AP - 34

STAGE 1 & 2 WORKPLANS

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Stage 1 Abatement Plan (AP-34)
Navajo Refining Company
North Monument 6-Inch Gathering Line
Lea County, New Mexico

April 2, 2004

Prepared for:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

APPENDICES

LIST OF PLATES

APPENDICES

I. Introduction

By letter dated February 4, 2004, the New Mexico Oil Conservation Division is requiring Navajo Refining Company (Navajo) to submit a Stage 1 investigation proposal to complete the definition of the lateral and vertical extent of soil and groundwater contamination at the North Monument 6-inch crude gathering line located in Unit L, Section 30, Township 19 South, Range 37 East near Monument in Lea County. The plan is being required pursuant to OCD Rule 19.E.1 and OCD Rule 19.E.3. The stage 1 abatement plan presented herein complies with the requirements of these rules and incorporates work already performed at the site since detection of the crude oil release described below.

II. Background

On October 5, 2002, a leak was discovered in a 6 in. crude oil gathering line operated by Navajo Refining Company in the vicinity of Monument, New Mexico. The leak was discovered as a result of an inventory discrepancy and subsequently a section of pipeline located near Maddox Road west of Monument was found to be leaking. The leak area is located in the NW/4, SW/4, Section 30, T19S, R37E, which is approximately two miles west of Monument, New Mexico (Figure 1, Vicinity Map). The location is adjacent to Maddox Road approximately one-half mile north of its intersection with NM 322. The leak location is situated on relatively level ground.

At the time the leak was discovered, Navajo was investigating the likelihood of a leak by digging exploratory holes adjacent to the line to detect petroleum hydrocarbons. When the first detection was made, Navajo notified the NMOCD Hobbs District Office verbally with follow-up submittal of Form #C-141 on October 16, 2002 (Appendix A).

Additional digging using a backhoe was performed under the supervision of Safety and Environmental Solutions, Inc. (SESI). Heavier equipment including a trackhoe was used to daylight the pipeline so that the extent of the problem could be determined. The entire section of the impacted pipeline has been removed and a replacement line has been installed approximately 150 ft. south of the original location.

III. Investigation Status

Contaminate and Size of Leak

Initial and follow-up excavation exposed 600 ft. of pipeline, which was subsequently removed. Between five and seven leaks were found in that section of line. The length of time the pipeline was leaking and the amount of crude oil released is unknown, but the volume is estimated at 2,100 barrels* using inventory records. The pipeline was relatively new and was in service less than two years at the time the leak was discovered. The leak may have been caused by another party that moved acidized crude oil (oil containing acid

* The original estimate of 2,024 barrels submitted with Form C-141 on October 16 is revised upwards to 2,100 barrels based on further review of inventory records by Navajo.

from well treatment) into the line. The line was not in operation continuously which meant that a slug of the acid was apparently positioned in the section of line for some time thereby causing the leak.

Crude oil leaked from the pipeline in two major locations. The first was located to the east of Maddox Road at a distance from 300 to 400 ft. east of the road, and the second area is immediately adjacent to Maddox Road on the west side. The impacted soils area is generally a rectangular area approximately 700 ft. by 300 ft. oriented in the direction of the pipeline (east-west) for a total of 210,000 square-feet (4.8 acres) (Plate 1). Impacts within that area range from free hydrocarbon product in exploratory boreholes to a show of hydrocarbon product in soil samples collected during drilling.

Vertical and Horizontal Extent of Contamination in the Vadose Zone

Following discovery of the leak, a backhoe first uncovered the line, then heavy equipment was used to excavate a large trench approximately 15-16 ft. deep adjacent to the north side of the line in the area most heavily impacted by the leaks. For safety reasons a shallow bench area (approximately 4-ft. deep) on the north side of the trench also was excavated. (See Appendix B for photographs).

The trench provided a vertical cross-section of the area above and below the pipe, and showed evidence of downward migration of hydrocarbon from the pipeline trench to below the bottom of the trench (See 11/13/02 photographs). Additional digging by the onsite trackhoe determined the presence of saturated hydrocarbons beneath the bottom of the trench. Several soil samples were collected during the early portion of the delineation and the analytical results showed the samples have highly elevated concentrations of petroleum hydrocarbons (Table 1).

For safety reasons, the NMOCD has approved backfilling of the trench (NMOCD email from Ed Martin, NM OCD, to Bob Allen, SESI, dated October 8, 2003). The south face of the trench has a vertical wall approximately 12 to 15 ft. high and presents a safety hazard to SESI and other personnel working in the trench. The trench will be backfilled to the level of the north bench with clean soils currently stockpiled on site. Additional clean fill and/or tested remediated soil will be utilized as necessary. Prior to backfilling 13 temporary recovery boreholes completed in the trench bottom will be extended to the bench surface to allow continued oil recovery. Another five recovery boreholes currently on the bench will continue in operation.

Additional excavation of highly stained soils along the pipeline trace may take place at the time of backfill of the shallow bench. This material was backfill material for the original pipeline trench and was saturated during the time of release. The material will be excavated to the depth of the original pipeline trench and stockpiled on site for testing and possible on-site remediation. Due to the close proximity of recovery boreholes on the south side of the trench, only limited excavation on the south side of the trench will be performed. Only trench soils on the east side of Maddox road will be removed; soils west of Maddox Road will remain due to adjacent high-pressure gas and water lines at that location which make further excavation difficult.

Further delineation of hydrocarbon impacts was performed using a hollow-stem auger. To date, a total of 97 boreholes have been drilled on the east side of Maddox Road and another 38 have been drilled on the west side of Maddox Road. Of these boreholes, a total of 74 have been completed as temporary recovery boreholes with screened PVC and a sand pack (Plate 1).

During drilling of the boreholes, samples were collected at various intervals for analysis for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylenes (BTEX) and the laboratory results for selected samples are shown in Table 1. Initially, it was intended to collect samples from every borehole. However, as the extent of the problem became apparent, sample collection was generally reduced to documentation of contamination away from the pipeline, and verification samples at outlying boreholes where field observation indicated an unimpacted borehole. Boreholes not completed as temporary recovery boreholes were plugged back to the surface with bentonite from the bottom to about 15 ft. from the surface. Above 15 ft., they were backfilled with uncontaminated cuttings.

Soil Characteristics

Soils beneath the site are non-homogenous to a depth of 25-30 ft. They consist of a mixture of sand, silt and clay with frequent zones of hard, consolidated caliche and occasional sandstone. The caliche is characterized by being either laminar with thin intermediate zones of fine-grained sand, or well-cemented zones ranging from several inches to over a foot in thickness. Core samples show alternating zones of caliche and thin sand lenses at the surface with increasing clay with depth. However, no consistent "marker" bed of any type of sediment was observed in the area delineated.

Within the soil material zones of enhanced permeability exist either as primary permeability through sand lenses, or as secondary permeability in zones of poorly cemented or fractured caliche. This is evidenced by the detection of significant product in some boreholes and the absence or near absence of product in adjacent boreholes 25 ft. away. These pathways for vertical and horizontal hydrocarbon movement are called preferential pathways and are discussed further below. However, the presence, or lack thereof, of preferential pathways appears almost random in the area of the leaks, and the presence or absence of hydrocarbon product could be determined only though the drilling of exploratory boreholes.

IV. Groundwater Characterization

Immediately following detection of the leaky line, three monitor wells were installed at the site to determine depth to groundwater and for sampling for dissolved phase petroleum hydrocarbons (BTEX*). Two replacement wells were drilled in November and December 2002. Depth to groundwater at the site varies from 18 to 25 ft. below ground surface as measured in the recently installed monitor wells. Redbed was encountered in one well (MW-5) at a depth of 35 ft. Water level measurements have been taken

* BTEX constituents are benzene, toluene, ethylbenzene and total xylenes

beginning in October 2002 and the results are presented in Table 3. The ground water flow direction and hydraulic gradient have been determined for the site. Groundwater potentiometric maps for October 2002, November 2002, and March 2004 are shown in Figures 2, 3 and 4, respectively. Groundwater flow is generally east-southeast and the hydraulic gradient in March 2004 was 0.0044, which is relatively flat.

No water wells are known to have been affected by the leak. A windmill for stock watering is located approximately one-half mile downgradient from the site. The well was sampled several days following the detection of the leak; no BTEX was detected at a reporting level of 0.002 mg/L. Chloride content was 100 mg/L and total dissolved solids (TDS) was 528 mg/L. Groundwater sampling results are shown in Table 4.

Following installation and development of the first three monitoring wells (MW-1, -2 and MW-3), groundwater samples were obtained for analysis for BTEX. No BTEX was detected in the three wells at a reporting level of 0.002 mg/L. A water sample from one borehole impacted by hydrocarbon product (BH-7) was collected for water chemistry analysis. The results show chloride and TDS at 124 and 636 mg/L, respectively.

A fourth monitoring well was installed 100 ft. downgradient from the last borehole having a show of hydrocarbon product. At the time of drilling in November 2002, there was no indication of hydrocarbon product in the groundwater or the overlying soils. However following well development and purging for sampling in late December 2002 hydrocarbon product was detected with a thickness of 1.6 ft. This well was plugged on January 28, 2003.

Similarly, hydrocarbon product was detected in MW-2 on November 18, 2002. A replacement well, MW-5, was drilled on November 22 and MW-2 was plugged on January 23, 2003. Both MW-2 and MW-4 were plugged due to the large zone of water/hydrocarbon mixing that was created by hydrocarbon product coming in contact with a column of water 8 to 12 ft. thick. The water filled borehole exposed a thickness of aquifer to contamination which otherwise would have been protected to some extent by this thickness of undisturbed earth materials. The two monitor wells were plugged by removing or drilling out the casing and circulating a cement/bentonite grout from bottom to top. This issue of is examined further in Section VI, Discussion.

The remaining monitor wells not impacted by hydrocarbon product, MW-1, 3 and 5, were sampled on December 30, 2002. No BTEX was detected at a reporting limit of 0.002 mg/L. However, BTEX was subsequently detected in MW-5 in October 2003 and in MW-3 in March 2004 (Table 4). The constituent detected was benzene, which is typically at the leading edge of an advancing plume of dissolved phase groundwater because it is the most soluble of the four BTEX constituents.

V. Product Recovery

Product recovery commenced on October 11, 2002 by pumping borehole BH-4. Boreholes with significant thickness of petroleum hydrocarbons were completed as 2-in. temporary recovery boreholes. To date 74 temporary recovery boreholes have been

completed. To recover oil, 12-volt purge pumps are placed in boreholes close to the pipeline leak locations and in other boreholes having a large thickness of oil. The recovered oil is stored in 300- or 800-gallon tanks placed next to the well. Currently, over 25 pumps are installed to recover product and additional pumps are installed as necessary. A 12-volt dc power supply and a timer with variable on and off settings operate these pumps. The 12-volt power supply receives its power from conventional 110-volt ac power available at the site. Wells not receiving pumps but with significant product thickness are pumped weekly and the product is stored in a tank mounted on a portable trailer.

When the smaller tanks are full, an oilfield pumper transfers fluid to a large 500-barrel frac tank, which has been placed on site. Fluid in the frac tank is gauged before and after fluid transfer to determine the amount of oil recovered. The oil and water is trucked to Navajo's Lea Refinery in Lovington for processing. As of March 2004, the volume of crude oil recovered to date is 1,079 barrels, or 45,318 gallons.

VI. Discussion and Conceptual Model

Information available from the soil coring indicates a variable lithology at the site. However, at a depth of approximately 20 to 25 ft. fine-grained materials (silt and clay) predominate (See sample borehole logs, Appendix C). The top of the saturated groundwater zone is also present at this depth. The combination of the two allows for the establishment of a relatively thick capillary fringe in the fine-grained sediments. A capillary zone is characterized by water in the soil pores that is under tension (existing at a negative pressure). This phenomenon allows pore spaces to be saturated with water even though they are above the water table. The capillary rise in uniform fine-grained sediments can be several feet or greater. For example, the rise in silt is 3.5 ft. while the rise in medium sand is under 10 in.* Where sediments are non-uniform, the thickness of the capillary zone is variable and, unlike the water table, the top of the capillary fringe is not a planar surface.

The presence of a capillary fringe impedes the downward movement of crude oil at the site. When the capillary fringe is encountered, it acts as a barrier to further vertical migration until and unless the volume of oil is sufficient to overcome the water capillary forces and move the water downward out of the soil pores. Until that occurs the oil will pond and spread laterally on top of the capillary fringe forming what can be called an "oil table" (Figure 5*).

If a monitor well is drilled through the oil into the water-saturated zone, ponded oil will drain into the monitoring well until equilibrium is reached with the oil in the formation. Oil accumulation in the monitor well allows recovery of the free product using conventional pumps.

As the soil coring results at Monument show, in addition to the predominant fine-grained

* Fetter, C.W. 1993. Chapter 5, Multiphase Flow, *Contaminant Hydrogeology*, Prentice-Hall, Upper Saddle River, NJ.

materials, there are thin zones of sand, gravels, and poorly cemented or fractured caliche. These zones will have much higher permeabilities for fluid movement than the finer grained materials. Even though both fine and coarse-grained material above the water capillary fringe is oil saturated, the coarser grained material will allow faster lateral movement of oil to wells drilled for oil recovery.

A typical groundwater monitoring well will have 10 to 15 ft. of screen with the top of the screen extending for several feet above the water table. While this design is appropriate for monitoring dissolved phase hydrocarbons and other constituents in the saturated zone, it is not appropriate for recovery of hydrocarbons at this site. As mentioned above, to a great extent the capillary fringe prevents or slows movement of free product to deeper saturated zones. However, placement of a conventional monitor well circumvents the capillary zone and allows the oil direct contact with the water table, which in turn can allow more soluble oil constituents, such as BTEX, to move from the oil phase to the groundwater as a dissolved contaminant. A well with 10 ft. or greater saturated thickness provides a much greater medium for migration to the water and into the groundwater aquifer than does a well with limited contact with groundwater.

Consequently, at the Monument site, the temporary recovery boreholes are completed only a maximum of one to three feet into the saturated zone to minimize mixing and recovery of non-hydrocarbon fluid. Further, both MW-2 and MW-4 monitor wells, which were impacted by hydrocarbon product within three months following completion, were plugged to prevent mixing of water over the approximate 10 to 12 ft. of saturated thickness.

The groundwater gradient at the site is relatively flat as described in Section IV. However, it would appear that hydrocarbon product movement is quite rapid based on the sudden detection at MW-4. This apparent contradiction is resolved by considering movement of hydrocarbon in horizontal permeable zones in the unsaturated zone. Movement in these zones is unhindered by water and controlled by gravity. These zones have been given the name "preferential pathways" and their occurrence has implications for both delineation and hydrocarbon recovery.

Preferential pathways complicate hydrocarbon delineation because their distribution is generally random throughout the site. No single horizontal zone has yet been identified which may collect and concentrate hydrocarbons. Detection has been solely through the drilling of individual boreholes, identifying permeable zones in the soil cores, and noting the amount of product that flows into an open borehole. Those borings that fill with measurable hydrocarbons are completed as temporary recovery wells.

Preferential pathways, where present, can allow a considerable amount of hydrocarbon to be recovered when they are penetrated by a temporary recovery well. Proof of that at this site are boreholes where initial recovery was over one hundred gallons of product after pumping for only several days.

Figure 6 provides a conceptual model of oil flow at Monument. The figure shows mobile

oil on top of the capillary zone and example horizontal preferential pathways. In some boreholes within the oil zone, no hydrocarbon has been detected or recovered. This is due to lack of preferential pathways intersecting the drilled borehole.

The direction of groundwater movement is important for several reasons. In addition to preferential pathways that enhance lateral movement of oil, the slope of the water table impacts horizontal movement of oil. Free oil, which has ponded on the top of the water capillary fringe, moves horizontally down the slope of the capillary fringe unimpeded by water-filled pores. Though the hydraulic gradient is small at Monument (1 ft. drop every 227 ft.), the slope is sufficient to move hydrocarbon product 280 ft. southeast of the easternmost pipeline leak.

Further, if there are areas where the capillary fringe is thin compared to the overlying thickness of oil or where capillary sediments are somewhat permeable, hydrocarbon product can break through the capillary fringe directly into the water table and move with the groundwater flow (Figure 6). Finally, groundwater movement is important because dissolved phase hydrocarbon can move into the groundwater through direct contact of oil and water, or by advection/diffusion through the capillary fringe.

VII. Abatement Plan

The purpose of the Stage 1 abatement plan is "to design and conduct a site investigation that will adequately define site conditions, and provide the data necessary to select and design an effective abatement option." Pursuant to OCD Rule 19.E.3, a Stage 1 abatement plan may include but not be limited to information as needed to select and implement an abatement option. Accordingly, Navajo will generate and include the following information and data in the report to be submitted following such site investigation as necessary to determine abatement options. Information previously generated and included with this report is expected to satisfy some to the investigation report requirements.

a. *Descriptions of the site, including a site map, and of site history including the nature of the release that caused the water pollution, and a summary of previous investigations.*

   Information satisfying much of this requirement is submitted herein. It will be updated as necessary for submittal with the Stage 1 report.

b. *Additional site investigation to define (i) site geology and hydrogeology, the vertical and horizontal extent and magnitude of vadose-zone and groundwater contamination, subsurface hydraulic conductivity, transmissivity, storativity, and rate and direction of contaminant migration, inventory of water wells inside and within one (1) mile from the perimeter of the three dimensional body where the standards set forth in [the rule] are exceeded, and location and number of such wells actually or potentially affected by the pollution; and (ii) surface-water hydrology, seasonal stream flow characteristics, groundwater/surface-water relationships, ... [etc.].*

   Additional investigation is necessary to fill gaps in data already collected at the site, including the drilling of additional boreholes, installation of additional

monitor wells, and measurement of aquifer properties. An inventory of water wells will be conducted within one mile of the perimeter of the site and wells that potentially could be affected by the contamination identified.

Additional delineation of contamination is to be performed at the site in areas east of Maddox Road. The area to the west of the road has been adequately characterized, but unfortunately hydrocarbon cannot be recovered from directly beneath the road due the need to keep it open for travel. The focus will be on several areas where current information is inadequate and contamination is known or suspected to occur. The areas are located from west to east as shown on the map (Figure 7) and described below:

1. The first area ("A") is immediately east of the overhead power lines. This area has not yet been drilled, but several temporary boreholes contain oil to the west and this contamination may have migrated eastward. Drilling of 7 to 10 boreholes is anticipated in this area.
2. The next two areas ("B", "C") are located to the north and south of the now removed pipeline. Only limited drilling has been performed, because daylighting of the pipeline showed no leaks in the area. However, boreholes that have been drilled show small amounts of free product or contaminated soil. A grid with 25 ft. centers will overlie these two areas; drill locations will be randomly selected such that 25 % of the area is tested for subsurface hydrocarbon impacts. The number of boreholes expected to be advanced is 4 to 6 north of the pipeline trace, and 5 to 7 boreholes south of the pipeline.
3. In the area north of both the abandoned pipeline and the current excavation ("D"), 7 to 10 infill borings will be drilled. This area shows significant thickness of free product and the infill borings will allow improved and faster recovery.
4. South of the abandoned line ("E"), approximately 12 to 15 borings are necessary to provide infill borings and to determine the extent of free product to the south.
5. South of the replacement pipeline ("F"), 5 to 7 borings are anticipated to be drilled to determine if free product has migrated in the direction of MW-5, which now exhibits dissolved phase benzene in the groundwater at that location The grid methodology described above also will be utilized at this location.
6. Further to the east ("G") approximately 10 borings are expected to be drilled to determine the source of free product that impacted MW-4 and caused it to be plugged. This area represents the easternmost area of known contamination. The closest leak was approximately 300 ft. northwest of MW-4 indicating that preferential pathways were instrumental in moving the hydrocarbon product somewhat rapidly through the subsurface during the time the leak was active.

If all boreholes are drilled, the number of new investigation boreholes will be

between 50 and 65. Where recoverable hydrocarbon is encountered, boreholes will be completed for recovery of hydrocarbon product as described above. For locations where hydrocarbons are minimal or not present, soil samples will be obtained for documentation/verification purposes and analyzed for TPH and BTEX, and the boreholes plugged to within 15 ft. of the surface with bentonite (hydrated) and with uncontaminated cuttings to the surface.

In addition to use of boreholes for contamination delineation, between 8 and 9 new monitor wells will be located and drilled along the south and east perimeter of the site. The approximate locations are shown on the attached map. Before installation of the monitor wells, construction details will be discussed with NM OCD technical staff. Due to the preferential pathways in the vadose zone, it is proposed that the screened area not extend above the top of the water table so as to avoid physical contact with any oil that may be present nearby. The purpose of this design is to prevent potential free phase product migration into the saturated zone where it could mix with water in the monitor well and contaminate 10 or more feet aquifer thickness with dissolved phase constituents.

To determine the hydraulic conductivity and transmissivity of the sediments, groundwater slug-tests will be conducted on the monitor wells and the drawdown and recovery data analyzed with procedures commonly utilized for this purpose. Determination of storativity usually requires installation of closely spaced monitor wells so that one can serve as an observation well for the pumping well. At this location with a shallow water table, storativity can be estimated from technical publications and a separate monitor well solely for this purpose is not necessary.

No intermittent, ephemeral or permanent sources of surface-water are present in the area of the leak, so no hydrological or biological studies of the impact of the release on surface water are necessary.

c. *Monitoring program, including sampling stations and frequencies, for the duration of the abatement plan that may be modified, after approval by the Director, as additional sampling stations are created.*

Following installation of the monitoring wells, they will be developed to remove any mud, silt and sand inadvertently introduced during the drilling process. The well locations and elevations will be located and surveyed by a registered professional surveyor. Water levels will be measured quarterly and wells will be sampled quarterly for BTEX constituents following purging to ensure a fresh sample. In addition, the initial sampling will also include major cations and anions to establish a baseline condition for these constituents although produced water was not released to the environment as a result of the pipeline leaks.

d. *Quality assurance plan, consistent with the sampling and analytical techniques listed in [the Water Quality Control Commission regulations] for all work to be conducted pursuant to the abatement plan.*

Samples will be collected and handled in accordance with appropriate protocols for collection, preservation and transport of samples including maintaining a chain-of-custody and record keeping. The analytical laboratory selected to

perform the analyses will be monitored for compliance with the applicable QA/QC standards.

e. *A schedule for all Stage 1 abatement plan activities, including the submission of summary quarterly progress reports, and the submission, for approval by the Director, of a detailed final site investigation report.*

It is expected that all investigation work proposed within the State 1 abatement plan will be completed within six months of the date of approval. Quarterly progress reports will be submitted within 30 days following the end of the previous quarter. The report will include work performed and analytical results of from testing of water quality in new and existing monitor wells. A final report will be prepared and submitted within 60 days of the completion of the work.

f. *Any additional information that may be required to design and perform an adequate site investigation.*

The information necessary to design and perform an adequate site investigation is included in the above paragraphs.

VIII. Additional Information

During the time of review of this proposed Stage 1 Abatement Plan and subsequent to its anticipated approval by OCD, Navajo will continue with the existing oil recovery program, including completion of boreholes for temporary use for oil recovery. During this time, and prior to submittal and approval of a Stage 2 Abatement Plan, Navajo may desire to initiate additional actions to recover hydrocarbon and/or to prevent or minimize free or dissolved phase hydrocarbon movement from existing impacted area. If such work is proposed, Navajo will notify the OCD of the proposed activity and seek to meet and discuss the anticipated work with the OCD prior to beginning work.

IX. Report Tables and Figures

Table 1. Results of Investigation Soils Testing, Navajo Monument 6" Gathering Line Leak

Sample Location and Depth	Sample Date	TPH (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethyl-benzene (mg/Kg)	Total Xylenes (mg/Kg)	Total BTEX (mg/Kg)
Excavation Samples:							
Trench A, 12 ft.	10/07/02	40,700	15.1	57.2	61.4	267	401
E. Trench, N. Wall	10/10/02	873	<0.005	<0.005	0.017	0.121	0.138
Borehole Samples:							
BH-1, 20 ft.	10/10/02	9,500	2.90	12.8	15.6	72.5	104
BH-1A, 20 ft.	10/10/02	<10	0.053	0.04	0.014	0.110	0.217
BH-2, 15 ft.	10/10/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-2, 20 ft.	10/10/02	<10	<0.005	<0.005	<0.005	<0.015	<0.006
BH-2, 25 ft.	10/10/02	<10	<0.005	<0.005	<0.005	<0.015	<0.007
BH-9, 13 ft.	10/12/02	<10	<0.005	<0.005	<0.005	<0.015	<0.008
BH-9 20 ft.	10/12/02	3,730	0.567	2.45	4.12	19.2	26.3
BH-10, 20 ft.	10/15/02	118	0.021	0.116	0.184	0.863	1.18
BH-12, 20 ft.	10/15/02	4,940	1.89	3.82	4.87	22.5	33.1
BH-15, 23 ft.	10/16/02	9,880	1.15	2.54	5.37	25.9	35.0
BH-18, 21 ft.	10/19/02	35.6	<0.005	<0.005	<0.005	<0.015	<0.005
BH-18, 24 ft.	10/19/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-20, 22 ft.	10/19/02	532	<0.005	0.065	0.325	1.73	2.12
BH-21, 10 ft.	10/29/02	99.3	<0.005	<0.005	<0.005	<0.015	<0.005
BH-21, 15 ft.	10/29/02	2,910	0.524	3.55	7.76	39.0	50.8
BH-21, 22 ft.	10/29/02	1,500	0.379	1.75	2.73	12.5	17.4
BH-22, 10 ft.	10/29/02	20.2	0.016	0.062	0.043	0.181	0.302
BH-22,13 ft.	10/29/02	857	0.808	3.02	3.73	18.1	25.7
BH-22, 17 ft.	10/29/02	3,210	0.295	1.02	1.20	6.98	9.50
BH-23, 13 ft.	10/29/02	922	0.446	1.62	1.74	7.71	11.5
BH-23, 18 ft.	10/29/02	5,200	2.67	9.18	11.3	50.1	73.3
BH-24, 13 ft.	10/29/02	2,050	0.173	0.524	3.29	17.8	21.8
BH-24, 18 ft.	10/29/02	5,070	3.99	13.8	17.0	79.4	114
BH-25, 15 ft.	10/30/02	3,070	0.326	0.930	3.14	16.3	20.7
BH-25, 17-18 ft.	10/30/02	9,520	1.68	13.100	19.6	88.2	123
BH-26, 10 ft.	10/30/02	296	0.006	0.026	0.032	0.104	0.168
BH-26, 15 ft.	10/30/02	19.4	<0.005	<0.005	<0.005	<0.015	<0.005
BH-26, 20 ft.	10/30/02	132	0.154	1.31	1.98	8.66	12.1
BH-26, 23 ft.	10/30/02	<10	0.007	0.038	0.066	0.343	0.454
BH-27, 15-16 ft.	10/30/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-27, 20 ft.	10/30/02	<10	0.040	0.024	0.015	0.074	0.153
BH-27, 23 ft.	10/30/02	<10	<0.005	<0.005	<0.005	0.026	0.026
BH-28, 15 ft.	10/30/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-28, 18 ft.	10/30/02	659	0.323	0.549	1.05	4.85	6.77
BH-28, 23 ft.	10/30/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-29, 15 ft.	10/30/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-29, 20 ft.	10/30/02	3,940	1.99	7.24	10.1	45.6	64.9
BH-29, 24 ft.	10/30/02	108	0.088	0.477	0.516	2.28	3.36
BH-30, 20 ft.	10/31/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-30, 25 ft.	10/31/02	2,750	1.75	10.5	13.8	58.5	84.6
BH-30, 27 ft.	10/31/02	1,240	<0.005	0.135	0.817	4.03	4.98
BH-31, 21-22 ft.	10/31/02	4,140	0.416	4.5	7.23	32.8	44.9
BH-31, 26-27 ft.	10/31/02	272	0.119	0.325	0.464	2.34	3.25

Table 1. Results of Investigation Soils Testing, Navajo Monument 6" Gathering Line Leak

Sample Location and Depth	Sample Date	TPH (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethyl-benzene (mg/Kg)	Total Xylenes (mg/Kg)	Total BTEX (mg/Kg)
BH-31, 30 ft.	10/31/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
BH-32, 23-24 ft.	10/31/02	5.84	<0.005	<0.005	<0.005	0.093	0.093
BH-32, 25 ft.	10/31/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-33, 21 ft.	10/31/02	1,620	2.10	7.45	8.00	34.3	51.9
BH-33, 25 ft.	10/31/02	13.7	<0.005	<0.005	0.005	0.055	0.060
BH-34, 24 ft.	11/01/02	516	0.02	0.605	1.28	5.77	7.68
BH-34, 26 ft.	11/01/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-35, 22-23 ft.	11/01/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-36, 27.5 ft.	11/01/02	528	0.093	0.355	0.577	2.45	3.48
BH-36, 29 ft.	11/01/02	<10	<0.005	<0.005	0.005	0.034	0.039
BH-37, 25-26 ft.	11/05/02	2,000	0.301	3.11	5.15	23.4	32.0
BH-37, 29 ft.	11/05/02	144	<0.005	<0.005	0.005	0.021	0.026
BH-38, 16-17 ft.	11/05/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-38, 29 ft.	11/05/02	927	<0.005	1.05	2.69	13.4	17.1
BH-39, 25 ft.	11/05/02	1,430	0.442	3.72	5.61	25.3	35.1
BH-39, 27 ft.	11/05/02	5,080	0.467	6.40	11.7	55.6	74.2
BH-41, 25 ft.	11/06/02	1,930	<0.005	0.179	0.997	5.37	6.55
BH-43, 19-20 ft.	11/06/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-44, 15 ft.	11/06/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-44, 17-18 ft.	11/06/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-45, 17-18 ft.	11/07/02	2,060	0.464	3.34	5.87	26.3	36.0
BH-45, 23 ft.	11/07/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-46, 18-19 ft.	11/07/02	169	<0.005	<0.005	<0.005	<0.015	<0.005
BH-46, 22-23 ft.	11/07/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-47, 17-18 ft.	11/07/02	1,460	<0.005	0.011	0.113	1.06	1.18
BH-47, 22-23 ft.	11/07/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-49, 25 ft.	11/08/02	1,150	<0.005	<0.005	0.018	0.164	0.182
BH-50, 20 ft.	11/08/02	1,420	<0.005	<0.005	0.044	0.331	0.375
BH-50, 22-23 ft.	11/08/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-51, 23-24 ft.	11/08/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-51, 27-28 ft.	11/08/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-52, 18-19 ft.	11/08/02	<10	0.021	0.038	0.020	0.102	0.18
BH-53, 28 ft.	11/09/02	180	0.036	0.388	0.892	3.96	5.28
BH-56, 25 ft.	11/12/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-60, 1-2 ft.	11/13/02	13,300	<0.005	0.314	1.54	9.62	11.5
BH-65, 2-3 ft.	11/14/02	11,900	<0.005	0.788	5.33	19.8	25.9
BH-65, 7-8 ft.	11/14/02	3,260	0.336	3.29	5.14	23.4	32.2
BH-68, 17-18 ft.	11/15/02	79.0	0.065	0.239	0.278	1.25	1.83
BH-68, 23 ft.	11/15/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-69, 17 ft.	11/15/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-69, 25 ft.	11/15/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-70, 22 ft.	11/15/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-71, 14 ft.	11/16/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-71, 17-18 ft.	11/16/02	601	0.200	0.719	0.929	4.26	6.11
BH-71, 24 ft.	11/16/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-72, 21 ft.	11/21/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-73, 18 ft.	11/21/02	<10	<0.005	<0.005	<0.005	<0.015	<0.005

Table 1. Results of Investigation Soils Testing, Navajo Monument 6" Gathering Line Leak

Sample Location and Depth	Sample Date	TPH (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethyl-benzene (mg/Kg)	Total Xylenes (mg/Kg)	Total BTEX (mg/Kg)
BH-74, 16 ft.	11/21/02	<10	0.048	0.277	0.332	1.80	2.46
BH-74, 18 ft.	11/21/02	76.7	<0.005	<0.005	<0.005	<0.015	<0.005
BH-78, 21 ft.	11/23/02	10,900	2.94	13.2	17.0	73.3	106
BH-78, 24 ft.	11/23/02	672	<0.005	<0.005	0.014	0.119	0.133
BH-80, 7-8 ft.	11/23/02	16.0	<0.005	<0.005	<0.005	<0.015	<0.005
BH-80, 14 ft.	11/23/02	21,500	5.83	29.9	35.8	143	215
BH-80, 20 ft.	11/23/02	1,950	<0.005	0.162	1.01	6.04	7.21
BH-83, 20-22 ft.	03/06/03	56.2	<0.005	<0.005	<0.005	<0.015	<0.005
BH-84, 18-19 ft.	03/06/03	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-85, 21-23 ft.	03/06/03	906	0.040	0.079	0.056	0.322	0.497
BH-85, 27 ft.	03/06/03	1,920	6.55	13.9	15.5	64.9	101
BH-86, 28-29 ft.	03/07/03	1,600	0.036	0.635	1.43	7.39	9.49
BH-87, 29-30 ft.	03/07/03	2.92	0.007	0.020	0.016	0.072	0.115
BH-88, 22-23 ft.	03/07/03	28,000	12.3	40.0	43.8	194	290
BH-89, 27-28 ft.	03/08/03	4,140	1.72	6.74	8.94	42.6	60.0
BH-90, 25-28 ft.	03/08/03	38.8	0.006	0.027	0.420	0.242	0.695
BH-91, 26-27 ft.	03/08/03	1,100	<0.005	0.034	0.164	0.972	1.170
BH-92, 24-29 ft.	03/11/03	20,400	3.00	17.2	25.2	124	169
BH-93, 27-28 ft.	03/11/03	<10	<0.005	<0.005	<0.005	<0.015	<0.005
BH-94, 25-29 ft.	03/11/03	36.4	<0.005	0.008	0.026	0.159	0.193
West BH-1A, 26-27 ft.	10/13/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
West BH-1, 23-24 ft.	04/08/03	8,180	5.18	17.9	20.0	77.9	121
West BH-2, 20-24 ft.	10/13/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
West BH-3, 23-24 ft.	10/14/02	727	0.010	0.061	1.127	0.701	1.90
West BH-3A, 25-29 ft.	03/12/03	5,030	0.149	0.244	1.82	10.9	13.1
West BH-4, 28 ft.	10/14/02	3,790	0.135	2.82	6.41	30.2	39.6
West BH-6, 25 ft.	10/17/02	950	0.036	0.336	0.503	2.35	3.23
West BH-6, 30 ft.	10/17/02	1,670	1.44	2.79	45.0	21.1	70.3
West BH-6A, 27-28 ft.	04/11/03	341	0.005	0.011	0.022	0.123	0.161
West BH-9, 24-29 ft.	03/12/03	3,520	0.317	1.37	2.09	9.69	13.5
West BH-9, 28-29 ft.	03/12/03	487	<0.005	0.104	0.944	3.29	4.34
West BH-10, 25-26 ft.	03/12/03	937	<0.005	0.046	0.379	2.48	2.91
West BH-12, 24-25 ft.	04/01/03	862	0.047	0.451	0.981	4.78	6.26
West BH-12, 27-29 ft.	04/01/03	96.4	0.006	0.032	0.042	0.241	0.321
West BH-13, 25-26 ft.	04/01/03	<10	<0.005	<0.005	<0.005	<0.015	<0.005
West BH-13, 28-29 ft.	04/01/03	17.7	<0.005	<0.005	<0.005	<0.015	<0.005
West BH-15, 28 ft.	04/02/03	1,150	0.044	0.94	2.00	9.11	12.1
West BH-16, 26 ft.	04/03/03	86.6	<0.005	<0.005	0.017	0.090	0.107
West BH-19, 26-27 ft.	04/04/03	2,120	1.18	4.59	5.13	21.6	32.5
West BH-21, 27-28 ft.	04/07/03	1,800	0.589	1.76	1.82	0.589	4.76
West BH-22, 26-29 ft.	04/07/03	4,440	2.39	7.91	8.35	33.9	52.6
West BH-23, 25-29 ft.	04/08/03	34.5	<0.005	<0.005	0.010	0.048	0.058
West BH-24, 27-28 ft.	04/08/03	237	0.439	0.116	0.801	3.914	5.27
West BH-25, 27-28 ft.	04/18/03	1,900	0.416	0.397	1.86	10.5	13.2
West BH-26, 27-28 ft.	04/18/03	1,320	<0.005	0.084	0.535	3.10	3.72
West BH-26, 29 ft.	04/18/03	138	0.009	0.028	0.280	1.46	1.78

Table 1. Results of Investigation Soils Testing, Navajo Monument 6" Gathering Line Leak

Sample Location and Depth	Sample Date	TPH (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethyl-benzene (mg/Kg)	Total Xylenes (mg/Kg)	Total BTEX (mg/Kg)
West BH-27, 29 ft.	04/18/03	2,190	0.010	0.220	1.26	6.89	8.38
West BH-27, 30-32 ft.	04/18/03	891	0.030	0.131	0.498	2.47	3.13
West BH-28, 26-28 ft.	04/21/03	1,800	<0.005	0.488	1.74	9.40	11.6
West BH-28, 31-32 ft.	04/21/03	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
West BH-29, 25-26 ft.	04/21/03	1,380	<0.005	0.316	1.53	7.61	9.46
West BH-30, 26 ft.	04/22/03	1,910	<0.005	0.029	0.355	2.33	2.71
West BH-30, 29 ft.	04/22/03	826	<0.005	0.015	0.192	1.38	1.59
West BH-31, 29 ft.	04/23/03	1,550	<0.005	0.020	0.116	2.03	2.17
West BH-32, 27-28 ft.	04/23/03	1,440	0.041	0.691	1.30	5.92	7.95
West BH-33, 26 ft.	04/24/03	398	<0.005	0.113	0.727	8.55	9.39
Monitor Well Samples:							
MW-3, 25 ft.	10/12/02	<10.0	<0.005	<0.005	<0.005	0.009	0.009
MW-4, 13 ft.	11/16/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
MW-4, 16 ft.	11/16/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
MW-4, 22 ft.	11/16/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
MW-4, 30 ft.	11/16/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
MW-5, 20 ft.	11/22/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
MW-5, 35 ft.	11/22/02	<10.0	<0.005	<0.005	<0.005	<0.015	<0.005
Notes:							
Sample from Trench A was from a trench dug 20 ft. north of pipeline and approximately 300 ft. east of Maddox Road							
Sample from East Trench was from a trench dug 20 ft. north of pipeline and approximately 475 ft. east of Maddox Road							
Samples collected by Safety and Environmental Solutions, Inc., Hobbs.							
TPH analyses EPA 600/4-79-020 418.1; BTEX analyses EPA SW-846 method 8260; Cardinal Laboratories, Hobbs, NM							

Table 2. Borehole and Monitor Well Status, Navajo North Monument 6" Gathering Line Leak

Borehole	Date Drilled	Depth Drilled (ft.)	Status
East of Maddox Road:			
BH-1	10/10/02	20	Strong Hydrocarbon odor at 20' plugged back to surface
BH-1A	10/10/02	25	No odor at 25' plugged back to surface
BH-1B	10/17/02	28	Hydrocarbon saturated - completed as recovery well
BH-2	10/10/02	25	No odor at 25' plugged back to surface
BH-3	- -	- -	Not Drilled (area next to pipeline daylighted)
BH-4	10/10/02	25	Hydrocarbon saturated - completed as recovery well
BH-5	10/12/02	25	Hydrocarbon show - plugged back to surface
BH-6	10/13/02	22.5	Hydrocarbon show - plugged back to surface
BH-7	10/13/02	23	Hydrocarbon saturated - completed as recovery well
BH-8	10/13/02	25	Hydrocarbon saturated - completed as recovery well
BH-9	10/12/02	23	H/C saturated - completed as recovery well - Plugged on 10-13
BH-9A	10/13/02	23	Hydrocarbon saturated - completed as recovery well
BH-10	10/15/02	23	**No odor at 23' backfilled to surface**
BH-11	10/15/02	23	Hydrocarbon saturated - completed as recovery well
BH-12	10/15/02	22	Hydrocarbon saturated - completed as recovery well
BH-13	10/15/02	22	Hydrocarbon saturated - completed as recovery well
BH-14	10/16/02	22	Hydrocarbon saturated - completed as recovery well
BH-15	10/16/02	26	Hydrocarbon show - plugged back to surface
BH-16	10/19/02	28	Hydrocarbon saturated - completed as recovery well
BH-17	10/19/02	25	Hydrocarbon saturated - completed as recovery well
BH-18	10/19/02	25	Hydrocarbon show - plugged back to surface
BH-19	10/19/02	24	Hydrocarbon saturated - completed as recovery well
BH-20	10/19/02	23	Hydrocarbon show - plugged back to surface
BH-21	10/29/02	23	Hydrocarbon saturated - completed as recovery well
BH-22	10/29/02	19	Hydrocarbon saturated - completed as recovery well
BH-23	10/29/02	19	Hydrocarbon saturated - completed as recovery well
BH-24	10/29/02	18	Hydrocarbon saturated - completed as recovery well
BH-25	10/30/02	18.5	Hydrocarbon saturated - completed as recovery well
BH-26	10/30/02	23	Hydrocarbon show - plugged back to surface
BH-27	10/30/02	23	Hydrocarbon show - plugged back to surface
BH-28	10/30/02	23	Hydrocarbon show - plugged back to surface
BH-29	10/30/02	24	Hydrocarbon saturated - completed as recovery well
BH-30	10/31/02	28	Hydrocarbon saturated - completed as recovery well
BH-31	10/31/02	30	Hydrocarbon show - plugged back to surface
BH-32	10/31/02	25	Hydrocarbon show - plugged back to surface
BH-33	10/31/02	25	Hydrocarbon show - plugged back to surface
BH-34	11/01/02	28	Hydrocarbon show - plugged back to surface
BH-35	11/01/02	25	**Clean, verification sample collected, plugged back to surface**
BH-36	11/01/02	30	Hydrocarbon saturated - completed as recovery well
BH-37	11/05/02	30	Hydrocarbon saturated - completed as recovery well
BH-38	11/05/02	30	Hydrocarbon odor - plugged back to surface
BH-39	11/05/02	27.5	Hydrocarbon saturated - completed as recovery well

Table 2. Borehole and Monitor Well Status, Navajo North Monument 6" Gathering Line Leak

Borehole	Date Drilled	Depth Drilled (ft.)	Status
BH-40	11/05/02	27.5	Hydrocarbon saturated - completed as recovery well
BH-41	11/06/02	28.5	Hydrocarbon saturated - completed as recovery well
BH-42	11/06/02	27	Hydrocarbon saturated - completed as recovery well
BH-43	11/06/02	25	Hydrocarbon show - plugged back to surface
BH-44	11/06/02	20	**Clean, verification sample collected, plugged back to surface**
BH-45	11/07/02	25	Hydrocarbon saturated - completed as recovery well
BH-46	11/07/02	25	**Clean, verification sample collected, plugged back to surface**
BH-47	11/07/02	25	Hydrocarbon saturated - completed as recovery well
BH-48	11/07/02	27	Hydrocarbon saturated - completed as recovery well
BH-49	11/08/02	29	Hydrocarbon show - plugged back to surface
BH-50	11/08/02	28	Hydrocarbon show - plugged back to surface
BH-51	11/08/02	28	**Clean, verification sample collected, plugged back to surface**
BH-52	11/08/02	28	Hydrocarbon saturated - completed as recovery well
BH-53	11/09/02	28	Hydrocarbon saturated - completed as recovery well
BH-54	11/09/02	28	Hydrocarbon saturated - completed as recovery well
BH-55	11/09/02	26	Hydrocarbon saturated - completed as recovery well
BH-56	11/12/02	25	Hydrocarbon saturated - completed as recovery well
BH-57	11/13/02	12.5	Hydrocarbon saturated - completed as recovery well
BH-58	11/13/02	13.5	Hydrocarbon saturated - completed as recovery well
BH-59	11/13/02	12.5	Hydrocarbon saturated - completed as recovery well
BH-60	11/13/02	15	Hydrocarbon saturated - completed as recovery well
BH-61	11/13/02	15	Hydrocarbon saturated - completed as recovery well
BH-62	11/13/02	15	Hydrocarbon saturated - completed as recovery well
BH-63	11/14/02	13.5	Hydrocarbon saturated - completed as recovery well
BH-64	11/14/02	13.5	Hydrocarbon saturated - completed as recovery well
BH-65	11/14/02	15	Hydrocarbon saturated - completed as recovery well
BH-66	11/14/02	15	Hydrocarbon saturated - completed as recovery well
BH-67	11/15/02	13	Hydrocarbon saturated - completed as recovery well
BH-68	11/15/02	25	Hydrocarbon show - completed as temporary well
BH-69	11/15/02	25	**Clean, verification sample collected, plugged back to surface**
BH-70	11/15/02	20	**Clean, verification sample collected, plugged back to surface**
BH-71	11/16/02	25	Hydrocarbon saturated - completed as recovery well
BH-72	11/21/02	23	Hydrocarbon saturated - completed as recovery well
BH-73	11/21/02	20	**Clean, verification sample collected, plugged back to surface**
BH-74	11/21/02	20	Hydrocarbon show - plugged back to surface
BH-75	11/21/02	18	Hydrocarbon saturated - completed as recovery well
BH-76	11/22/02	19	Hydrocarbon saturated - completed as recovery well
BH-77	11/23/02	24	Hydrocarbon saturated - completed as recovery well
BH-78	11/23/02	24	Hydrocarbon show - plugged back to surface
BH-79	- -	- -	Staked -- to be drilled

Table 2. Borehole and Monitor Well Status, Navajo North Monument 6" Gathering Line Leak

Borehole	Date Drilled	Depth Drilled (ft.)	Status
BH-80	11/23/02	27.5	Hydrocarbon saturated - completed as recovery well
BH-81	01/23/03	29	Hydrocarbon saturated - completed as recovery well
BH-82	03/05/03	30	Hydrocarbon saturated - completed as recovery well
BH-83	03/06/03	29	Hydrocarbon saturated - completed as recovery well
BH-84	03/06/03	29	Hydrocarbon saturated - completed as recovery well
BH-85	03/06/03	29	Hydrocarbon show - plugged back to surface
BH-86	03/07/03	29	Hydrocarbon odor - plugged back to surface
BH-87	03/07/03	30	**Clean, verification sample collected, plugged back to surface**
BH-88	03/07/03	30	Hydrocarbon saturated - completed as recovery well
BH-89	03/10/03	29	Hydrocarbon saturated - completed as recovery well
BH-90	03/10/03	28	Hydrocarbon saturated - completed as recovery well
BH-91	03/10/03	28	Hydrocarbon show - plugged back to surface
BH-92	03/10/03	29	Hydrocarbon saturated - completed as recovery well
BH-93	03/11/03	29	Hydrocarbon show - plugged back to surface
BH-94	03/11/03	18	Lost drill bit in hole - plugged back to surface
BH-94A	03/11/03	29	**Clean, verification sample collected, plugged back to surface**
Number of temporary recovery wells east of Maddox Road: ***59***			
West of Maddox Road:			
WBH-1	10/13/02	24.5	No odor at 24.5' plugged back to surface
WBH-1A	04/08/03	29	Hydrocarbon saturated - completed as recovery well
WBH-2	10/13/02	24	No odor at 24' plugged back to surface
WBH-2A	04/02/03	29	Hydrocarbon saturated - completed as recovery well
WBH-3	10/13/02	25	Hydrocarbon odor at 25' plugged back to surface
WBH-3A	03/12/03	29	Hydrocarbon saturated - completed as recovery well
WBH-4	10/14/02	30	No odor at 30' plugged back to surface
WBH-5	10/16/02	28.5	Hydrocarbon show - plugged back to surface
WBH-5A	10/17/02	28.5	Hydrocarbon saturated - completed as recovery well
WBH-6	10/17/02	30	Hydrocarbon show - plugged back to surface
WBH-6A	04/11/03	29	Hydrocarbon show - plugged back to surface
WBH-7	10/17/02	30	Hydrocarbon saturated - completed as recovery well
WBH-7A	04/22/03	30	Hydrocarbon saturated - completed as recovery well
WBH-8	10/17/02	28	Hydrocarbon saturated - completed as recovery well
WBH-9	03/12/03	29	Hydrocarbon show - plugged back to surface
WBH-10	03/12/03	29	Hydrocarbon show - plugged back to surface
WBH-11	04/01/03	29	Hydrocarbon saturated - completed as recovery well
WBH-12	04/01/03	29	Hydrocarbon show - plugged back to surface
WBH-13	04/01/03	29	**Clean, verification sample collected, plugged back to surface**
WBH-14	04/02/03	29	Hydrocarbon saturated - completed as recovery well
WBH-15	04/02/03	29	Hydrocarbon saturated - completed as recovery well
WBH-16	04/03/03	29	Hydrocarbon saturated - completed as recovery well
WBH-17	04/03/03	29	Hydrocarbon saturated - completed as recovery well
WBH-18	04/03/03	29	Hydrocarbon saturated - completed as recovery well
WBH-19	04/04/03	29	Hydrocarbon saturated - completed as recovery well

Table 2. Borehole and Monitor Well Status, Navajo North Monument 6" Gathering Line Leak

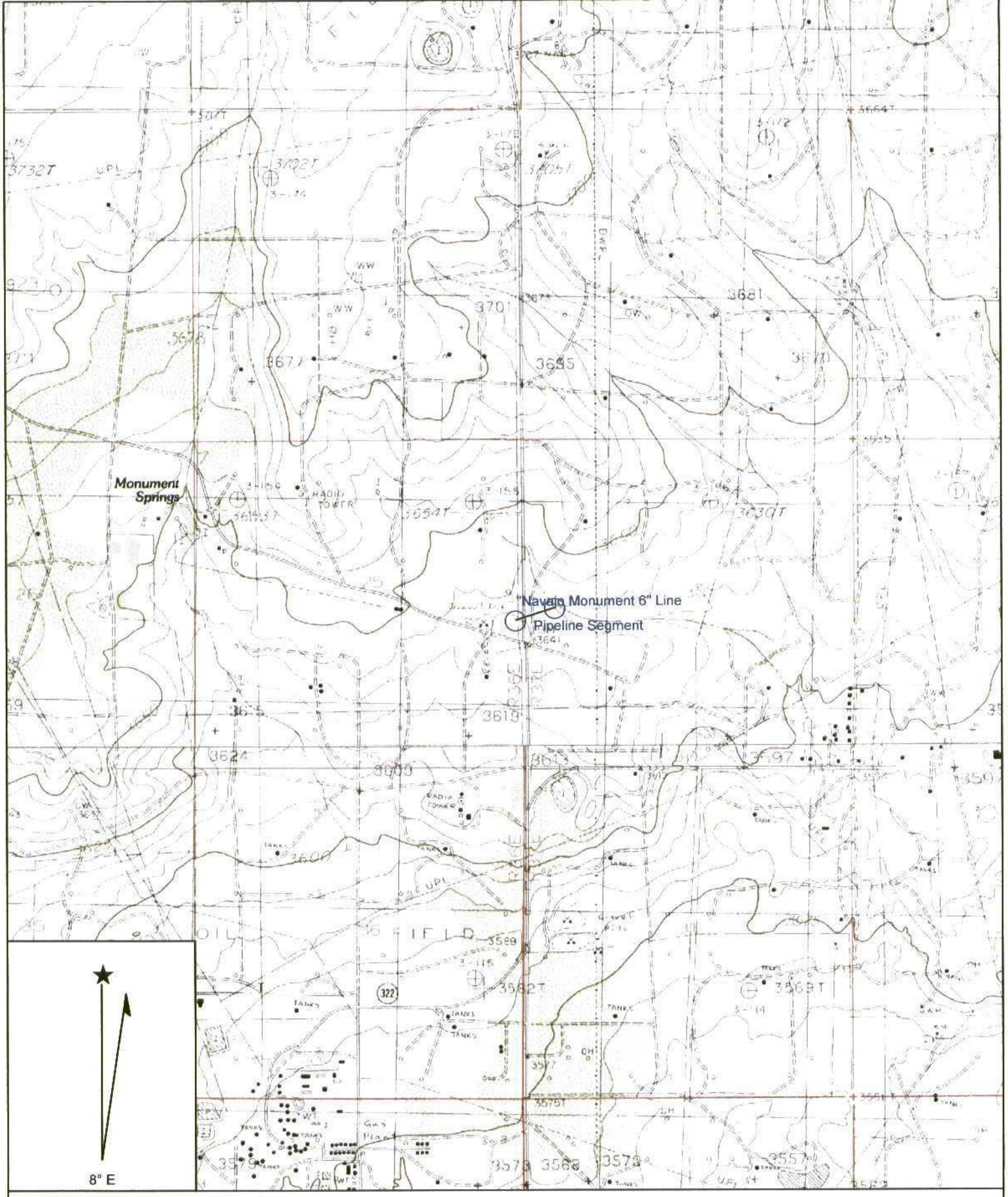
Borehole	Date Drilled	Depth Drilled (ft.)	Status
WBH-20	04/04/03	29	Hydrocarbon saturated - completed as recovery well
WBH-21	04/07/03	29	Hydrocarbon show - plugged back to surface
WBH-22	04/07/03	29	Hydrocarbon show - plugged back to surface
WBH-23	04/08/03	29	**Clean, verification sample collected, plugged back to surface**
WBH-24	04/08/03	29	Hydrocarbon show - plugged back to surface
WBH-25	04/18/03	29	Hydrocarbon show - plugged back to surface
WBH-26	04/18/03	29	Hydrocarbon show - plugged back to surface
WBH-27	04/18/03	33	Hydrocarbon saturated - completed as recovery well
WBH-28	04/21/03	32	Hydrocarbon show - plugged back to surface
WBH-29	04/21/03	32	Hydrocarbon saturated - completed as recovery well
WBH-30	04/22/03	32	Hydrocarbon show - plugged back to surface
WBH-31	04/23/03	31	Hydrocarbon show - plugged back to surface
WBH-32	04/23/03	31	Hydrocarbon show - plugged back to surface
WBH-33	04/24/03	31	Hydrocarbon show - plugged back to surface
Number of temporary recovery wells west of Maddox Road: 17			
Monitor Wells:			
MW-1	10/11/02	35	No hydrocarbon sign - completed as monitor well
MW-2	10/12/02	35	No hydrocarbon sign when drilled; 0.71 ft. product 11/18
			MW-2 plugged 01/23/03
MW-3	10/12/02	35	No hydrocarbon sign - completed as monitor well
MW-4	10/16/02	30	No hydrocarbon sign when drilled; 1.62 ft. product 12/30
			MW-4 plugged 01/28/03
MW-5	11/22/02	35	No hydrocarbon sign - completed as monitor well to replace MW-2
Number of sampling monitor wells: 3			

Table 3. Water Level Elevation Data, Navajo North Monument 6" Gathering Line

Well Name, Depth Below TOC (ft.)	Elevation Top of Casing (feet)	Measure-ment Date	Depth to Product Below TOC (feet)	Depth to Water Below TOC (feet)	Product Thickness (feet)	Corrected Depth to Water (feet)	Corrected Water Level Elev. (feet)	Water Saturated Thickness (feet)
MW-1	3,670.05	10/14/02	- -	25.51	0	25.51	3,644.54	12.2
37.72		10/20/02	- -	25.44	0	25.44	3,644.61	12.3
		10/21/02	- -	25.44	0	25.44	3,644.61	12.3
		11/18/02	- -	25.02	0	25.02	3,645.03	12.7
		12/27/02	- -	25.17	0	25.17	3,644.88	12.6
37.73		05/21/03	- -	25.58	0	25.58	3,644.47	12.2
37.73		10/14/03	- -	26.42	0	26.42	3,643.63	11.3
37.68		03/15/04	- -	26.40	0	26.40	3,643.65	11.3
MW-2	3,671.40	10/14/02	- -	27.42	0	27.42	3,643.98	10.2
37.65		10/20/02	- -	27.35	0	27.35	3,644.05	10.3
		10/21/02	- -	27.36	0	27.36	3,644.04	10.3
		11/18/02	26.98	27.69	0.71	27.10	3,644.30	10.5
		12/27/02	26.62	29.99	3.37	27.21	3,644.19	10.4
Note: Corrected depth to water = Static DTW - (Prod. Thickness x SG), SG = 0.8251 (API=40); plugged 01/23/03								
MW-3	3,666.41	10/14/02	- -	24.31	0	24.31	3,642.10	13.2
37.47		10/20/02	- -	24.20	0	24.20	3,642.21	13.3
		10/21/02	- -	24.21	0	24.21	3,642.20	13.3
		11/18/02	- -	23.82	0	23.82	3,642.59	13.7
		12/27/02	- -	23.96	0	23.96	3,642.45	13.5
37.49		05/21/03	- -	24.36	0	24.36	3,642.05	13.1
37.49		10/14/03	- -	25.07	0	25.07	3,641.34	12.4
37.45		03/15/04	- -	25.01	0	25.01	3,641.40	12.4
MW-4	3,661.76	11/18/02	- -	20.26	0	20.26	3,641.50	8.7
28.93		12/27/02	- -	20.52	0	20.52	3,641.24	8.4
		12/30/02	20.30	21.92	1.62	20.58	3,641.18	8.3
Note: Corrected depth to water = Static DTW - (Prod. Thickness x SG), SG = 0.8251 (API=40); plugged 01/28/03								
MW-5	3,670.43							
35.80		12/27/02	- -	26.53	0	26.53	3,643.90	9.3
39.32		05/21/03	- -	26.88	0	26.88	3,643.55	12.4
39.32		10/14/03	- -	27.66	0	27.66	3,642.77	11.7
39.33		03/15/04	- -	27.64	0	27.64	3,642.79	11.7
Note: TOC -Top of Casing								

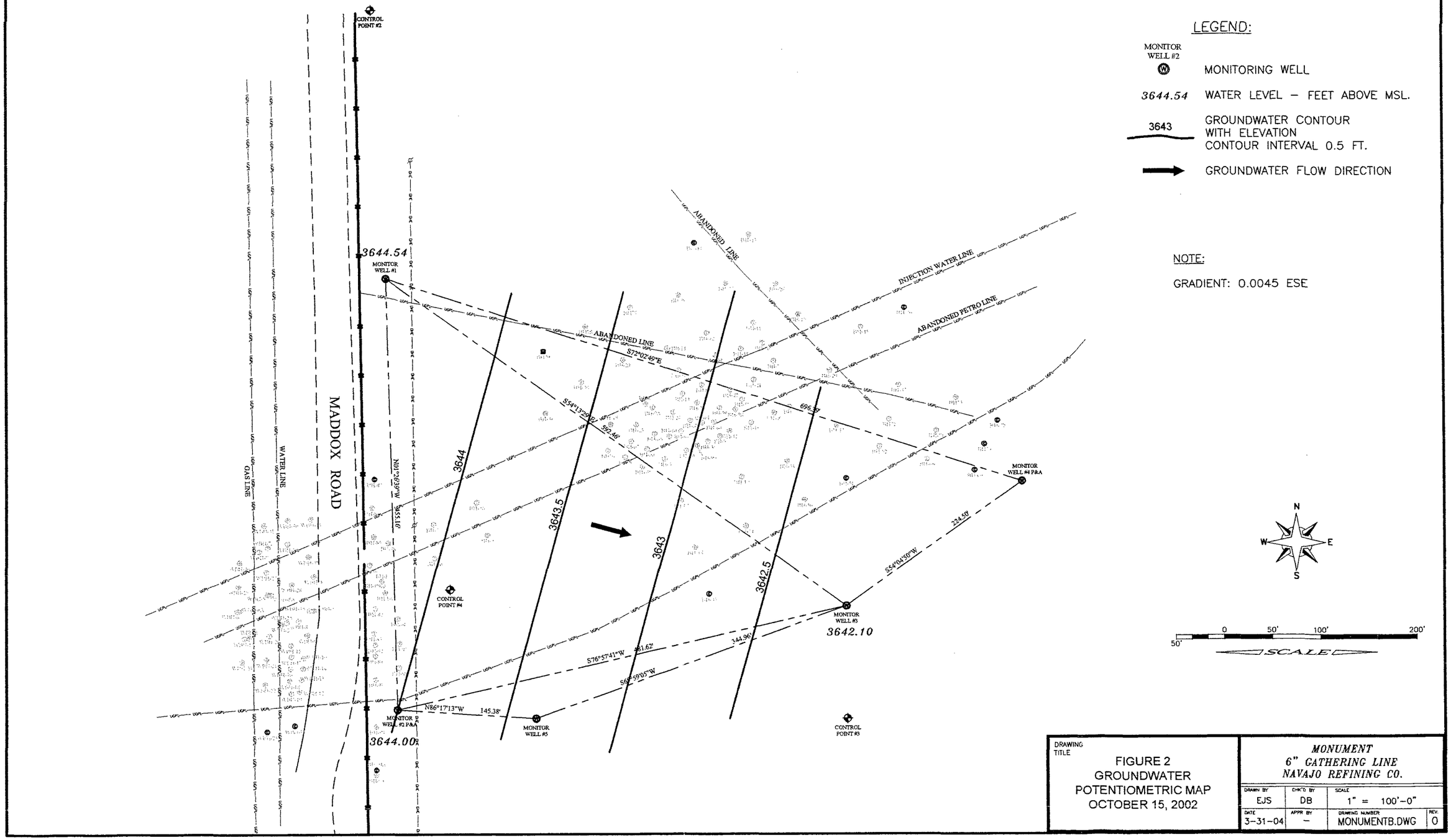
Table 4. Water Quality Sampling, Navajo North Monument 6" Gathering Line

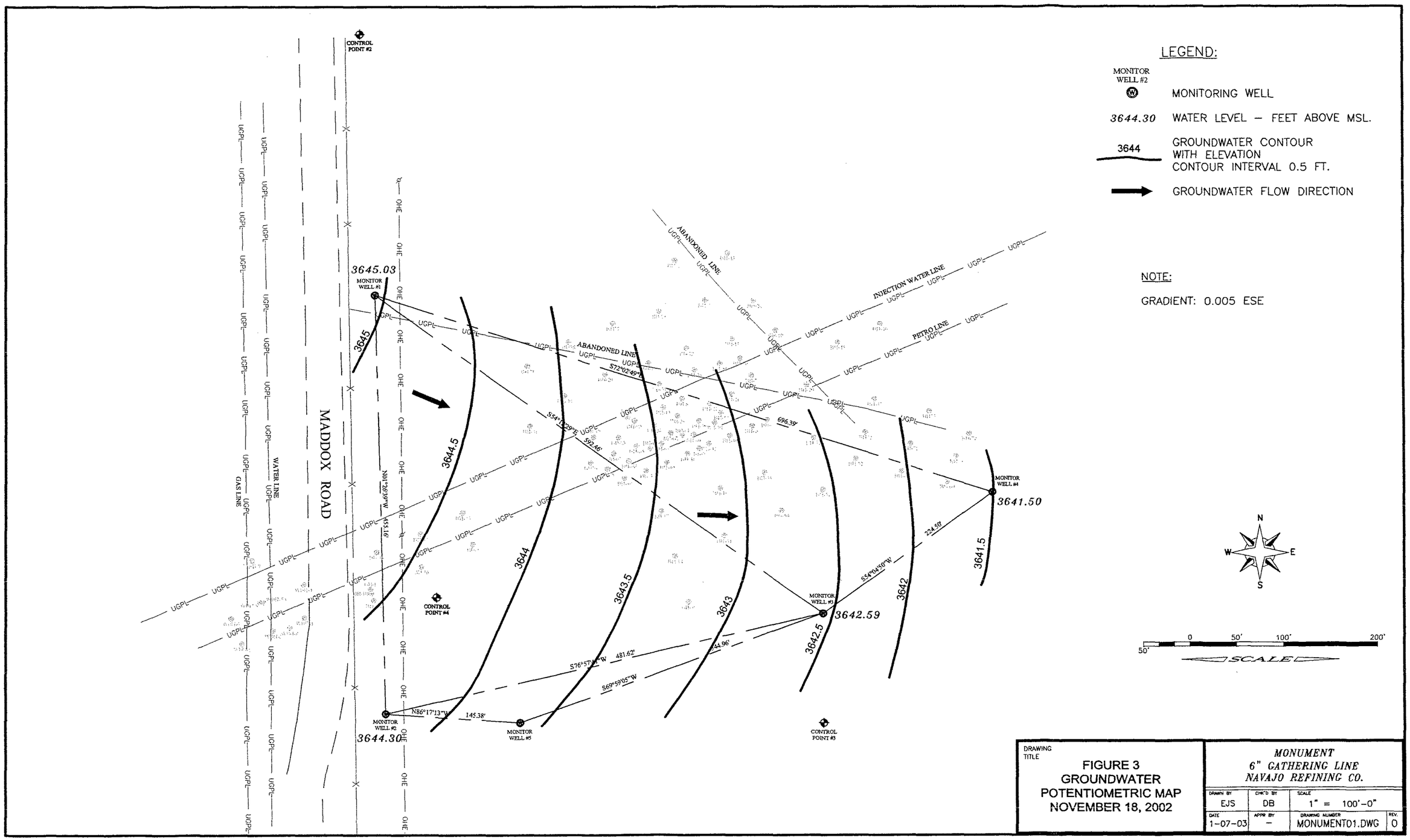
Monitoring Well	Sample Date	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (total, mg/L)	Total BTEX (mg/L)	Chloride (mg/L)	Total Dissolved Solids (mg/L)
MW-1	10/21/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	12/27/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	05/21/03	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	10/15/03	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	03/15/04	<0.002	<0.002	<0.002	<0.006	<0.002	264	950
MW-2	10/21/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	12/27/02	Hydrocarbon product detected, plugged 01/23/03						
MW-3	10/21/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	12/27/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	05/21/03	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	10/15/03	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	03/15/04	0.010	<0.002	<0.002	<0.006	0.010	144	837
MW-4	12/27/02	Hydrocarbon product detected, plugged 01/28/03						
MW-5	12/30/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	05/21/03	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
	10/15/03	0.045	<0.002	<0.002	<0.006	0.045	--	--
	11/06/03	0.070	<0.002	<0.002	<0.006	0.070	--	--
	03/15/04	0.056	<0.002	<0.002	<0.006	0.056	132	797
Sec 30	10/08/02	<0.002	<0.002	<0.002	<0.006	<0.002	--	--
Windmill	10/10/02	--	--	--	--	--	100	528
BH-7	11/04/02	--	--	--	--	--	124	636
Notes:								
Complete cation/anion water chemistry analysis performed in addition to chloride and TDS shown.								
Analyses performed at Cardinal Laboratories, Hobbs, NM								
Analyses performed using EPA SW-846 methods 8260 (volatile organics) and 160.1 (TDS), and Standard Method 4500-Cl B (Cl).								



Name: MONUMENT NORTH
Date: 4/1/2004
Scale: 1 inch equals 2000 feet

Location: 032° 37' 53.9" N 103° 17' 59.2" W
Caption: Figure 1. Vicinity Map
Navajo Monument 6" Line


CONTROL POINT #2
3644.54
MONITOR WELL #1
ABANDONED LINE
INJECTION WATER LINE
ABANDONED PETRO LINE
S72°02'40"E
S54°13'28"E
592.46'
696.38'
MONITOR WELL #4 P&A
MADDOX ROAD
GAS LINE
WATER LINE
N01°39'39"W
3551.8'
3644
3643.5
3643
3642.5
CONTROL POINT #4
MONITOR WELL #3
3642.10
224.50'
S54°04'50"W
344.96'
S76°57'41"W
261.62'
S65°59'05"W
N86°17'13"W
145.38'
MONITOR WELL #2 P&A
3644.00
MONITOR WELL #5
CONTROL POINT #5
LEGEND:
MONITOR WELL #2
MONITORING WELL
3644.54
WATER LEVEL – FEET ABOVE MSL.
3643
GROUNDWATER CONTOUR WITH ELEVATION CONTOUR INTERVAL 0.5 FT.
GROUNDWATER FLOW DIRECTION
NOTE:
GRADIENT: 0.0045 ESE
N
W
E
S
0
50'
100'
200'
50'
SCALE
DRAWING TITLE
FIGURE 2
GROUNDWATER
POTENTIOMETRIC MAP
OCTOBER 15, 2002
MONUMENT
6" GATHERING LINE
NAVAJO REFINING CO.
DRAWN BY EJS
CHK'D BY DB
SCALE 1" = 100'-0"
DATE 3-31-04
APPR BY –
DRAWING NUMBER MONUMENTB.DWG
REV. 0



LEGEND:

MONITOR WELL #2 — MONITORING WELL

3644.30 — WATER LEVEL – FEET ABOVE MSL.

3644 — GROUNDWATER CONTOUR WITH ELEVATION CONTOUR INTERVAL 0.5 FT.

GROUNDWATER FLOW DIRECTION

NOTE:

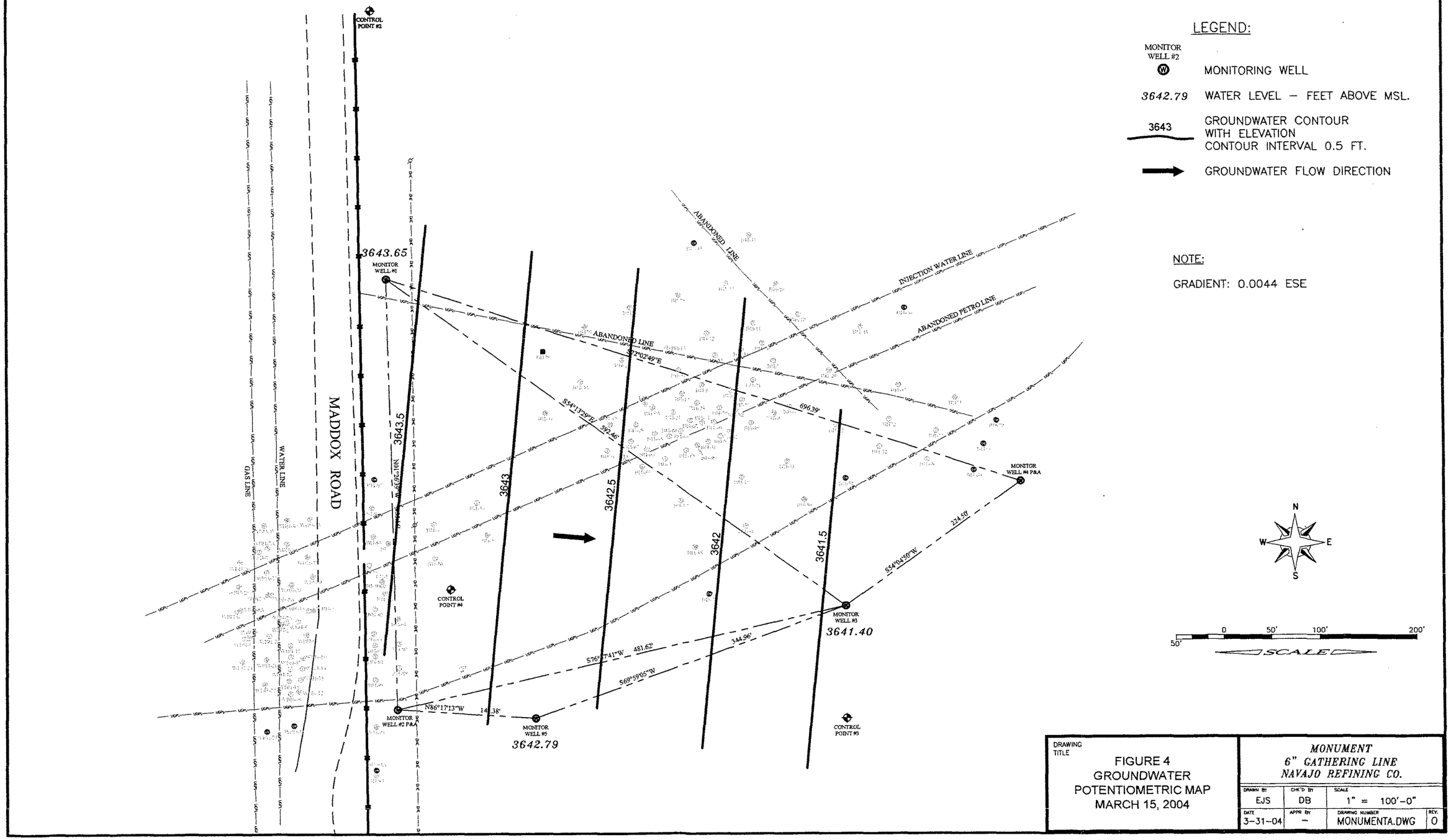
GRADIENT: 0.005 ESE

DRAWING TITLE

FIGURE 3
GROUNDWATER POTENTIOMETRIC MAP
NOVEMBER 18, 2002

MONUMENT
6" GATHERING LINE
NAVAJO REFINING CO.

DRAWN BY	CHK'D BY	SCALE	
EJS	DB	1" = 100'-0"	
DATE	APPR BY	DRAWING NUMBER	REV.
1-07-03	–	MONUMENT01.DWG	0


CONTROL POINT #2
3643.65
MONITOR WELL #1
ABANDONED LINE
S27°02'49"E
INJECTION WATER LINE
ABANDONED PETRO LINE
S54°13'29"E
592.46'
696.39'
MONITOR WELL #4 P&A
MADDOX ROAD
GAS LINE
WATER LINE
3643.5
3643
3642.5
3642
3641.5
CONTROL POINT #4
CONTROL POINT #3
MONITOR WELL #3
3641.40
224.58'
S54°14'50"W
S76°27'41"W 481.62'
344.96'
S69°59'05"W
N86°17'13"W 141.38'
MONITOR WELL #2 P&A
MONITOR WELL #5
3642.79
LEGEND:
MONITOR WELL #2
MONITORING WELL
3642.79 WATER LEVEL – FEET ABOVE MSL.
3643 GROUNDWATER CONTOUR WITH ELEVATION CONTOUR INTERVAL 0.5 FT.
GROUNDWATER FLOW DIRECTION
NOTE:
GRADIENT: 0.0044 ESE
N
W
E
S
0 50' 100' 200'
50'
SCALE
DRAWING TITLE
FIGURE 4
GROUNDWATER POTENTIOMETRIC MAP
MARCH 15, 2004
MONUMENT
6" GATHERING LINE
NAVAJO REFINING CO.
DRAWN BY: EJS
CHK'D BY: DB
SCALE: 1" = 100'-0"
DATE: 3-31-04
APPR BY: –
DRAWING NUMBER: MONUMENTA.DWG
REV: 0

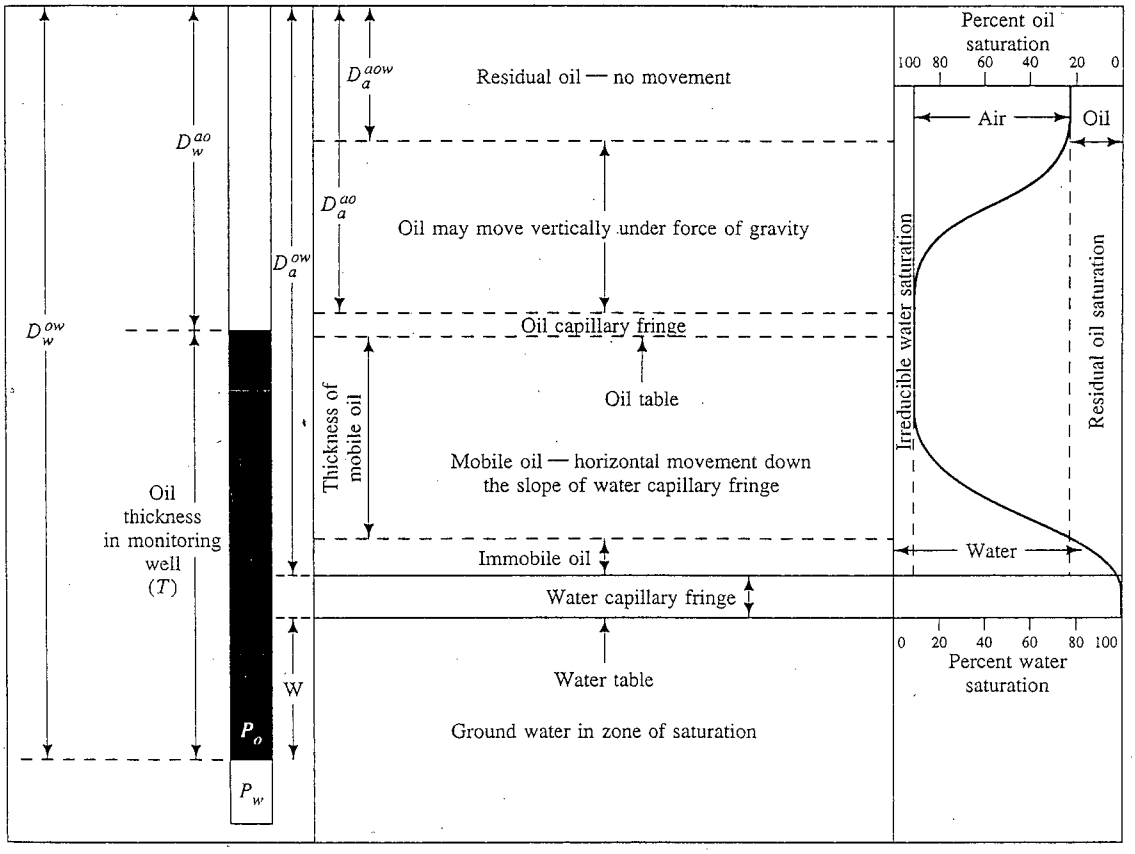


FIGURE 5.19 Comparison of distribution of mobile oil in an aquifer with the thickness of floating oil in a monitoring well for the case where a water capillary fringe exists below the zone of mobile oil.

(Reproduced from *Contaminant Hydrogeology*, by C.W. Fetter, Prentice-Hall, 1993)

Figure 5. Distribution of Mobile Oil in an Aquifer with a Capillary Fringe and a Monitor Well

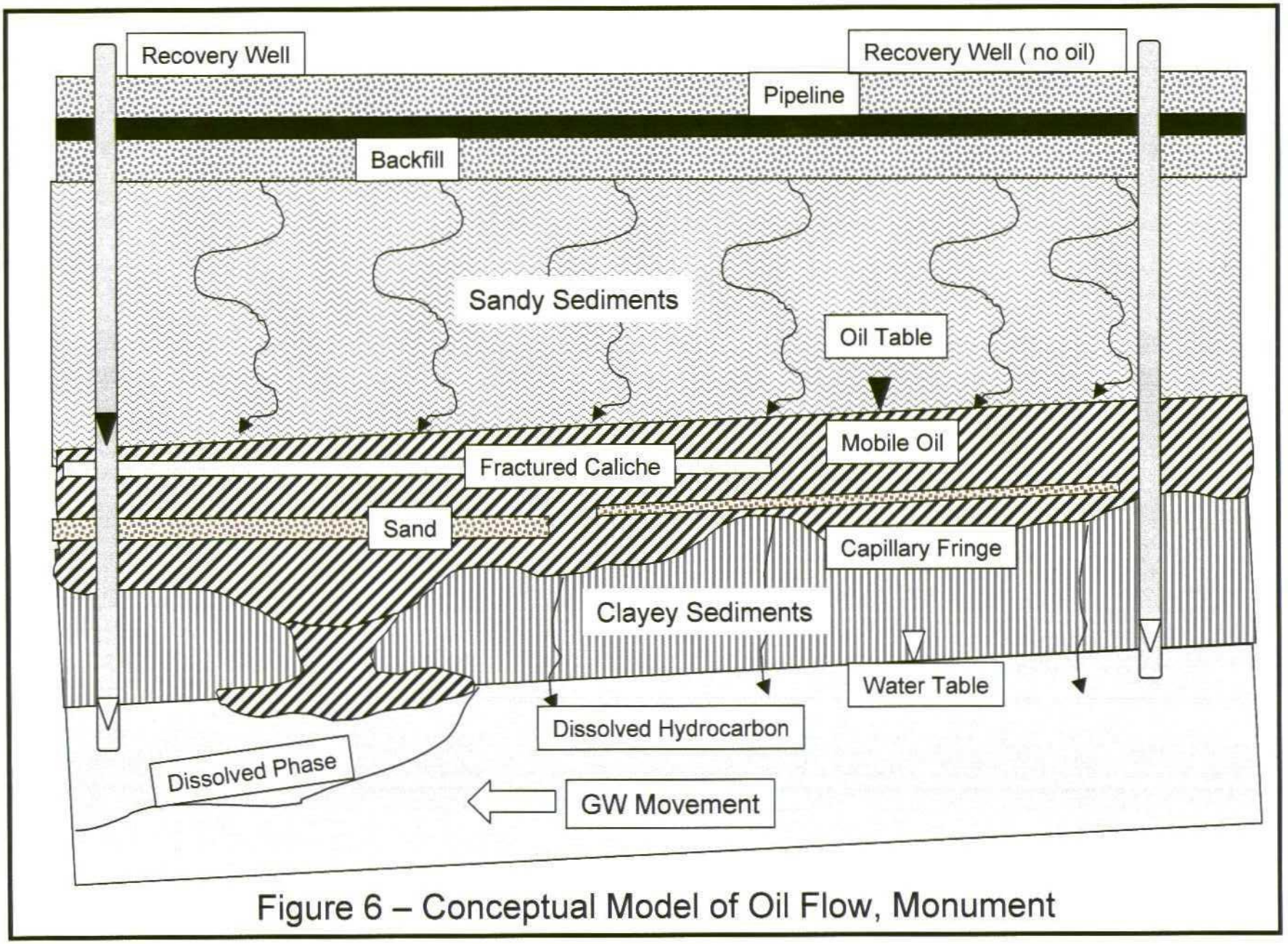
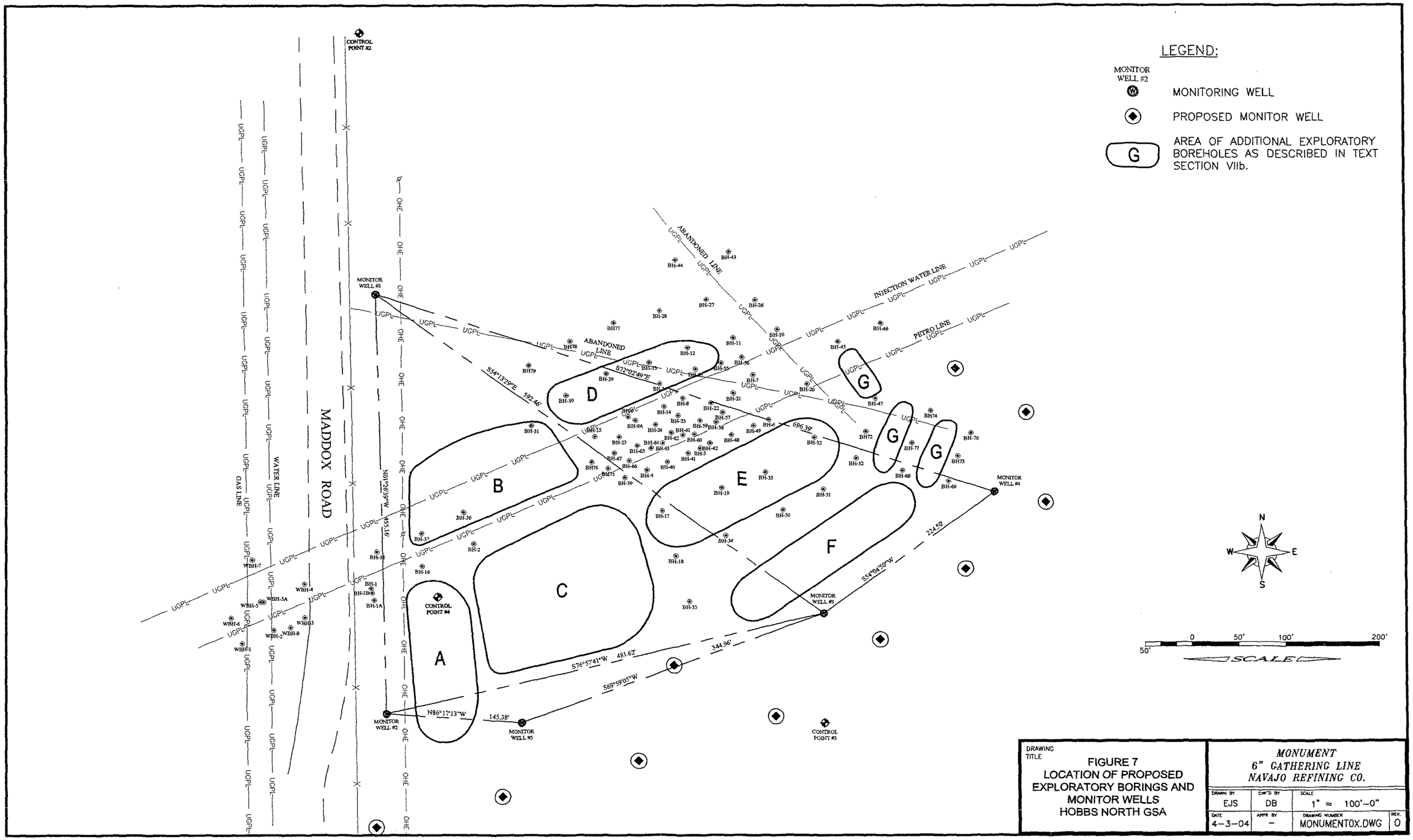


Figure 6 – Conceptual Model of Oil Flow, Monument


CONTROL POINT #2
MONITOR WELL #1
MONITOR WELL #2
MONITOR WELL #3
MONITOR WELL #4
MONITOR WELL #5
CONTROL POINT #4
CONTROL POINT #5
MADDOX ROAD
GAS LINE
WATER LINE
ABANDONED LINE
INJECTION WATER LINE
PETRO LINE
UGPL
OHE
A
B
C
D
E
F
G
S54°13'29"E 592.46'
S72°02'49"E
N01°26'39"W 455.16'
696.39'
224.50'
S54°04'50"W
344.96'
S76°57'41"W 481.62'
S69°59'05"W
N86°17'13"W
145.38'
LEGEND:
MONITOR WELL #2
MONITORING WELL
PROPOSED MONITOR WELL
AREA OF ADDITIONAL EXPLORATORY BOREHOLES AS DESCRIBED IN TEXT SECTION VIIb.
N
W
E
S
0 50' 100' 200'
50'
SCALE
DRAWING TITLE
FIGURE 7
LOCATION OF PROPOSED EXPLORATORY BORINGS AND MONITOR WELLS
HOBBS NORTH GSA
MONUMENT
6" GATHERING LINE
NAVAJO REFINING CO.
DRAWN BY EJS
CHK'D BY DB
SCALE 1" = 100'-0"
DATE 4-3-04
APPR BY -
DRAWING NUMBER MONUMENT0X.DWG
REV. 0

X. Appendices

Appendix A. Copy of OCD Form C-141

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 South First, Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
2040 South Pacheco, Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
2040 South Pacheco
Santa Fe, NM 87505

Form C-141
Revised March 17, 1999

Submit 2 Copies to appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company: Navajo Refining Co.	Contact: Darrell Moore Dickie Townley
Address: 501 E. Main Artesia NM	Telephone No.: 505-748-3311
Facility Name:	Facility Type: Pipeline

Surface Owner	Mineral Owner	Lease No.
State of NM		

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
								Lea

10 miles west of Hobbs. Turn South on Maddox Rd. Go 3 miles. Leak site is on both sides of Maddox Rd.

NATURE OF RELEASE

Type of Release: Crude Oil	Volume of Release: 2024 bbls.	Volume Recovered:
Source of Release: Leak in pipeline	Date and Hour of Occurrence: 10/5/02	Date and Hour of Discovery: 10/5/02 11:00am
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	If YES, To Whom? Larry Johnson	
By Whom? Dickie Townley	Date and Hour: 10/5/02 4:00 pm	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse.	

If a Watercourse was Impacted, Describe Fully.*

Describe Cause of Problem and Remedial Action Taken.* A corrosive was introduced into the pipeline by unknown persons and/or producers. This caused several leaks in the pipeline. We are currently delineating and putting pumps in wells that show free product.

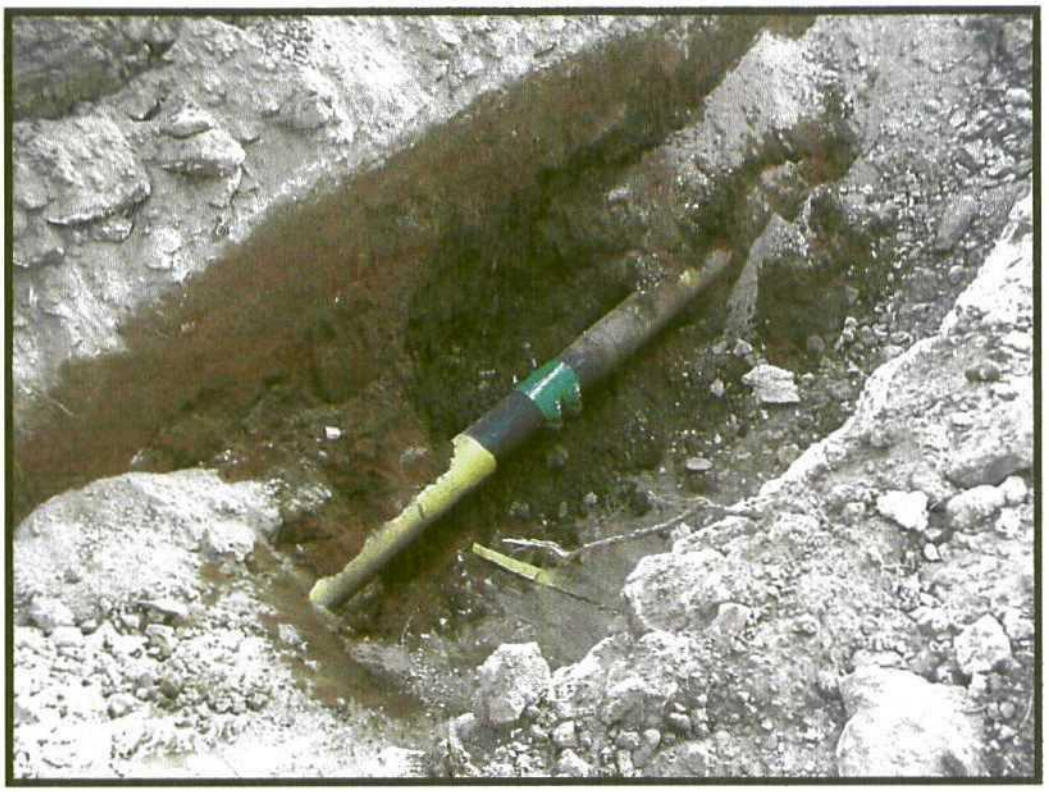
Describe Area Affected and Cleanup Action Taken.* Area affected is still being determined.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Signature: Darrell Moore	OIL CONSERVATION DIVISION
Printed Name: Darrell Moore	Approved by District Supervisor:
Title: Env. Mgr. for Waters Waste	Approval Date: / Expiration Date:
Date: 10/16/02 Phone: 505-748-3311	Conditions of Approval: / Attached ☐

* Attach Additional Sheets If Necessary

Appendix B. Site Photographs



1st Leak Site 10-5-02

1st Leak Site 10-5-02

1st Bell Hole 10-5-02

Delineation Bell Hole 10-5-02

Delineation Bell Hole 10-5-02

2nd Bell Hole 10-5-02

Eastern Trench 10-6-02

Eastern Trench 10-6-02

Trench just East of Maddox Rd. Looking West 10-6-02

Trench just East of Maddox Rd. Looking East 10-6-02

Site Looking East from Maddox Rd. 10-6-02

East End Excavation 10-9-02

East End Excavation 10-9-02

East End Excavation 10-9-02

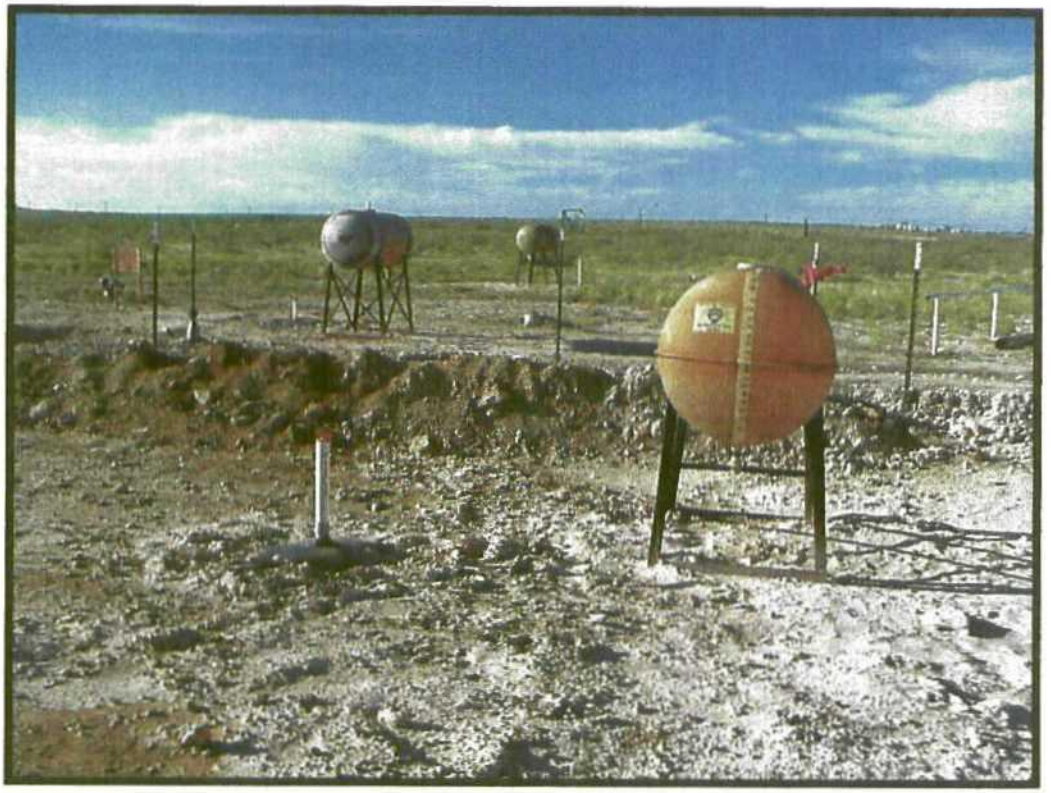
Bore Hole # 4 Oil Being Bailed 10-10-02

Bore Hole # 4 Core Sample 10-10-02

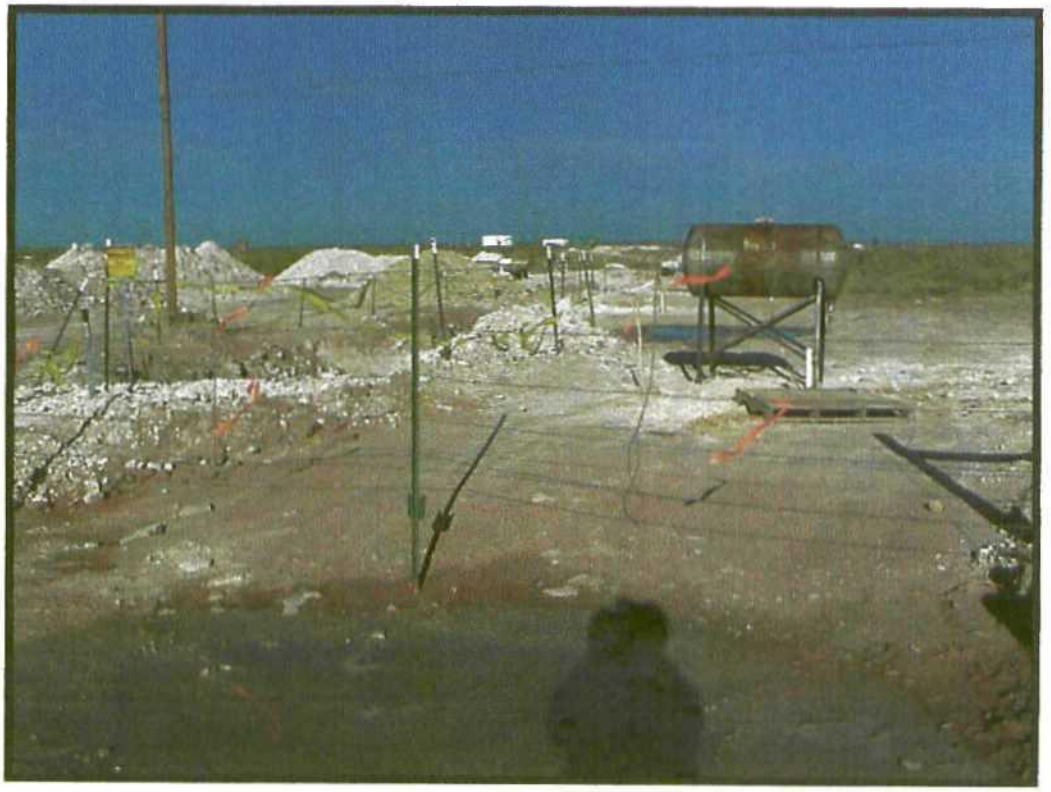
Bore hole # 4 Core Sample 25' 10-10-02

Bore hole # 4 Core Sample 25' 10-10-02

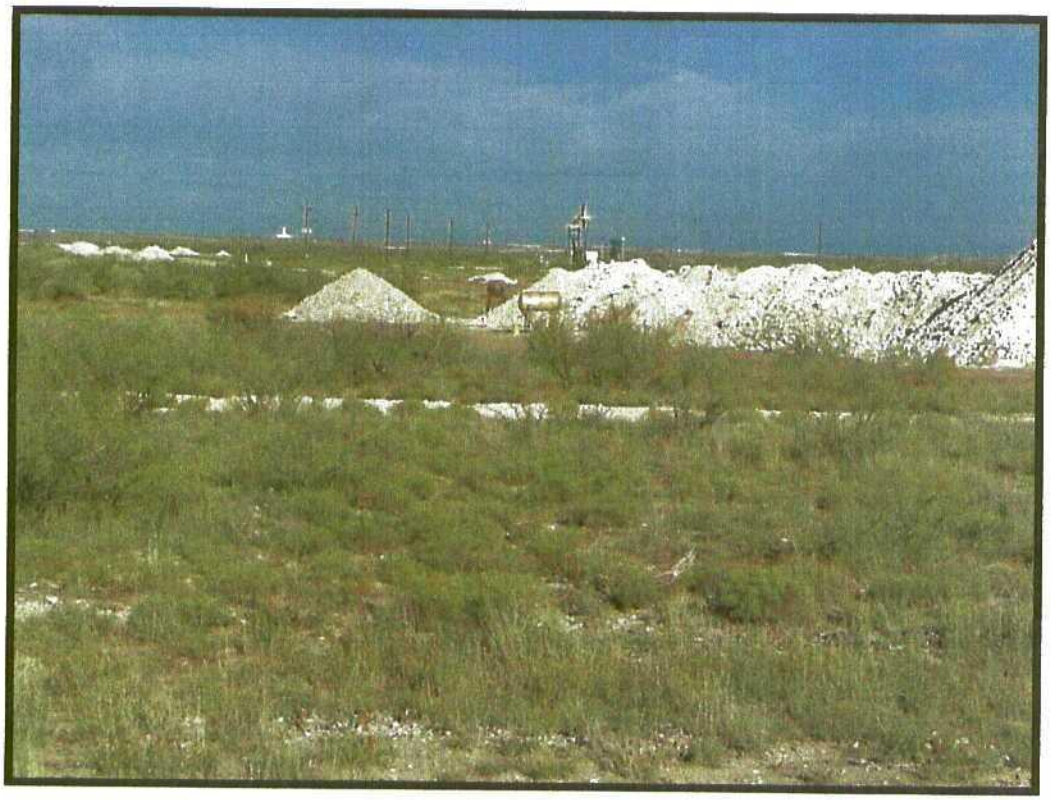
Recovery Well # 4 10-11-02



Westside Maddox Road Looking North 10-20-02



East Side Maddox Road Looking East 10-20-02



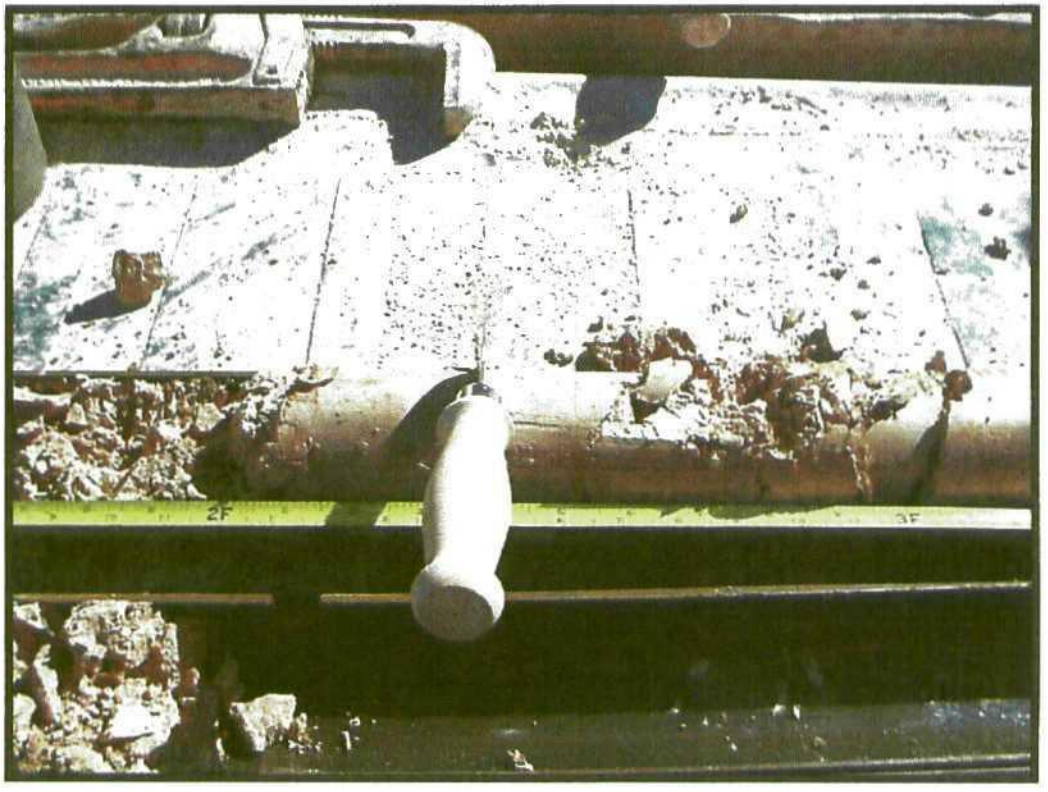
Clean Spoils on East Side 10-20-02

North View of East Side 10-20-02

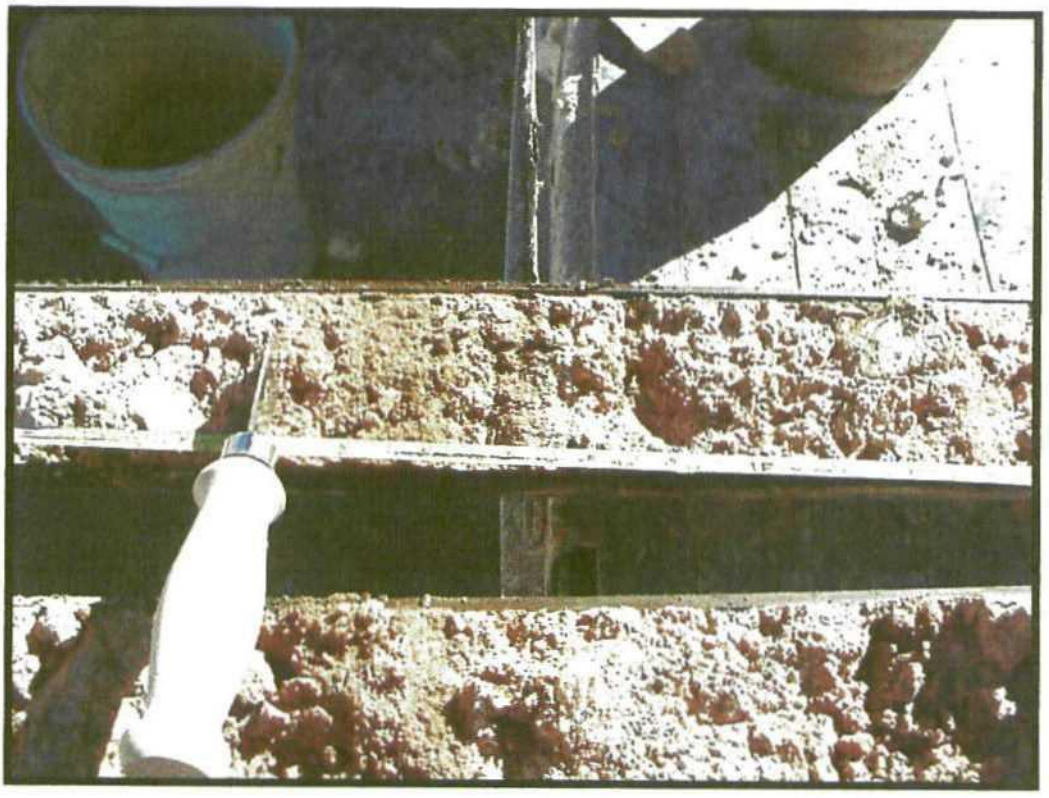
Completing Bore Hole # 41 11/6/02

Bore Hole #41 11/6/02

Core Sample Bore Hole # 41 11/6/02



Core Sample Bore Hole # 41 11/6/02

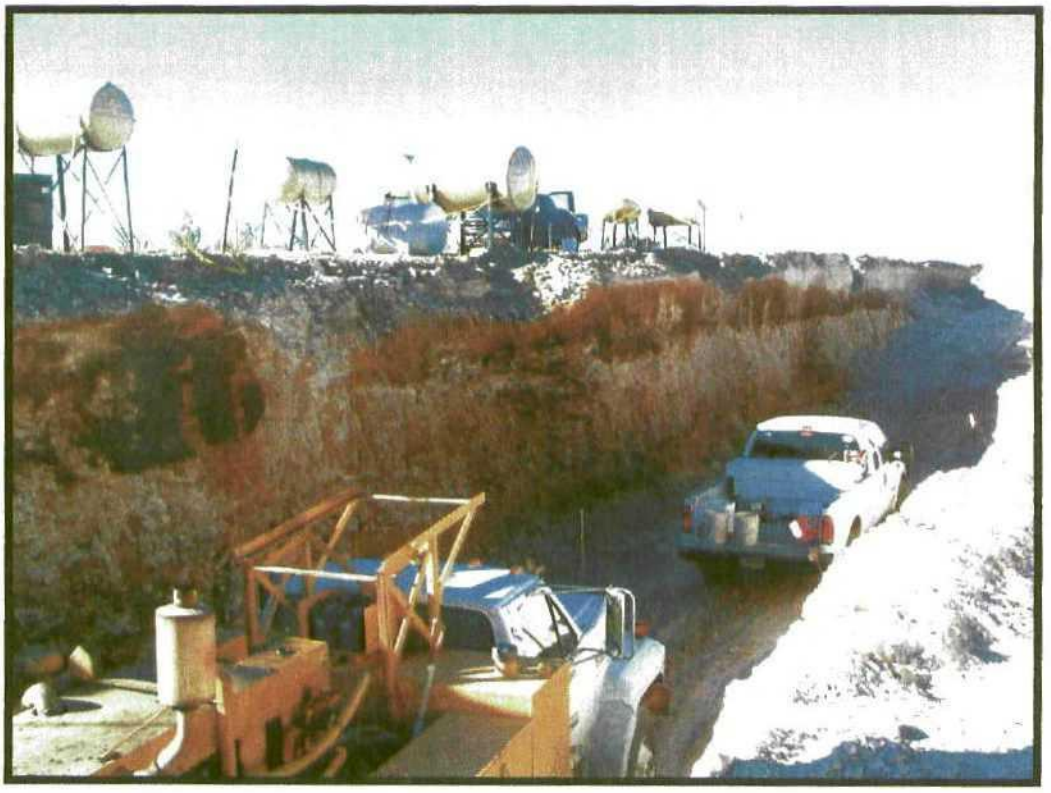


Core Sample Bore Hole # 41 11/6/02

Core Sample Bore Hole # 41 11/6/02

Core Sample Bore Hole # 41 11/6/02

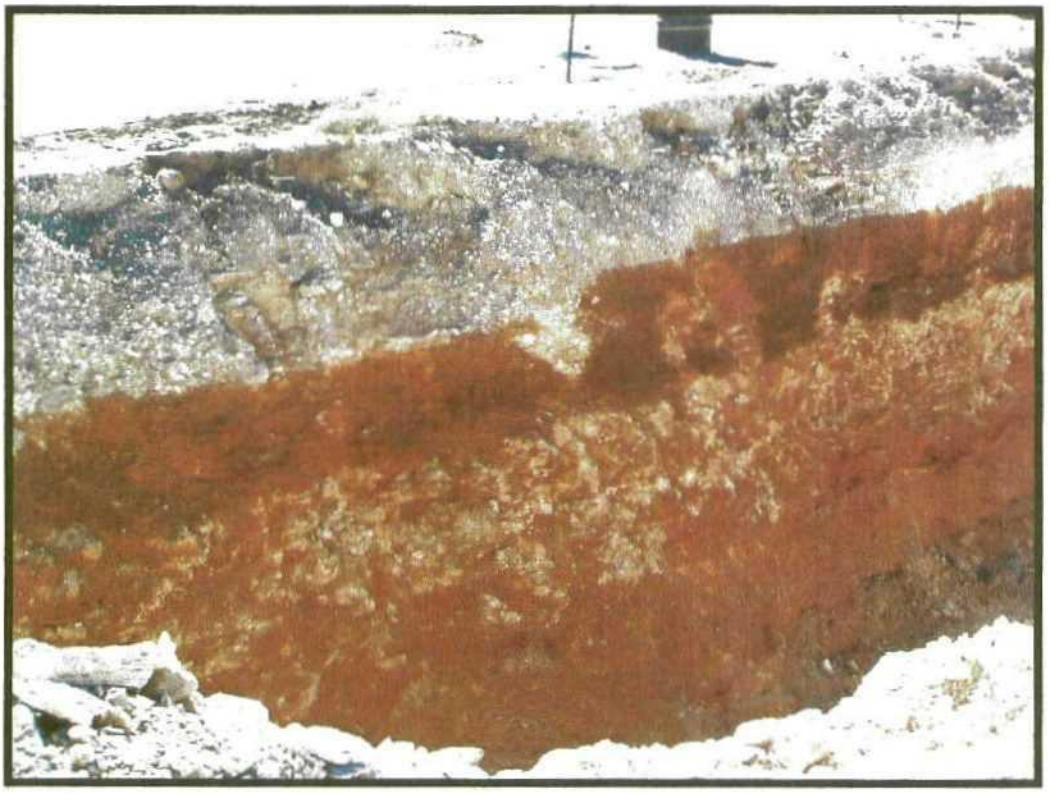
Core Sample Bore Hole # 41 11/6/02



Installation of temporary recovery wells at the Monument pipeline release site, November 13, 2002
The pipeline was located adjacent to the base of the hydrocarbon stained soil on the left wall.

Installation of temporary recovery wells at the Monument pipeline release site, November 13, 2002
The pipeline was located adjacent to the base of the hydrocarbon stained soil on the left wall.

Installation of temporary recovery wells at the Monument pipeline release site, November 13, 2002
The pipeline was located adjacent to the base of the hydrocarbon stained soil on the left wall.

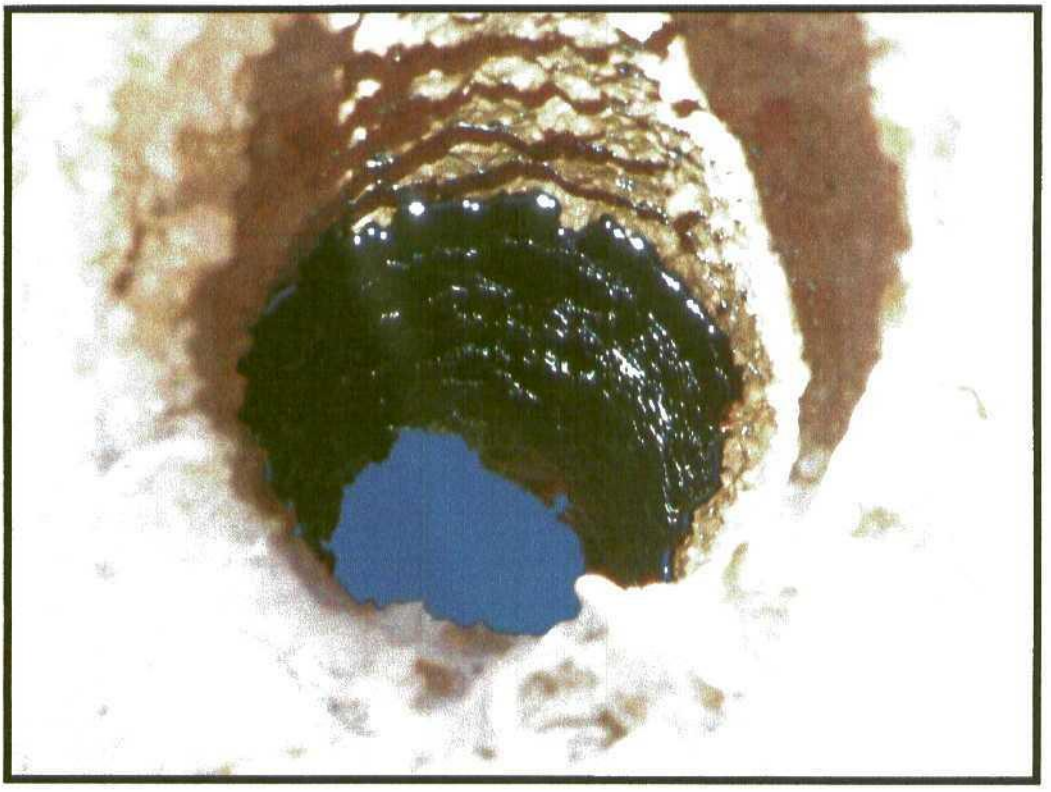


Installation of temporary recovery wells at the Monument pipeline release site, November 13, 2002
The pipeline was located adjacent to the base of the hydrocarbon stained soil on the left wall.

Bore Hole # 57 11/13/02

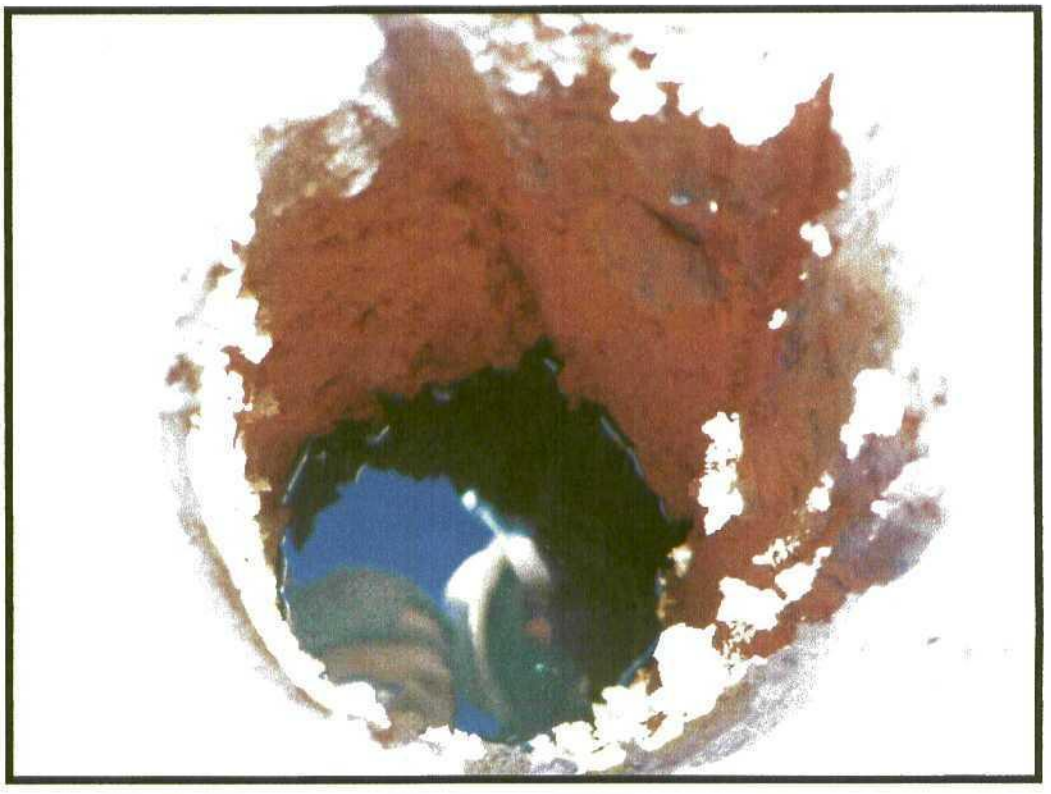
Bore Hole # 57 11/13/02

Bore Hole # 58 11/13/02

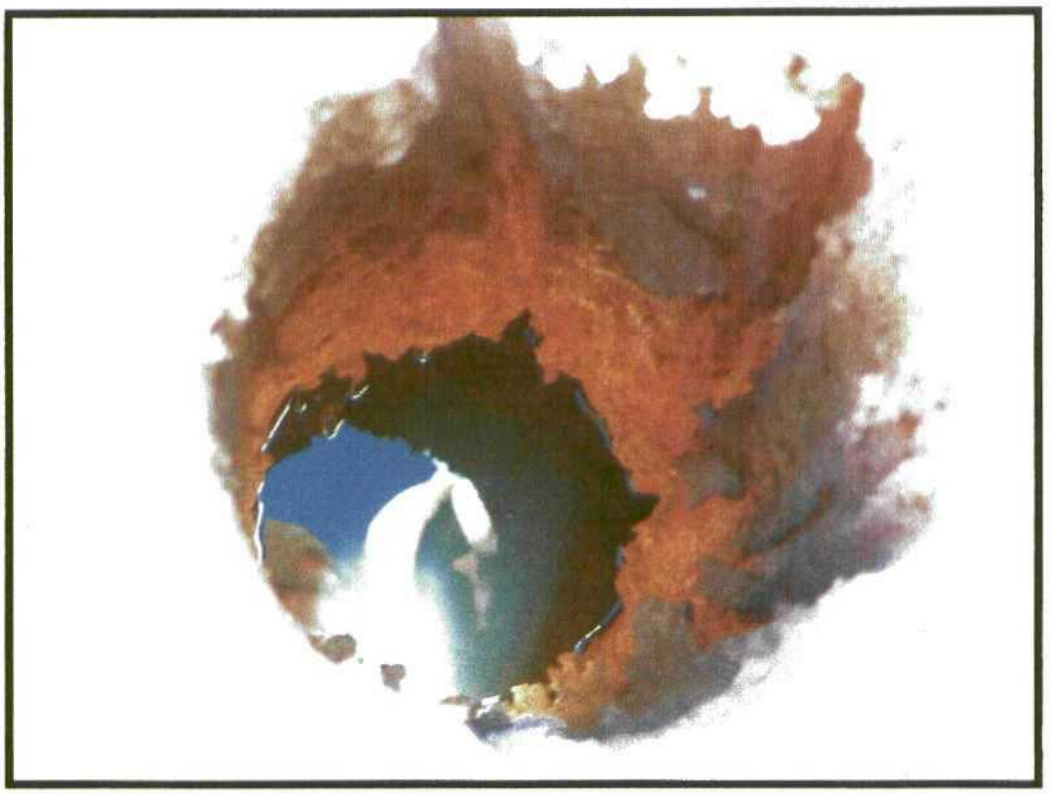


Bore Hole # 58 11/13/02

Bore Hole # 58 11/13/02



Bore Hole # 58 11/13/02



Bore Hole # 58 11/13/02

Core Sample Bore Hole #61 11/13/02

Core Sample Bore Hole #61 11/13/02

Appendix C. Selected Borehole Logs

LOG OF BORING BH-04

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

Navajo Refining Company
Artesia, New Mexico

Date, Time Started: : 10/10/02, 1600
Date, Time Completed : 10/11/02, 1200
Hole Diameter: : 8-1/4 in.
Drilling Method: : Hollow-stem auger, CME-75
Sampling Method: : Cuttings, core barrel

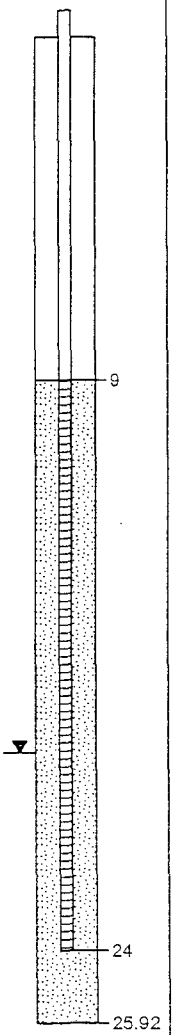
Drilled By: : Eco Drilling
Logged By: : D.G. Boyer

Sample Condition
- Remoulded
- Undisturbed
- Lost
- Rock Core

Sample Type:
- AR Air Rotary Cuttings
- CB Core Barrel (2.5' or 5')
- CT Auger Cuttings
- NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0				Soil		0-0.5 ft. Surface soil	
		CB	1	CA/SM		0.5-5 ft. Caliche in core tip, no H/C odor	
5							
		CB	3			5-10 ft. CALICHE with SILTY SAND, light brown, at 7.5 ft. becoming stained with strong H/C odor	
10				SM/CA		10-11.4 ft. SILTY SAND with CALICHE, sand light brown, very fine grained, H/C odor	
				CA		11.4-12.3 ft. CALICHE, stained gray and black, some crystaline calcite, H/C odor	
		CB	3.5	CL		12.3-13.3 ft. SANDY CLAY, H/C saturated	
15				CA		15-15.2 ft. Caliche	
						15.2-16.7 CALICHE and SANDY SILT mixture	
		CB	1.7				
20				CA/ML			
		CB	1.5			20-25 ft. H/C saturated	
25							
30							

BH-4



Notes:
In auger stem: DTP 23.03 ft, no water, oil rising in auger
10/11: DTP 19.50 ft. (18.80 ft. BGS), pumped 13 gallon free product in ~7 min.
Completed as 4-in. temporary recovery well with 15 ft. 20-slot screen, sand pack.

H/C - Petroleum hydrocarbon

LOG OF BORING BH-41

(Page 1 of 1)

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

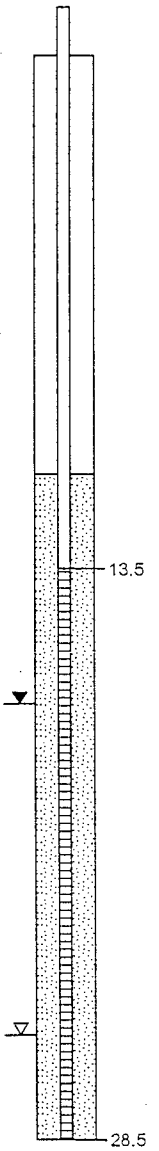
Navajo Refining Company
Artesia, New Mexico

Date, Time Started:	: 11/06/02, 1000	Drilled By:	: Eco Drilling
Date, Time Completed	: 11/06/02, 1140	Logged By:	: D.G. Boyer
Hole Diameter:	: 8-1/4 in.		
Drilling Method:	: Hollow-stem auger, CME-75		
Sampling Method:	: Cuttings, core barrel		

Sample Condition
- Remoulded
- Undisturbed
- Lost
- Rock Core

Sample Type:
- AR Air Rotary Cuttings
- CB Core Barrel (2.5' or 5')
- CT Auger Cuttings
- NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0–20		CT		CA/SM		0-19 ft. Cuttings, CALICHE with SILTY SAND, hard drilling 9-10 ft.	
20		CB	3.8	CL		Clayey 19-20 ft. 20-20.7 ft. GRAVELLY CLAY, H/C saturated 20.7-23.8 ft. SILTY CLAY, with frequent caliche rock and sandstone. Occasional fine grained sand, tight, not much saturation	
25		CB	3.9			25-28.9 ft. SILTY CLAY, with caliche rock and fragments. H/C saturated at 25 ft.and from 28-28.9 ft. Saturated where have more gravel than clay (center of core also saturated, core comressed walls and squeezed H/C out).	H7194-7
30							



Notes:
Completed as 2-in. temporary recovery well with 15 ft. 20-slot screen, sand pack to 11 ft. BGS
H/C - Petroleum hydrocarbon
Laboratory analyses by Cardinal Laboratories

LOG OF BORING BH-57

(Page 1 of 1)

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

Navajo Refining Company
Artesia, New Mexico

Date, Time Started: : 11/13/02, 0920
Date, Time Completed : 11/13/02, 1025
Hole Diameter: : 8-1/4 in.
Drilling Method: : Hollow-stem auger, CME-75
Sampling Method: : Cuttings, core barrel

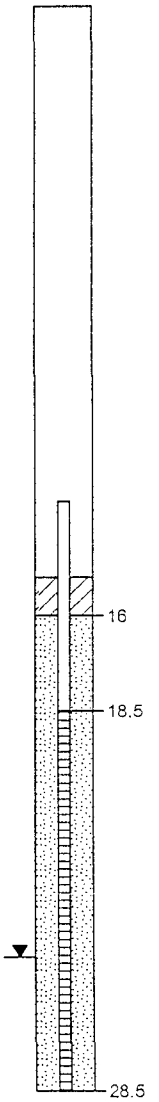
Drilled By: : Eco Drilling
Logged By: : D.G. Boyer

Sample Condition
- Remoulded
- Undisturbed
- Lost
- Rock Core

Sample Type:
- AR Air Rotary Cuttings
- CB Core Barrel (2.5' or 5')
- CT Auger Cuttings
- NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0						0-15 ft. Borehole installed in excavation trench, approximately 15 ft. deep. Measurements approximate from original ground surface.	
15		CB	1.2	GC		15-20 ft. CLAYEY GRAVEL, gravels caliche with sandy clay, unsaturated, H/C odor	
20						20-21.3 CLAYEY GRAVEL, caliche gravel and clay, some H/C saturation.	
		CB	3.6	CL		21.3-23.6 ft. CLAY, with occasional caliche gravel, caliche, and sand, tight	
25						25-26 ft. SANDY CLAY, H/C saturated	
		CB	3.4			26-27.9 ft. CLAY, with occasional sand and caliche, H/C show at 2 ft.	
				CA/CL		27.9-28.4 ft. CALICHE and CLAY, water saturated with H/C also, drilled to 28.5 ft.	
30							

BH-57



Notes:
Completed as 2-in. temporary recovery well with 10 ft. 20-slot screen, sand pack to 1 ft. below excavation base, bentonite to excavation bottom
H/C - Petroleum hydrocarbon

LOG OF BORING BH-58

(Page 1 of 1)

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

Navajo Refining Company
Artesia, New Mexico

Date, Time Started: : 11/13/02, 0920
Date, Time Completed : 11/13/02, 1025
Hole Diameter: : 8-1/4 in.
Drilling Method: : Hollow-stem auger, CME-75
Sampling Method: : Cuttings, core barrel

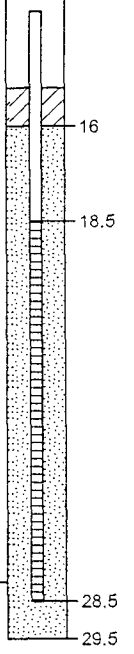
Drilled By: : Eco Drilling
Logged By: : D.G. Boyer

Sample Condition
- Remoulded
- Undisturbed
- Lost
- Rock Core

Sample Type:
- AR Air Rotary Cuttings
- CB Core Barrel (2.5' or 5')
- CT Auger Cuttings
- NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0–15						0-15 ft. Borehole installed in excavation trench, approximately 15 ft. deep. Measurements approximate from original ground surface.	
15–17.8		CB	3	CA		15-17.8 ft. CALICHE, hard, dry, H/C odor	
17.8–18				CL		light brown, 17.8-18 ft. SANDY CLAY	
18–20						20-23 ft. CLAY, brown, occasional thin sandy zones	
20–23		CB	4			23-23.7 ft. CLAY, brown, soft becoming sandy 23.7-24 ft. SANDY CLAY, brown, sandstone pieces, H/C odor throughout	
23–25						25-25.6 ft. SANDY CLAY, brown, strong H/C odor	
25–28.1		CB	3.7			25.6-28.1 ft. CLAY, mottled brown and chalk color	
28.1–28.7						28.1-28.7 ft. GRAVELLY CLAY, H/C and water saturated	

BH-58



Notes:
Completed as 2-in. temporary recovery well with 10 ft. 20-slot screen, sand pack to 1 ft. below excavation base, bentonite to excavation bottom
H/C - Petroleum hydrocarbon

LOG OF BORING BH-61

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

Navajo Refining Company
Artesia, New Mexico

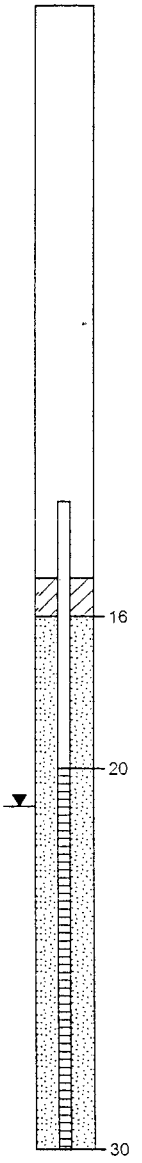
Date, Time Started:	: 11/13/02, 1250	Drilled By:	: Eco Drilling
Date, Time Completed	: 11/13/02, 1400	Logged By:	: D.G. Boyer
Hole Diameter:	: 8-1/4 in.		
Drilling Method:	: Hollow-stem auger, CME-75		
Sampling Method:	: Cuttings, core barrel		

Sample Condition
- Remoulded
- Undisturbed
- Lost
- Rock Core

Sample Type:
- AR Air Rotary Cuttings
- CB Core Barrel (2.5' or 5')
- CT Auger Cuttings
- NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0						0-15 ft. Borehole installed in excavation trench, approximately 15 ft. deep. Measurements approximate from original ground surface.	
15				MH/CA		15-15.6 ft CLAYEY, SANDY SILT, with CALICHE, light brown, H/C odor	
				CA/CL		15.6-17 ft. CALICHE with CLAY, caliche rocks to 3 in., clay interstitial, zones of black-grey weathering at 17 ft.	
		CB	3.6			17-18.6 ft. CLAY with frequent caliche, soft at 18 ft. Gray-black mottling 18-18.5 ft. H/C odor through out.	
20				CL		20-20.8 ft. CLAY, silty, frequent caliche rock, H/C saturated	
		CB	3.9			20.8-23.6 ft. CLAY, with caliche and occasional sand, becoming sandy at 23.6 ft.	
				SC		23.6-23.9 ft. CLAYEY SAND, fine grained	
25						25-26 ft. SANDY CLAY, H/C saturated	
		CB	3.9	CL		26-28.9 ft. CLAY, with caliche gravel, mottled, H/C saturated in places	
30							

BH-61



Notes:
Completed as 2-in. temporary recovery well with 10 ft. 20-slot screen, sand pack to 1 ft. below excavation base, bentonite to excavation bottom
H/C - Petroleum hydrocarbon

LOG OF BORING BH-80

Hydrocarbon Site Investigation
Monument 6" Crude Gathering Line

Navajo Refining Company
Artesia, New Mexico

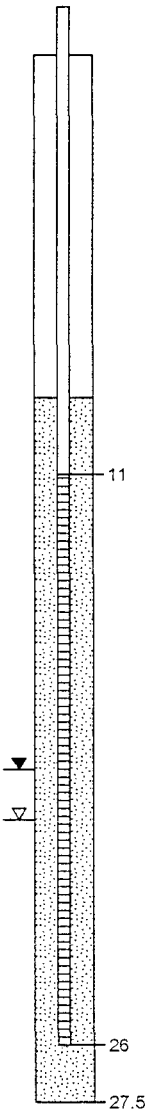
Date, Time Started: : 11/23/02, 1345
Date, Time Completed : 11/23/02, 1700
Hole Diameter: : 8-1/4 in.
Drilling Method: : Hollow-stem auger, CME-75
Sampling Method: : Cuttings, core barrel

Drilled By: : Eco Drilling
Logged By: : D.G. Boyer

Sample Condition: Remoulded; Undisturbed; Lost; Rock Core

Sample Type: AR Air Rotary Cuttings; CB Core Barrel (2.5' or 5'); CT Auger Cuttings; NR No recovery

Depth in Feet	Samples	Sample Type	Recovery (ft.)	USCS	GRAPHIC	DESCRIPTION	Lab No.
0						Surface soil	
		CB	2.0	CA/SM		coarse grained-2 CALICHE with SILTY SAND, light brown, sand very fine to fine grained, no H/C odor	
5							
		CB	4.4			CALICHE with SILTY SAND, sand very fine to fine grained, chalk color, possible slight H/C odor	H7250-7
10						10-12.4 ft. CALICHE with SILTY SAND, sand very fine to fine grained, light brown, clayey at 12 ft.	
		CB	2.4	CA		12-12.4 ft. CALICHE, light brown, caliche soft to hard, fragments and gravels, very strong H/C odor 15-15.6 ft. CALICHE, rock, thick, massive, hard, laminations	H7250-8
15				CA/ML		CALICHE, with SANDY SILT, light brown, fragments and chips, dry H/C odor, increasing clay, 17-17.7 ft.	
		CB	4.0	CL		17.7-19 ft. SILTY CLAY, stiff, dry, with caliche fragments and chips, very strong H/C odor	
20						19-21.7 ft. SILTY CLAY, with occasional caliche gravels, mottled chalk and brown color, damp, soft, plastic, H/C odor throughout	H7250-9
		CB	4.0			21.7-22.3 ft. GRAVELLY CLAY, H/C saturated 22.3-22.8 ft. SILTY CLAY, H/C saturated 22.8-23.6 ft. SANDY CLAY, H/C saturated	
				SC		23.6-25 ft. CLAYEY SAND, brown, fine grained, H/C saturated	
25		CB	1.0	Slough		Slough only, core ran out of tube due to oil.	
30							



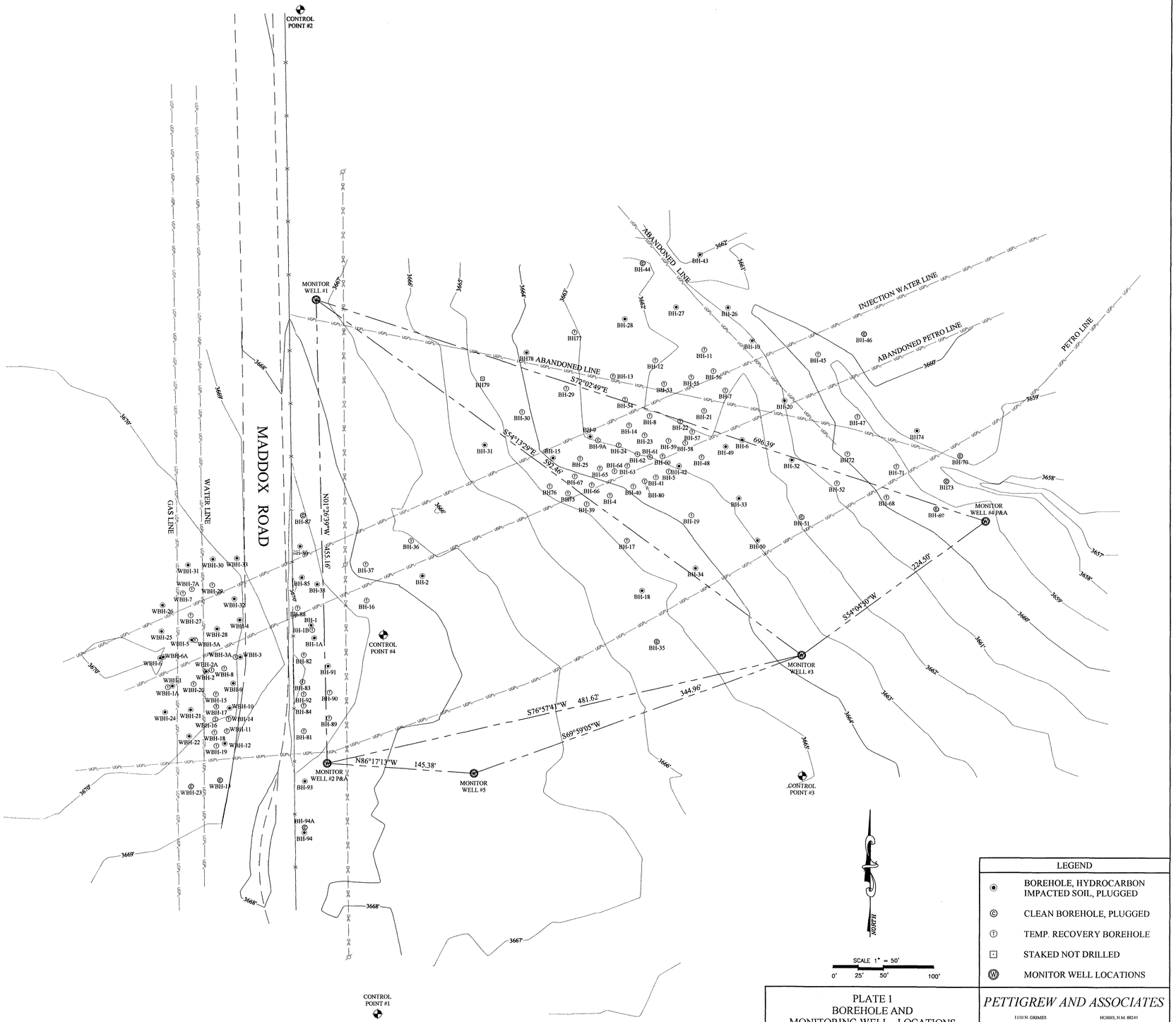
Notes:
Completed as temporary recovery well with 15 ft. screen, 11 bags sand.
Oil came to the surface as driller was cleaning out hole with auger.
H/C - Petroleum hydrocarbon
Laboratory analyses by Cardinal Laboratories

DESCRIPTION	NORTHING	EASTING	ELEVATION @ GROUND	ELEVATION @ CASING
MONITOR WELL #1	595024.03	859738.59	3667.48	3670.05
MONITOR WELL #2 P&A	594569.02	859750.07	3668.82	3671.40
MONITOR WELL #3	594677.68	860219.27	3663.64	3666.41
MONITOR WELL #4 P&A	594809.38	860401.08	3659.13	3661.76
MONITOR WELL #5	594559.61	859895.14	3668.35	3670.43

DESCRIPTION	NORTHING	EASTING	ELEVATION
CONTROL POINT #1	594323.01	859800.10	3666.91
CONTROL POINT #2	595307.82	859722.10	3667.07
CONTROL POINT #3	594559.22	860219.98	3665.24
CONTROL POINT #4	594695.33	859805.39	3669.31

DESCRIPTION	NORTHING	EASTING	ELEVATION
WBH-1	594645.17	859595.71	3669.9
WBH-1A	594643.97	859591.15	3670.3
WBH-2	594659.37	859629.28	3669.9
WBH-2A	594660.79	859634.55	3669.7
WBH-3	594673.44	859662.86	3670.0
WBH-3A	594673.47	859658.09	3670.0
WBH-4	594709.70	859662.17	3670.2
WBH-5	594690.15	859614.99	3670.5
WBH-5A	594690.00	859618.42	3670.7
WBH-6	594672.54	859583.69	3670.2
WBH-6A	594673.50	859586.72	3669.9
WBH-7	594735.74	859606.12	3670.4
WBH-7A	594739.49	859615.46	3670.6
WBH-8	594662.41	859647.05	3670.5
WBH-9	594647.74	859655.88	3670.2
WBH-10	594623.46	859652.32	3669.8
WBH-11	594600.92	859649.68	3669.3
WBH-13	594552.35	859642.78	3669.4
WBH-14	594612.61	859651.44	3669.2
WBH-15	594637.09	859638.79	3669.9
WBH-16	594612.46	859638.37	3669.1
WBH-17	594625.02	859639.25	3669.7
WBH-18	594599.60	859637.40	3668.8
WBH-19	594586.38	859639.25	3669.1
WBH-20	594647.12	859616.76	3669.5
WBH-21	594621.76	859613.77	3670.3
WBH-22	594596.49	859613.47	3670.0
WBH-23	594546.24	859614.28	3669.8
WBH-24	594619.57	859588.62	3670.1
WBH-25	594698.62	859584.83	3670.4
WBH-26	594724.15	859585.97	3670.5
WBH-27	594714.14	859613.72	3669.9
WBH-28	594700.99	859639.78	3671.3
WBH-29	594743.82	859635.13	3670.4
WBH-30	594769.10	859635.65	3669.8
WBH-31	594763.52	859611.19	3670.1
WBH-32	594730.25	959656.94	3670.3
WBH-33	594770.04	859659.47	3669.9

DESCRIPTION	NORTHING	EASTING	ELEVATION
BH-1	594704.45	859733.72	3669.7
BH-1A	594692.06	859737.04	3670.0
BH-1B	594699.91	859734.79	3670.0
BH-2	594753.05	859843.87	3667.6
BH-3	-	-	-
BH-4	594833.12	860029.34	3664.4
BH-5	594857.07	860087.35	3663.2
BH-6	594888.10	860159.99	3661.8
BH-7	594936.60	860143.09	3662.3
BH-8	594911.13	860068.53	3662.2
BH-9	594890.91	860009.77	3662.8
BH-9A	594887.32	860017.27	3662.7
BH-10	594985.77	860169.70	3660.8
BH-11	594976.48	860122.42	3661.6
BH-12	594965.83	860073.96	3662.1
BH-13	594949.96	860032.04	3662.9
BH-14	594901.91	860048.05	3662.2
BH-15	594869.59	859972.80	3663.2
BH-16	594728.86	859788.75	3669.0
BH-17	594788.89	860046.10	3665.3
BH-18	594739.87	860061.05	3665.4
BH-19	594813.97	860109.74	3664.1
BH-20	594926.55	860201.91	3661.1
BH-21	594916.35	860122.24	3661.0
BH-22	594905.91	860098.82	3657.2
BH-23	594892.35	860063.44	3657.8
BH-24	594882.47	860037.86	3658.2
BH-25	594869.25	859999.62	3658.8
BH-26	595017.93	860145.76	3661.0
BH-27	594936.60	860143.09	3662.3
BH-28	595006.38	860043.68	3662.4
BH-29	594937.78	859985.73	3663.7
BH-30	594914.51	859942.26	3664.8
BH-31	594881.48	859905.42	3665.4
BH-32	594868.68	860209.16	3661.4
BH-33	594830.80	860156.86	3662.8
BH-34	594762.17	860113.90	3664.3
BH-35	594690.27	860075.78	3665.6
BH-36	594787.44	859832.86	3666.3
BH-37	594764.42	859787.91	3667.7
BH-38	594744.62	859739.97	3669.2
BH-39	594824.94	860006.26	3665.0
BH-40	594841.96	860052.26	3664.0
BH-41	594851.35	860074.70	3663.5
BH-42	594862.30	860097.54	3663.2
BH-43	595069.96	860117.90	3661.6
BH-44	595061.23	860061.19	3662.3
BH-45	594972.53	860235.16	3659.6
BH-46	594992.53	860280.48	3660.6
BH-47	594910.96	860274.24	3659.6
BH-48	594871.19	860119.79	3662.9
BH-49	594881.58	860143.59	3662.0
BH-50	594789.70	860175.46	3663.0
BH-51	594812.46	860219.09	3662.0
BH-52	594845.96	860253.89	3661.0
BH-53	594942.70	860082.55	3661.8
BH-54	594927.00	860043.92	3662.7
BH-55	594949.26	860109.41	3661.8
BH-56	594955.47	860131.54	3661.3
BH-57	594895.89	860110.61	3647.9
BH-58	594885.00	860103.59	3648.1
BH-59	594887.03	860087.07	3648.3
BH-60	594871.93	860081.10	3648.7
BH-61	594871.18	860068.67	3649.0
BH-62	594873.71	860056.33	3649.4
BH-63	594862.29	860046.44	3649.4
BH-64	594856.95	860033.72	3649.7
BH-65	594859.75	860019.32	3650.3
BH-66	594843.50	860011.14	3651.5
BH-67	594851.76	859994.51	3653.6
BH-68	594832.50	860303.13	3660.1
BH-69	594821.08	860352.27	3659.4
BH-70	594873.36	860375.71	3658.9
BH-71	594862.62	860312.78	3658.8
BH-72	594874.76	860264.13	3660.1
BH-73	594848.58	860362.21	3658.3
BH-74	594897.60	860333.12	3659.3
BH-75	594834.98	859987.79	3654.6
BH-76	594841.90	859969.59	3655.4
BH-77	594993.13	859993.93	3663.4
BH-78	594973.14	859946.69	3664.0
BH-79	594946.73	859903.18	3664.8
BH-80	594847.36	860063.51	3663.2
BH-81	594600.84	859726.86	3669.0
BH-82	594675.38	859726.59	3669.5
BH-83	594649.25	859725.26	3668.8
BH-84	594625.77	859726.56	3669.2
BH-85	594751.27	859724.76	3669.7
BH-86	594781.86	859723.02	3669.6
BH-87	594812.05	859725.82	3669.0
BH-88	594721.31	859720.33	3669.4
BH-89	594613.54	859751.84	3668.2
BH-90	594638.62	859752.26	3668.7
BH-91	594664.61	859750.68	3669.5
BH-92	594637.09	859726.55	3669.1
BH-93	594551.31	859727.81	3668.8
BH-94	594500.68	859727.57	3668.4
BH-94A	594505.67	859727.96	3668.4



LEGEND	
◉	BOREHOLE, HYDROCARBON IMPACTED SOIL, PLUGGED
Ⓒ	CLEAN BOREHOLE, PLUGGED
Ⓣ	TEMP. RECOVERY BOREHOLE
⊡	STAKED NOT DRILLED
Ⓦ	MONITOR WELL LOCATIONS

PLATE 1
BOREHOLE AND MONITORING WELL LOCATIONS
MONUMENT, NEW MEXICO

REV	DATE	DESCRIPTION
4	03/30/2004	LEGEND EDIT
3	01/26/2004	LEGEND EDIT
0	10/15/2002	FINAL PLAT
00	10/15/2002	PRELIMINARY PLAT
	10/14/2002	DATE OF SURVEY

PETTIGREW AND ASSOCIATES
1110 N. GRIMES HOBBS, N.M. 88240
(505) 393-9827

PLAT OF LOCATION SURVEY FOR
Safety & Environmental Solutions, Inc.
HOBBS, NEW MEXICO 88240

PROJ. No. 2002.1154 | DRN BY: A. GARCIA
DWG \AutoCAD SES Well & Monument\dwg\SES WELLS R4.dwg
BOOK HOBBS LOCAL #8 | SHEET SHEET 1