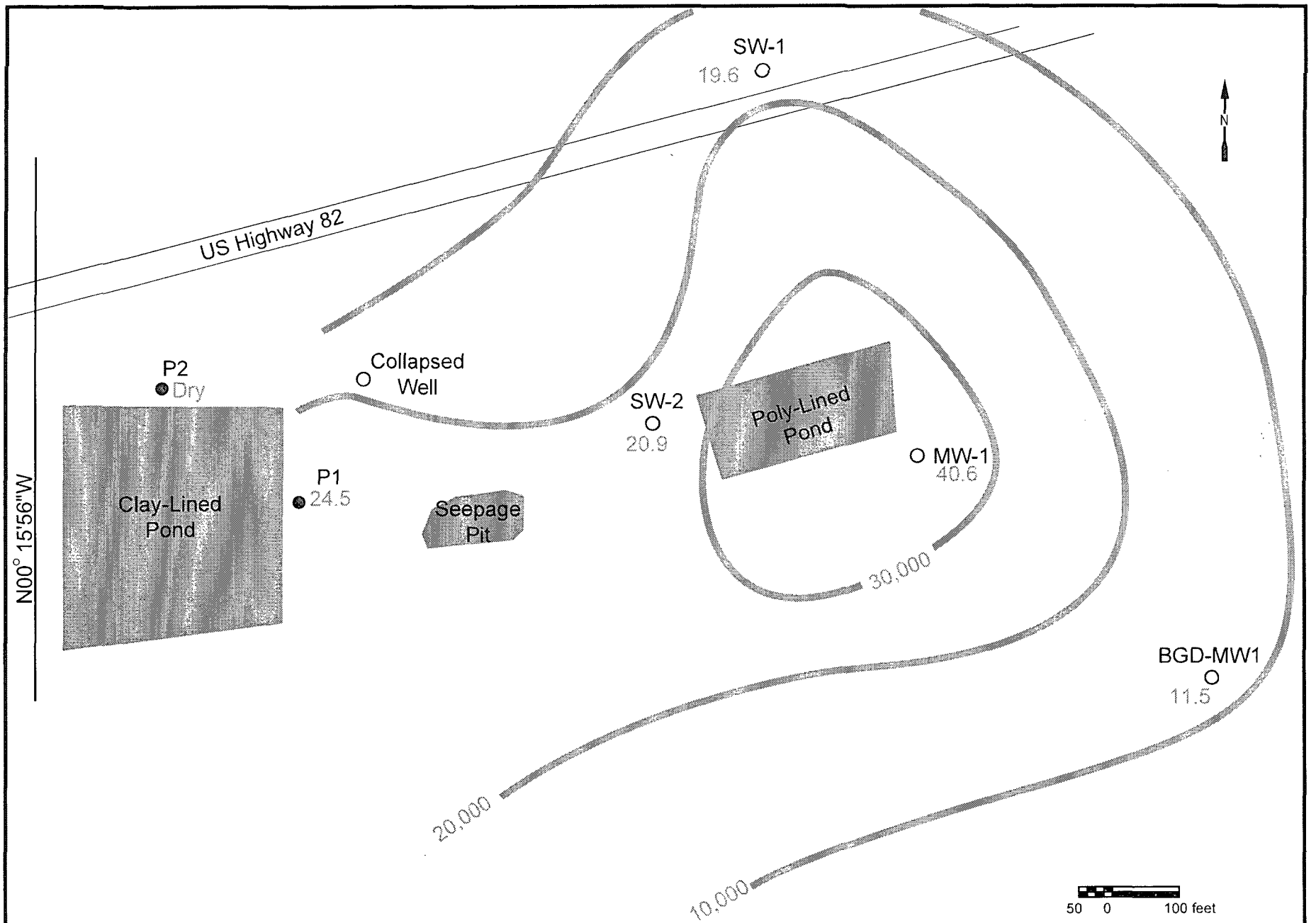
R.T. HICKS CONSULTANTS, LTD. 901 Rio Grande Blvd. NW Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.246.1818	Loco Hills GSF	Plate 5
	Potentiometric Surface Map Static	August 2004



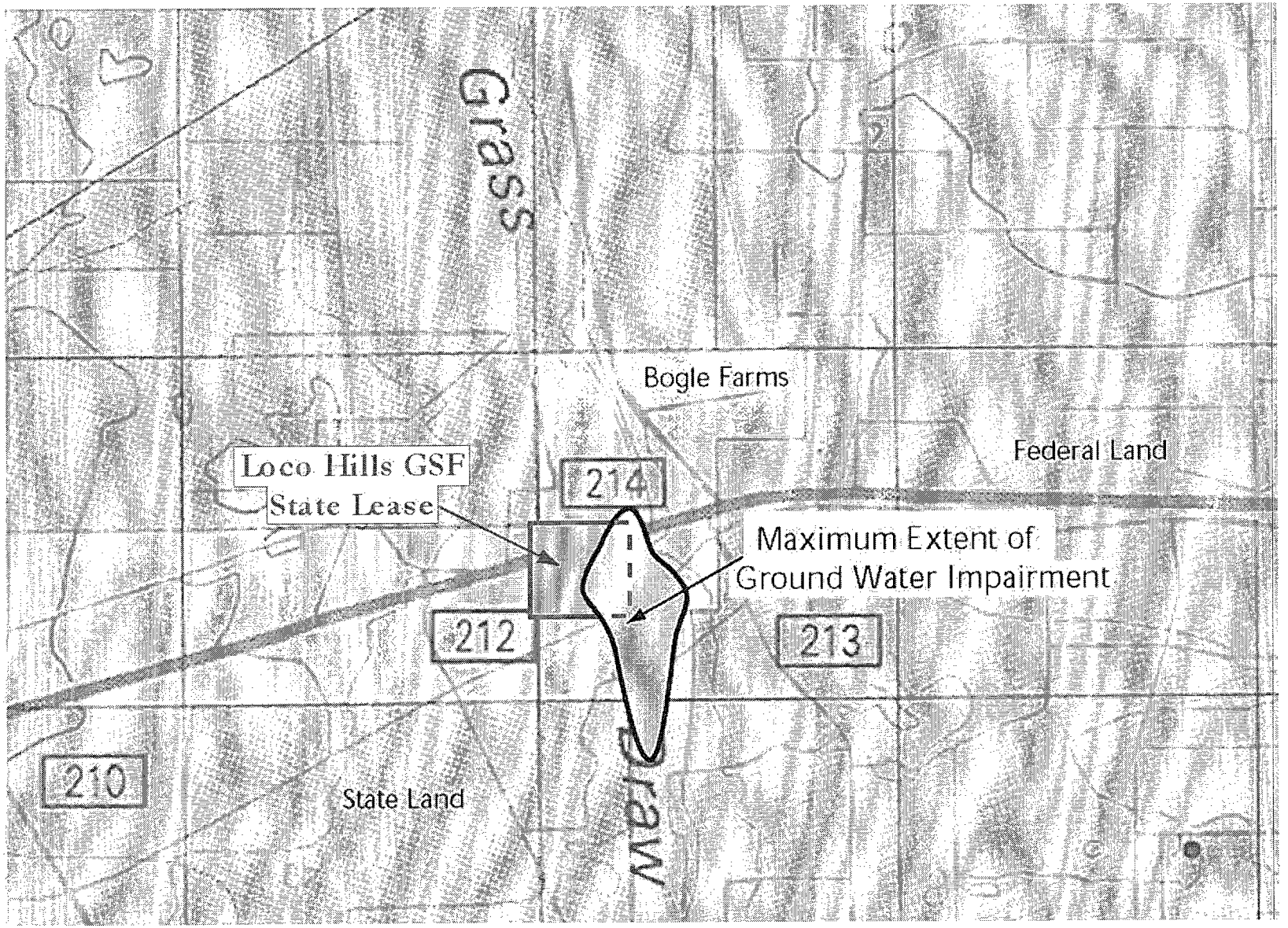
R.T. HICKS CONSULTANTS, LTD. 901 Rio Grande Blvd. NW Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.246.1818	Loco Hills GSF	Plate 6
	Potentiometric Surface Map, August 17, 2004	August, 2004



R.T. Hicks Consultants, Ltd. 901 Rio Grande Blvd. NW, Suite F-142 Albuquerque, New Mexico 87104	Chloride in Cuttings (ppm) and Ground Water	Plate 7
	Loco Hills GSF	Jul-04



R.T. HICKS CONSULTANTS, LTD. 901 Rio Grande Blvd. NW Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.246.1818	Loco Hills GSF	Plate 8
	Chloride in Ground Water (10^3 mg/L)	August 2004



R.T. Hicks Consultants, Ltd. 901 Rio Grande Blvd. NW, Suite F-142 Albuquerque, NM 87104 505.266.5004 Fax: 505.266.0745	Loco Hills GSF	Plate 9
	Maximum Extent of Ground Water Impairment	October 2004

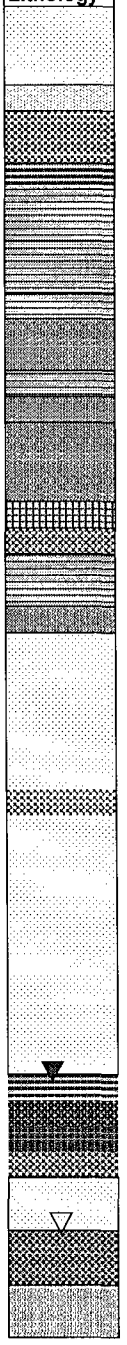
ABATEMENT PLAN APPENDIX A

WELL LOGS

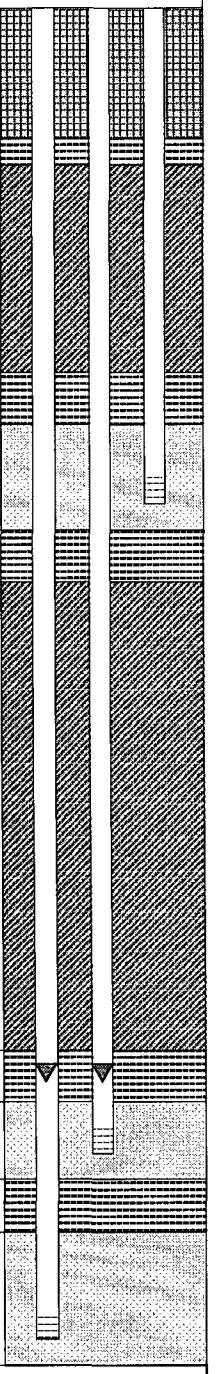
Logger:	David Hamilton	**Client:**	**Well ID:**
Driller:	Dubose Drilling	LHGSF	
Drilling Method:	Air Rotary	**Project Name:**	
Start Date:	6/17/2004		P-1
End Date:	6/18/2004	**Location:**	
Notes:		*Loco Hills*	

Depth (feet)	Description
0.0	Surface, sand, some gypsum, some clay, red, 0-7 ft.
2.0	
4.0	
6.0	Sand, light red, dry, 7-9 ft.
8.0	Caliche, sand, 9-12 ft.
10.0	
12.0	Clay, caliche, red, dry, 12-14 ft.
14.0	Clay, red, dry, 14-17 ft.
16.0	
18.0	Clay, some sand, minor caliche, red, dry, 17-22 ft.
20.0	
22.0	Clay, some sand, red, dry, 22-25 ft.
24.0	Sand, clay, red, dry, 25-27 ft.
26.0	
28.0	Clay, red, dry, 27-28 ft.
30.0	Sand, some clay, light red, dry, 28-32 ft.
32.0	Sand, silt, clay, light red, dry, 32-39 ft.
34.0	
36.0	
38.0	Limestone, light grey, dry, 39-41 ft.
40.0	Sand, limestone, 41-42 ft.
42.0	Clay, red, soft, 42-46 ft.
44.0	
46.0	Clay, sand and caliche, 46-48 ft.
48.0	Gypsum, white, dry, 48-61ft.
50.0	
52.0	
54.0	
56.0	
58.0	Gypsum, hard, white, 61-63 ft.
60.0	
62.0	
64.0	Gypsum, white, dry, 63-82 ft.
66.0	
68.0	
70.0	
72.0	
74.0	
76.0	
78.0	
80.0	
82.0	Clay, red, moist, 82-84 ft.
84.0	Clay, red, gypsum, 84-87 ft.
86.0	Clay, gypsum, hard, 87-88 ft.
88.0	Sand, clay, limestone, 88-91 ft.
90.0	Gypsum, clay, tan, dry, 91-93 ft.
92.0	
94.0	Gravel, wet, 93-97 ft., est. 1-2 gal./min.
96.0	
98.0	Sand, clay, tan, 97-101ft.
100.0	

Lithology



Piezometer Construction



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Loco Hills GSF

Plate D-1

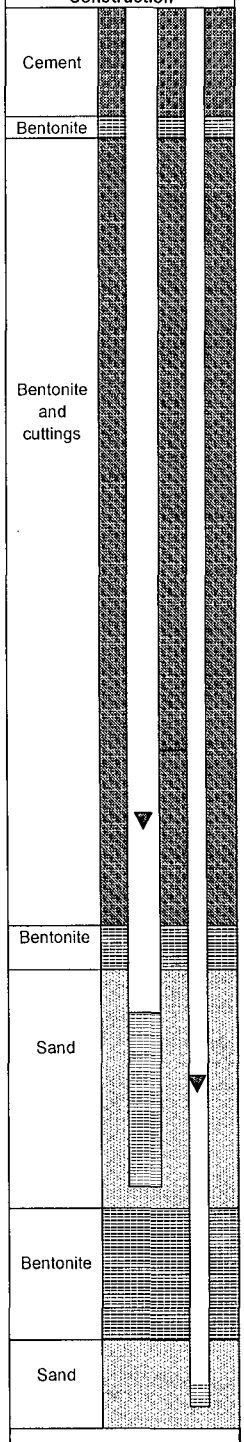
July 2004

Logger:	David Hamilton	**Client:**	**Well ID:**
Driller:	Dubose Drilling	LHGSF	BGD MW-1
Drilling Method:	Air Rotary	**Project Name:**	
Start Date:	6/17/2004		
End Date:	6/18/2004	**Location:**	
Notes:		Loco Hills	

Depth (feet)	Description
0.0	Surface, 0-5 ft.
2.0	
4.0	Sand, clay, grey, 5-9 ft.
6.0	
8.0	Sand, caliche, tan, 9-11 ft.
10.0	Clay, sand, red, 11-14 ft.
12.0	
14.0	Sand, clay, red, 14-19 ft.
16.0	
18.0	Clay, red, little sand, 19-22 ft.
20.0	
22.0	Sand, clay, red, 22-26 ft.
24.0	
26.0	Clay, sand, red, 26-29 ft.
28.0	Sand, clay, red, dry, 29-39 ft.
30.0	
32.0	
34.0	
36.0	
38.0	Clay, red, 39-41 ft.
40.0	Sand, clay, red, 41-48 ft.
42.0	
44.0	
46.0	
48.0	Clay, sand, 48-49 ft.
50.0	Sand, clay, 49-51 ft.
52.0	Clay, red, soft, some sand, 51-54ft.
54.0	Sand, tan, 54-55 ft.
56.0	Clay, red, some sand and gypsum, 55-62 ft.
58.0	
60.0	
62.0	
64.0	Gypsum, white, dry, 62-74 ft.
66.0	
68.0	
70.0	
72.0	
74.0	Gypsum, clay, soft, 74-80 ft.
76.0	
78.0	
80.0	Gypsum, white, dry, 80-87 ft.
82.0	
84.0	
86.0	Clay, gypsum, moist, 87-93 ft.
88.0	
90.0	
92.0	Clay, sand, red, moist, 93-97 ft.
94.0	
96.0	Clay, gypsum, sand, 97-100 ft.
98.0	
100.0	Clay, sand, red, 100-102 ft.
102.0	Gypsum, 102-105 ft.
104.0	Limestone, gypsum, 105-109 ft.
106.0	
108.0	
110.0	Clay, limestone, gypsum, 109-114 ft.
112.0	
114.0	Gypsum, 114-117 ft.
116.0	Clay, red, 117-125 ft.
118.0	
120.0	
122.0	
124.0	Clay, grey-blue, 125-129 ft.
126.0	
128.0	
130.0	

Lithology

Well and Piezometer Construction



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Loco Hills GSF

Plate D- 2

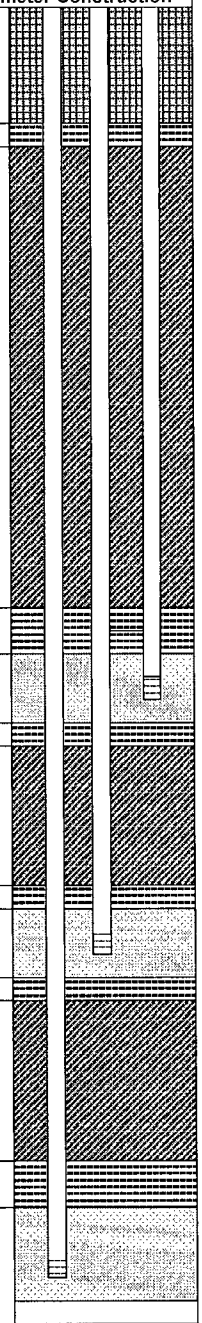
July 2004

Logger:	David Hamilton	**Client:**	**Well ID:**
Driller:	Dubose Drilling	LHGSF	
Drilling Method:	Air Rotary	**Project Name:**	
Start Date:	6/23/2004		
End Date:	6/24/2004	**Location:**	**P-2**
Notes:		Loco Hills	

Depth (feet)	Description
0.0	Surface, 0-6 ft.
2.0	
4.0	
6.0	Clay, red, dry, 6-10 ft.
8.0	
10.0	Clay, red, dry, little caliche 10-12 ft.
12.0	Clay, red, dry, 12-16 ft.
14.0	
16.0	Clay, red, dry, little sand, 16-18 ft.
18.0	Clay, red, dry, 18-27 ft.
20.0	
22.0	
24.0	
26.0	Clay, sand, red, dry, 27-33 ft.
28.0	
30.0	
32.0	Sand, clay, red, dry, 33-47 ft.
34.0	
36.0	
38.0	
40.0	
42.0	
44.0	
46.0	Clay, red, gypsum, 45-50 ft.
48.0	
50.0	Clay, sand, red, slightly soft, 50-53 ft.
52.0	Sand, clay, red, 53-63 ft.
54.0	
56.0	
58.0	
60.0	
62.0	Clay, sand, red, some gypsum, 63-67 ft.
64.0	
66.0	Gypsum, white, dry, 67-69 ft.
68.0	Clay, red, gypsum, 69-75 ft.
70.0	
72.0	
74.0	Gypsum, clay, red, some blue, 75-78 ft.
76.0	
78.0	Clay, red, gypsum, some sand, 78-83 ft.
80.0	
82.0	
84.0	Gypsum, clay, grey and red, 83-88 ft.
86.0	
88.0	Clay, grey and red, some gypsum, 88-99 ft.
90.0	
92.0	
94.0	
96.0	
98.0	Gypsum, white, dry, 99-103 ft.
100.0	
102.0	Clay, red, some silt and gypsum, soft, 103-105 ft.
104.0	
106.0	Clay, red, dry, 105-110 ft.
108.0	
110.0	

Lithology

Well and Piezometer Construction



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Loco Hills GSF

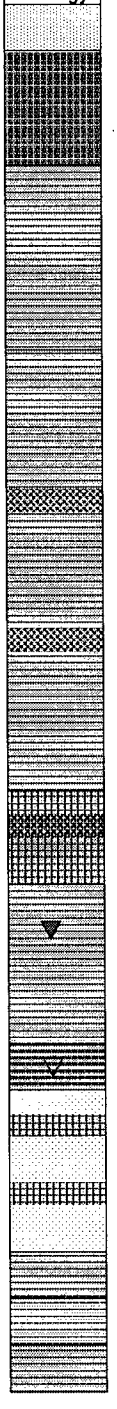
Plate D-3

July 2004

Logger:		**Client:**	**Well ID:**
Driller:		LHGSF	
Drilling Method:		**Project Name:**	
Start Date:	5/1/2003		**MW-1**
End Date:	5/1/2003	**Location:**	
Notes:		Loco Hills	

Depth (feet)	Description
0.0	Surface, very fine grained sand, red, 0-5 ft.
2.0	
4.0	Caliche, sand, clay, 5-14 ft.
6.0	
8.0	
10.0	
12.0	
14.0	Clay, red, very sandy, 14-30 ft.
16.0	
18.0	
20.0	
22.0	
24.0	
26.0	
28.0	
30.0	Clay, some fine gravel, 30-67 ft.
32.0	
34.0	
36.0	
38.0	
40.0	
42.0	
44.0	
46.0	
48.0	
50.0	
52.0	
54.0	
56.0	
58.0	
60.0	
62.0	
64.0	
66.0	
68.0	Conglomerate, limestone, grey to dark grey, 67-77 ft.
70.0	
72.0	
74.0	
76.0	Clay, red, 77-88 ft.
78.0	
80.0	
82.0	
84.0	
86.0	
88.0	
90.0	Clay, red, very sticky, 88-93 ft.
92.0	
94.0	Limestone, gypsum, white to light grey, some fractured, 93-109 ft.
96.0	
98.0	
100.0	
102.0	
104.0	
106.0	
108.0	Clay, red, 109-113 ft.
110.0	
112.0	Clay, blue grey, 113-116 ft.
114.0	
116.0	Clay, red, silty, 116-120 ft.
118.0	
120.0	

Lithology



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

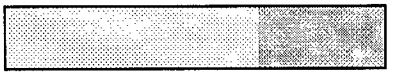
Loco Hills GSF

Plate D-4

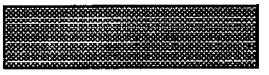
July 2004

Well Log Legend

Anhydrites, white, yellow, and limey

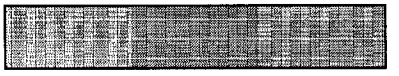


Gravels

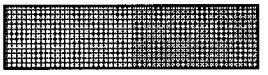


Sands, coarse to fine grained

Silts, tan, brown, red and grey



Limestone, light grey, grey



Clays, dry, wet, red to dark red

Hydrocarbon impacted lithology

APPENDIX B
Water Well Driller's Logs

Revised December 1975 13214 159

IMPORTANT — READ INSTRUCTIONS ON BACK BEFORE FILLING OUT THIS FORM.

Declaration of Owner of Underground Water Right

Eddy County

Declaration No. ~~03-13~~ RA-8233 Date received **July 10, 1991**

STATEMENT

1. Name of Declarant Bogle Farms
   Mailing Address PO Drawer 460 Dexter, NM 88230
   County of Chaves, State of
2. Source of water supply Shallow water (artesian or shallow water aquifer)
3. Describe well location under one of the following subheadings:
   a. NW ¼ NW ¼ ¼ of Sec. 22 Twp. 17S Rge. 29E N.M.P.M., in Eddy County.
   b. Tract No. of Map No. of the
   c. X = feet, Y = feet, N. M. Coordinate System Zone in the Grant.
   On land owned by Bogle Farms
4. Description of well: date drilled Prior 1915 driller **unknown** depth 87 feet.
   outside diameter of casing 6 inches; original capacity 3½ gal. per min.; present capacity 3½ gal. per min.; pumping lift 80 feet; static water level 80 feet (above) (below) land surface;
   make and type of pump Windmill 10' Dempster
   make, type, horsepower, etc., of power plant
   Fractional or percentage interest claimed in well 100%
5. Quantity of water appropriated and beneficially used 1.54 (acre feet per acre) (acre feet per annum)
   for Livestock & Wildlife purposes.
6. Acreage actually irrigated acres, located and described as follows (describe only lands actually irrigated):

Subdivision	Sec.	Twp.	Range	Acres Irrigated	Owner

(Note: location of well and acreage actually irrigated must be shown on plat on reverse side.)

7. Water was first applied to beneficial use Prior 1915 (month, day, year) and since that time has been used fully and continuously on all of the above described lands or for the above described purposes except as follows:
8. Additional statements or explanations:

I, Stuart Bogle being first duly sworn upon my oath, depose and say that the above is a full and complete statement prepared in accordance with the instructions on the reverse side of this form and submitted in evidence of ownership of a valid underground water right, that I have carefully read each and all of the items contained therein and that the same are true to the best of my knowledge and belief.

Bogle Farms, declarant.
by: Stuart Bogle

Subscribed and sworn to before me this 12th day of June A.D. 19 91

My commission expires July 11, 1991 Anita K. Wagner Notary Public

FILED

UNDER NEW MEXICO LAW A DECLARATION IS ONLY A STATEMENT OF DECLARANT'S CLAIM ACCEPTANCE FOR FILING DOES NOT CONSTITUTE APPROVAL OR REJECTION OF THE CLAIM.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Rusty + Josie Van Curen Owner's Well No. RA-9342
Street or Post Office Address 13 Diane Drive
City and State Artesia NM 88210

Well was drilled under Permit No. RA-9342 and is located in the:
Lot 7, Block 3 Rock Farm Subdivision
a. ____ ¼ NE ¼ SE ¼ SW ¼ of Section 19 Township 16S Range 26E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in ____ County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Martin Water Well Drlg Co. License No. WD-1064
Address 9725 Hope Hwy Artesia, New Mexico 88210

Drilling Began May 2, 98 Completed May 3, 98 Type tools Rotary Size of hole 7 7/8 in.

Elevation of land surface or ____ at well is 0 ft. Total depth of well 320 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 110 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
143	204	61	Sand + Gravel	30+

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5½	PVC	Bell	0	220	220	———	140	220

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:
____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 5/18/98

Quad ____ FWL ____ FSL ____

File No. RA 9342 Use DOM Location No. 16S.26E.19.34421

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered	
0	1	1	Topsoil	Brown
1	15	14	caliche & Rock	Tan - various
15	36	21	caliche & sand	Tan
36	62	26	clay	Tan
62	90	28	sand	Tan
90	108	18	clay	Red
108	114	6	sand & Gravel	Tan - various
114	143	29	clay	Red
143	204	61	Sand & Gravel	Tan & various
204	220	16	clay	Red

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Delford Martin
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.