AP - 086

STAGE 1 WORKPLAN

6/06/2008

AP086

Highlander Environmental Corp.

Midland, Texas

Stage 1 Abatement Plan
OXY, USA, Inc.
Todd ATB #1 (Section 36)
Section 36, T7S, R35E
NMOCD AP086

June 6, 2008

1.0 EXECUTIVE SUMMARY

As part of a due diligence assessment for Pogo Producing Company (Pogo), this site, formerly operated by Latigo Petroleum, Inc., was inspected by Highlander Environmental Corp. of Midland, Texas. Due to visual historic spills, Highlander supervised a soils investigation at this site. The site location is shown on Figures 1 and 2.

The soil investigation consisted of placement of hand auger holes and boreholes to assess the subsurface soils. Based on the soil assessment, a monitor well was installed to assess the groundwater qualities at the Site.

Impacted areas were investigated around the abandoned tank battery (ATB) pad and south of the ATB. In the area of AH-3 and AH-7, the subsurface soils were impacted above the New Mexico Oil Conservation Division (NMOCD) Recommended Remedial Action Levels (RRAL) with total petroleum hydrocarbons from surface to maximum depths of 4 feet to 10 feet below surface, respectively. In addition, elevated chloride concentrations were noted in the two boreholes from surface to depths of 20 feet to 70 feet below surface. The hand auger and borehole locations are shown on Figure 3. The analytical results are shown in Table 1 and Table 2.

Based on the results, borehole (BH-2) was converted to a temporary 2-inch monitor well. Groundwater was encountered at approximately 63 feet below top of casing (TOC). On September 6, 2006 and May 15, 2007, Highlander purged and sampled the well per OCD guidelines for analyses of chlorides and BTEX. Chloride concentrations exceeded New Mexico Water Quality Control Commission (NMWQCC) standards, while hydrocarbon constituents (BTEX) were detected at levels below the NMWQCC action levels. The analytical results are shown in Table 3.

A total of ten (10) monitor wells have been installed at this facility. The well locations are shown on the attached Figures 4 and 5. The wells have been gauged and sampled. Four of the perimeter monitor wells have remained dry. The results are summarized in Table 3.

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On July 25, 2007, the Director of the New Mexico Oil Conservation Division (OCD), Environmental Bureau was notified in writing of groundwater impact at the above-referenced site in accordance with NM Rule 116. In order to further delineate the site, additional monitor wells were installed. During this time Plains Exploration & Production Company (PXP) purchased Pogo. In March 2008, OXY assumed operating responsibility for this site from PXP.

2.0 BACKGROUND & PREVIOUS WORK

Highlander Environmental Corp. (Highlander) performed a limited subsurface investigation at the Latigo Todd UT Hobbs R #10 ATB, Section 31, Township 7 South, Range 36 East, Roosevelt County, New Mexico. The site location is shown on Figures 1 and 2.

Several impacted areas were investigated around the ATB. A total of seven auger holes were installed in visually impacted areas on July 25, 2006. TPH concentrations and chloride concentrations were defined in all auger holes with the exception of AH-3 (chlorides) and AH-7 (TPH and chlorides). Two boreholes were installed in the vicinity of AH-3(BH-1) and AH-7 (BH-2). BH-1 exhibited TPH concentrations below the RRAL at 20' below ground surface (bgs). BH-2 was installed south of the ATB in an area measuring 45' x 50'. TPH at 10' was below the RRAL. Elevated chloride concentrations were found from the surface to a depth of 70 feet below surface. In order to further define the lateral extent of impact, an additional four auger holes were installed and sampled. The auger and borehole locations are shown on Figure 3. The analytical results are shown in Table 1 and Table 2.

Based on the results, borehole (BH-2) was converted to a temporary 2-inch monitor well. Groundwater was encountered at approximately 63 feet below top of casing (TOC). On September 6, 2006 and May 15, 2007, Highlander purged and sampled the well per OCD guidelines for analyses of chlorides and BTEX. Chloride concentrations exceed New Mexico Water Quality Control Commission (NMWQCC) standards, while hydrocarbon constituents (BTEX) were detected at levels below the NMWQCC action levels. The monitor well was completed as a permanent monitor well. On July 25, 2007, the Director of the New Mexico Oil Conservation Division (OCD), Environmental Bureau was notified in writing of groundwater impact at the above-referenced site in accordance with NM Rule 116. The analytical results are shown in Table 3.

In September 2007, an additional nine (9) monitor wells were installed at this facility. The well locations are shown on the attached Figures 4 and 5. The wells were gauged and sampled on September 19, 2007 and December 7, 2007. The results are summarized in Table 3. Chloride concentrations exceed New Mexico Water Quality Control Commission (NMWQCC) standards, while hydrocarbon constituents (BTEX) were detected at levels below the NMWQCC action levels. Four of the perimeter monitor wells, MW-5, MW-6, MW-9 and MW-10 remained dry.

3.0 GEOLOGY & HYDROGEOLOGY

3.1 Regional and Local Geology

According to the *Geologic Atlas of Texas Brownfield Sheet* (1974), the site is comprised of windblown sand. The sands are dark brown to grayish brown and occur in sheets locally in the form of cover sand, dunes and dune ridges. The sands are derived from lacustrine, fluviatile, and eolian deposits. Dune and dune ridges comprised of light brown to reddish sand overly the windblown sands in the western part of the area. These sands are mostly derived from the Gatuna Formation and average in thickness from 5 to 10 feet.

3.2 Regional and Local Hydrogeology

Groundwater occurs under unconfined conditions in the Ogallala Formation. The Ogallala Formation is regionally known as the High Plains Aquifer. Recharge to the Ogallala Formation occurs through infiltration of rainfall and snowmelt. Discharge occurs principally through pumping from wells.

The regional flow direction for groundwater in the High Plains aquifer is primarily to the south-southeast, however, the localized flow in this area appears to be towards the west-southwest, towards the edge of the Caprock. The depth to water in the monitor wells range from 63' to 70' (TOC).

3.3 Water Well Inventory

Highlander performed an internet search of the New Mexico Office of the State Engineer (OSE) and the United States Geologic Survey (USGS) databases for water wells within a ½ mile radius of the subject site.

No water well records were found in the OSE or USGS databases for the prescribed radius. However, wells were reported in Section 26 Section 23, and Section 34 T-7-S, R-35-E with reported depths to water of 50', 198' and 116' bgs, respectively. The water well inventory data sheet is included in Appendix A.

4.0 SUBSURFACE SOILS

The soils in the vicinity of this site are typically windblown sands. The sands are dark brown to grayish brown and occur in sheets locally in the form of cover sand, dunes and dune ridges. The sands are derived from lacustrine, fluviatile, and eolian deposits. Dune and dune ridges comprised of light brown to reddish sand overly the windblown sands in the western part of the area. These sands are mostly derived from the Gatuna Formation and average in thickness from 5 to 10 feet. The soil borings at this site indicate sand and sandstone to approximately 60' where sandy clay is encountered.

5.0 GROUNDWATER QUALITY

5.1 Installation of Additional Monitor Wells

No additional monitor wells are planned at this time. Copies of the boring and completion logs are included in Appendix B. A water table map was generated for the most recent sampling event and is shown as Figure 4. Four of the perimeter monitor wells remain dry.

5.2 Monitoring Program

The original monitoring well (MW-1) has been sampled four times since September 6, 2006. The most recent sampling was performed on all six of the monitor wells that contained fluid on December 7, 2007. Quarterly sampling of all wells will commence in the third quarter of 2008 and continue until further notice.

5.3 Hydrocarbons in Groundwater

Traces of BTEX constituents have only been reported in MW-1 and MW-3 and only at levels well below the WQCC standards.

5.4 Other Constituents of Concern

Chloride concentrations have been defined as shown on the attached Figure 5. Chloride concentrations are highest around MW-1.

6.0 CONCLUSIONS

TPH concentrations were either below the RRAL or limited to the surface 1.0' in 9 of the 11 auger holes. TPH concentrations were defined below the RRAL in one of the two remaining auger holes (AH-3) at a depth of approximately 5.0' bgs. Chloride impact in the soil is limited to the vicinity of BH-1 (AH-3) and BH-2 (AH-7).

The extent of chloride impact in the groundwater has been defined at this site, and no BTEX constituents currently exceed the WQCC standards. There does not appear to be any receptors in the proximity of this site. In fact, the perimeter monitor wells have remained dry, bringing in to question whether this is a viable aquifer or if it is perched water from historic leaks at the ATB. Quarterly groundwater gauging and sampling will commence in the third quarter of 2008. OXY proposes to continue to monitor all ten wells on a quarterly basis to evaluate aquifer viability, plume stability, groundwater parameters and to develop an appropriate groundwater remediation system, if any. If conditions do not improve or if they deteriorate, a workplan for additional investigation will be prepared and submitted to the NMOCD.

7.0 SOIL CORRECTIVE ACTION PLAN (CAP)

The majority of TPH impact is limited to the initial 1.0' of soil. In these areas, the soils will be tilled and treated to promote degradation of TPH concentrations. These soil areas will be periodically monitored until confirmation samples confirm RRALs have been met. The deeper TPH and chloride impact at BH-1 (AH-3) and BH-2 (AH-7) will be removed to a depth of approximately 4.0' and taken to an approved disposal facility. A 1.0' thick clay barrier or 40 mil liner will be placed into the excavation. The remainder of the excavation will be backfilled with clean fill material.

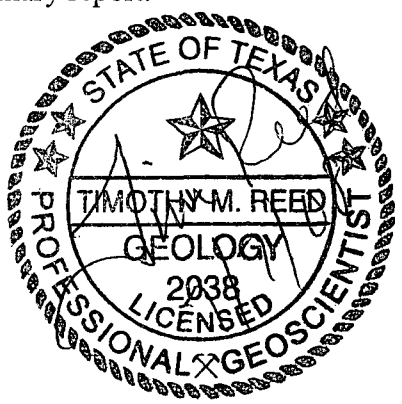
8.0 QUALITY ASSURANCE/ QUALITY CONTROL

All monitor wells were constructed to EPA and industry standards. All downhole equipment (i.e., drill rods, drill bits, etc.) were thoroughly decontaminated between each use with a steam cleaner.

The wells were inspected for the presence of phase-separated hydrocarbons (PSH) and found not to contain any. The wells were properly purged and sampled with clean, dedicated, polyethylene bailers and disposable line. The groundwater samples were submitted to a laboratory for analysis of Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) by method EPA 8021B, chloride, sulfate and total dissolved solids.

9.0 PROPOSED SCHEDULE OF ACTIVITIES

Upon approval, quarterly sampling of the ten (10) existing monitor wells will be continued and all results will be submitted in an annual summary report within the first quarter of 2009. Also, upon approval, all soil activities will be commenced and the results reported in the annual summary report.



Respectfully submitted,
Highlander Environmental Corp.

Timothy M. Reed, P.G
Vice President

cc: Daniel Sanchez-NMOCD
enclosures: figures, water well information, boring and completion logs, tables

FIGURES

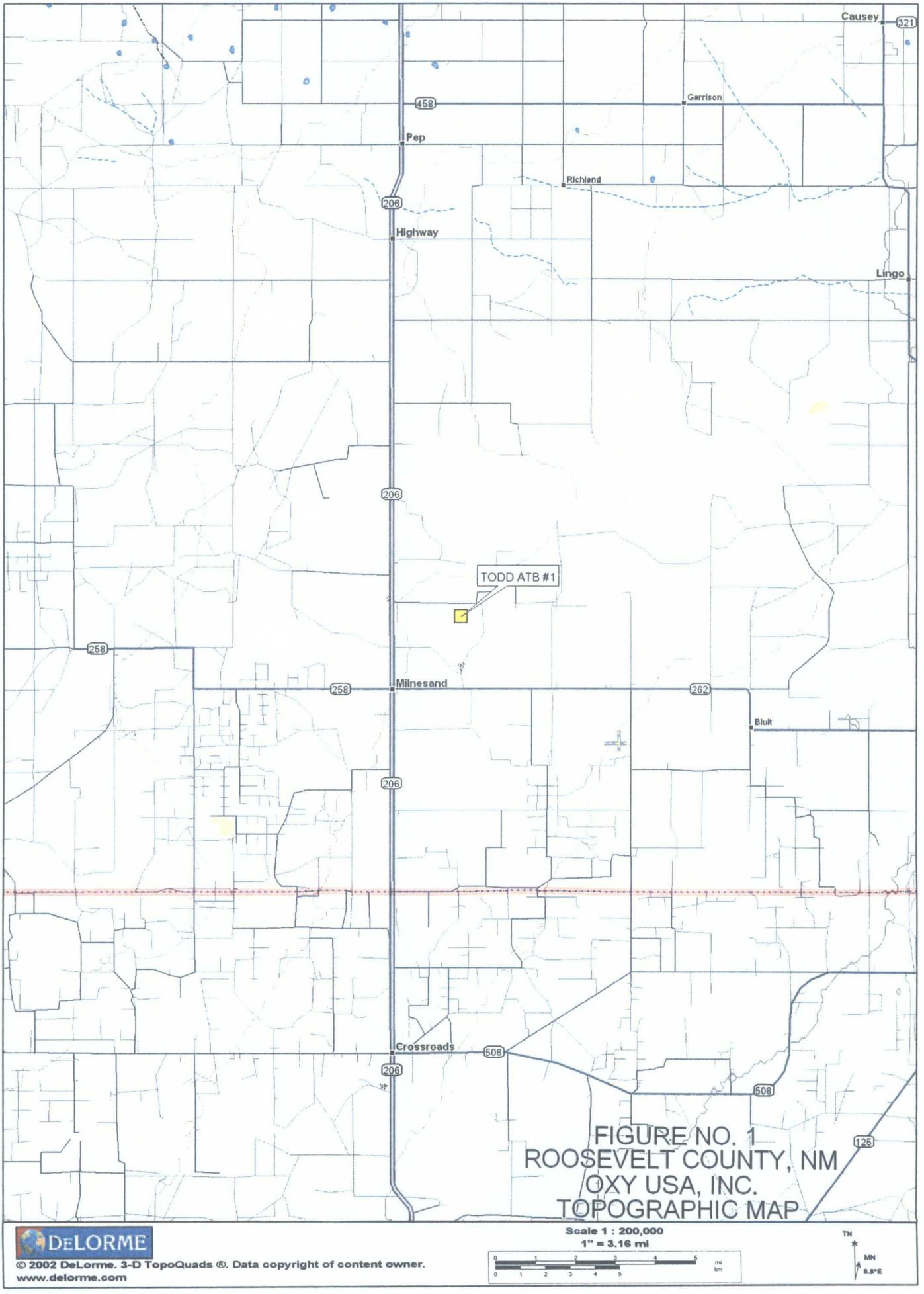


FIGURE NO. 1
ROOSEVELT COUNTY, NM
OXY USA, INC.
TOPOGRAPHIC MAP

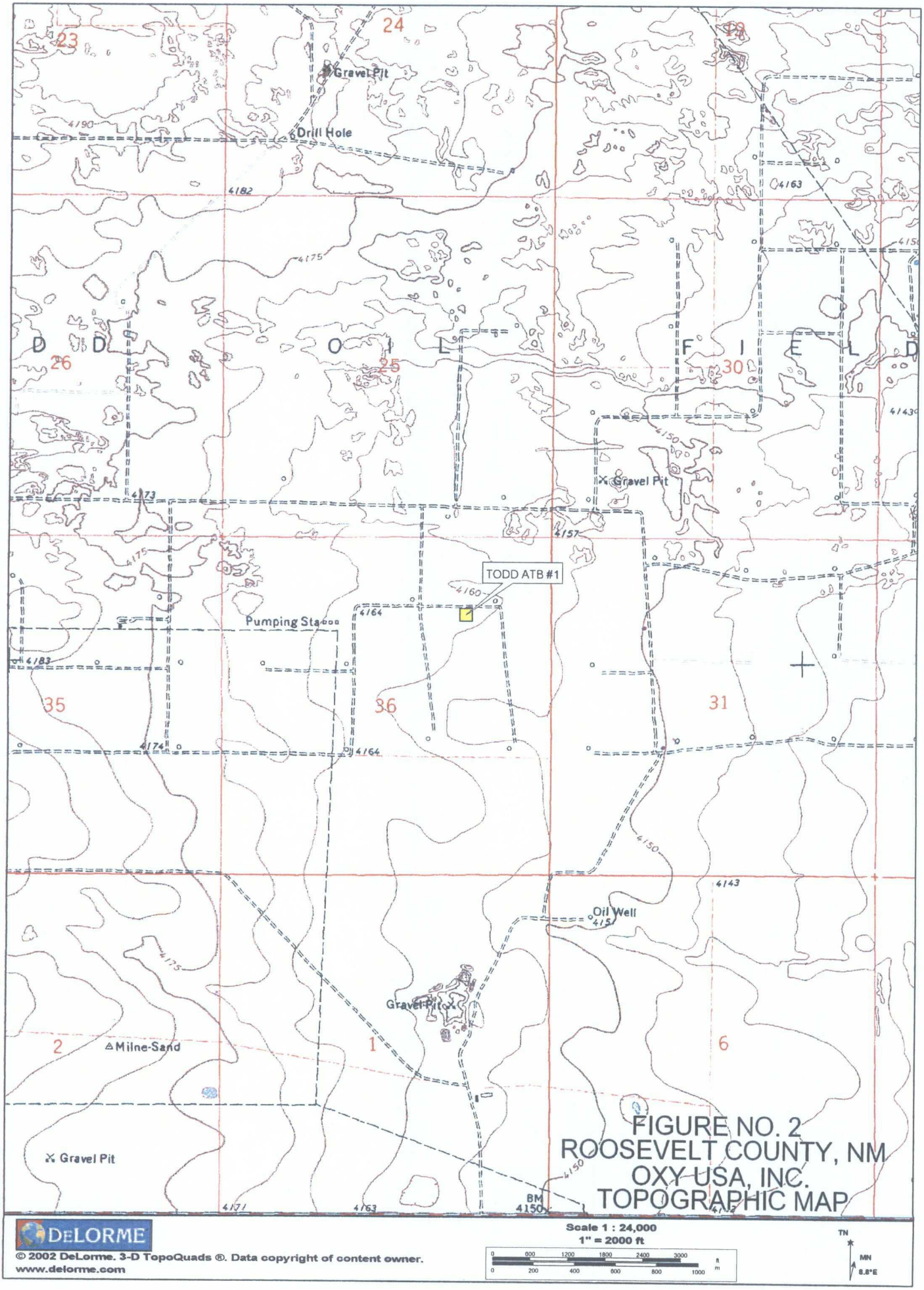
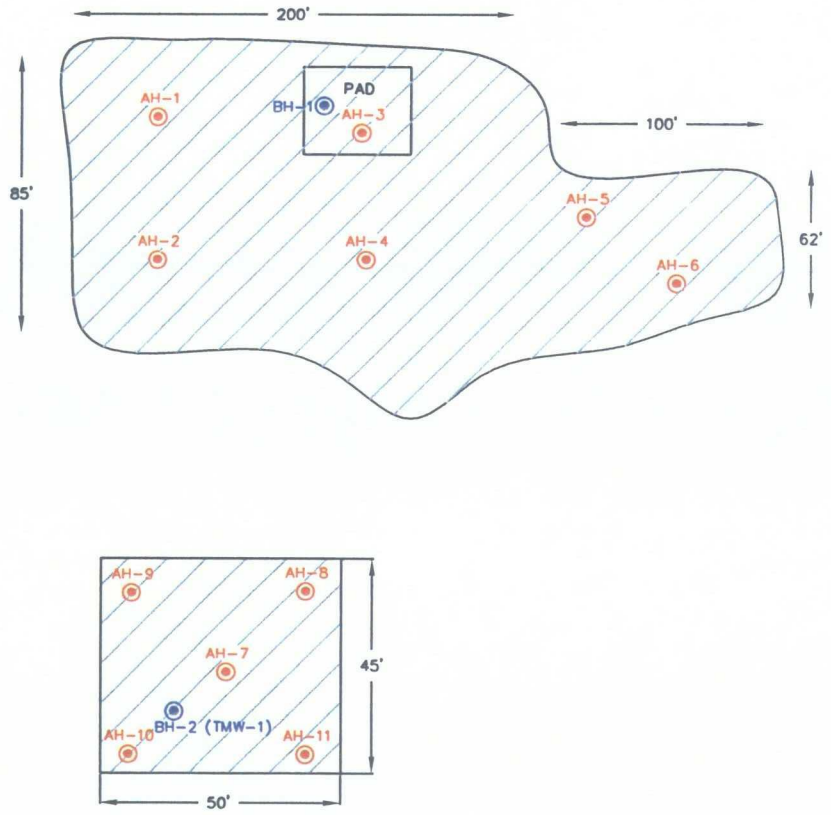


FIGURE NO. 2
ROOSEVELT COUNTY, NM
OXY USA, INC.
TOPOGRAPHIC MAP



BORE HOLES
SPILL AREAS
SAMPLE LOCATIONS

NOT TO SCALE

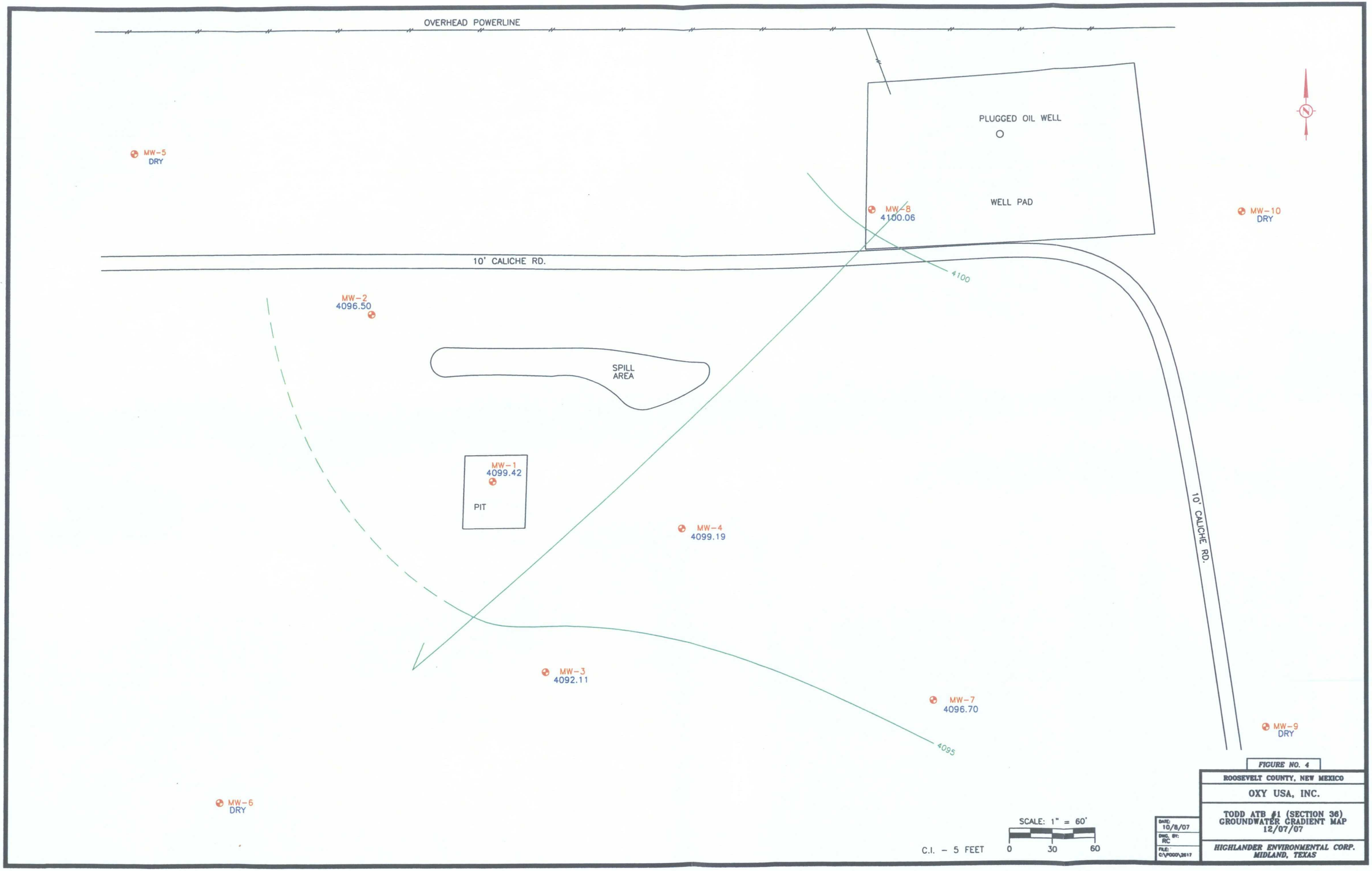
FIGURE NO. 3

ROOSEVELT COUNTY, NEW MEXICO

OXY USA, INC.
TODD UT ATB #1 (SECTION 36)

DATE: 7/20/07
DWN. BY: RC
FILE: C:\POGO\2617\TODD ATB #1

HIGHLANDER ENVIRONMENTAL CORP.
MIDLAND, TEXAS


OVERHEAD POWERLINE
PLUGGED OIL WELL
WELL PAD
MW-10
DRY
MW-5
DRY
MW-8
4100.06
10' CALICHE RD.
4100
MW-2
4096.50
SPILL
AREA
MW-1
4099.42
PIT
MW-4
4099.19
10' CALICHE RD.
MW-3
4092.11
MW-7
4096.70
MW-9
DRY
4095
MW-6
DRY
SCALE: 1" = 60'
0
30
60
C.I. - 5 FEET
DATE: 10/8/07
DWG. BY: RC
FILE: C:\FOOO\2617
FIGURE NO. 4
ROOSEVELT COUNTY, NEW MEXICO
OXY USA, INC.
TODD ATB #1 (SECTION 36)
GROUNDWATER GRADIENT MAP
12/07/07
HIGHLANDER ENVIRONMENTAL CORP.
MIDLAND, TEXAS

RESULTS IN mg/L

0 30 60

SCALE: 1" = 60'

DATE	10/8/07
BWO, BY:	RC
FILE:	C:\P000\3617

HIGHLANDER ENVIRONMENTAL CORP.
MIDLAND, TEXAS

TODD ATB #1 (SECTION 36)
CHLORIDE CONCENTRATION MAP
12/07/07

OXY USA, INC.

ROOSEVELT COUNTY, NEW MEXICO

FIGURE NO. 5

MW-1
71,000

PIT

MW-4
23,500

MW-7
22,700

MW-3
36,600

MW-6
DRY

MW-9
DRY

10' CALICHE RD.

SPILL AREA

MW-2
20,100

10' CALICHE RD.

MW-10
DRY

MW-8
39,100

WELL PAD

PLUGGED OIL WELL

MW-5
DRY

OVERHEAD POWERLINE

TABLES

Table 1
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethlybenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
AH-1	7/25/2006	0-1	<2.00	**1260**	**1260**	<0.0200	<0.0200	<0.0200	<0.0200	**67.4**
	7/25/2006	1-1.5	<1.00	**158**	**158**	-	-	-	-	<10.0
	7/25/2006	2-2.5	<1.00	<50.0	<50.0	-	-	-	-	**83.7**
AH-2	7/25/2006	0-1	<2.00	**726**	**726**	<0.0200	<0.0200	<0.0200	<0.0200	**22.1**
	7/25/2006	1-1.5	<1.00	**61.6**	**61.6**	-	-	-	-	**23.2**
	7/25/2006	2-2.5	<1.00	<50.0	<50.0	-	-	-	-	**43.0**
AH-3	7/25/2006	0-1	**1180**	**969**	**2149**	<0.100	<0.100	**0.213**	**0.817**	**5780**
	7/25/2006	1-1.5	**1530**	**9310**	**10840**	<0.200	<0.200	<0.200	**1.41**	**3860**
	7/25/2006	2-2.5	**578**	**6710**	**7288**	-	-	-	-	**1760**
	7/25/2006	4-4.5	**29.7**	**1010**	**1039.7**	-	-	-	-	**2690**
	7/25/2006	5-5.5	<1.00	**98.7**	**98.7**	-	-	-	-	**3320**
	7/25/2006	6-6.5	-	-	-	-	-	-	-	**4030**
	7/25/2006	7-7.5	**2.29**	**63.9**	**66.19**	-	-	-	-	**3180**
AH-4	7/25/2006	0-1	**869**	**2270**	**3139**	<0.0500	<0.0500	**0.408**	**1.02**	**126**
	7/25/2006	1-1.5	<1.00	<50.0	<50.0	-	-	-	-	**172**
	7/25/2006	2-2.5	<1.00	<50.0	<50.0	-	-	-	-	**102**

(-) Not Analyzed

Table 1
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethlybenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
AH-5	7/25/2006	0-1	<1.00	**157**	**157**	-	-	-	-	**14.5**
	7/25/2006	1-1.5	<1.00	**131**	**131**	-	-	-	-	**49.2**
	7/25/2006	2-2.5	<1.00	<50.0	<50.0	-	-	-	-	**22.3**
AH-6	7/25/2006	0-1	<5.00	**1250**	**1250**	<0.0500	<0.0500	<0.0500	<0.0500	**12.3**
	7/25/2006	1-1.5	<1.00	**95.4**	**95.4**	-	-	-	-	**62.6**
	7/25/2006	2-2.5	<1.00	**52.7**	**52.7**	-	-	-	-	**12.5**
AH-7	7/25/2006	0-1	**14.0**	**4960**	**4974.0**	<0.100	<0.100	**0.735**	**0.292**	**163**
	7/25/2006	1-1.5	**229**	**7420**	**7649**	<0.0500	<0.0500	**2.81**	**1.55**	**895**
	7/25/2006	2-2.5	**75.6**	**20400**	**20475.6**	-	-	-	-	**2040**
	7/25/2006	3-3.5	**154**	**12800**	**12954**	-	-	-	-	**1980**
	7/25/2006	4-4.5	**234**	**11300**	**11534**	-	-	-	-	**4190**
	7/25/2006	5-5.5	**218**	**7850**	**8068**	-	-	-	-	**2960**
AH-8	8/31/2007	0-1	<1.00	<50.0	<50.00	-	-	-	-	-
	8/31/2007	2-2.5	<1.00	<50.0	<50.00	-	-	-	-	-
	8/31/2007	4-4.5	**278**	**1940**	**2218**	-	-	-	-	-
	8/31/2007	6-6.5	**51.8**	**431**	**482.8**	-	-	-	-	-

(-) Not Analyzed

Table 1
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethlybenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
AH-9	8/31/2007	0-1	<1.00	**693**	**693**	-	-	-	-	-
	8/31/2007	2-2.5	<1.00	<50.0	<50.00	-	-	-	-	-
	8/31/2007	4-4.5	<1.00	<50.0	<50.00	-	-	-	-	-
AH-10	8/31/2007	0-1	<1.00	**692**	**692**	-	-	-	-	-
	8/31/2007	2-2.5	<1.00	<50.0	<50.00	-	-	-	-	-
	8/31/2007	4-4.5	<1.00	<50.0	<50.00	-	-	-	-	-
AH-11	8/31/2007	0-1	<10.0	**11200**	**11200**	-	-	-	-	-
	8/31/2007	2-2.5	<1.00	<50.0	<50.00	-	-	-	-	-
	8/31/2007	4-4.5	<1.00	<50.0	<50.00	-	-	-	-	-
Area AH-1,2	8/25/2006	0-.5'	**14.9**	**6710**	**6724.9**	-	-	-	-	-
Area AH-4	8/25/2006	0-.5'	<5.00	**3770**	**3770**	-	-	-	-	-
Area AH-6	8/25/2006	0-.5'	<5.00	**4080**	**4080**	-	-	-	-	-

(-) Not Analyzed

Table 2
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethlybenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
BH-1	9/1/2006	10-12'	**110**	**770**	**880**	-	-	-	-	**1960**
	9/1/2006	15-17'	**47.1**	<50.0	**47.1**	-	-	-	-	**693**
	9/1/2006	20-22'	**17.7**	<50.0	**17.7**	-	-	-	-	**289**
BH-2	9/1/2006	10-12'	**81.9**	**136**	**217.9**	-	-	-	-	**770**
	9/1/2006	15-17'	**22.7**	**242**	**264.7**	-	-	-	-	**250**
	9/1/2006	20-22'	-	-	-	-	-	-	-	**1670**
	9/1/2006	30-32'	-	-	-	-	-	-	-	**5400**
	9/1/2006	40-42'	-	-	-	-	-	-	-	**5730**
	9/1/2006	50-52'	-	-	-	-	-	-	-	**1710**
	9/1/2006	60-62'	-	-	-	-	-	-	-	**3460**
	9/1/2006	70-72'	-	-	-	-	-	-	-	<200

(-) not analyzed

Table 3
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Date Gauged	Total Depth (feet)	Top of Casing Elevation (feet)	Measured Groundwater Elevations (feet)	Corrected Groundwater Elevations (feet)	Sample Number	TPH (mg/kg)			Benzene (mg/L)	Toluene (mg/L)	Ethyl-benzene (mg/L)	Xylene (mg/L)	Chloride (mg/L)	TDS (mg/L)
								C6-C12	C12-C35	Total						
TMW-1 (MW-1)	09/06/06	N.G.	77.80	4,162.45	N.G.	N.G.	N.A.	-	-	-	**0.00200**	<0.00100	**0.00180**	<0.00100	**23,700**	-
	05/15/07	N.G.		4,162.45	N.G.	N.G.	N.A.	-	-	-	<0.00100	<0.00100	<0.00100	<0.00100	**100,000**	-
	09/19/07	09/19/07		4,162.45	63.11	4,099.34	137419				<0.00100	<0.00100	<0.00100	**0.02110**	**73,900**	-
	12/07/07	12/04/07		4,162.45	63.03	4,099.42	-	-	-	-	-	-	-	-	**71,000**	**125,700**
MW-2	09/21/07	09/19/07	78.66	4,164.75	69.77	4,094.98	137491				<0.00100	<0.00100	<0.00100	<0.00100	**18,900**	-
	12/07/07	12/04/07		4,164.75	68.25	4,096.50	-	-	-	-	-	-	-	-	**20,100**	**49,400**
MW-3	09/21/07	09/19/07	78.86	4,162.53	73.45	4,089.08	137492				**0.00220**	<0.00100	<0.00100	<0.00100	**41,100**	-
	12/07/07	12/04/07		4,162.53	70.42	4,092.11	-	-	-	-	-	-	-	-	**36,600**	**88,200**
MW-4	09/19/07	09/19/07	78.82	4,162.45	63.27	4,099.18	137420				<0.00100	<0.00100	<0.00100	**0.01020**	**24,100**	-
	12/07/07	12/04/07		4,162.45	63.26	4,099.19	-	-	-	-	-	-	-	-	**23,500**	**44,500**
MW-5	09/19/07	09/19/07	81.75	4,164.26	Dry	Dry	-				-	-	-	-	-	-
	12/07/07	12/04/07		4,164.26	Dry	Dry	-				-	-	-	-	-	-
MW-6	09/19/07	09/19/07	81.66	4,163.06	Dry	Dry	-				-	-	-	-	-	-
	12/07/07	12/04/07		4,163.06	Dry	Dry	-				-	-	-	-	-	-

(-) not analyzed N.G. - Not gauged N.A. - Not Availabe TMW-1 converted to MW-1 on September 17, 2007

Table 3
Pogo Producing Company
TODD UT ATB #1 (SECTION 36)
Roosevelt County, New Mexico

Sample ID	Date Sampled	Date Gauged	Total Depth (feet)	Top of Casing Elevation (feet)	Measured Groundwater Elevations (feet)	Corrected Groundwater Elevations (feet)	Sample Number	TPH (mg/kg)			Benzene (mg/L)	Toluene (mg/L)	Ethyl-benzene (mg/L)	Xylene (mg/L)	Chloride (mg/L)	TDS (mg/L)
								C6-C12	C12-C35	Total						
MW-7	09/19/07	09/19/07	81.51	4,161.93	65.18	4,096.75	137421				<0.00100	<0.00100	<0.00100	<0.00100	**39,400**	-
	12/07/07	12/04/07		4,161.93	65.23	4,096.70	-				-	-	-	-	**22,700**	**46,400**
MW-8	09/19/07	09/19/07	81.51	4,162.49	62.59	4,099.90	137422				<0.00100	<0.00100	<0.00100	<0.00100	**6,640**	-
	12/07/07	12/04/07		4,162.49	62.43	4,100.06	-				-	-	-	-	**39,100**	**95,100**
MW-9	09/25/07	09/25/07	78.00	4,161.67	Dry	Dry	-				-	-	-	-	-	-
	12/07/07	12/04/07		4,161.67	Dry	Dry	-				-	-	-	-	-	-
MW-10	09/25/07	09/25/07	78.00	4,161.83	Dry	Dry	-				-	-	-	-	-	-
	-	12/04/07		4,161.83	Dry	Dry	-				-	-	-	-	-	-

(-) not analyzed N.G. - Not gauged N.A. - Not Availabe TMW-1 converted to MW-1 on September 17, 2007

APPENDIX A

Water Well Data
Average Depth to Groundwater (ft)
ATB #1 (Section 36), Roosevelt County, New Mexico

6 South 35 East

6	5	4	3	2	1
7	8	9	10	11	12 **75** **90**
18	17	16	15	14	13 **55**
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

6 South 36 East

6 **70**	5 **85**	4 **90**	3	2	1
7	8	9	10	11	12 **100**
18	17	16	15	14 **90**	13 **94**
19 **63**	20	21	22 **100**	23	24 **90**
30	29	28 **142**	27	26	25
31	32	33	34	35	36

6 South 37 East

6	5	4	3	2 **90**	1
7 **82**	8	9	10	11	12
18	17	16	15	14	13
19	20	21 **80**	22 **98**	23 **90**	24
30	29	28	27	26	25
31	32	33	34	35	36

7 South 35 East

6	5	4	3	2 **211**	1
7 **190**	8	9	10 **188**	11 **197**	12
18	17 **191**	16	15	14	13
19 **181**	20	21	22	23 **198**	24
30	29 **158**	28	27	26 **50**	25
31 **53**	32	33	34 **116**	35	36

7 South 36 East

6 **194**	5 **149**	4	3	2	1
7	8	9	10	11 **185**	12
18	17	16	15	14	13
19	20	21	22	23 **185**	24 **180**
30	29 **183**	28 **183**	27 **187**	26	25
31	32	33	34	35	36 **155**

7 South 37 East

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14 **172**	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

8 South 35 East

6	5	4	3	2	1
7	8	9	10 **80**	11 **70**	12
18	17 **60**	16	15	14 **78**	13
19	20	21	22	23	24
30	29 **120**	28	27	26	25
31	32	33	34	35	36

8 South 36 East

6	5	4	3	2	1
7	8	9	10	11	12
18	17 **184**	16	15 **85**	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

8 South 37 East

6	5	4	3 **177**	2	1
7 **87**	8	9	10 **112**	11	12
18 **90**	17	16 **97**	15	14	13
19 **92**	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

88 New Mexico State Engineers Well Reports

105 USGS Well Reports

90 Geology and Groundwater Conditions in Southern Lea, County, NM (Report 6)
Geology and Groundwater Resources of Eddy County, NM (Report 3)

34 NMOCD - Groundwater Data

APPENDIX B

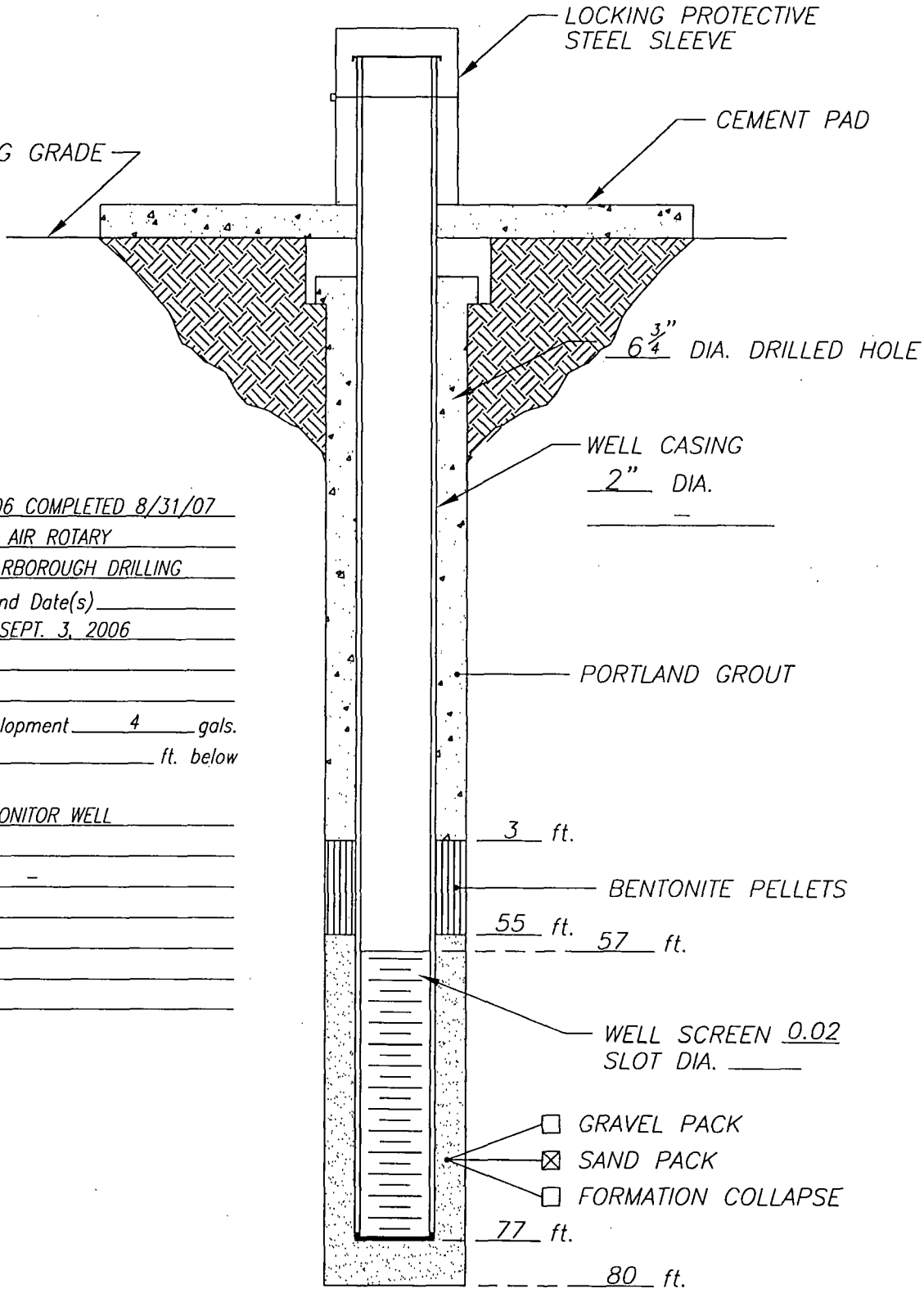
SAMPLE LOG

Boring/Well: MW-1
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 80
Date Installed: 09/01/06

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
10-15	--	Dark hydrocarbon stainded soil with caliche intermixed
15-20	--	Buff limestone with strong hydocarbon odor
20-25	--	Tan/buff limestone with no hydrocarbon odor (no salt)
30-35	--	Tan calcareous sand (salty)
40-45	--	Tan calcareous sand (salty)
50-55	--	Brown/tan large grain sand with small pebbles (very salty)
60-65	--	Brown/tan sand (salty)
70-75	--	Tan/yellow mottled clay
75-80	--	Tan/yellow mottled clay

Total Depth is 80 feet Groundwater encountered at 71 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 9/1/06 COMPLETED 8/31/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING - SEPT. 3, 2006

Water Removed During Development 4 gals.
Static Depth to Water _____ ft. below Ground Level
Well Purpose MONITOR WELL

Remarks -

DATE: 10/3/07 *Highlander Environmental*	CLIENT: *POGO PRODUCING INC* PROJECT: *TODD ATB #1* LOCATION: *ROOSEVELT CO, NM*	WELL NO. MW-1

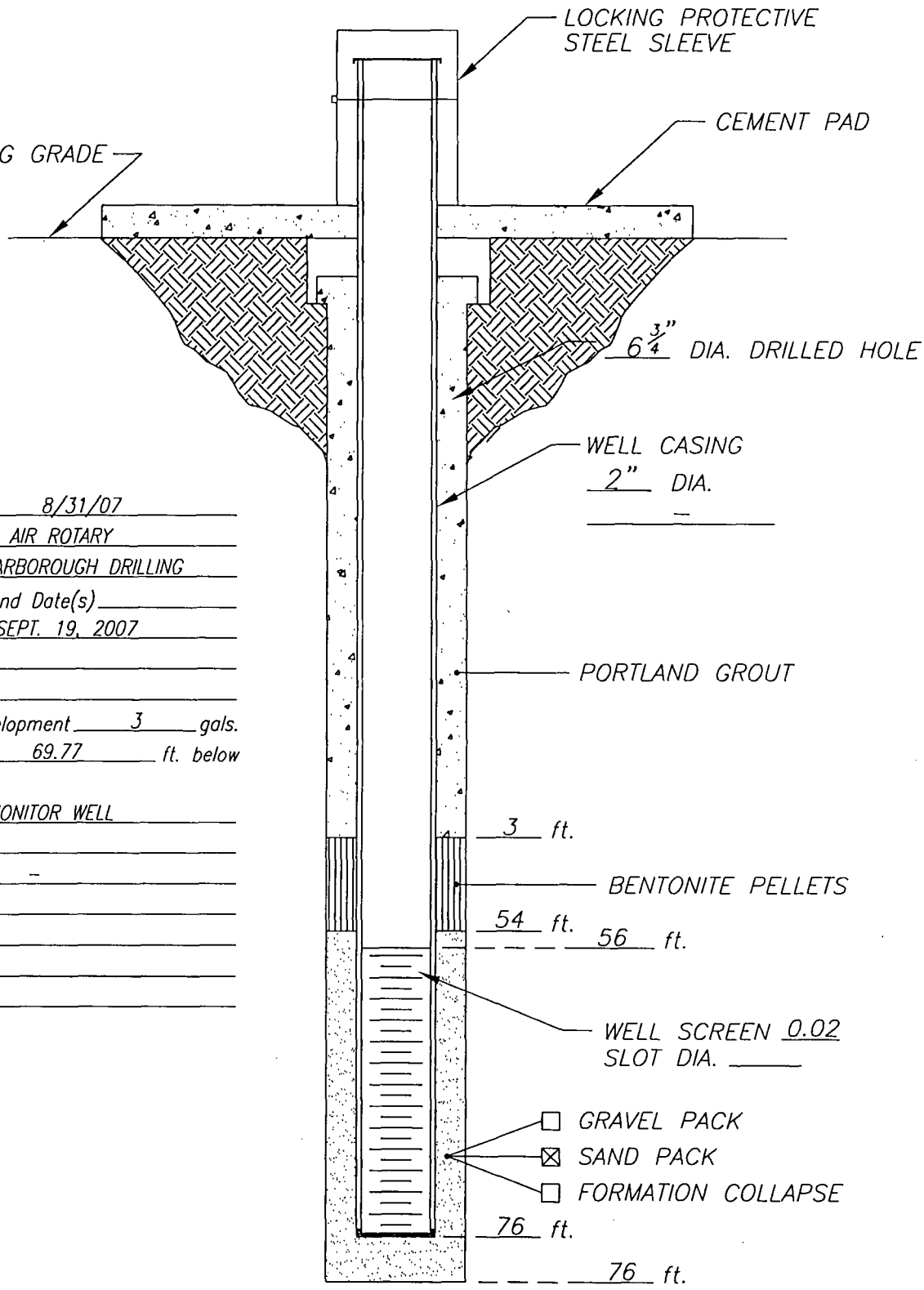
SAMPLE LOG

Boring/Well: MW-2
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 76
Date Installed: 08/31/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Grayish to red medium grain sand
5-10	--	Grayish tan fine grain sand
10-15	--	Buff (slightly sandy) limestone
15-20	--	Buff (slightly sandy) limestone
20-25	--	Buff (slightly sandy) limestone
25-30	--	Tan/buff calcareous fine grain sand
30-35	--	Tan/buff calcareous fine grain sand
35-40	--	Tan/buff calcareous fine grain sand
40-45	--	Tan/buff calcareous fine grain sand
45-50	--	Buff limestone with chert (hard)
50-55	--	Buff/tan medium grain sand with pebbles (poorly sorted)
55-60	--	Buff/tan medium grain sand with pebbles (poorly sorted)
60-65	--	Reddish tan fine to medium grain well sorted sand
65-70	--	Tan/brown slightly sandy clay
70-75	--	Tan/brown clay of high plasticity

Total Depth is 76 feet Groundwater encountered at 63 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 8/31/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING - SEPT. 19, 2007

Water Removed During Development 3 gals.
Static Depth to Water 69.77 ft. below Ground Level
Well Purpose MONITOR WELL

Remarks -

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-2
	LOCATION: ROOSEVELT CO, NM	

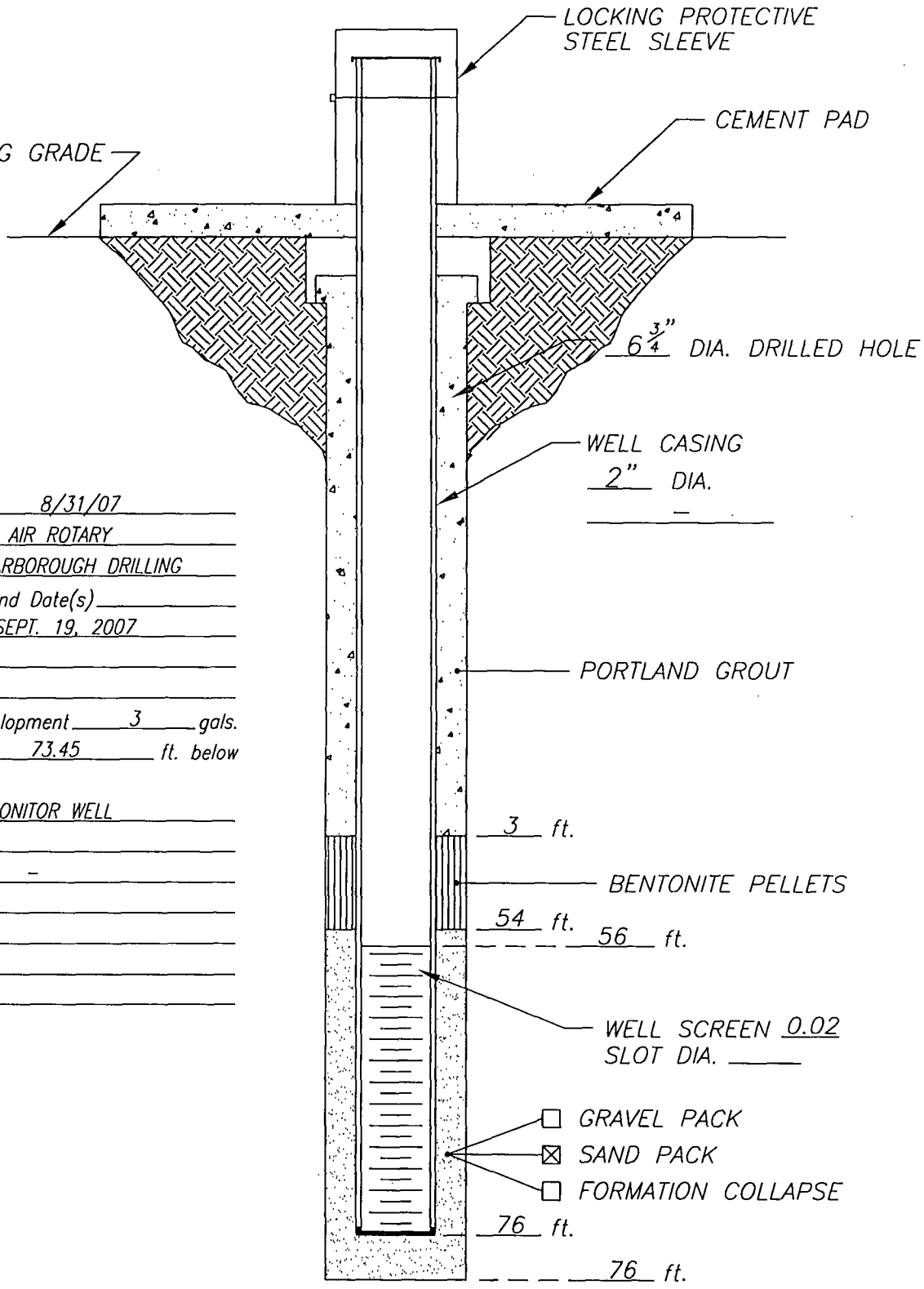
SAMPLE LOG

Boring/Well: MW-3
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 76
Date Installed: 08/31/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Brown silty sand
5-10	--	Buff slightly sandy limestone
10-15	--	Buff/tan sandy limestone
15-20	--	Buff/tan sandy limestone
20-25	--	Buff/tan sandy limestone
25-30	--	Tan/buff calcareous sand
30-35	--	Tan/buff calcareous sand
35-40	--	Tan fine grain calcareous sand
40-45	--	Buff sandy limestone
45-50	--	Buff/tan calcareous sand with chert
50-55	--	Buff/tan calcareous sand intermixed with gravel
55-60	--	Tan clayey sand to a sandy clay
60-65	--	Tan clay of high plasticity
65-70	--	Tan clay of high plasticity
70-75	--	Tan/yellow clay of high plasticity

Total Depth is 76 feet Groundwater encountered at 61 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 8/31/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING - SEPT. 19, 2007

Water Removed During Development 3 gals.
Static Depth to Water 73.45 ft. below Ground Level
Well Purpose MONITOR WELL

Remarks -

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-3
	LOCATION: ROOSEVELT CO, NM	

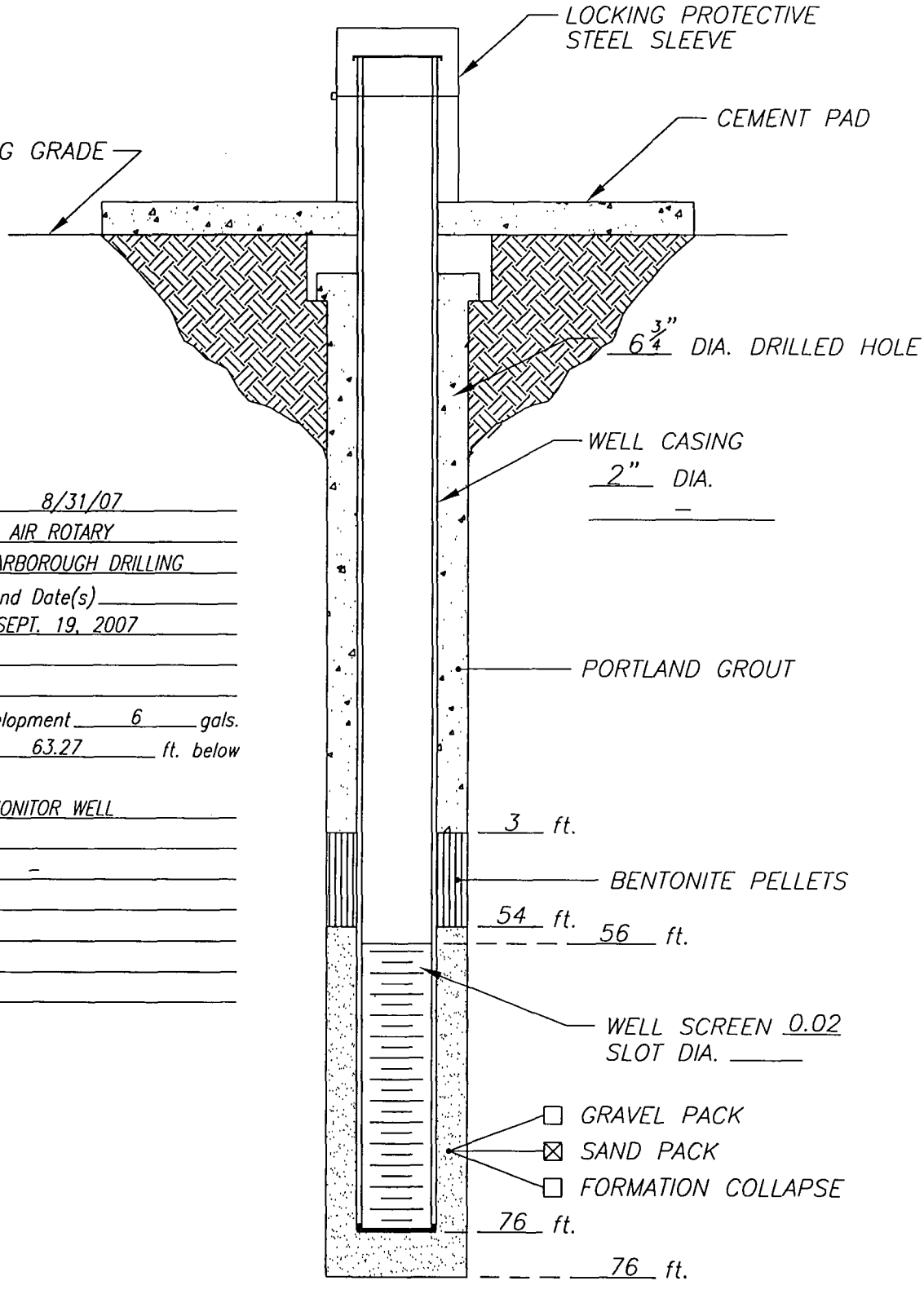
SAMPLE LOG

Boring/Well: MW-4
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 76
Date Installed: 08/31/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Gray/brown silty sand
5-10	--	Buff/tan (slightly sandy) limestone
10-15	--	Buff/tan (slightly sandy) limestone
15-20	--	Buff/tan (slightly sandy) limestone
20-25	--	Buff/tan calcareous fine grain sand
25-30	--	Buff/tan calcareous fine grain sand
30-35	--	Buff/tan calcareous fine grain sand (increasing sand)
35-40	--	Tan calcareous sand
40-45	--	Buff slightly sandy limestone with chert
45-50	--	Buff slightly sandy limestone with chert and pebbles intermixed
50-55	--	Brown/tan fine to medium grain sand with pebbles intermixed (some gravel)
55-60	--	Brown/tan fine to medium grain sand with pebbles intermixed (some gravel)
60-65	--	Tan slightly sandy clay of high plasticity
65-70	--	Tan clay of high plasticity
70-75	--	Tan clay of high plasticity

Total Depth is 76 feet Groundwater encountered at 63 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 8/31/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING - SEPT. 19, 2007

Water Removed During Development 6 gals.
Static Depth to Water 63.27 ft. below Ground Level
Well Purpose MONITOR WELL

Remarks -

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-4
	LOCATION: ROOSEVELT CO, NM	

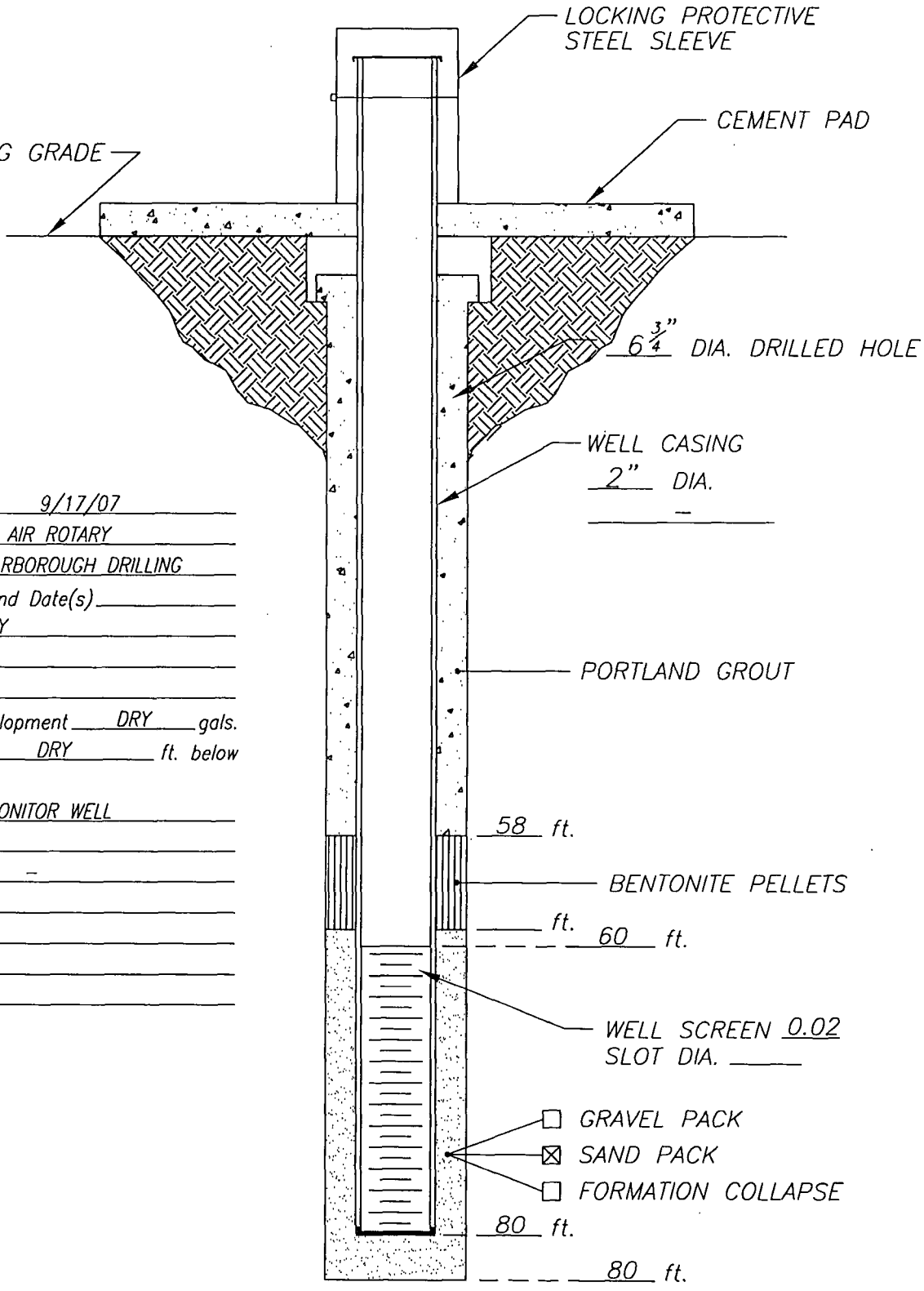
SAMPLE LOG

Boring/Well: MW-5
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 80
Date Installed: 09/17/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Brown medium grain sand
5-10	--	Tan/buff sand intermixed with limestone
10-15	--	Buff fine grain sandy limestone
15-20	--	Buff fine grain sandy limestone
20-25	--	Buff fine grain sandy limestone
25-30	--	Tan well sorted fine grain sand with sandstone intermixed
30-35	--	Tan well sorted fine grain sand with sandstone intermixed
35-40	--	Tan well sorted fine grain sand with sandstone intermixed
40-45	--	Tan well sorted fine grain calcareous sand with chert intermixed
45-50	--	Sandstone (hard) about 1.5 feet thick at 48 to 49.5
50-55	--	Tan medium grain sand with gravel intermixed
55-60	--	Tan fine grain sand with sandstone intermixed
60-65	--	Tan/brown clay
65-70	--	Tan/yellow clay of high plasticity (moist)
70-75	--	Tan medium grain sand
75-80	--	Tan clay of high plasticity

Total Depth is 80 feet Slight moisture encountered at 65 feet however, no groundwater observed.

WELL CONSTRUCTION LOG



Installation Date(s) 9/17/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s) DRY

Water Removed During Development DRY gals.
Static Depth to Water DRY ft. below Ground Level
Well Purpose MONITOR WELL

Remarks –

DATE: 10/3/07 *Highlander Environmental*	CLIENT: *POGO PRODUCING INC* PROJECT: *TODD ATB #1* LOCATION: *ROOSEVELT CO, NM*	WELL NO. MW-5

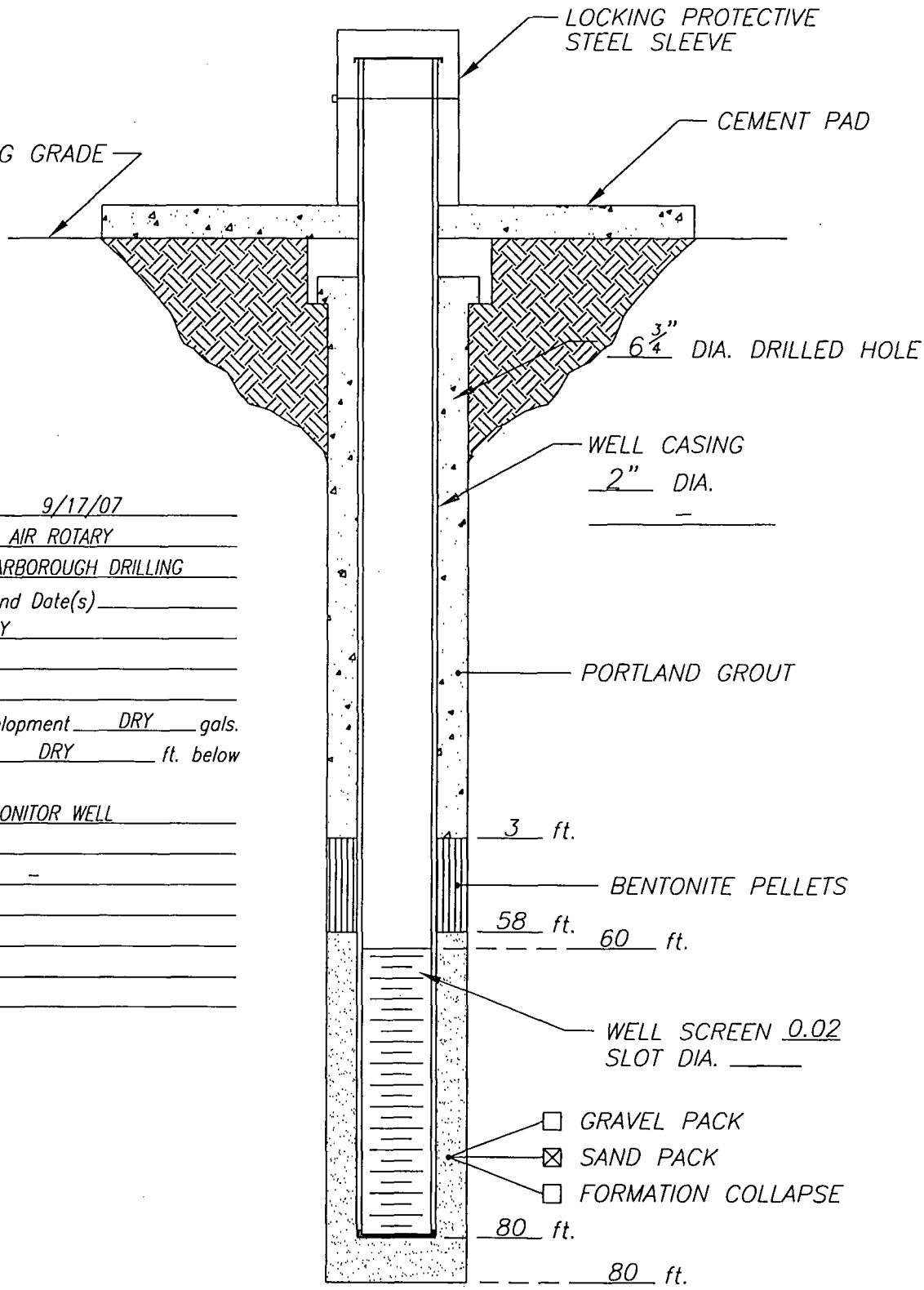
SAMPLE LOG

Boring/Well: MW-6
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 80
Date Installed: 09/17/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Tan fine grain sand
5-10	--	Grey to brown medium grain sand
10-15	--	Buff fine grain sandy limestone
15-20	--	Buff fine grain sandy limestone with increasing sand
20-25	--	Buff limestone (hard) intermixed with chert and sand
25-30	--	Tan/buff calcareous fine grain sand
30-35	--	Tan fine grain well sorted sand
35-40	--	Tan fine grain well sorted sand
40-45	--	Tan fine grain well sorted sand
45-50	--	Tan fine grain well sorted sand
50-55	--	Tan fine grain well sorted sand
55-60	--	Tan fine grain well sorted sand intermixed with sandstone
60-65	--	Tan to yellow well sorted fine grain sand
65-70	--	Tan clay of high plasticity
70-75	--	Tan clay of high plasticity
75-80	--	Brown medium grain sand with clay intermixed

Total Depth is 80 feet Slight moisture encountered at 65 feet however, no groundwater observed.

WELL CONSTRUCTION LOG



Installation Date(s) 9/17/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s) DRY

Water Removed During Development DRY gals.
Static Depth to Water DRY ft. below Ground Level
Well Purpose MONITOR WELL

Remarks –

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-6
	LOCATION: ROOSEVELT CO, NM	

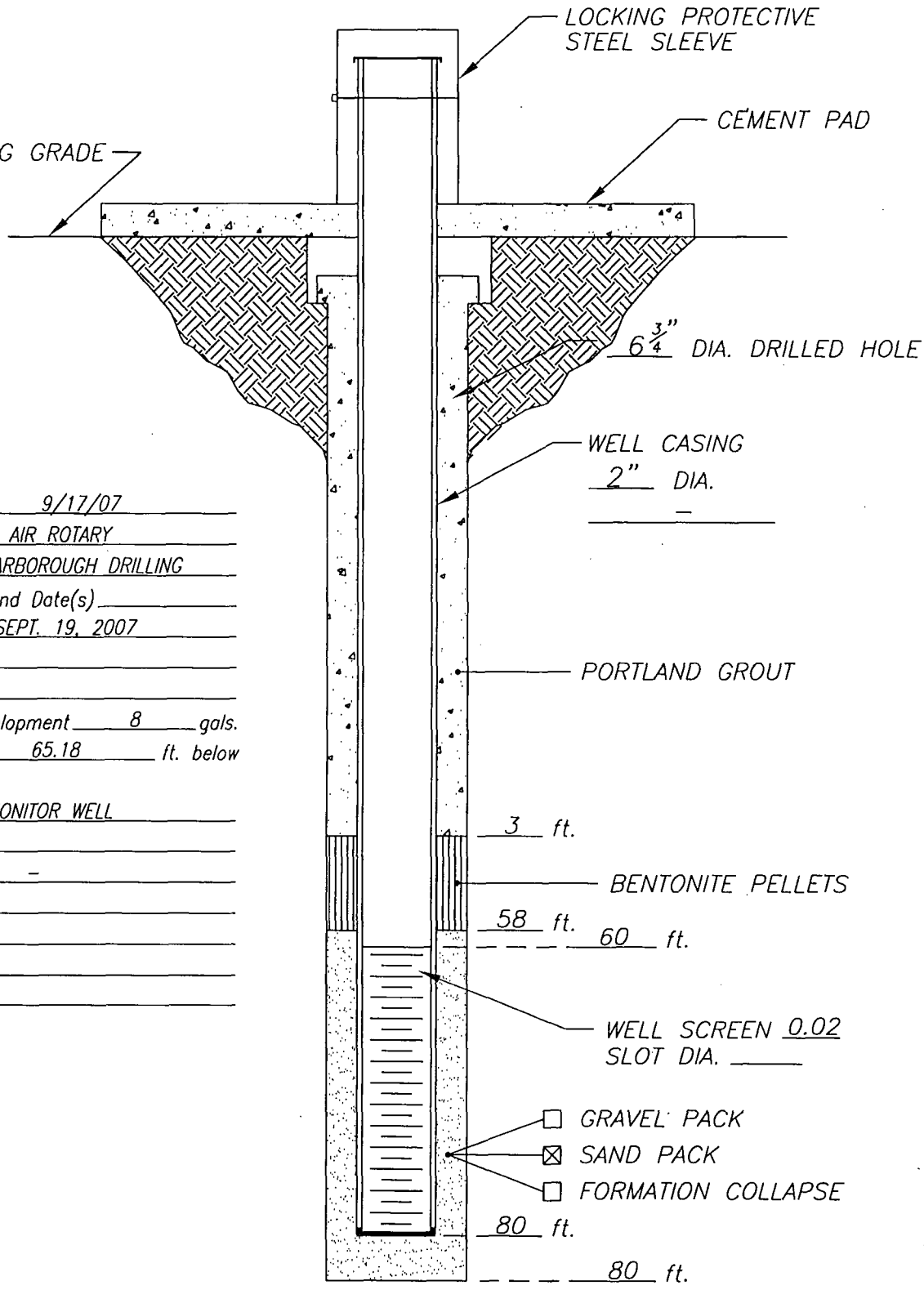
SAMPLE LOG

Boring/Well: MW-7
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 80
Date Installed: 09/17/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Tan/brown fine grain sand (blow sand)
5-10	--	Tan/buff calcareous sand
10-15	--	Tan/buff calcareous sand
15-20	--	Buff/tan fine grain sandy limestone
20-25	--	Buff/tan fine grain sandy limestone
25-30	--	Tan/buff calcareous sand
30-35	--	Tan/buff calcareous sand
35-40	--	Tan fine grain sand
40-45	--	Tan fine grain sandy intermixed with sandstone
45-50	--	Brown medium grain sand with gravel intermixed
50-55	--	Brown medium grain sand with gravel intermixed
55-60	--	Brown medium grain sand with gravel intermixed
60-65	--	Brown/tan medium grain sand (moist)
65-70	--	Tan/brown sandy clay of high plasticity
70-75	--	Tan/yellow clay of high plasticity
75-80	--	Tan/yellow clay of high plasticity

Total Depth is 80 feet Groundwater encountered at 65 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 9/17/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING - SEPT. 19, 2007

Water Removed During Development 8 gals.
Static Depth to Water 65.18 ft. below Ground Level
Well Purpose MONITOR WELL

Remarks -

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-7
	LOCATION: ROOSEVELT CO, NM	

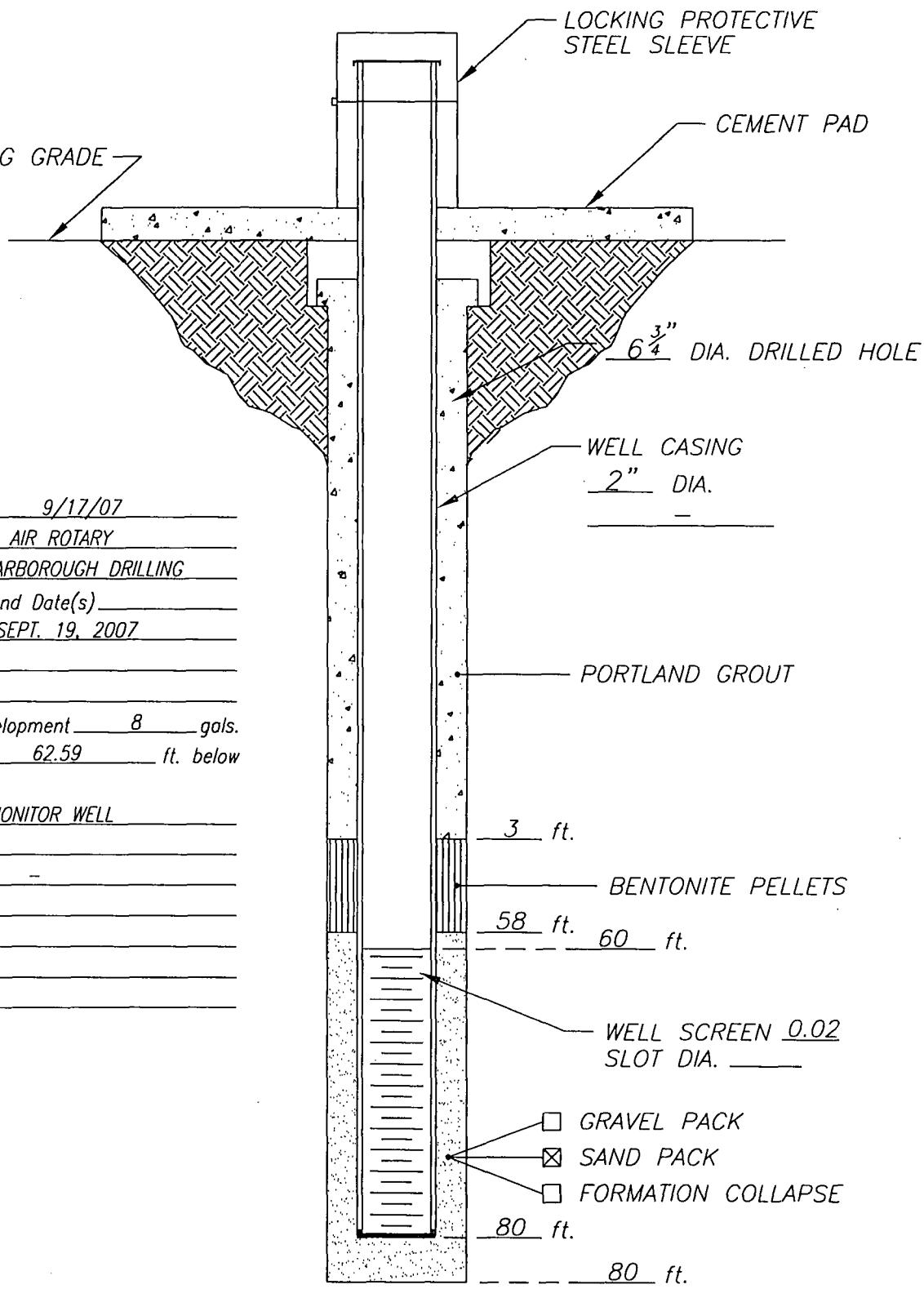
SAMPLE LOG

Boring/Well: MW-8
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 80
Date Installed: 09/17/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Gray/brown medium grain sand
5-10	--	Tan fine grain calcareous sand
10-15	--	Buff/tan fine grain sandy limestone
15-20	--	Buff/tan fine grain sandy limestone
20-25	--	Tan/buff fine grain calcareous sand with sandstone intermixed
25-30	--	Tan fine grain sand with sandstone intermixed
30-35	--	Tan fine grain sand with sandstone intermixed
35-40	--	Tan fine grain sand with sandstone intermixed
40-45	--	Tan fine grain sand with sandstone intermixed
45-50	--	Tan fine grain sand with sandstone intermixed
50-55	--	Tan medium grain sand with gravel intermixed
55-60	--	Brown medium grain sand with gravel intermixed
60-65	--	Brown medium grain sand (moist)
65-70	--	Tan clay of high plasticity
70-75	--	Tan clay of high plasticity
75-80	--	Tan clay of high plasticity

Total Depth is 80 feet Groundwater encountered at 63 feet below ground surface.

WELL CONSTRUCTION LOG



Installation Date(s) 9/17/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s)
HANDBAILING – SEPT. 19, 2007

Water Removed During Development 8 gals.
Static Depth to Water 62.59 ft. below Ground Level
Well Purpose MONITOR WELL

Remarks –

DATE: 10/3/07 *Highlander Environmental*	CLIENT: *POGO PRODUCING INC* PROJECT: *TODD ATB #1* LOCATION: *ROOSEVELT CO, NM*	WELL NO. MW–8

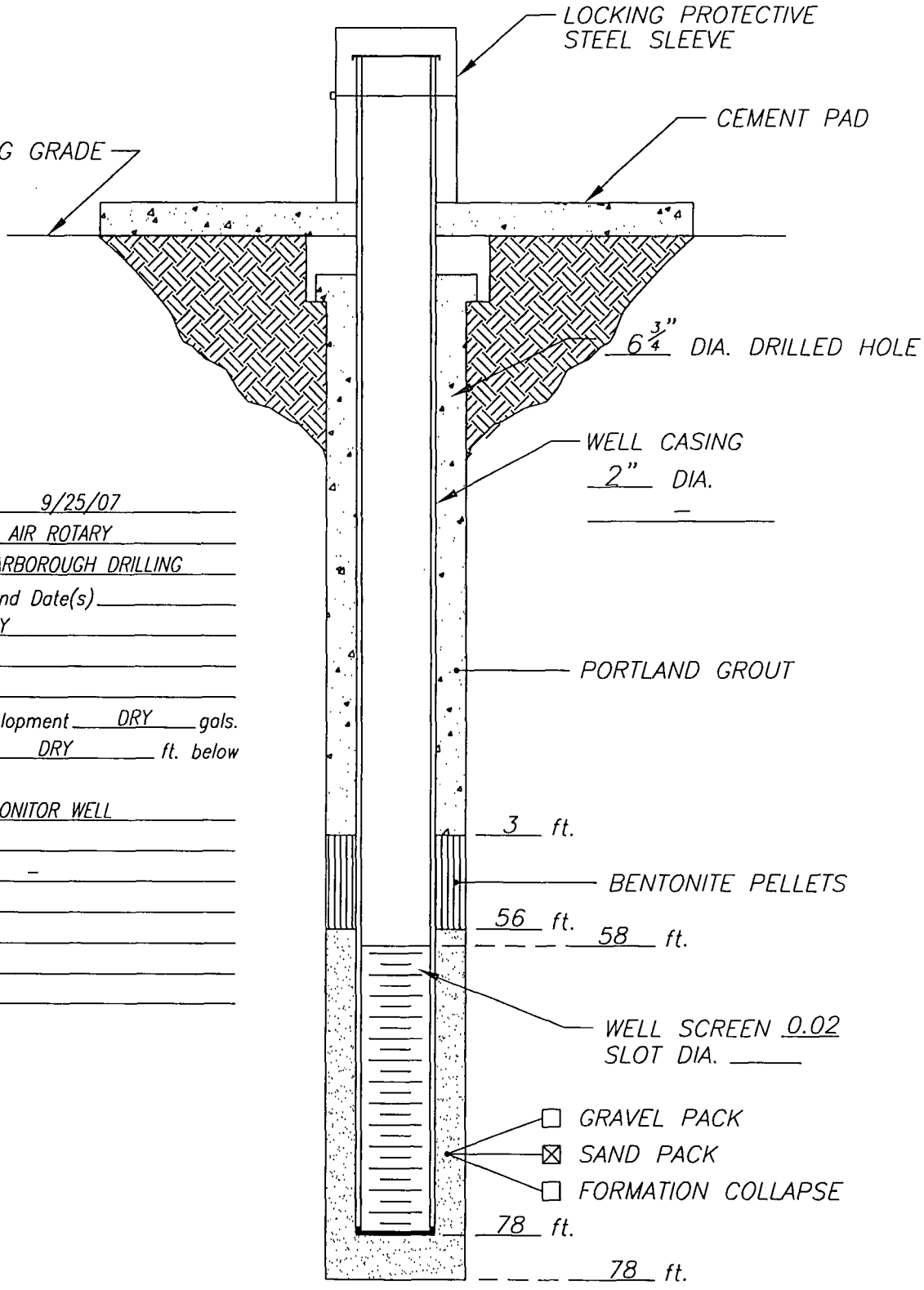
SAMPLE LOG

Boring/Well: MW-9
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 78
Date Installed: 09/25/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Tan/brown fine grain sand (blow sand)
5-10	--	Buff/tan calcareous sand
10-15	--	Buff limestone with chert
15-20	--	Buff limestone with chert
20-25	--	Buff fine grain sandy limestone
25-30	--	Tan/buff calcareous sand
30-35	--	Tan/buff calcareous sand
35-40	--	Tan/buff calcareous sand
40-45	--	Tan/buff calcareous sand
45-50	--	Tan/buff calcareous sand
50-55	--	Tan/buff calcareous sand
55-60	--	Brown medium grain sand
60-65	--	Brown medium grain sand
65-70	--	Brown clay of high plasticity
70-75	--	Brown clay of high plasticity
75-78	--	Brown clay of high plasticity

Total Depth is 78 feet Slight moisture at 64 feet.

WELL CONSTRUCTION LOG



Installation Date(s) 9/25/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s) DRY

Water Removed During Development DRY gals.
Static Depth to Water DRY ft. below Ground Level
Well Purpose MONITOR WELL

Remarks –

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-9
	LOCATION: ROOSEVELT CO, NM	

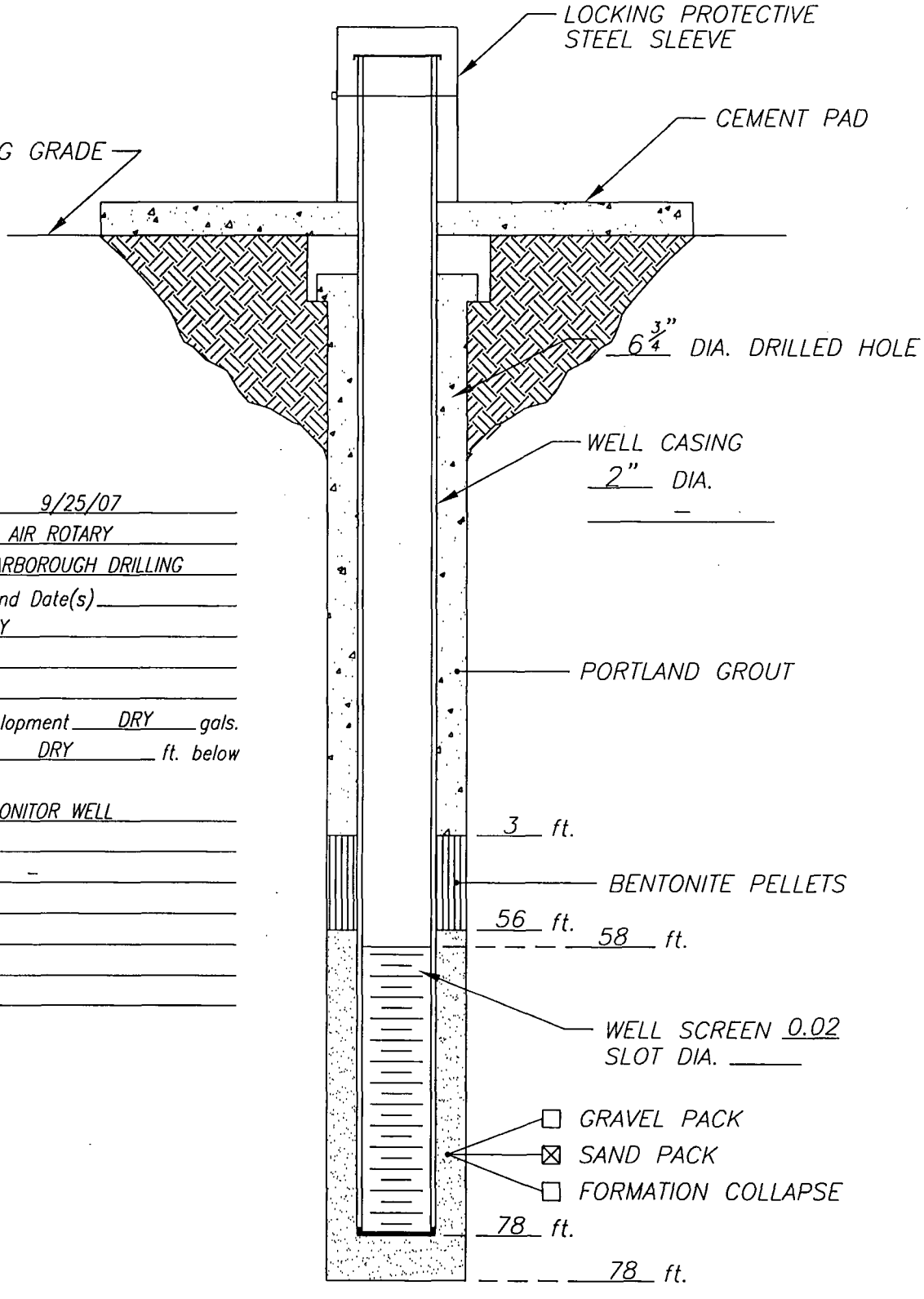
SAMPLE LOG

Boring/Well: MW-10
Project Number: 2617
Client: Pogo Production Inc.
Site Location: Todd ATB #1
Location: Roosevelt County, New Mexico
Total Depth 78
Date Installed: 09/25/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Tan/brown medium grain sand
5-10	--	Buff/tan calcareous sand
10-15	--	Buff/tan calcareous sand
15-20	--	Buff limestone with chert
20-25	--	Buff limestone with chert
25-30	--	Tan/buff fine grain calcareous sand
30-35	--	Tan/buff fine grain calcareous sand
35-40	--	Tan fine grain sand
40-45	--	Tan/buff fine grain calcareous sand
45-50	--	Buff fine grain sandy limestone
50-55	--	Brown medium grain sand intermixed with sandstone
55-60	--	Brown medium grain sand intermixed with sandstone
60-65	--	Brown medium grain sand
65-70	--	Brown clay of high plasticity
70-75	--	Brown clay of high plasticity
75-78	--	Brown clay of high plasticity

Total Depth is 78 feet Slight moisture at 64 feet.

WELL CONSTRUCTION LOG



Installation Date(s) 9/25/07
Drilling Method AIR ROTARY
Drilling Contractor SCARBOROUGH DRILLING
Development Technique(s) and Date(s) DRY

Water Removed During Development DRY gals.
Static Depth to Water DRY ft. below Ground Level
Well Purpose MONITOR WELL

Remarks –

DATE: 10/3/07	CLIENT: POGO PRODUCING INC	WELL NO.
Highlander Environmental	PROJECT: TODD ATB #1	MW-10
	LOCATION: ROOSEVELT CO, NM	