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REPORTS

DATE:

1999

UNOCAL CORPORATION
GROUNDWATER INVESTIGATION REPORT
SOUTH VACUUM UNIT
LEA COUNTY, NEW MEXICO

OCTOBER 20, 1999

Prepared For:

Unocal Corporation
Asset Management Group
P. O. Box 1283
Nederland, Texas 77627

Prepared By:

Energy & Environmental Systems
415 West Wall, Suite 1818
Midland, Texas 79701

TRW Systems & Information Technology Group 415 West Wall Street, Suite 1818 Midland, TX 79701

October 18, 1999

Mr. William C. Olson
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
2040 S. Pacheco
Santa Fe, New Mexico 87505

RE: GROUNDWATER INVESTIGATION REPORT
SOUTH VACUUM UNIT
LEA COUNTY, NEW MEXICO

Dear Mr. Olson:

TRW Inc. – Energy & Environmental Systems (TRW) has completed the installation and sampling of three additional monitoring wells (MW-2, MW-3, and MW-4) at the South Vacuum Unit in Lea County, New Mexico. The investigation was conducted in accordance with the July 9, 1999 Groundwater Investigation Work Plan submitted by the Asset Management Group of Unocal Corporation (Unocal) and the requirements specified in your letter dated August 19, 1999. This Groundwater Investigation Report documents the results of the monitoring well installation and sampling activities conducted by TRW on September 28-30, 1999.

Site Background and History

The South Vacuum Unit site is located in the SW¼ of the SW¼ of section 36, Township 18 South, and Range 36 East. A pit used for surface impoundment of produced water was located adjacent to a former saltwater disposal (SWD) well at the site. According to OCD records at the Hobbs District office, the State Lea "I" SWD well was initially completed as a dry hole and was plugged and abandoned by the Pure Oil Company on June 1, 1960. The dry hole was re-entered and completed as a SWD well on September 22, 1962. The State Lea "I" SWD well was plugged and abandoned on April 5, 1971. Reclamation operations for the former saltwater disposal pit were completed in January 1995. A groundwater monitoring well (MW-1) was installed on January 25, 1995. Based on the results of laboratory analyses of samples collected from this monitoring well, the chloride and total dissolved solids (TDS) concentrations exceed New Mexico Water Quality Commission (WQCC) standards. The suspected source area for chloride and TDS impact to the groundwater beneath the site is from the former SWD pit.

Procedures

Monitoring Well Construction Methods

Drilling operations for the three additional monitoring wells (MW-2, MW-3, and MW-4) were conducted by Diversified Water Well Drilling using an air-rotary drilling rig. The monitoring wells were constructed of 2-inch diameter schedule 40 PVC well casing and 20 feet of 0.010-inch slotted well screen. At least 5 feet of well screen was installed above the water table leaving approximately 15 feet of well screen below the water table. The screened portion of each monitoring well was surrounded with a filterpack consisting of 8/16 Brady sand (MW-3) or 20/40 Colorado sand (MW-2 and MW-4) that was capped with approximately 35 to 45 feet of bentonite. The remaining 10 feet of annular space in each monitoring well was sealed with a portland cement grout emplaced from the top of the bentonite plug to ground surface. A 4-foot by 4-foot concrete pad was constructed at the surface and the top of casing protected with an above ground, locked steel well cover. The monitoring well construction diagrams are provided in Attachment A. The monitoring well and soil borings locations and elevations were surveyed by Basin Surveys of Hobbs, New Mexico. A copy of the survey plat is included in Attachment B.

Groundwater Sampling Methods

Monitoring wells MW-2, MW-3, and MW-4 were developed by hand with clean bailers at least 24 hours prior to purging and sampling. Each of the four monitoring wells, MW-1 through MW-4, was gauged for depth to groundwater using a Solinst Model 101 electronic water indicator immediately prior to purging operations. A total of approximately 220 gallons was purged from the site monitoring wells using a decontaminated 2-inch diameter Grundfos Redi Flo2 submersible pump. Field parameters, including pH, conductivity, temperature, and dissolved oxygen were measured during purging, and groundwater samples collected after these parameters stabilized. Water samples collected from monitoring wells MW-1, MW-2, MW-3, and MW-4 for laboratory analysis were transferred into 1,000 milliliter (ml) plastic containers for analysis of total dissolved solids (TDS) (EPA Method 160.1) and chloride (EPA Method 325.3). For each set of samples, chain of custody forms documenting sample identification numbers, collection times, and delivery times to the laboratory were completed. All water samples were placed in an ice-filled cooler immediately after collection and transported to SPL, Inc. in Houston, Texas for analysis.

Local Geology

The lithology of the subsurface soils in monitoring wells MW-2 through MW-4 was similar. Generally, the unsaturated zone is composed of a hard, weathered and fractured, light gray caliche layer to a depth of approximately 4 to 9 feet. Tan to light gray siliceous sandstone layers interbedded with a very fine-grained sand occurred from approximately 5 feet to 19 to 27 feet; however the very fine-grained sand layer gradationally became more dominant with depth and the sandstone layers occurred as intermittent stringers to the bottom of the borings. Groundwater was encountered at depths ranging from 56 to 66 feet below ground surface. A detailed description of the subsurface soils is provided on the lithologic logs in Attachment A.

Groundwater Gradient

Depth to groundwater occurs at approximately 47 to 64 feet below ground surface at the site. Groundwater elevations are summarized in Table 1. A groundwater gradient map indicating the direction of groundwater flow is illustrated in Figure 1. A historical groundwater elevation graph is shown in Figure 2. The groundwater gradient direction is to the southeast with a hydraulic gradient of approximately 0.0043 ft/ft. According to published reports (*Ground-Water Conditions in Northern Lea County, New Mexico*, Ash, 1963 and *Geology and Ground-Water Conditions in Southern Lea County, New Mexico*, Nicholson and Clebsch, 1961) the groundwater encountered at the site is that of the Tertiary Ogallala Formation. The Ogallala Formation unconformably overlies the impermeable red-beds of the Triassic Chinle Formation at an elevation of approximately 3700 feet above mean sea level (AMSL). Based on the current groundwater elevations measured on site and published data referenced, the saturated thickness of the Ogallala Formation at the site ranges from approximately 85 to 95 feet.

Groundwater Analytical Results

Groundwater sample analytical results are presented in Table 2. The WQCC standards are presented for comparison. Those constituents that recorded concentrations above the WQCC standards are highlighted in boldface type. The WQCC standard of 250 mg/L for chloride was exceeded in MW-1 (1094 mg/L), MW-2 (298 mg/L), and MW-4 (1576 mg/L). The WQCC standard of 1,000 mg/L for TDS was exceeded in MW-1 (2,318 mg/L) and MW-4 (2,981 mg/L). The groundwater samples obtained from upgradient monitoring well MW-3 had chloride and TDS concentrations below WQCC standards.

The TDS and chloride concentrations in monitoring well MW-1 are depicted graphically in Figure 3 and 4, respectively. The concentration isopleths were drawn utilizing the Surfer® (version 6.0) contour modeling program (Kriging method). Since this contouring program does not take into account the known groundwater gradient, some of the isopleths were manually converged into a more southeasterly orientation. A graph depicting historical TDS and chloride concentrations in monitoring well MW-1 is shown in Figure 5.

Table 1
Summary of Groundwater Elevation Measurements
Unocal South Vacuum Unit

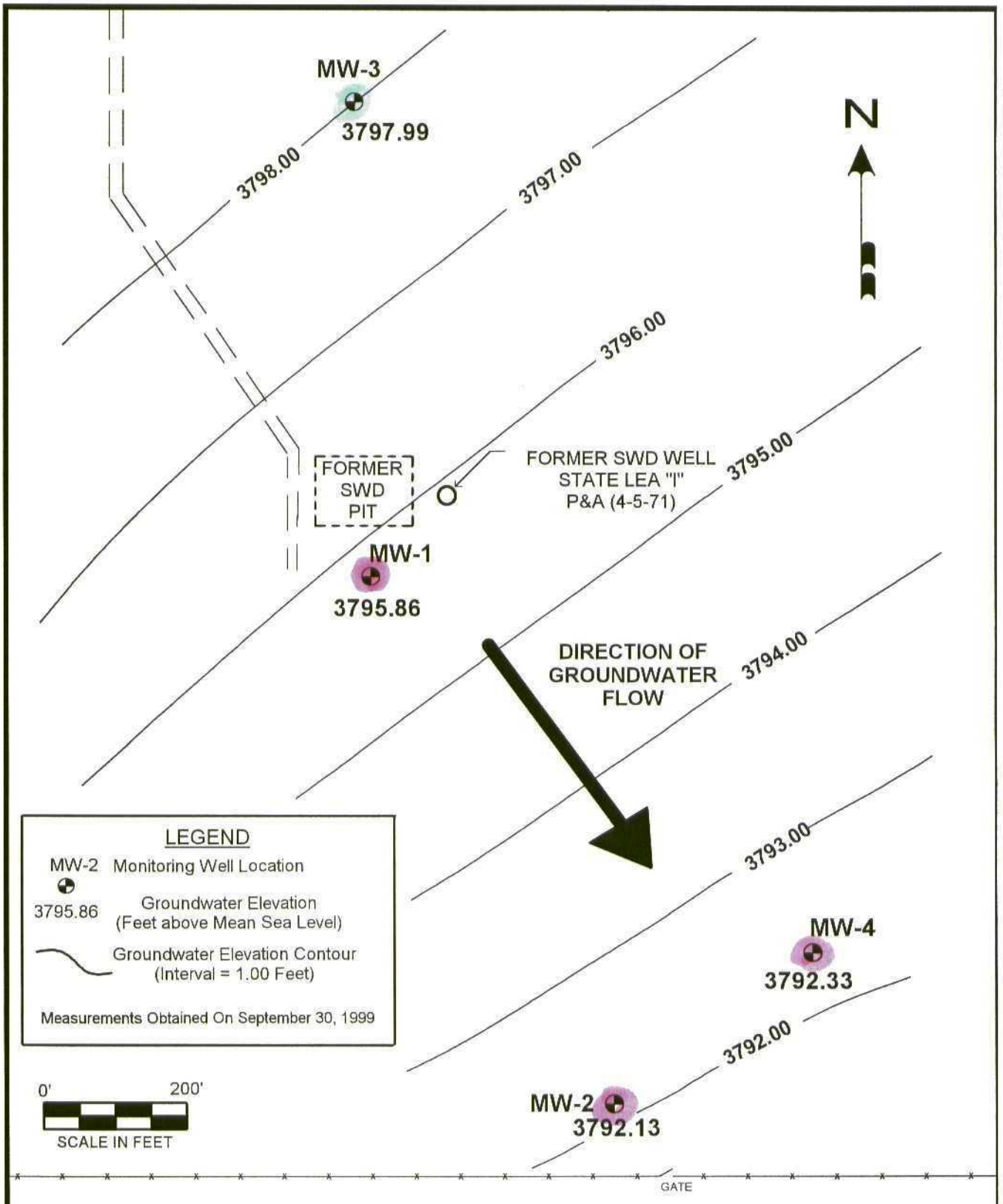
Monitoring Well	Measurement Date	Ground Surface Elevation (feet AMSL)	Top of Casing Elevation (feet AMSL)	Depth to Groundwater (feet BTOC)	Groundwater Elevation (feet AMSL)
MW-1	01/27/95	3856.76	3858.37	59.57	3798.80
	05/18/95	3856.76	3858.37	61.30	3797.07
	08/28/96	3856.76	3858.37	61.57	3796.80
	08/13/97	3856.76	3858.37	61.75	3796.62
	09/30/99	3856.76	3858.37	62.51	3795.86
MW-2	09/30/99	3839.11	3841.64	49.51	3792.13
MW-3	09/30/99	3862.20	3864.73	66.74	3797.99
MW-4	09/30/99	3849.87	3852.51	60.18	3792.33

AMSL - Above Mean Sea Level; BTOC - Below Top of Casing
Groundwater flow direction is to the southeast with a gradient of approx. 0.0043 ft/ft.
Elevations and state plane coordinates surveyed by Basin Surveys, Hobbs, NM.

Table 2
Summary of TDS and Chloride Concentrations
Unocal South Vacuum Unit

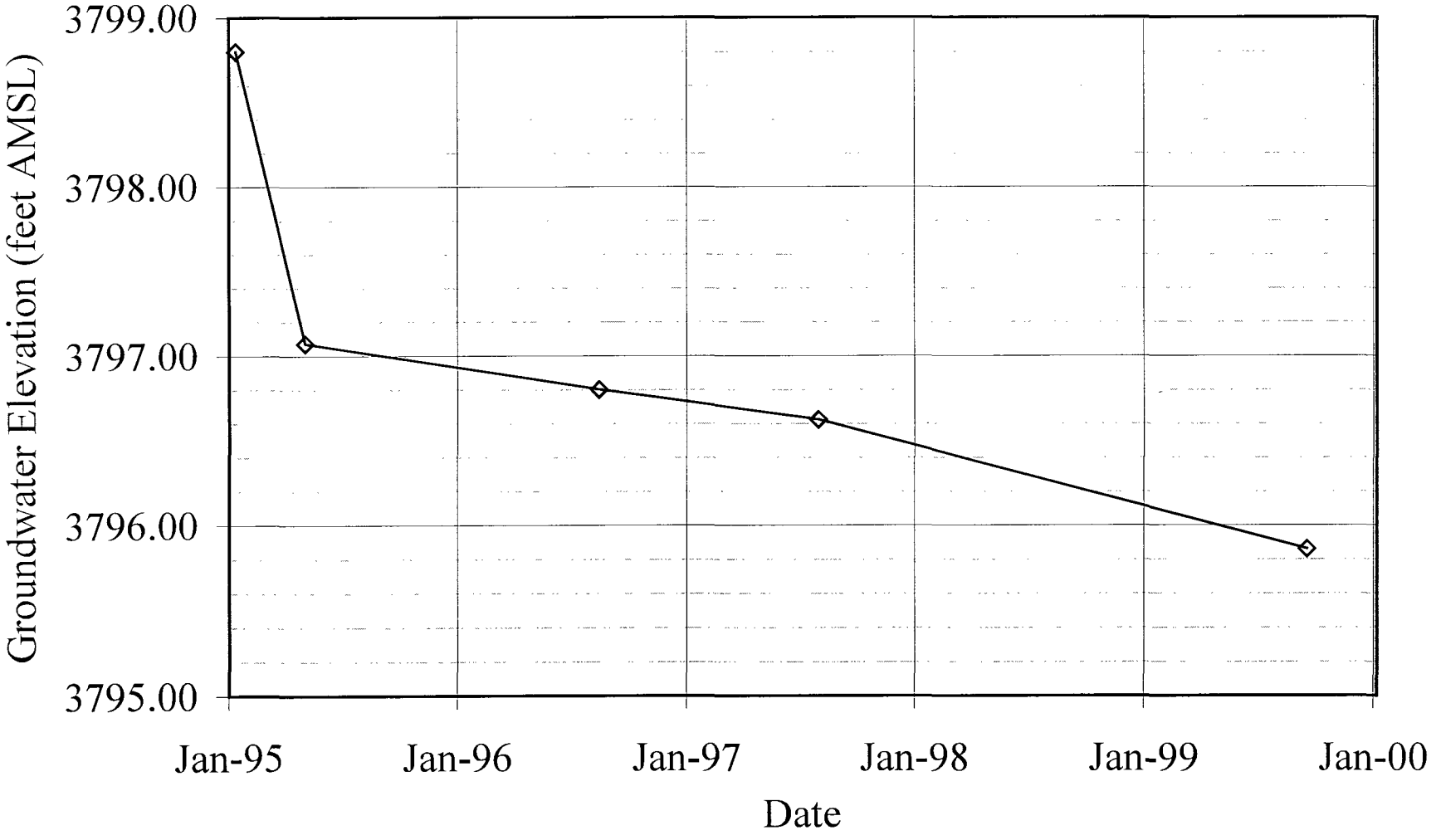
Monitoring Well	Sample Date	Chloride Concentration (mg/L)	TDS Concentration (mg/L)
MW-1	01/27/95	**1174**	**2250**
	05/18/95	**983**	**2251**
	08/28/96	**1420**	**2730**
	08/13/97	**1400**	**2800**
	12/14/98	**1400**	**2400**
	09/29/99	**1094**	**2318**
MW-2	09/30/99	**298**	922
MW-3	09/30/99	73.6	427
MW-4	09/30/99	**1576**	**2981**
WQCC Standards		250	1000

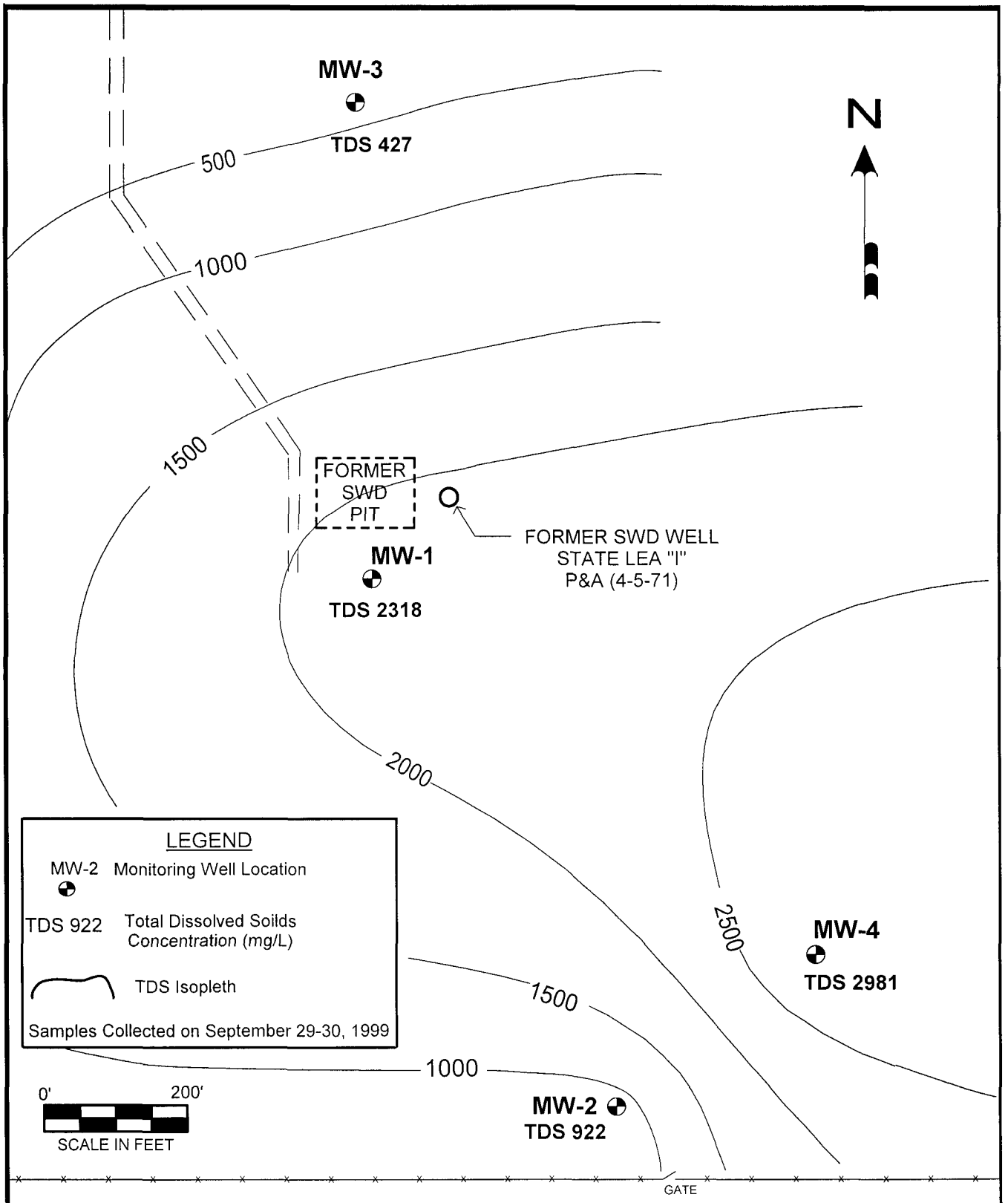
Total Dissolved Soilds (TDS) and chloride concentrations in milligrams per liter (mg/L)
Analyses performed by Trace Analysis Inc., Lubbock, TX (1995-1998) and SPL, Inc., Houston, TX (1999).
Values in boldface type indicate concentrations exceed New Mexico Water Quality Commission (WQCC) standards.



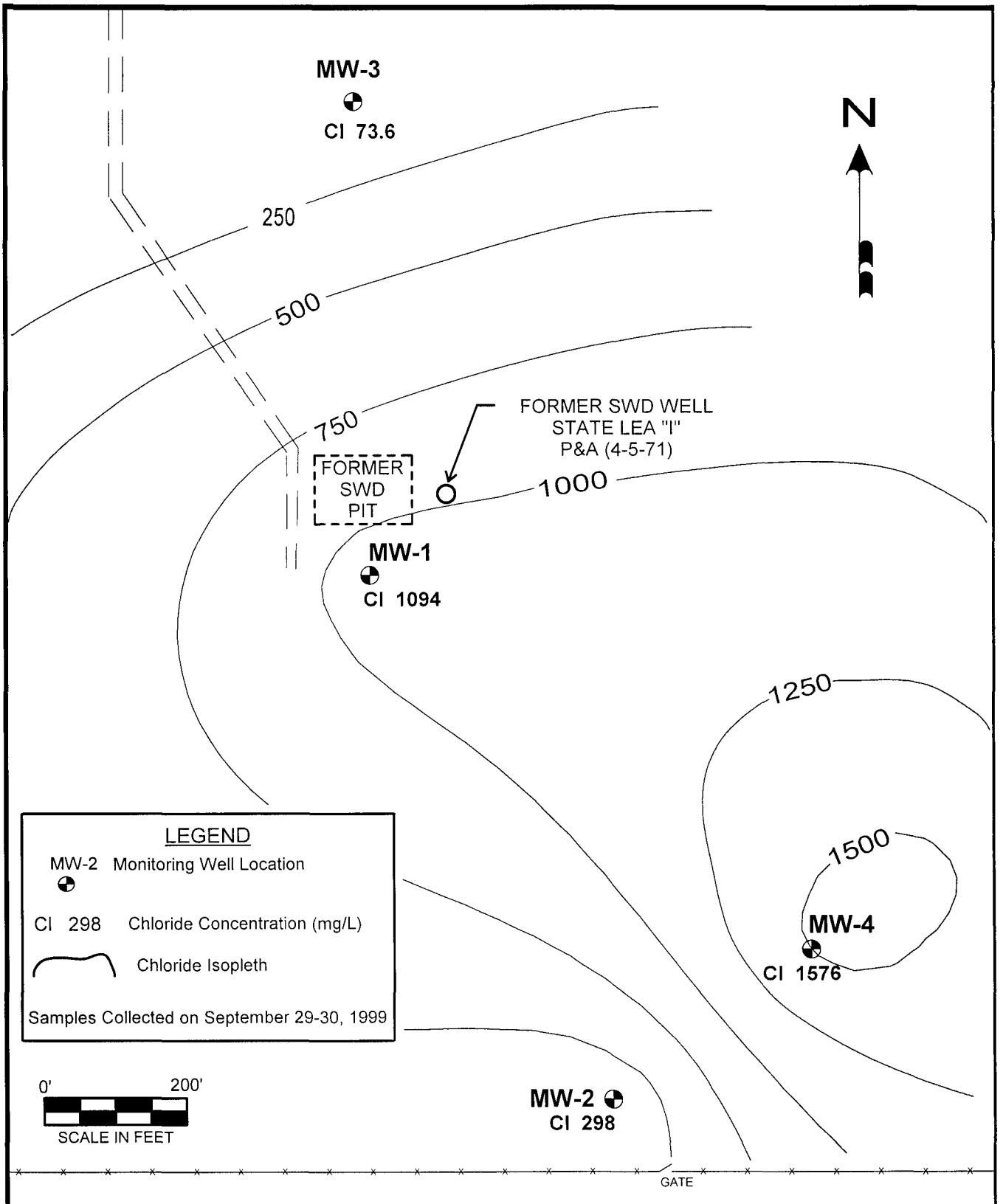
TRW	SITE: UNOCAL SOUTH VACUUM UNIT	FIGURE 1 GROUNDWATER ELEVATION MAP
	DATE: 9/30/99 | REV. NO.: 100599	
	AUTHOR: GJV | DRN BY: GJV	
	CK'D BY: DTL | FILE: VACUUM.TCW	

Figure 2
Historical Groundwater Elevations (MW-1)



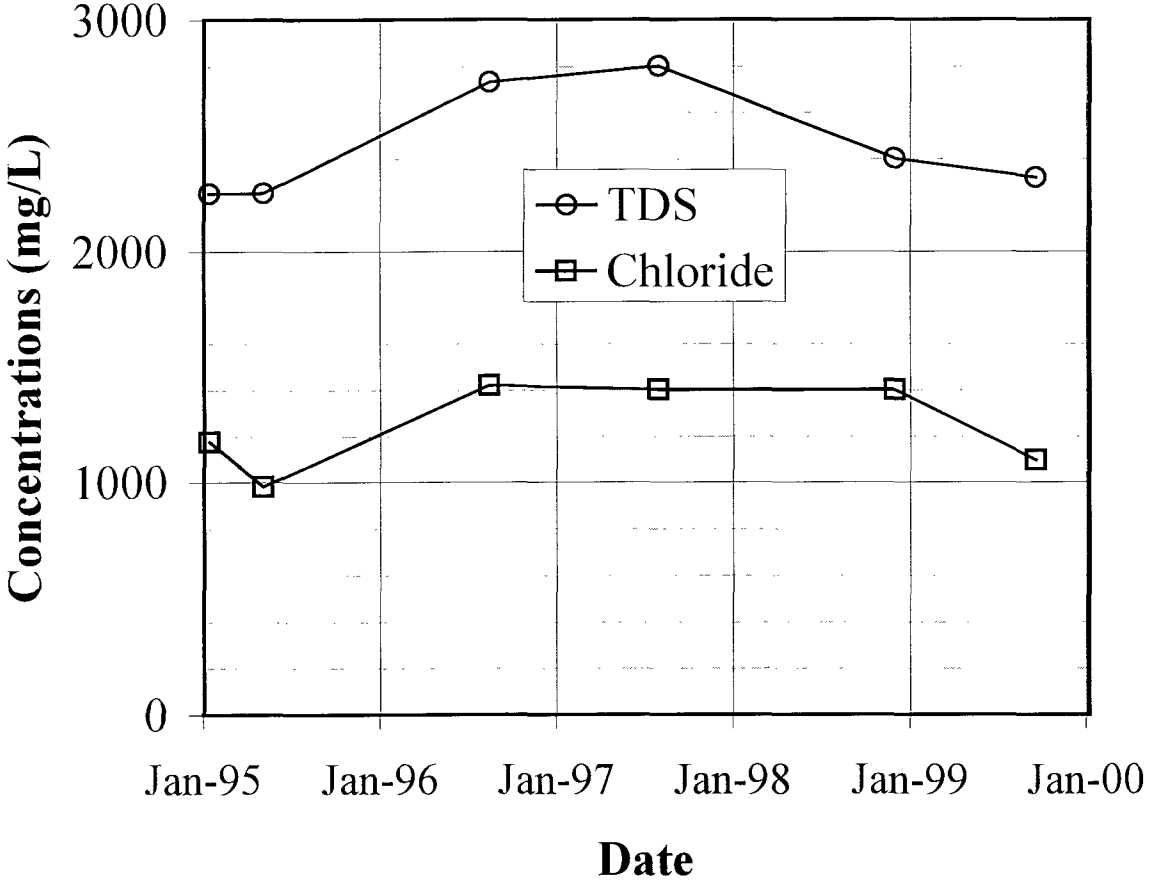


TRW	SITE: UNOCAL SOUTH VACUUM UNIT	**FIGURE 3** **TDS CONCENTRATION MAP**
	DATE: 9/30/99 | REV. NO.: 100599	
	AUTHOR: GJV | DRN BY: GJV	
	CK'D BY: DTL | FILE: VACUUM.TCW	



TRW	SITE: UNOCAL SOUTH VACUUM UNIT	**FIGURE 4**
	DATE: 9/30/99 / REV. NO.: 100599	**CHLORIDE CONCENTRATION MAP**
	AUTHOR: GJV / DRN BY: GJV	
	CK'D BY: DTL / FILE: VACUUM.TCW	

Figure 5
Chloride and TDS Concentrations (MW-1)



Conclusions

The results of this groundwater investigation at the South Vacuum Unit are summarized as follows:

- The WQCC standard of 1,000 mg/L for TDS in groundwater was exceeded in MW-1 and MW-4.
- The WQCC standard of 250 mg/L for chloride in groundwater was exceeded in MW1, MW-2 and MW-4.
- The higher TDS and chloride concentrations in downgradient monitoring well MW-4 indicate the plume has migrated in the downgrdient direction (southeast) and that there is not a continual source (former SWD pit near MW-1).

Recommendations

At least one additional monitoring well is recommended in the downgradient (southeast) direction (south side of Highway 529) for downgradient delineation.

Sincerely,

Gilbert J. Van Deventer, REM

Attachments

xc: Ben Terry, Unocal – Houston, TX
Kevin Behrens, IT Group – Houston, TX
Donna Williams, OCD - Hobbs, NM

ATTACHMENTS

ATTACHMENT A

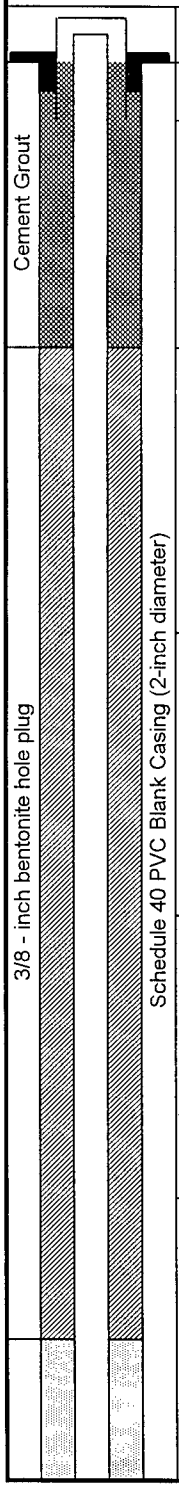
LITHOLOGIC LOGS AND

MONITORING WELL CONSTRUCTION DIAGRAMS

LITHOLOGIC LOG (MONITORING WELL)

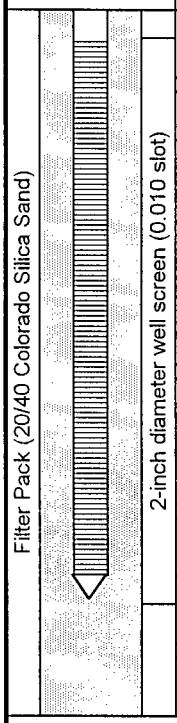
Energy & Environmental Systems

MONITORING WELL NO:	MW-2	TOTAL DEPTH:	71 Feet
SITE ID:	South Vacuum Unit	CLIENT:	Unocal Corporation
SURFACE ELEVATION:	3839.11	COUNTY:	Lea
CONTRACTOR:	Diversified Water Wells	STATE:	New Mexico
DRILLING METHOD:	Air Rotary	LOCATION:	SW/4, Sec 36, T18S, R35E
START DATE:	9/29/99	FIELD REP.:	John Fergerson
COMPLETION DATE:	9/29/99	FILE NAME:	
COMMENTS:	Located approx. 900 ft. downgradient (south-southeast) of former SWD pit.		



LITH.	USCS	SAMPLE Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
	CL		0750				Silty clay, black-dk brown, moist.
	Cal SM	0-5	0801	Cuttings	0.0	5	Silty sand, white-tan-lt gray, vf grain, mod consol, interbedded with caliche.
		5-10	0855	Cuttings	0.0	10	
		10-15	0859	Cuttings	0.0	15	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
		15-20	0902	Cuttings	0.0	20	
		20-25	0908	Cuttings	0.0	25	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
	SM	25-30	0911	Cuttings	0.0	30	
		30-35	0913	Cuttings	0.0	35	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
		35-40	0915	Cuttings	0.0	40	
		40-45	0922	Cuttings	0.0	45	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone and chert nodules.
		45-50	0928	Cuttings	0	50	

MONITORING WELL NO: MW-2 TOTAL DEPTH: 71 Feet

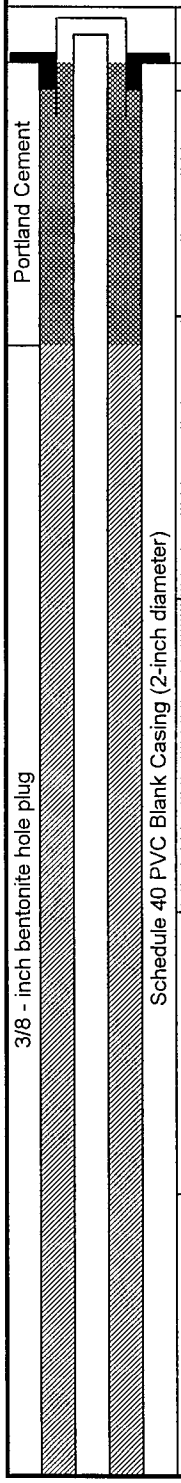


LITH.	USCS	SAMPLE Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
							Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, moist, interbedded with w cemented sandstone, chert nodules, and trace limestone.
		50-55	0938	Cuttings	0.0	55	
							Groundwater encountered at 56 feet
		55-60	0942			60	
	SM						Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with w cemented sandstone, chert nodules, and trace limestone.
		60-65	0946			65	
		65-70	0951			70	
							Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with w cemented sandstone, chert nodules, and trace limestone.
		70-75	0955			75	Bottom of monitoring well at 71 feet
							Total depth of boring 75 feet

LITHOLOGIC LOG (MONITORING WELL)

Energy & Environmental Systems

MONITORING WELL NO:	MW-3	TOTAL DEPTH:	77 Feet
SITE ID:	South Vacuum Unit	CLIENT:	Unocal Corporation
SURFACE ELEVATION:	3862.20	COUNTY:	Lea
CONTRACTOR:	Diversified Water Wells	STATE:	New Mexico
DRILLING METHOD:	Air Rotary	LOCATION:	SW/4, Sec 36, T18S, R35E
START DATE:	9/28/99	FIELD REP.:	John Fergerson
COMPLETION DATE:	9/28/99	FILE NAME:	
COMMENTS:	Located approx. 650 ft. north of former SWD pit.		



LITH. USCS	SAMPLE Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
CL		0945				Silty clay, black-dk brown, moist.
						Caliche, white-tan-gray, interbedded with w cemented sandstone.
	0-5	0950	Cuttings	0.0	5	
CAL SM	5-10	1005	Cuttings	0.0	10	Sandstone, tan-lt gray, vf grain, w cemented, interbedded with mod consol-unconsol, vf grain sand, and caliche.
	10-15	1010	Cuttings	0.0	15	
	15-20	1015	Cuttings	0.0	20	Silty sand, tan-white-lt gray-reddish brown, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
	20-25	1020	Cuttings	0.0	25	
	25-30	1022	Cuttings	0.0	30	
SM	30-35	1025	Cuttings	0.0	35	Silty sand, tan-white-lt gray-reddish brown, vf grain, mod consol unconsol, w sorted, interbedded with w cemented sandstone.
	35-40	1029	Cuttings	0.0	40	
	40-45	1033	Cuttings	0.0	45	Silty sand, tan-white-lt gray-reddish brown, vf grain, mod consol-unconsol, w sorted, sl moist, interbedded with w cemented sandstone.
	45-50	1036	Cuttings	0.0	50	

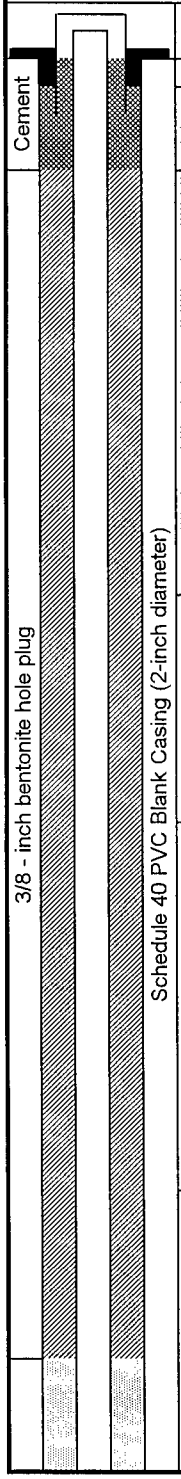
MONITORING WELL NO: MW-3 TOTAL DEPTH: 77 Feet

LITH.	USCS	SAMPLE Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
							Silty sand, tan-white-lt gray-reddish brown, vf grain, mod consol-unconsol, w sorted, sl moist, interbedded with w cemented sandstone.
	SM	50-55	1039	Cuttings	0.0	55	
		55-60	1041	Cuttings	0.0	60	
							Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, moist, interbedded with w cemented sandstone and limestone.
		60-65	1048			65	
							Groundwater encountered at 66 feet
	SM LS	65-70	1051			70	
							Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with well cemented sandstone and limestone.
		70-75	1054			75	
		75-80	1057			80	Bottom of monitoring well at 77 feet
							Total depth of boring 80 feet

LITHOLOGIC LOG (MONITORING WELL)

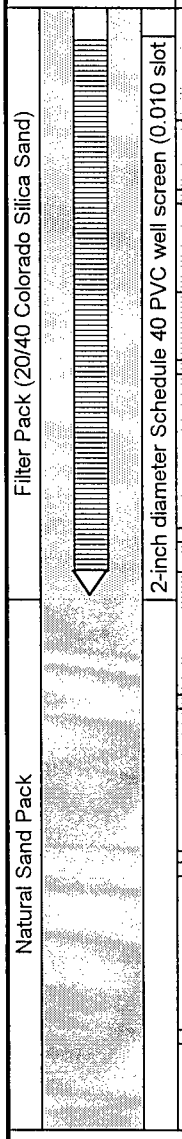
Energy & Environmental Systems

MONITORING WELL NO:	MW-4	TOTAL DEPTH:	71 Feet
SITE ID:	South Vacuum Unit	CLIENT:	Unocal Corporation
SURFACE ELEVATION:	3849.87	COUNTY:	Lea
CONTRACTOR:	Diversified Water Wells	STATE:	New Mexico
DRILLING METHOD:	Air Rotary	LOCATION:	SW/4, Sec 36, T18S, R35E
START DATE:	9/28/99	FIELD REP.:	John Fergerson
COMPLETION DATE:	9/28/99	FILE NAME:	
COMMENTS:			



LITH.	USCS	Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
	CL		1155				Silty clay, black-dk brown, moist.
							Caliche, white-tan-lt gray, interbedded with well cemented sandstone.
		0-5	1200	Cuttings	0.0	5	Sandstone, tan-lt brown-lt gray, w cemented, interbedded with mod consol-unconsol, vf grain sand, and caliche.
	CAL SM	5-10	1205	Cuttings	0.0	10	
		10-15	1225	Cuttings	0.0	15	
		15-20	1245	Cuttings	0.0	20	Sandstone, tan-lt brown-lt gray-reddish brown, w cemented, interbedded with mod consol-unconsol, vf grain sand.
		20-25	1300	Cuttings	0.0	25	
		25-30	1307	Cuttings	0.0	30	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
	SM	30-35	1310	Cuttings	0.0	35	
		35-40	1314	Cuttings	0.0	40	
		40-45	1318	Cuttings	0.0	45	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, interbedded with w cemented sandstone.
		45-50	1322	Cuttings	0.0	50	

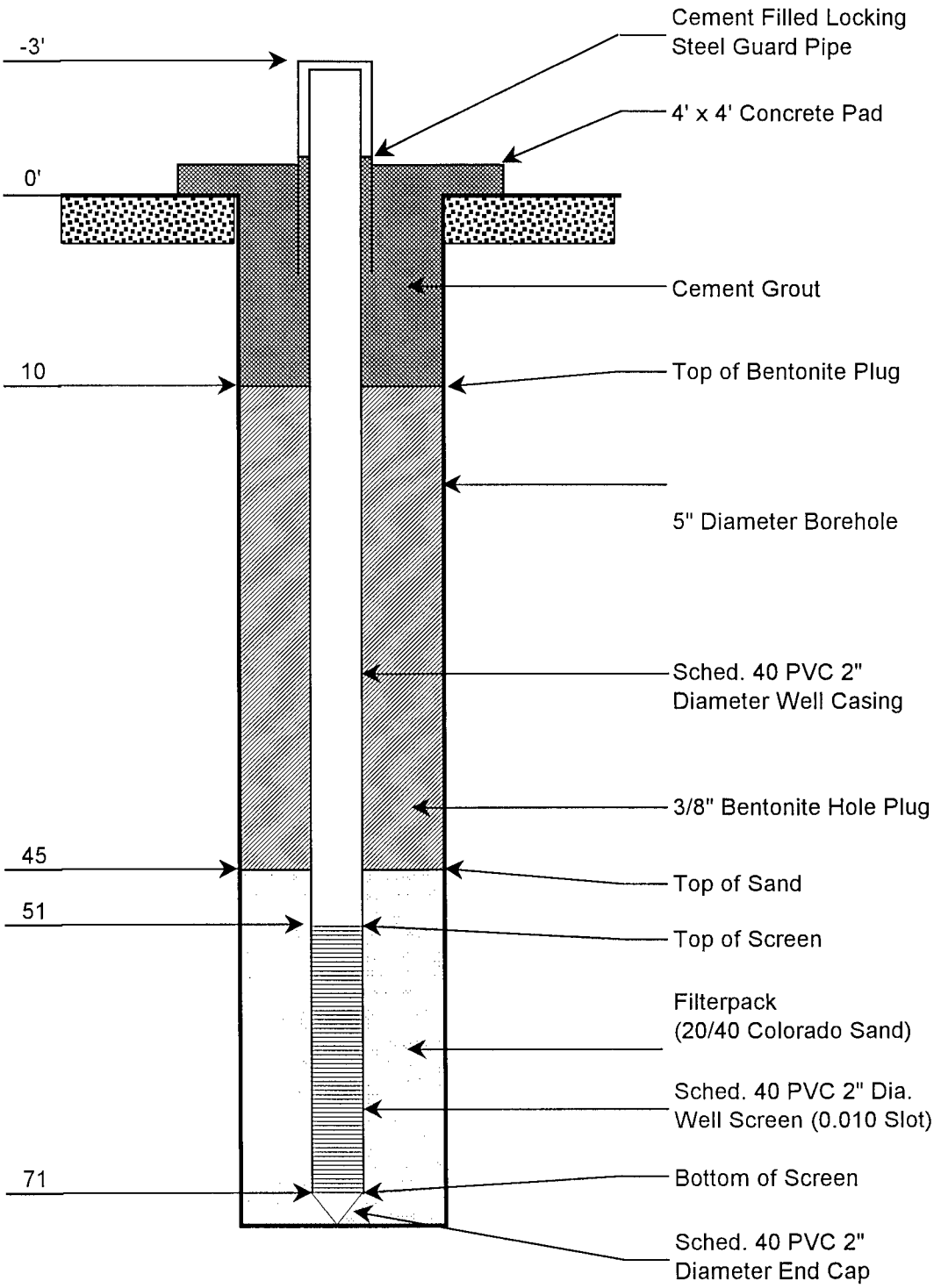
MONITORING WELL NO: MW-4 TOTAL DEPTH: 71 Feet



LITH.	USCS	SAMPLE Depth	Time	Type	PID	DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE, SORTING, ROUNDING, CONSOL., DIST. FEATURES
	SM						Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, moist, interbedded with w cemented sandstone.
		50-55	1325	Cuttings	0.0	55	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, moist, interbedded with w cemented sandstone, limestone, and chert nodules. Groundwater encountered at 56 feet
		55-60	1328			60	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with w cemented sandstone, limestone, and chert nodules.
		60-65	1334			65	
		65-70	1338			70	
	SM LS	70-75	1342			75	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with w cemented sandstone, limestone, and chert nodules.
		75-80	1346			80	
		80-85	1354			85	Silty sand, tan-lt brown-lt gray, vf grain, mod consol-unconsol, w sorted, wet, interbedded with w cemented sandstone, limestone, and chert nodules.
		85-90	1358			90	Bottom of monitoring well at 71 feet

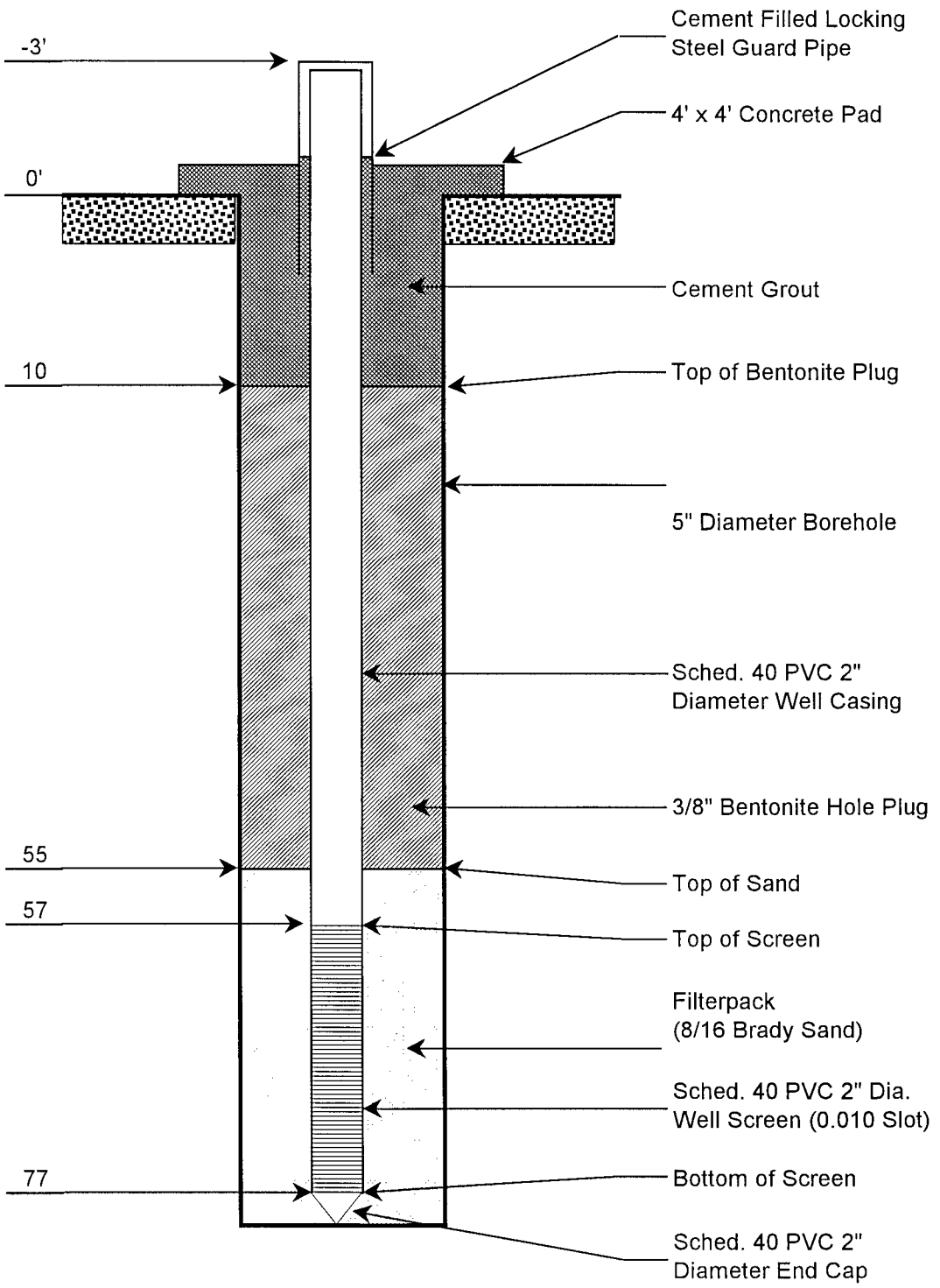
Total depth of boring 90 feet

MONITORING WELL CONSTRUCTION DIAGRAM (MW-2)



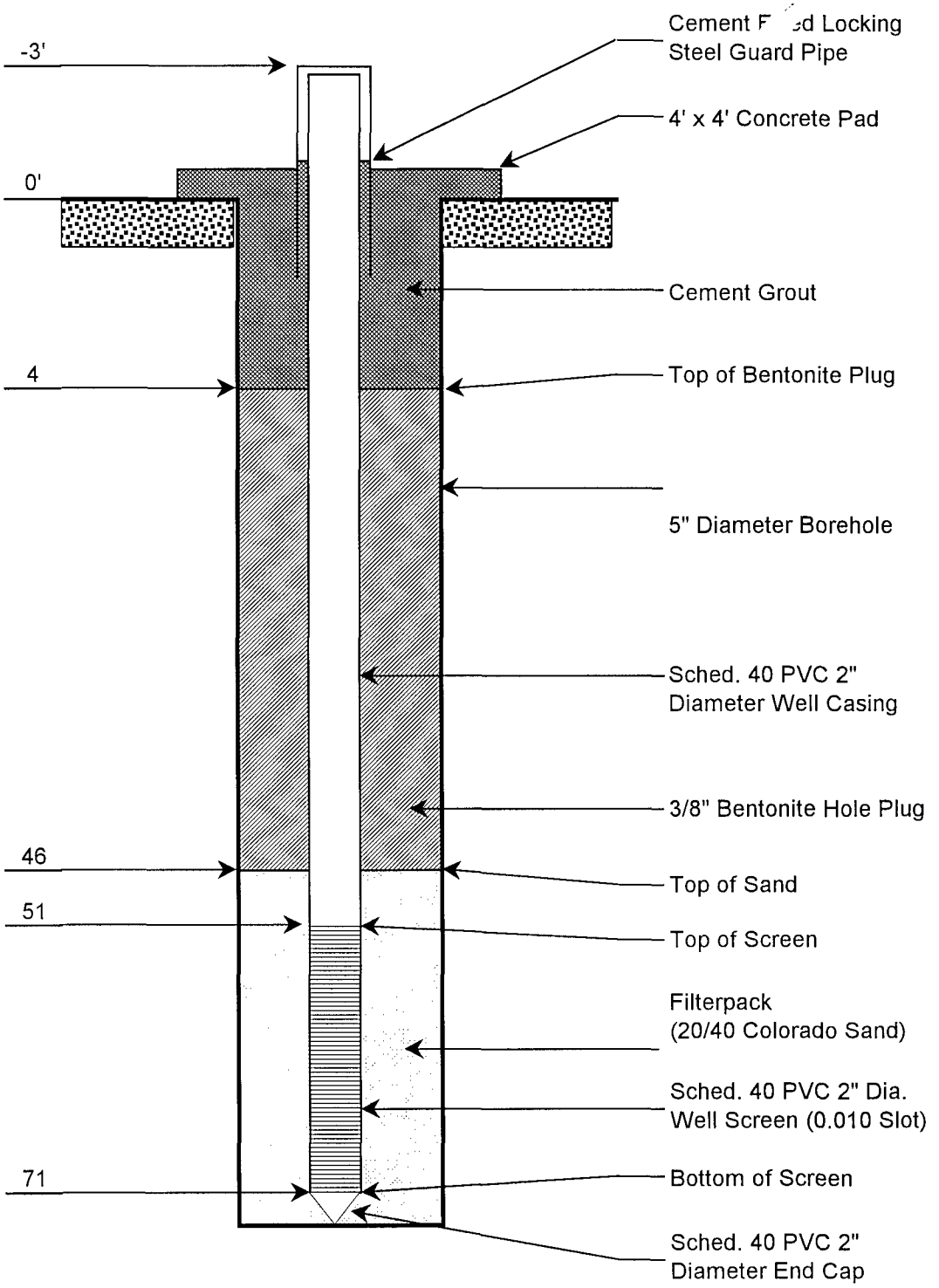
TRW Energy & Environmental Systems	SITE: Unocal - South Vacuum Unit		**MW-2 Monitoring Well Construction Diagram**
	DATE: 09/29/99	REV. NO.: 1	
	AUTHOR: GJV	DRAWN BY: GJV	
	CK'D BY: DTL	FILE: Well Bore Diagram	

MONITORING WELL CONSTRUCTION DIAGRAM (MW-3)



TRW Energy & Environmental Systems	SITE: Unocal - South Vacuum Unit		**MW-3 Monitoring Well Construction Diagram**
	DATE: 09/28/99	REV. NO.: 1	
	AUTHOR: GJV	DRAWN BY: GJV	
	CK'D BY: DTL	FILE: Well Bore Diagram	

MONITORING WELL CONSTRUCTION DIAGRAM (MW-4)



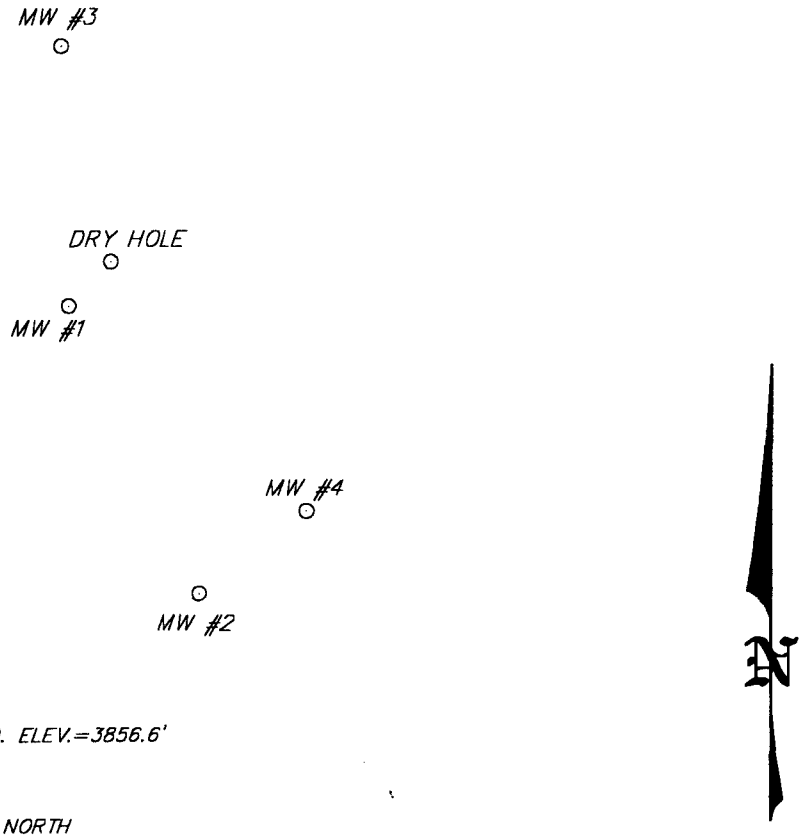
TRW Energy & Environmental Systems	SITE: Unocal - South Vacuum Unit		**MW-4 Monitoring Well Construction Diagram**
	DATE: 09/28/99	REV. NO.: 1	
	AUTHOR: GJV	DRAWN BY: GJV	
	CK'D BY: DTL	FILE: Well Bore Diagram	

ATTACHMENT B

SURVEY PLAT OF

UNOCAL SOUTH VACUUM UNIT

SECTION 35, TOWNSHIP 18 SOUTH, RANGE 35 EAST, N.M.P.M.,
LEA COUNTY, **NEW MEXICO.**



NOTE:

- COORDINATES ARE NMSPCE NAD83(92)
- ELEVATIONS ARE NAVD 88 (92)
- DRY HOLE MKR ELEVATION – ORIGINAL NAVD 29 GRD. ELEV.=3856.6' SURVEYED BY JOHN WEST ON 1-6-1960
- CASING ELEVATIONS – MARKS ON NORTH SIDE OF 2" PVC CASING
- GROUND ELEVATION – BOLT SET IN CONCRETE ±0.5' NORTH OF CASING EXCEPT MW #1-SPOT ON CONCRETE ±0.5 NORTH

WELL	NORTHING	EASTING	CASING ELEV.	GRND ELEV.
MW #1	619281.058	822716.421	3858.37'	3856.76'
MW #2	618530.968	823060.987	3841.64'	3839.11'
MW #3	619954.109	822693.599	3864.73'	3862.20'
MW #4	618746.632	823341.129	3852.51'	3849.87'
DRY HOLE MKR	619396.127	822825.405	TOP OF MARKER 3864.91'	3859.00'

I HEREBY CERTIFY THAT THIS PLAT WAS PREPARED FROM FIELD NOTES OF AN ACTUAL SURVEY AND MEETS OR EXCEEDS ALL REQUIREMENTS FOR LAND SURVEYS AS SPECIFIED BY THIS STATE.

GARY L. JONES N.M. P.S. No. 7977
TEXAS P.L.S. No. 5074

GARY L. JONES NEW MEXICO 7977 REGISTERED PROFESSIONAL LAND SURVEYOR

500 0 500 1000 FEET

BASIN SURVEYS P.O. BOX 1786 – HOBBS, NEW MEXICO

TRW SYSTEMS AND INFORMATION

REF: MONITOR WELLS

MONITOR WELLS LOCATED IN
SECTION 35, TOWNSHIP 18 SOUTH, RANGE 35 EAST,
N.M.P.M., LEA COUNTY, NEW MEXICO.

W.O. Number: 9354	Drawn By: K. GOAD		
Date: 10-01-99	Disk: KJG #122 – TRW9354A.DWG	Survey Date: 09-30-99	Sheet 1 of 1 Sheets

ATTACHMENT C

LABORATORY ANALYTICAL REPORTS AND CHAIN-OF-CUSTODY DOCUMENTATION

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

October 7, 1999

Mr. Ben Terry
UNOCAL-MID CONTINENT-CERT
P.O. Box 1283 (Hwy 366)
Nederlands, TX 77627-1283

The following report contains analytical results for the sample(s) received at Southern Petroleum Laboratories (SPL) on October 2, 1999. The sample(s) was assigned to Certificate of Analysis No. (s) 9910079 and analyzed for all parameters as listed on the chain of custody.

Any data flags or quality control exceptions associated with this report will be footnoted in the analytical result page(s) or the quality control summary page(s).

If you have any questions or comments pertaining to this data report, please do not hesitate to contact me. Please reference the above Certificate of Analysis No. during any inquiries.

Again, SPL is pleased to be of service to you. We anticipate working with you in fulfilling all your current and future analytical needs.

Southern Petroleum Laboratories

Adrian Cardenas
Project Manager

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Southern Petroleum Laboratories, Inc.

Certificate of Analysis Number: 99-10-079

Approved for Release by:

Adrian Cardenas, Project Manager — Date: 10/11/99

Joel Grice
Laboratory Director

Ted Yen
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Certificate of Analysis No. H9-9910079-01

Unocal-Mid Continent-CERT
P.O. Box 1283 (Hwy 366)
Nederlands, TX 77627-1283
ATTN: Ben Terry

DATE: 10/07/99

PROJECT: #9924770, South Vacuum Unit
SITE: Lea County, NM
SAMPLED BY: TRW, Inc.
SAMPLE ID: MW-1 (9909291200)

PROJECT NO:
MATRIX: WATER
DATE SAMPLED: 09/29/99 12:00:00
DATE RECEIVED: 10/02/99

ANALYTICAL DATA

PARAMETER	RESULTS	DETECTION LIMIT	UNITS
Chloride Method 325.3 * Analyzed by: CV Date: 10/05/99 11:00:00	1094	25	mg/L
Total Dissolved Solids Method 160.1 * Analyzed by: BEN Date: 10/05/99 10:30:00	2318	10	mg/L

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

QUALITY ASSURANCE: These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Certificate of Analysis No. H9-9910079-02

Unocal-Mid Continent-CERT
P.O. Box 1283 (Hwy 366)
Nederlands, TX 77627-1283
ATTN: Ben Terry

DATE: 10/07/99

PROJECT: #9924770, South Vacuum Unit
SITE: Lea County, NM
SAMPLED BY: TRW, Inc.
SAMPLE ID: MW-3 (9909301020)

PROJECT NO:
MATRIX: WATER
DATE SAMPLED: 09/30/99 10:20:00
DATE RECEIVED: 10/02/99

ANALYTICAL DATA

PARAMETER	RESULTS	DETECTION LIMIT	UNITS
Chloride Method 325.3 * Analyzed by: CV Date: 10/05/99 11:00:00	73.6	1.0	mg/L
Total Dissolved Solids Method 160.1 * Analyzed by: BEN Date: 10/05/99 10:30:00	427	10	mg/L

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

QUALITY ASSURANCE: These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Certificate of Analysis No. H9-9910079-03

Unocal-Mid Continent-CERT
P.O. Box 1283 (Hwy 366)
Nederlands, TX 77627-1283
ATTN: Ben Terry

DATE: 10/07/99

PROJECT: #9924770, South Vacuum Unit
SITE: Lea County, NM
SAMPLED BY: TRW, Inc.
SAMPLE ID: MW-4 (9909301235)

PROJECT NO:
MATRIX: WATER
DATE SAMPLED: 09/30/99 12:35:00
DATE RECEIVED: 10/02/99

ANALYTICAL DATA

PARAMETER	RESULTS	DETECTION LIMIT	UNITS
Chloride Method 325.3 * Analyzed by: CV Date: 10/05/99 11:00:00	1576	25	mg/L
Total Dissolved Solids Method 160.1 * Analyzed by: BEN Date: 10/05/99 10:30:00	2981	10	mg/L

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

QUALITY ASSURANCE: These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Certificate of Analysis No. H9-9910079-04

Unocal-Mid Continent-CERT
P.O. Box 1283 (Hwy 366)
Nederlands, TX 77627-1283
ATTN: Ben Terry

DATE: 10/07/99

PROJECT: #9924770, South Vacuum Unit
SITE: Lea County, NM
SAMPLED BY: TRW, Inc.
SAMPLE ID: MW-2 (9909301355)

PROJECT NO:
MATRIX: WATER
DATE SAMPLED: 09/30/99 13:55:00
DATE RECEIVED: 10/02/99

ANALYTICAL DATA

PARAMETER	RESULTS	DETECTION LIMIT	UNITS
Chloride Method 325.3 * Analyzed by: CV Date: 10/05/99 11:00:00	298	5	mg/L
Total Dissolved Solids Method 160.1 * Analyzed by: BEN Date: 10/05/99 10:30:00	922	10	mg/L

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

QUALITY ASSURANCE: These analyses are performed in accordance with EPA guidelines for quality assurance.

QUALITY CONTROL

DOCUMENTATION

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

** SPL QUALITY CONTROL REPORT **

Matrix: Aqueous

Reported on: 10/06/99
Analyzed on: 10/05/99
Analyst: CV

This sample was randomly selected for use in the SPL quality control program. Samples chosen are fortified with a known concentration in duplicate. The results are as follows:

Chloride
Method 325.3 *

SPL Sample ID Number	Blank Value mg/L	LCS Concentration mg/L	Measured Concentration mg/L	% Recovery	QC Limits Recovery
LCS	ND	128	126.1	98.5	94 - 106

-9910060

Samples in batch:

9910063-03A 9910079-01A 9910079-02A 9910079-03A
9910079-04A

COMMENTS:

LCS-SPL ID#991136006-14

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

** SPL QUALITY CONTROL REPORT **

Matrix: Aqueous

Reported on: 10/06/99
Analyzed on: 10/05/99
Analyst: CV

This sample was randomly selected for use in the SPL quality control program. Samples chosen are fortified with a known concentration in duplicate. The results are as follows:

Chloride
Method 325.3 *

SPL Sample ID Number	Method Blank mg/L	Sample Result mg/L	Spike Added mg/L	Matrix Spike Result mg/L	Matrix Spike Recovery %	Matrix Spike Duplicate Result mg/L	Matrix Spike Duplicate Recovery %	RPD (%)	QC LIMITS (Advisory) RPD Max	QC LIMITS (Advisory) % REC
9910079-01A	ND	1094	1250	2364	102	2364	102	0	5	92 -109

-9910060

Samples in batch:

9910063-03A 9910079-01A 9910079-02A 9910079-03A
9910079-04A

COMMENTS:

LCS-SPL ID#991136006-14

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

** SPL QUALITY CONTROL REPORT **

Matrix: Aqueous

Reported on: 10/06/99
Analyzed on: 10/05/99
Analyst: BEN

This sample was randomly selected for use in the SPL quality control program. Samples chosen are fortified with a known concentration in duplicate. The results are as follows:

Total Dissolved Solids
Method 160.1 *

SPL Sample ID Number	Blank Value mg/L	LCS Concentration mg/L	Measured Concentration mg/L	% Recovery	QC Limits Recovery
LCS	ND	430	444	103	93 - 107

-9910068

Samples in batch:

9910067-01C 9910079-01A 9910079-02A 9910079-03A
9910079-04A

COMMENTS:
LCS# 991163011-11

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

** SPL QUALITY CONTROL REPORT **

Matrix: Aqueous

Reported on: 10/06/99
Analyzed on: 10/05/99
Analyst: BEN

This sample was randomly selected for use in the SPL quality control program. The results are as follows:

Total Dissolved Solids
Method 160.1 *

-- DUPLICATE ANALYSIS --

SPL Sample ID	Original Sample Concentration mg/L	Duplicate Sample mg/L	RPD	RPD Max.
9910079-01A	2318	2289	1.3	5

-9910068

Samples in batch:

9910067-01C 9910079-01A 9910079-02A 9910079-03A
9910079-04A

COMMENTS:
LCS# 991163011-11

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

9910079

TRW Inc.
Energy & Environmental Systems
415 West Wall St. Suite. 1818
Midland, Texas 79701
(915) 682-0008
FAX: (915) 682-0028

№ 13448

Chain of Custody

Date 10/1/99 Page 1 of 1

Lab Name: SPL Laboratories, Inc
Address: 8820 Interchange Drive
Houston, Tx 77054
Telephone: (713) 660-8975

Samplers (SIGNATURES)
John Ferguson

Sample Identification	Matrix	Date	Time	BTEX (EPA 8021B)	MTBE (EPA 8021B)	SVOC (EPA 8270)	PAH (EPA 8270)	VOC (EPA 8260)	TPH (EPA 418.1)	TPH (TX-1005)	TPH (TX-1006)	GRO (EPA 8015G)	DRO (EPA 8015D)	TDS (EPA 160.1)	Anions/Cations	Total Metals	TCLP Metals	Chlorides							Number of Containers
MW-1 (9909291200)	Water	9/29/99	1200											✓				✓							1
MW-3 (9909301020)	Water	9/30/99	1020											✓				✓							1
MW-4 (9909301235)	Water	9/30/99	1235											✓				✓							1
MW-2 (9909301355)	Water	9/30/99	1355											✓				✓							1

Analysis Request

Project Information

Project Name: South Vacuum Unit
Project Location: Lea County, NM
Project Manager: Ben Terry
AFE
Cost Center No.: 8864-9924770-4675-6044-3
Shipping ID No.: 0
P O No.:

Sample Receipt

Total Containers:
COC Seals:
Rec'd Good Cond/Cold: 4°C
Conforms to Records:
Lab No.:

Special Instructions/Comments: Unocal Site No. 9924770
Please send results to TRW Inc. at address above
Need Results By 10/7/99

Relinquished By: (1)	Relinquished By: (2)	Relinquished By: (3)
John Ferguson 1730 (Signature) (Time)	(Signature) (Time)	(Signature) (Time)
John Ferguson 10/1/99 (Printed Name) (Date)	(Printed Name) (Date)	(Printed Name) (Date)
TRW Inc (Company)	(Company)	(Company)
Received By: (1)	**Received By: (2)**	**Received By: (3)**
(Signature) (Time)	(Signature) (Time)	(Signature) 1000 (Time)
(Printed Name) (Date)	(Printed Name) (Date)	JULIAN CERDA 10/2/99 (Printed Name) (Date)
(Company)	(Company)	SPL (Company)

Distribution: White, Canary-Laboratory / Pink-TRW

SPL Houston Environmental Laboratory

Sample Login Checklist

Date:	Time:
10/2/99	1000

SPL Sample ID:
9910079

			Yes	No
1	Chain-of-Custody (COC) form is present.		✓	
2	COC is properly completed.		✓	
3	If no, Non-Conformance Worksheet has been completed.			
4	Custody seals are present on the shipping container.		✓	
5	If yes, custody seals are intact.		✓	
6	All samples are tagged or labeled.		✓	
7	If no, Non-Conformance Worksheet has been completed.			
8	Sample containers arrived intact		✓	
9	Temperature of samples upon arrival:		4° C	
10	Method of sample delivery to SPL:	SPL Delivery		
		Client Delivery		
		FedEx Delivery (airbill #)	791002269509	
		Other:		
11	Method of sample disposal:	SPL Disposal	✓	
		HOLD		
		Return to Client		

Name:	Date:
[signature]	10/2/99

ATTACHMENT D

PHOTODOCUMENTATION

View facing north showing drilling operations at MW-2 located approximately 900 feet downgradient (south-southeast) of the former SWD pit.

View facing southwest showing groundwater sampling operations at monitoring well MW-1 (background). The former SWD well P & A marker and remediated SWD pit is shown in the foreground.

View facing south showing drilling operations at MW-3 (left foreground)
located approximately 650 feet upgradient of the former SWD pit (right background).

View showing monitoring well installation for MW-4 (facing southeast).
MW-4 is located approximately 850 feet downgradient (southeast) of the former SWD pit.