AP - 012

STAGE 1 & 2 WORKPLANS

DATE:

Dec. 1999

ADDITIONAL SUBSURFACE INVESTIGATION REPORT
AND
STAGE 2 ABATEMENT PLAN

EOTT ENERGY CORP
TNM 98-05A RELEASE SITE
LEA COUNTY, NEW MEXICO

RECEIVED
JAN 12 2000
ENVIRONMENTAL BUREAU
OIL CONSERVATION DIVISION

Prepared For:
EOTT Energy Corp
5805 East Highway 80
Midland, Texas 79701

Environmental Technology Group, Inc. Project No. EOT1026C

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December 1999

A Report Prepared for:

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5805 East Highway 80
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Additional Subsurface Investigation Report
And
Stage 2 Abatement Plan

Environmental Technology Group, Inc. Project No. EOT1026C

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December 1999

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1.0 INTRODUCTION AND SITE BACKGROUND

The site is located approximately two miles northeast of the town of Eunice, New Mexico in Section 26, Township 21 South, Range 37 East. A site location map is provided as Figure 1. On February 2, 1998, an estimated 49 barrels of crude oil was released at the site, three barrels of which were recovered during the emergency response. Subsequent to the release, approximately 87 cubic yards of impacted soil was excavated and stockpiled on site as depicted on Figure 2, the Site Map. A subsurface investigation of the release was conducted in November 1998 and the results were summarized in a report dated March 5, 1999.

A review of the report indicates the following:

- The vertical extent of soil, impacted to above regulatory standards, extends to approximately 25 feet below the ground surface (bgs) in the release area;
- The horizontal extent of soil, impacted to above regulatory limits, is not defined to the north, northwest or west;
- Two wells contain phase separated hydrocarbons (PSH) and the downgradient extent of PSH is not defined; and
- Two wells contain ground water with dissolved phase benzene in excess of regulatory standards and the downgradient extent of impacted ground water is not defined.

During the initial borings, soil impacted to above regulatory limits, was present in the boring subsequently completed as monitoring well MW-1. The most highly impacted zone was the interval from the surface to five feet bgs. The field screening concentrations, collected by the photoionization detector (PID), and the soil laboratory data, indicate a general decrease in hydrocarbon concentrations with depth. A correlation with the PID readings and the soil laboratory data indicate that soil, impacted to above regulatory limits, is limited to the interval from the surface to 25 feet bgs.

In order to define the horizontal and vertical extent of impacted soils and ground water, six additional monitoring wells and borings were installed at the site in October 1999. This report summarizes the findings of the additional site investigation and integrates the data with the previous information as required to complete the Stage I Abatement Plan. In addition, remedial recommendations are presented in this report in order to satisfy the requirements of a Stage 2 Abatement Plan.

2.0 RECENT FIELD ACTIVITIES

Dissolved phase benzene, in excess of regulatory limits, was present in ground water samples collected from monitoring wells MW-3 and MW-4. Therefore, the crossgradient and downgradient extent of the dissolved phase plume was not defined. In order to determine this extent, monitoring wells MW-6, MW-7, MW-8 and MW-9 were installed as depicted on Figure 2. In addition, monitoring well MW-4 was installed upgradient of the release to insure that no other sources were contributing to the plume.

Phase separated hydrocarbons (PSH) have been present in monitoring wells MW-1 and MW-2 since their installation in November 1998. The thickness of PSH in monitoring well MW-1 ranged from 0.61 to 3.80 feet, generally increasing over time. The thickness of PSH in monitoring well MW-2 was generally constant, ranging between 2.5 to 2.8 feet thick. This trend changed in September 1999 with a significant decrease in PSH thickness in both wells at about that time. In order to determine whether this development was a result of downgradient movement of the PSH plume, monitoring well MW-10 was installed downgradient of the inferred thickest part of the PSH plume. Monitoring well MW-10 has had approximately 0.9 feet of product in it since it was installed.

In order to limit the spread of free product at the site, PSH skimmer pumps have been installed in the monitoring wells MW-1, MW-2 and MW-10. These pumps pump the Psh down to a sheen on average of thirty minutes and take almost a week to recover to their original thickness. Historical data on PSH recovery is provided as Table 1.

The soil profile generally consists of red or white sand, interbedded with clay and sandstone as depicted on the boring logs, provided as Appendix A. All of the soils penetrated by the recent borings were below regulatory limits with the exception of the boring later completed as monitoring well MW-10. Soils in the smear zone of that boring exceed the regulatory limit for TPH. The soil chemistry data are included as Table 2.

Ground water was detected at a depth of approximately 50 feet bgs during the well installations. The ground water gradient, as measured on October 29, 1999, was toward the southeast as depicted on Figure 3. The gradient is approximately 0.00075 feet/foot, which is a relatively shallow gradient and probably accounts for the significant crossgradient extent of the dissolved phase plume as discussed below. Historical and recent ground water elevation data is provided as Table 3.

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The dissolved phase plume, as measured on October 29, 1999, extends to monitoring wells MW-3, MW-8 and MW-9. However, only monitoring well MW-8 has a constituent concentration in excess of the MCLs, with a benzene concentration of 13 *u*g/L. Historical and recent ground water chemistry is included as Table 4 and the most recent data are posted on Figure 4.

The wells were completed as prescribed by OCD requirements and in accordance with protocols outlined in Section 6 of this report. The soil and ground water laboratory reports are included in Appendix B.

3.0 ABATEMENT OPTIONS

3.1 Soil Remediation

Abatement of impacted soil at the site is technically feasible using the following technologies:

- Excavation and Disposal
- Soil Vapor Extraction

- Bioremediation
- Bioremediation/Bioventing
- Chemical Oxidation

A reasonable estimation of the volume of impacted soil at the site is not possible using the existing data. It is recommended that a geoprobe survey be conducted around monitoring wells MW-1 and the existing excasvation to determine the extent. Until this data is acquired, costs associated with each remediation technology can not be estimated with any accuracy. Therefore, cost estimates for the technologies are not provided. However, given a reasonable estimate of the volume of impacted soil, the relative costs of each technology can be estimated and are provided below. In addition, operational issues associated with each technology are illustrated in order to rate the viability of the technologies.

Soil Vapor Extraction (SVE) is a viable technology to remediate the unsaturated zone at the site given the soil permeability. However, these systems are more effective on more volatile constituents such as those present in refined gasoline. Given the soil conditions and contaminate of concern (COC), a reasonable estimation of the practical radius of influence for each SVE well is approximately 25 feet. The total number of wells and their distribution would depend on the additional data gathered during the recommended geoprobe survey.

The wells would be connected to the system blower by lateral PVC lines installed approximately three feet below grade. The system would require an explosion proof blower in the ten horsepower range, housed in a weatherproof shed. In addition, an electrical supply, electrical panel and associated process logic controllers would be required. An air emission permit for the system effluent and associated monitoring would be required.

Experience with the installation of these systems indicates that the installation costs can be significant. Given the soil type and COC, it is estimated that the system would require approximately two years of operation. System maintenance would include monthly system checks, air monitoring and a possible motor replacement. Electrical costs, maintenance costs and monitoring costs for the system would be approximately $1,500.00 per month. While this technology would effectively remediate the soils at the site, the costs associated with this technology are relatively higher than the recommended option below.

Bioremediation of the COCs at this site is a technically feasible option. ETGI has extensive experience with this technology and has frequently applied hydrocarbon consuming bacteria to the subsurface using the Deep Remediation Injection System (DRIS) system (see below). It is estimated that this technology would also require a remediation period of approximately two years. Total costs, including the well installation, materials cost, inoculant cost, remediation progress monitoring and environmental supervision would be significantly higher than the recommended technology below.

By adding a biovent system to the site, aerobic bio-degradation could be accelerated at the site. This could result in a more rapid bioremediation schedule for the site. However, the cost associated with the installation of the system would represent a significant additional cost.

The chemical oxidation of hydrocarbons in the unsaturated zone, utilizing catalyzed Hydrogen Peroxide (H_2O_2) injected with the DRIS system is the recommended option. This technology is described in Section 4.0.

3.2 Ground Water Remediation

Regardless of the technology selected to remove the dissolved phase COCs in the ground water, the removal of free phase crude on the ground water should be the first step. The product can be removed utilizing a geo-vac type system, hydrophyllic belt systems, skimmer pumps or hand bailing. One of these systems should be employed before the remediation of dissolved phase constituents is feasible.

The removal of dissolved phase COCs is technically feasible using the following technologies:

- Pump and Treat
- Air Sparging
- Natural Attenuation

Past experience with pump and treat systems utilizing air strippers, granulated activated carbon, ultraviolet radiation or other COC removal technologies has been disappointing at sites similar to the subject site. The volume of water required to control the water table and facilitate the advection of impacted ground water toward the recovery well(s) in sandy material is significant.

One of two scenarios typically develop when employing this technique. Either the volume of water moved is inadequate to control the water table and the dissolved phase plume is not completely addressed, or the required amount of water is moved and the volume of water overwhelms the treatment system. Also, the water table rapidly returns to it's natural state when the system is down for repair or maintenance, resulting in periodic loss of control of the plume. It is difficult to estimate the required duration of these systems and the associated maintenance cost. However, it is probable that the use of this technology would be in excess of $100,000.00.

Air sparging (AS) is commonly utilized in conjunction with SVE systems. This would be a technically feasible combination at the site. However, the low volatility of the COC at this site requires a relatively long operational period. It is estimated that the addition of AS to the SVE system described above, would add approximately $60,000.00 to the total cost over the life of the project.

The treatment of the vadose zone with catalyzed hydrogen peroxide, as recommended above, will also actively degrade dissolved phase hydrocarbons in the ground water and provide oxygen to the ground water. The enhanced oxygen content usually promotes aerobic bacterial degradation in the dissolved phase as well as in the adsorbed phase.

For this reason, the treatment area for impacted soil will be expanded from the area of vadose zone impact to include the area of smear zone impact, as documented by monitoring wells with PSH and monitoring well MW-9, which has a dissolved phase benzene concentration above MCLs..

If both the vadose zone and smear zone soil is treated as recommended, and the free phase hydrocarbons are removed, it is expected that chemical degradation of dissolved phase COCs in the ground water, combined with natural degradation promoted by the subsurface aeration, inherent in the process, will be sufficient to remediate the impacted ground water.

It is estimated that given favorable conditions, COCs in the ground water may degrade to concentrations below regulatory limits over a period of approximately one year. If after that time, a suitable decrease in the dissolved phase concentrations have not been observed, additional technologies will be considered. The progress in ground water remediation will be monitored on a quarterly basis as described below. The current distribution of monitoring wells should be more than sufficient to document ground water conditions at the site.

4.0 REMEDIAL RECOMMENDATIONS

4.1 Free Product Removal

ETGI has already installed submersible skimmer pumps in monitoring wells MW-1, MW-2, and MW-10. If free phase product is observed in any other site wells, an additional skimmer pump should be utilized. The cost of this type of pump and associated equipment, including compressor, storage tank, and overfill protection, is approximately $7,800.00 for the first well installed. The incremental additional cost per well is approximately $2,900.00 per well. Historical data regarding PSH removal rates and recovery rates are provided as Table 1.

4.2 Soil Remediation

In order to remediate the petroleum impacted soil, ETGI recommends chemical oxidation of the hydrocarbons in place utilizing the injection of hydrogen peroxide ($H_2O_{2)}$, along with an iron sulfate catalyst. The soil conditions and depth of impacted soil should allow the use of the DRIS System with pilot holes advanced by a geoprobe unit as described below. The estimated cost for soil remediation at the site using this approach is approximately $85,000.00. The estimated period of active soil remediation activities should be approximately six months.

The concentration of petroleum constituents in the stockpiled soil is unknown. ETGI recommends that one representative sample of each of the small stockpiles soil be composited to determine the average concentration. If this concentration is above regulatory limits, it is recommended that the stockpiled soil be subject to remediation similar to that proposed to the impacted soil in place.

4.2.1 Injectate Volume and Composition

An estimate of the mass of crude oil present in the release area will be required before the injectate volume can be estimated. This will require the additional data from the recommended geoprobe survey. The volume of injectate required to remediate the soil to below the regulatory standards will then be calculated. These standards are 10 mg/Kg Benzene, 50 mg/Kg BTEX and 100 mg/Kg TPH. Given typical crude compositions at other, similar release sites, it is assumed that the 100 mg/Kg of TPH will be the limiting factor, therefore this will be considered the critical analyte.

Several published papers and the past Experience of ETGI at other similar sites indicate that a ratio of 5 lbs of a 50% solution of H_2O_2 to 1 lb of contaminant can result in the desired degradation as long as it is properly dispersed and comes into contact with a majority of the contaminant. The volume of injectate required at the site will be estimated using this ratio. In addition, a volume Iron Sulfate ($FeSO_4$), equal to 0.024%, of the amount of Hydrogen Peroxide used, will be injected in a 10 % solution with deionized water prior to the introduction of Hydrogen Peroxide.

It is also well documented that, for the optimal production of hydroxyl radicals, a soil pH of 3 to 4 is required. Prior to injection, several soil samples will be collected to determine if the natural soil pH is in this range. It is probable that the soil pH is somewhat higher than this optimal range and a pH buffering agent (dilute H_2SO_4) will be introduced with the Iron Sulfate.

The literature indicates that within two to three days after the reaction, the remaining H_2O_2 and H_2SO_4 will be below detectable limits. The process involves the conversion of ferrous iron to ferric iron and some portion of ferric iron will probably remain in the soil as a precipitate. Controlled bench scale studies indicate that approximately 20% of the total amount of iron introduced will be converted to ferric iron as a precipitate. This should not degrade permeability in the soil to any significant degree.

4.2.2 Injection Schedule and Progress Monitoring

The estimated total amount of injectate required to remediate the soil will not be applied during a single event. Approximately one-third of the total required will be injected during each of three events. Typically, the events are scheduled approximately one month apart to allow for a complete reaction and stabilization. During the period between events, representative soil samples will be collected to allow for the monitoring of progress at the site and the modification of injection locations or injectate composition as needed. In order to monitor the remedial progress between events, representative soil samples will be collected from the impacted zone at various depths. In addition, ground water samples will be collected from the monitoring wells in the treatment area between each application.

Subsequent to the last event, representative soil samples will be collected from the impacted zone at various depths. If these soil samples indicate that benzene, BTEX and/or TPH concentrations remain at levels significantly above the closure levels, subsequent injection events will be conducted.

4.2.3 Injectate Dispersion Method

The DRIS injection lance utilizes water, under pressures up to 5,000 lbs, to advance the lance into the subsurface. Once the desired depth is reached, valving on the head of the lance and at the DRIS trailer allow the water to be shut off. Subsequently the injectate is introduced to the subsurface under similar pressures. The DRIS unit also utilizes the introduction of pressurized air, in a band of small orifices (jets), located above the injectate jets. The air limits the volume of injectate allowed to escape out the pilot hole and facilitates the lateral movement of the injectate into the subsurface.

By injecting low volumes of liquid inoculates at high pressure, micro-fractures are created in the subsurface. Once the micro-fractures are opened, the inoculates are effectively dispersed into the soil. The DRIS system provides the intimate contact between the inoculate and the contaminant necessary to achieve contaminant reduction or degradation.

4.2.4 Injection Spacing

At the beginning of the first injection event, an area of the site will be selected to conduct a pilot test to determine the required spacing. Initially, a grid, on ten foot spacing, will be laid out and the lance will be advanced at each point. During injection, the movement of injectate from adjacent holes will confirm that the holes are within the radius of influence. Typically, the radius of influence is between five to fifteen feet in this type of soil. Subsequent to this estimate of the radius of influence, a grid will be laid out across the impacted portion of the site.

4.3 Ground Water Remediation

ETGI recommends the continued operation of the current active oil skimmer system in monitoring wells MW-1, MW-2 and MW-10 as discussed above. The PSH is stored in a bermed tank and hauled off-site at the required intervals. The minor amount of water produced by the system is characterized and disposed of at an off-site, permitted facility as needed.

If the geoprobe survey detects the presence of a significant thickness of PSH in areas adjacent to these monitoring wells, a recovery well will be installed in the area and an additional skimmer pump will be installed in the well. As discussed above, the cost of this type of pump and associated equipment, including compressor, storage tank, and overfill protection, is approximately $7,800.00 for the first well installed. The incremental additional cost per well is approximately $2,900.00 per well.

5.0 MONITORING PROGRAM

During and subsequent to the recommended remedial activities, the ground water elevations in all site monitoring wells will be gauged and monitored for the presence of PSH on a monthly basis. All of the site monitoring wells will be sampled quarterly and the samples will be submitted for the analysis of BTEX (EPA Method 8020, 5030) and TPH (EPA Method 8015, modified for DRO and GRO). An annual report will be provided with a summary of all field activities and data results. The following developments at the site will warrant timely notification interim to the annual report:

- The detection of COCs in currently non-impacted monitoring wells for two consecutive monitoring periods;
- The detection of PSH in any well in which PSH has not been present previously;
- The recurrence of PSH in any well in which PSH was removed during remedial activities.

The monitoring plan will continue until such time that site closure is granted by the appropriate regulatory agency. Significant trends in COC concentrations or other significant developments at the site may have a bearing on the timing of a closure request.

6.0 QA/QC PROCEDURES

6.1 Soil Sampling

Samples of subsurface soils will be obtained utilizing either a split spoon sampler (air rotary drilling rig) or a two inch, continuous sampling tube with a clean polybuterate liner (geoprobe). Representative soil samples will be divided into two separate portions using clean, disposable gloves and clean sampling tools. One portion of the soil sample will be placed in a disposable sample bag. The bag will be labeled and sealed for head-space analysis using a photo-ionization detector (PID) calibrated to a 100 ppm isobutylene standard. Each sample will be allowed to volatilize for approximately thirty minutes at ambient temperature prior to conducting the analysis.

The other portion of the soil sample will be placed in a sterile glass container equipped with a Teflon-lined lid furnished by the analytical laboratory. The container will be filled to capacity to limit the amount of head-space present. Each container will be labeled and placed on ice in an insulated cooler. Upon selection of samples for analysis, the cooler will be sealed for shipment to the laboratory. Proper chain-of-custody documentation will be maintained throughout the sampling process.

Soil samples will be delivered to Environmental Lab of Texas, Inc. in Midland, Texas for BTEX and TPH analyses using the methods described below. Soil samples will be analyzed for BTEX and TPH-DRO within fourteen days following the collection date.

The soil samples will be analyzed as follows:

- BTEX concentrations in accordance with EPA Method 8020, 5030
- TPH concentrations in accordance with modified EPA Method 8015-GRO/DRO

6.2 Ground Water Sampling

Monitoring wells will be developed and purged with a clean PVC bailer. The bailer will be cleaned prior to each use with Liqui-Nox detergent and rinsed with distilled water. Monitoring wells with sufficient recharge will be purged by removing a minimum of three well volumes. Monitoring wells that do not recharge sufficiently will be purged until no additional ground water can be obtained.

After purging the wells, ground water samples will be collected with a disposable Teflon sampler and polyethylene line by personnel wearing clean, disposable gloves. Ground water sample containers will be filled in the order of decreasing volatilization sensitivity (i.e., BTEX containers will be filled first and PAH containers second).

Ground water samples collected for BTEX analysis will be placed in 40 ml glass VOA vials equipped with Teflon-lined caps. The containers will be provided by the analytical laboratory. The vials will be filled to a positive meniscus, sealed, and visually checked to ensure the absence of air bubbles.

Ground water samples collected for PAH analysis will be filled to capacity in sterile, 1 liter glass containers equipped with Teflon-lined caps. Ground water samples collected for metals analysis will be filled to capacity in sterile, 1 liter plastic containers equipped with Teflon-lined caps. The containers will be provided by the analytical laboratory.

The filled containers will be labeled and placed on ice in an insulated cooler. The cooler will be sealed for transportation to the analytical laboratory. Proper chain-of-custody documentation will be maintained throughout the sampling process.

The ground water samples will be analyzed as follows:

- BTEX concentrations in accordance with EPA Method 8020, 5030
- TPH concentrations in accordance with modified EPA Method 8015-GRO/DRO

6.3 Decontamination Of Equipment

Cleaning of drilling equipment will be the responsibility of the drilling company. In general, the cleaning procedures will consist of using high pressure steam to wash the drilling and sampling equipment prior to drilling and prior to starting each hole. Prior to use, the sampling equipment will be cleaned with Liqui-Nox detergent and rinsed with distilled water.

6.4 Laboratory Protocol

The laboratory will be responsible for proper QA/QC procedures. These procedures will either be transmitted with the laboratory reports or on file at the laboratory.

7.0 SCHEDULE OF ACTIVITIES

The removal of free phase product at the site has already been initiated and will continue. Monitoring of the reduction of PSH at the site and system operations will be conducted on a weekly basis. Active soil and dissolved phase ground water remediation will be implemented within 30 day of approval of this Abatement Plan. Quarterly monitoring of the site ground water monitoring wells and annual reporting will continue regardless of the status of this plan.

8.0 LIMITATIONS

Environmental Technology Group, Inc. has prepared this Additional Subsurface Investigation Report and Stage 2 Abatement Plan to the best of its ability. No other warranty, expressed or implied, is made or intended.

Environmental Technology Group, Inc. has examined and relied upon documents referenced in the report and has relied on oral statements made by certain individuals. Environmental Technology Group, Inc. has not conducted an independent examination of the facts contained in referenced materials and statements. We have presumed the genuineness of the documents and that the information provided in documents or statements is true and accurate. Environmental Technology Group, Inc. has prepared this report in a professional manner, using the degree of skill and care exercised by similar environmental consultants. Environmental Technology Group, Inc. also notes that the facts and conditions referenced in this report may change over time and the conclusions and recommendations set forth herein are applicable only to the facts and conditions as described at the time of this report.

This report has been prepared for the benefit of EOTT Energy Corp. The information contained in this report including all exhibits and attachments, may not be used by any other party without the express consent of Environmental Technology Group, Inc. and/or EOTT Energy Corp.

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TABLES

TABLE 1

PSH RECOVERY DATA
TNM 98-05A
ETGI PROJECT # EOT1026C

		Pumped			Measured		
Well Number		Date	Time	Duration	Date	Time	PSH Thickness
1		10/25/99	13:03	0:17	10/25/99	12:15	1.80
2		-	-	-	10/25/99	13:30	1.43
1		-	-	-	10/26/99	8:20	0.06
2		10/26/99	8:46	0:15	10/26/99	8:30	1.43
1		11/02/99	15:10	0:12	11/02/99	15:00	0.30
2		11/02/99	14:35	0:13	11/02/99	14:05	0.32
10		-	-	-	11/02/99	15:45	0.02
1		11/12/99	11:50	0:11	11/12/99	11:45	0.37
2		11/12/99	12:30	0:10	11/12/99	12:05	0.13
10		-	-	-	11/12/99	12:50	0.03
1		11/15/99	10:43	0:20	11/15/99	10:20	0.20
2		11/15/99	11:15	0:10	11/15/99	10:30	Sheen
1		11/24/99	9:16	0:10	11/24/99	9:00	0.27
2		11/24/99	9:35	0:09	11/24/99	9:20	0.08
10		-	-	-	11/24/99	9:50	0.30
1		12/01/99	12:30	0:15	12/01/99	12:20	0.23
2		-	-	-	12/01/99	11:07	0.27
10		12/01/99	13:40	0:26	12/01/99	12:05	0.97
1		12/09/99	15:48	0:08	12/09/99	15:30	0.25
2		-	-	-	12/09/99	15:15	1.34
10		12/09/99	16:00	1:00	12/09/99	15:20	1.32
1		12/16/99	12:35	0:16	12/16/99	11:15	0.48
2		-	-	-	12/16/99	11:10	1.01
10		12/16/99	11:35	1:05	12/16/99	11:25	1.33

TABLE 2

SOIL CHEMISTRY DATA
TNM 98-05
ETGI # EOT1026C

SAMPLE LOCATION	SAMPLE DATE	SAMPLE DEPTH (FEET)	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL-BENZENE (mg/kg)	XYLENES (mg/kg)	Total BTEX (mg/kg)	TPH (mg/kg)	GRO C6-C10 (mg/kg)	DRO (C10-C25) (mg/kg)
MW-5	10/25/99	50-52	ND	0.122	ND	ND	0.122	29	ND	29
MW-6	10/25/99	38-40	ND	ND	ND	ND	ND	ND	ND	ND
MW-7	10/25/99	20-22	ND	ND	ND	ND	ND	ND	ND	ND
MW-7	10/25/99	40-42	ND	ND	ND	ND	ND	ND	ND	ND
MW-8	10/25/99	38-40	ND	ND	ND	ND	ND	ND	ND	ND
MW-9	10/25/99	38-40	ND	ND	ND	ND	ND	ND	ND	ND
MW-10	10/25/99	40-42	0.620	1.78	1.11	2.096	5.606	715	271	444

NOTES:NA = Not Analyzed
ND = Not Detected
Detection Limits = 0.1 mg/kg BTEX
10 mg/kg TPH
10 mg/kg GRO/DRO

TABLE 3

GROUNDWATER ELEVATION DATA
TNM 98-05A
ETGI PROJECT# EOT1026C

WELL NUMBER	DATE MEASURED	DEPTH TO WATER FROM PVC (feet)	ELEVATION OF WATER (feet)		PSH THICKNESS (feet)
			ACTUAL	CORRECTED	
MW-1	02/03/99	49.57	3,390.57	3,344.01	3.54
MW-1	05/12/99	49.31	3,390.57	3,344.01	3.32
MW-1	08/23/99	49.51	3,390.57	3,343.79	3.36
MW-1	11/29/99	45.84	3,390.57	3,344.93	0.23
MW-2	02/03/99	49.37	3,390.85	3,343.89	2.84
MW-2	05/12/99	49.02	3,390.85	3,344.01	2.56
MW-2	08/23/99	49.38	3,390.85	3,343.79	2.73
MW-2	11/29/99	46.25	3,390.85	3,344.83	0.27
MW-3	02/03/99	47.09	3,391.08	3,343.99	ND
MW-3	05/12/99	47.06	3,391.08	3,344.02	ND
MW-3	0823/99	47.24	3,391.08	3,343.84	ND
MW-3	11/29/99	46.18	3,391.08	3,344.80	ND
MW-4	02/03/99	47.01	3,390.81	3,343.80	ND
MW-4	05/12/99	46.91	3,390.81	3,343.90	ND
MW-4	08/23/99	47.16	3,390.81	3,343.65	ND
MW-4	11/29/99	46.03	3,390.81	3,344.78	ND
MW-5	11/29/99	46.55	3,391.53	3,344.98	ND
MW-6	11/29/99	46.45	3,391.14	3,344.69	ND
MW-7	11/29/99	46.52	3,391.21	3,344.69	ND
MW-8	11/29/99	46.42	3,391.14	3,344.72	ND
MW-9	11/29/99	46.45	3,391.47	3,344.82	ND
MW-10	11/29/99	47.23	3,391.26	3,344.85	0.97

TABLE 4

GROUND WATER CHEMISTRY DATA
TNM 98-05A
ETGI JOB # EOT1026C

SAMPLE LOCATION	SAMPLE DATE	BENZENE (mg/L)	TOLUENE (mg/L)	ETHYL-BENZENE (mg/L)	XYLENES (mg/L)	TOTAL BTEX (mg/L)
MW-3	02/03/99	0.012	0.006	0.001	ND	0.019
MW-3	05/12/99	0.013	0.009	ND	ND	0.022
MW-3	08/23/99	0.004	0.006	0.001	0.001	0.012
MW-3	11/29/99	0.003	0.003	0.001	0.001	0.008
MW-4	02/03/99	0.051	0.036	0.006	0.004	0.097
MW-4	05/12/99	0.221	0.141	0.024	0.032	0.418
MW-4	08/23/99	0.071	0.043	0.010	0.009	0.133
MW-4	11/29/99	0.002	0.002	0.009	0.006	0.019
MW-5	11/29/99	ND	ND	ND	ND	ND
MW-6	11/29/99	ND	ND	ND	ND	ND
MW-7	11/29/99	ND	ND	ND	ND	ND
MW-8	11/29/99	0.004	0.003	0.001	0.002	0.010
MW-9	11/29/99	0.013	0.009	0.002	0.004	0.028

Note: Detection limit = 0.001 mg/L

FIGURES

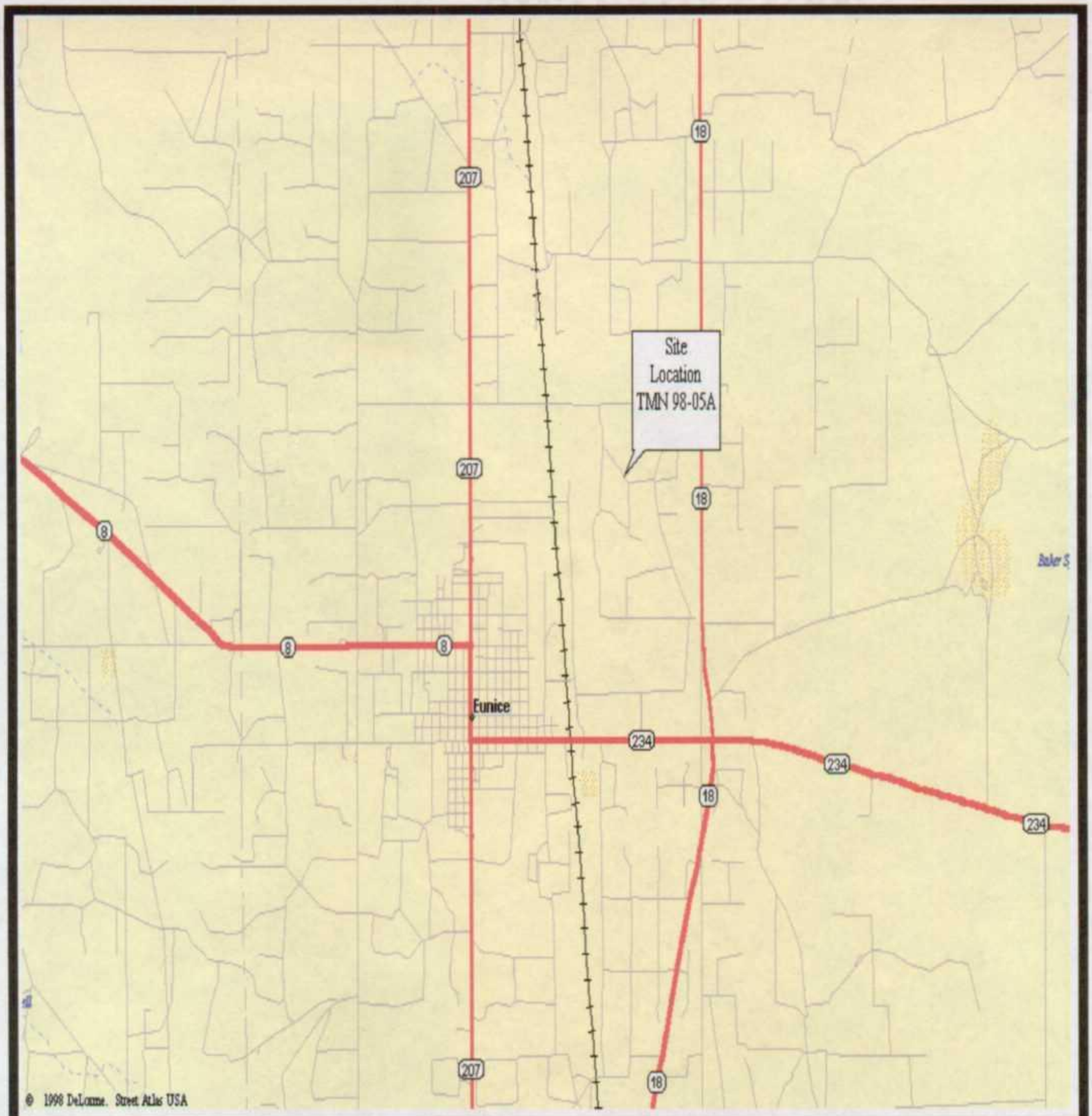


FIGURE
1

Not To Scale

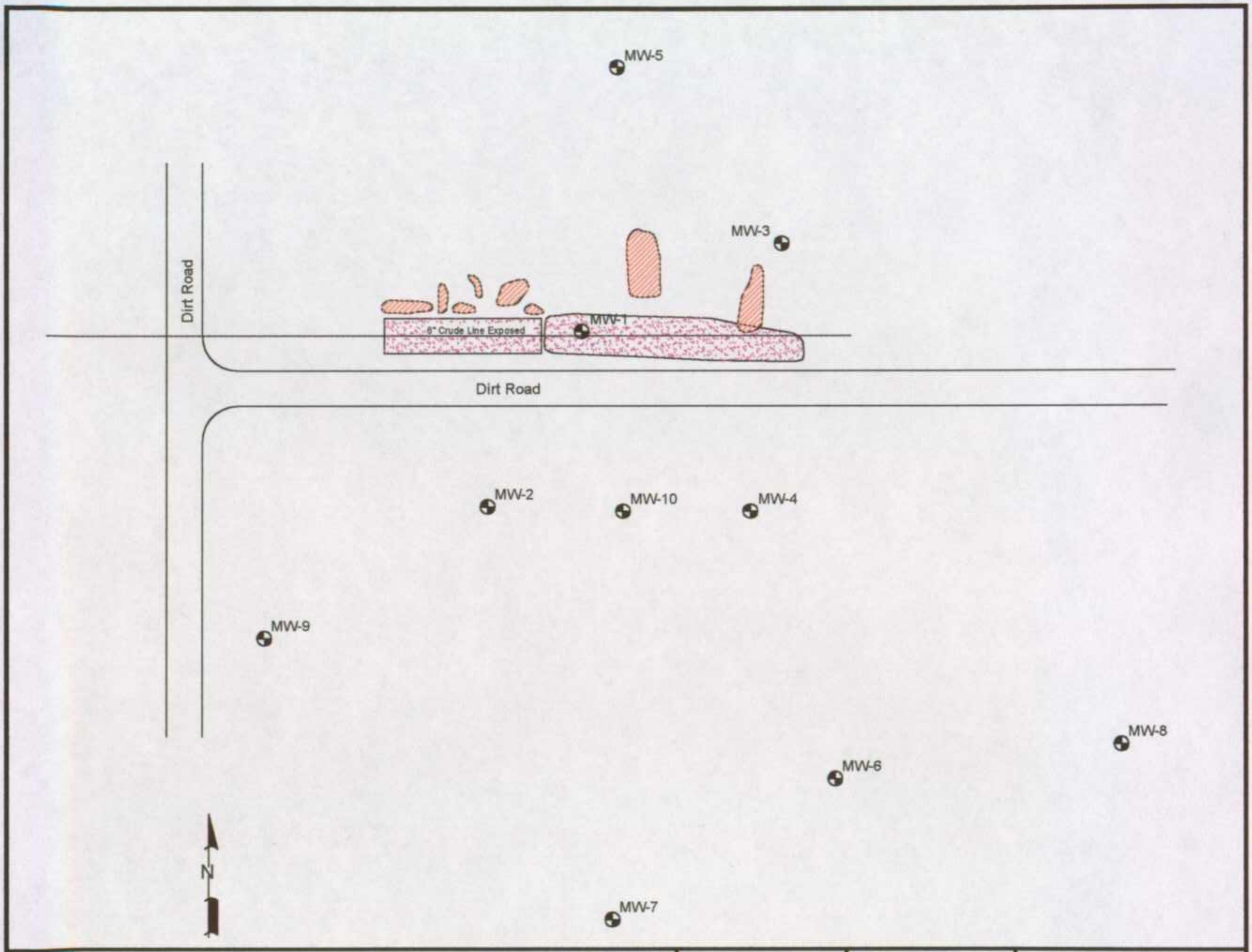
Site Location Map

EOTT Energy Corp.
Eott Release Site 98-05A
Lea County, NM

Environmental
Technology
Group, Inc.

11 - 22 - 99 RS

ETGI Project # EOT 1026C



LEGEND:

● Existing Monitoring Wells ▨ Stockpile Soil

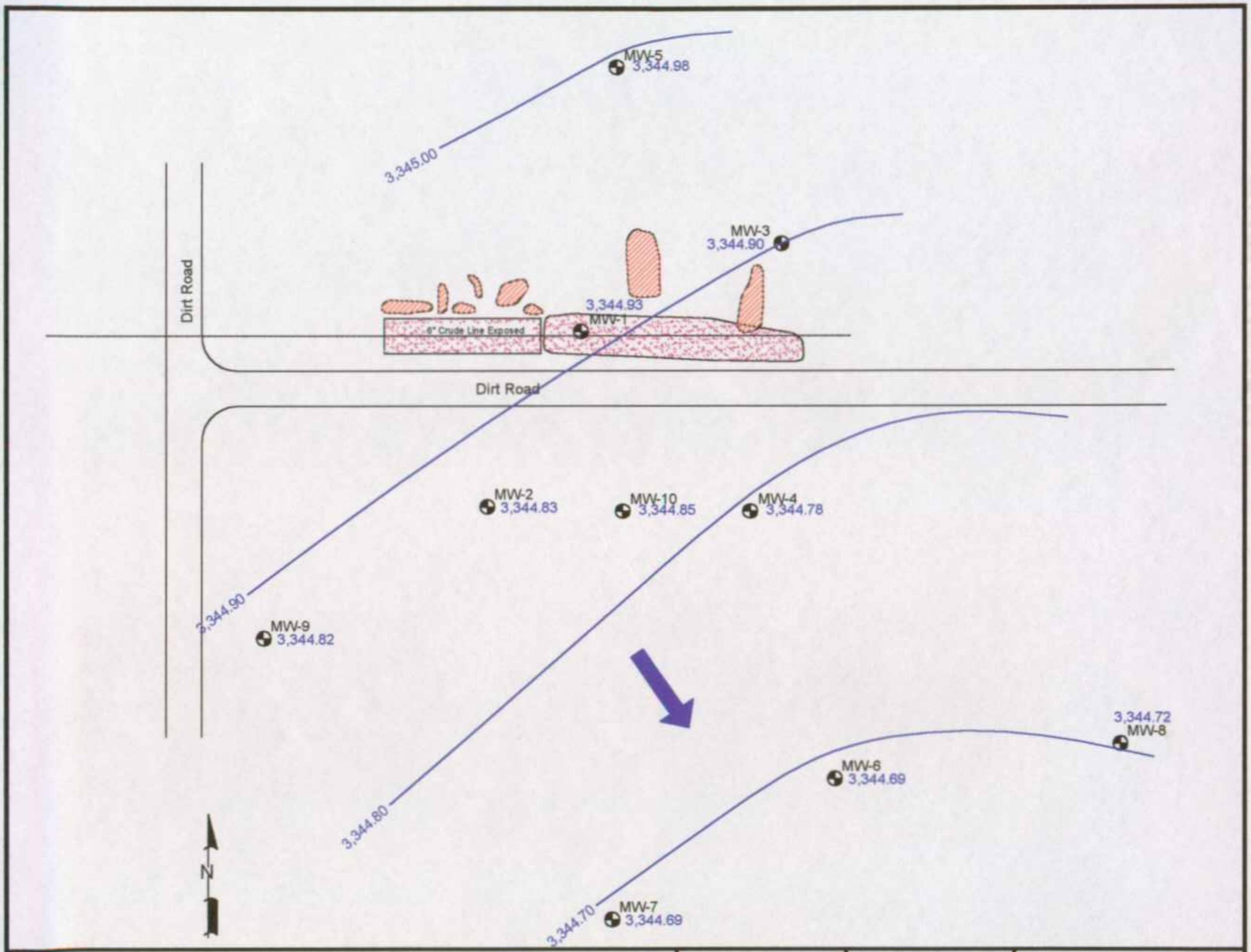
▨ Excavation Backfilled

Figure 2
Site Map

TNM 98-05A
Lea County, NM

Environmental Technology
Group, Inc.

Scale: 1" = 80'	Prep By: RS	Checked By: JN
September 28, 1999	ETGI Project # EOT 1026C	



LEGEND:

- ● Existing Monitoring Wells
- ▨ Stockpile Soil
- ➡ Inferred Ground Water Flow Direction
- ▨ Excavation Backfilled
- — Inferred Ground Water Gradient Contours
- 3,344.69 Ground Water Elevations

Figure 3
Inferred Ground Water Contours 10/29/99

TNM 98-05A
Lea County, NM

Environmental Technology Group, Inc.

Scale: 1" = 80'	Prep By: RS	Checked By: JN
September 28, 1999	ETGI Project # EOT 1026C	

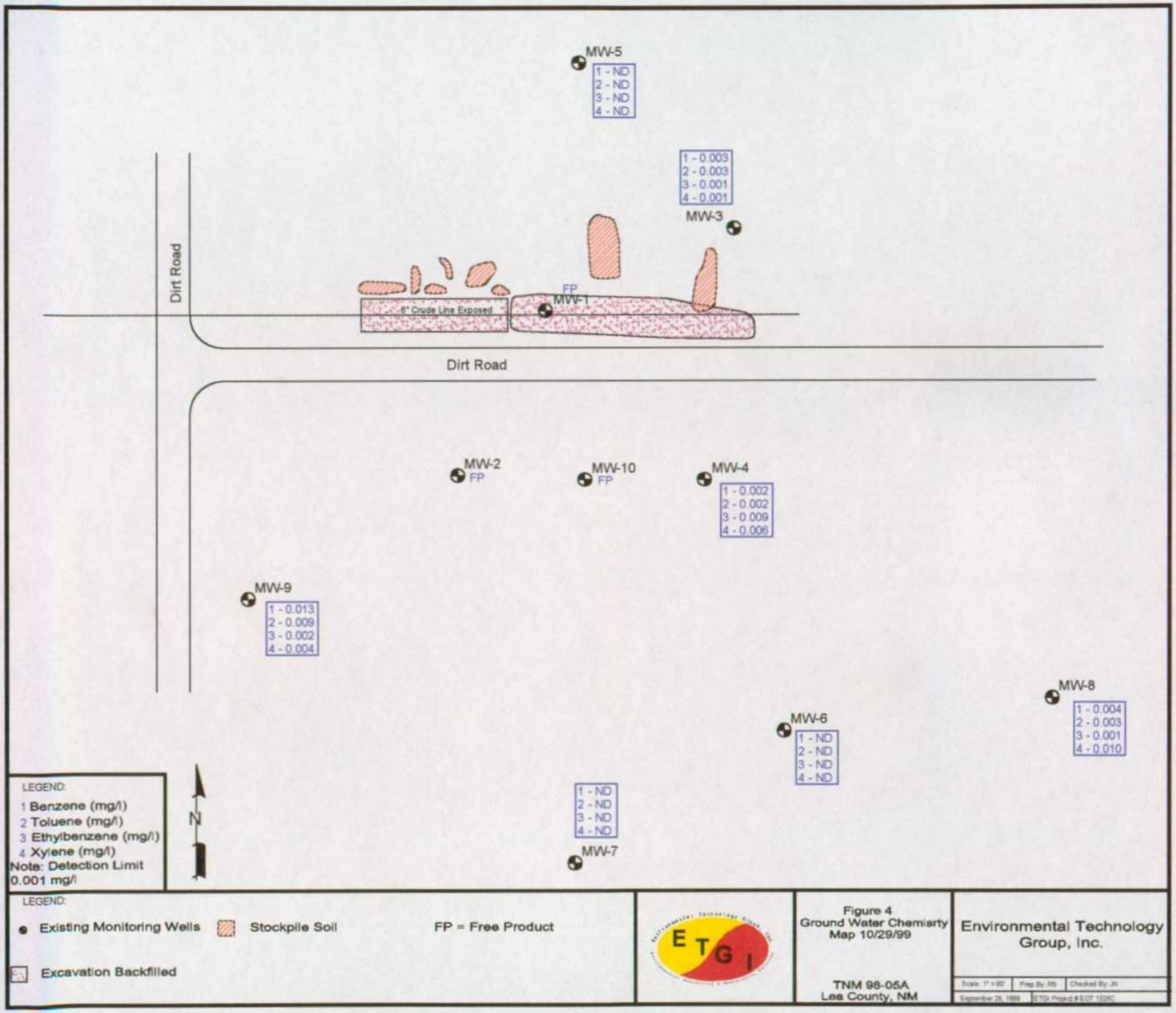


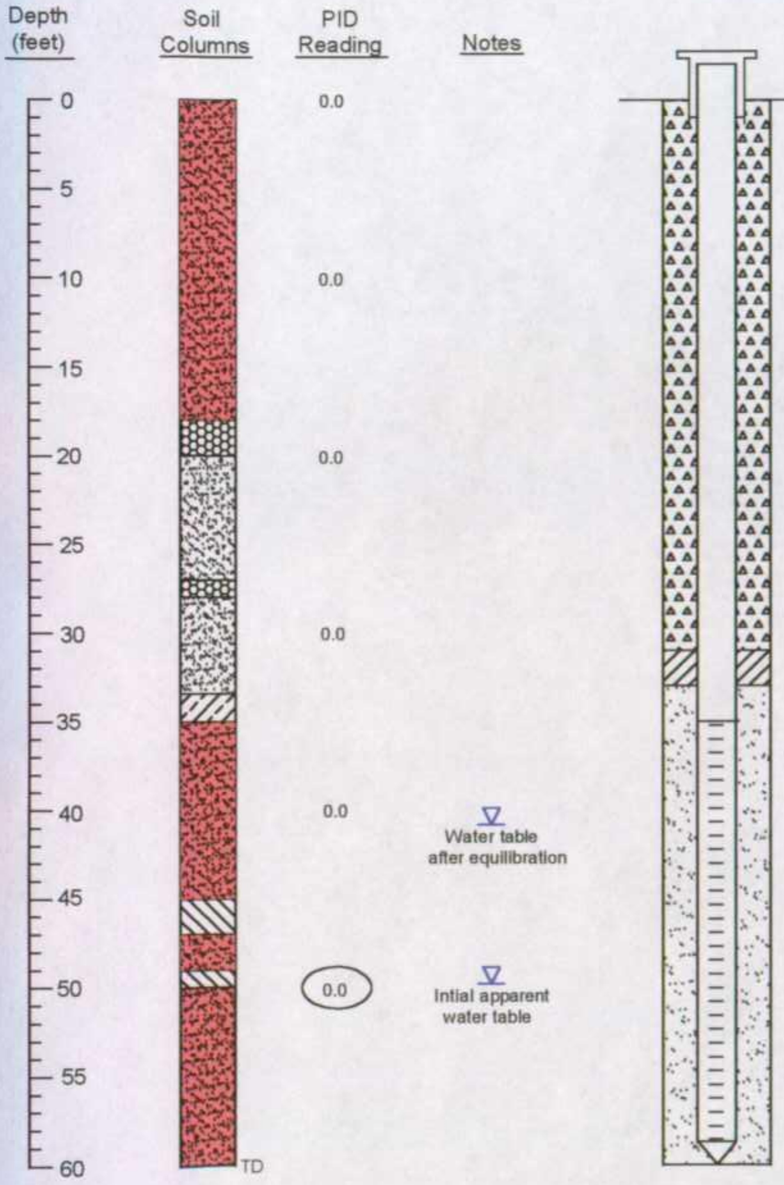
Figure 4
Ground Water Chemiarty
Map 10/29/99

TNM 98-05A
Lea County, NM

Environmental Technology
Group, Inc.

APPENDIX A

Monitoring Well MW-5



Monitoring Well Details

Date Drilled	10 - 25 - 99
Thickness of Bentonite Seal	2.0 ft
Lenght of PVC Well Screen	25 ft
Depth of PVC Well	60 ft
Depth of Exploratory Well	63 ft
Depth to Ground Water	50 / 44 ft

○ Indicates samples selected for laboratory analysis.

▨ Grout Surface Seal

▨ Bentonite Pellet Seal

▨ Sand Pack

☰ Screen

Legend

🟥	Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules.
☐	Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules.
▨	Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability.
▨	Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.
▦	Caliche
▼	Indicates the PSH level measured on date.
▽	Indicates the ground water level measured on date.
PID	Head-space reading in ppm obtained with a photo-ionization detector.
ND	Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

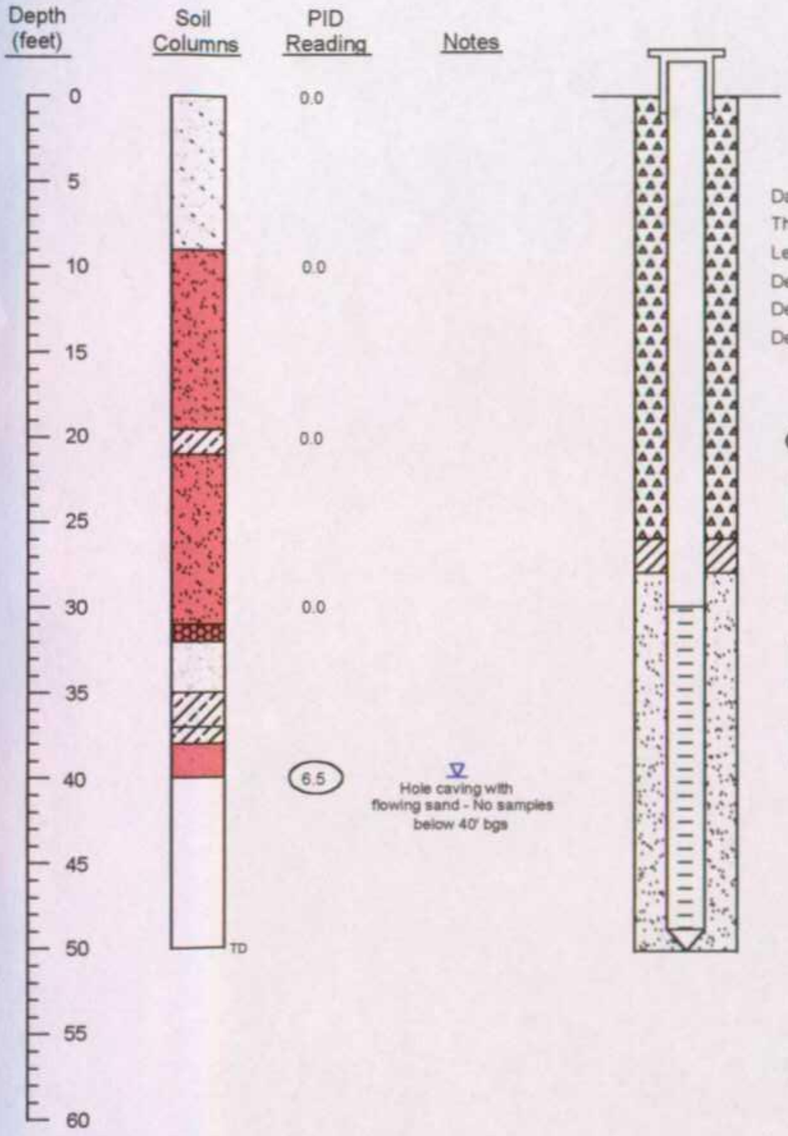
Monitoring Well - 5

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

Monitoring Well MW-6



Monitoring Well Details

Date Drilled	10 - 25 - 99
Thickness of Bentonite Seal	2.0 ft
Lenght of PVC Well Screen	20 ft
Depth of PVC Well	50 ft
Depth of Exploratory Well	50 ft
Depth to Ground Water	42 ft

○ Indicates samples selected for laboratory analysis.

▨ Grout Surface Seal

▨ Bentonite Pellet Seal

▨ Sand Pack

▤ Screen

Legend

🟥 Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules.

☐ Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules.

▨ Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability.

▨ Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.

▦ Caliche

▼ Indicates the PSH level measured on date.

▽ Indicates the ground water level measured on date.

PID Head-space reading in ppm obtained with a photo-ionization detector.

ND Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

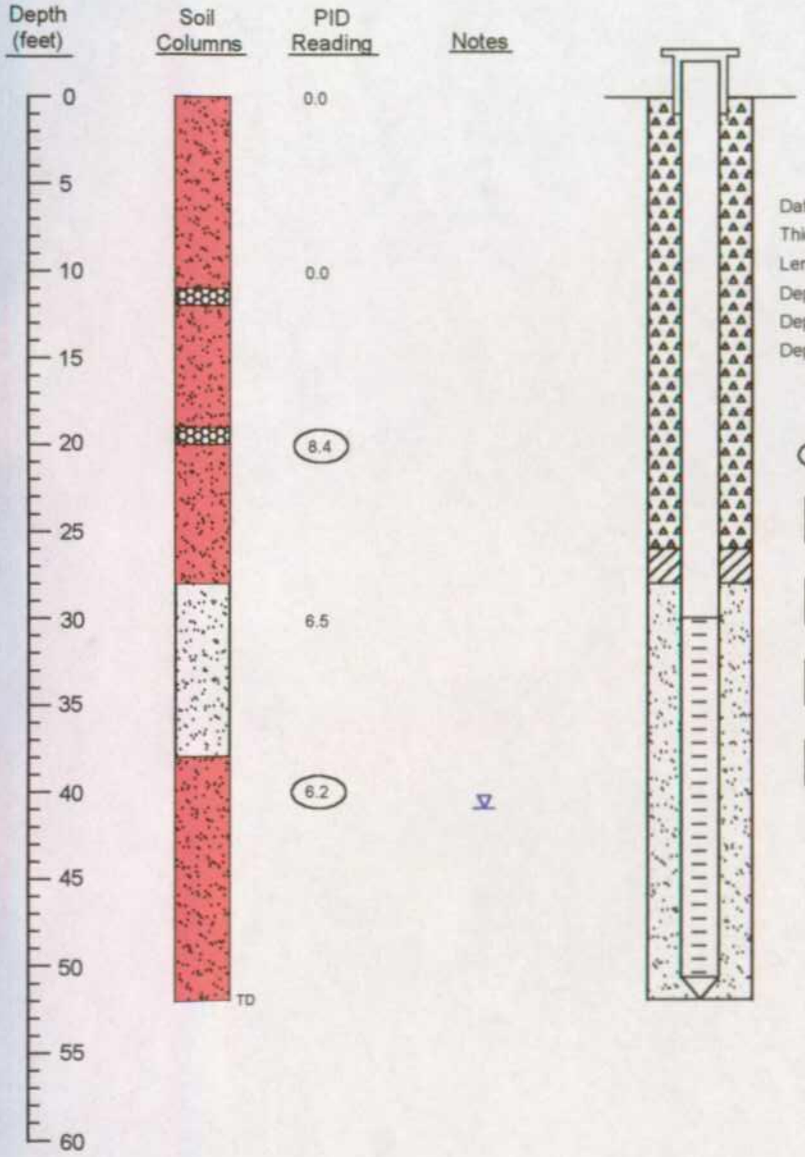
Monitoring Well - 6

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

Monitoring Well MW-7



Monitoring Well Details

Date Drilled 10 - 25 - 99
Thickness of Bentonite Seal 2.0 ft
Lenght of PVC Well Screen 20 ft
Depth of PVC Well 54 ft
Depth of Exploratory Well 54 ft
Depth to Ground Water 42 ft

○ Indicates samples selected for laboratory analysis.

▽ Grout Surface Seal

▨ Bentonite Pellet Seal

░ Sand Pack

☰ Screen

Legend

🟥 Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules.

░ Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules.

▨ Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability.

▧ Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.

▦ Caliche

▼ Indicates the PSH level measured on date.
∇ Indicates the ground water level measured on date.
PID Head-space reading in ppm obtained with a photo-ionization detector.
ND Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

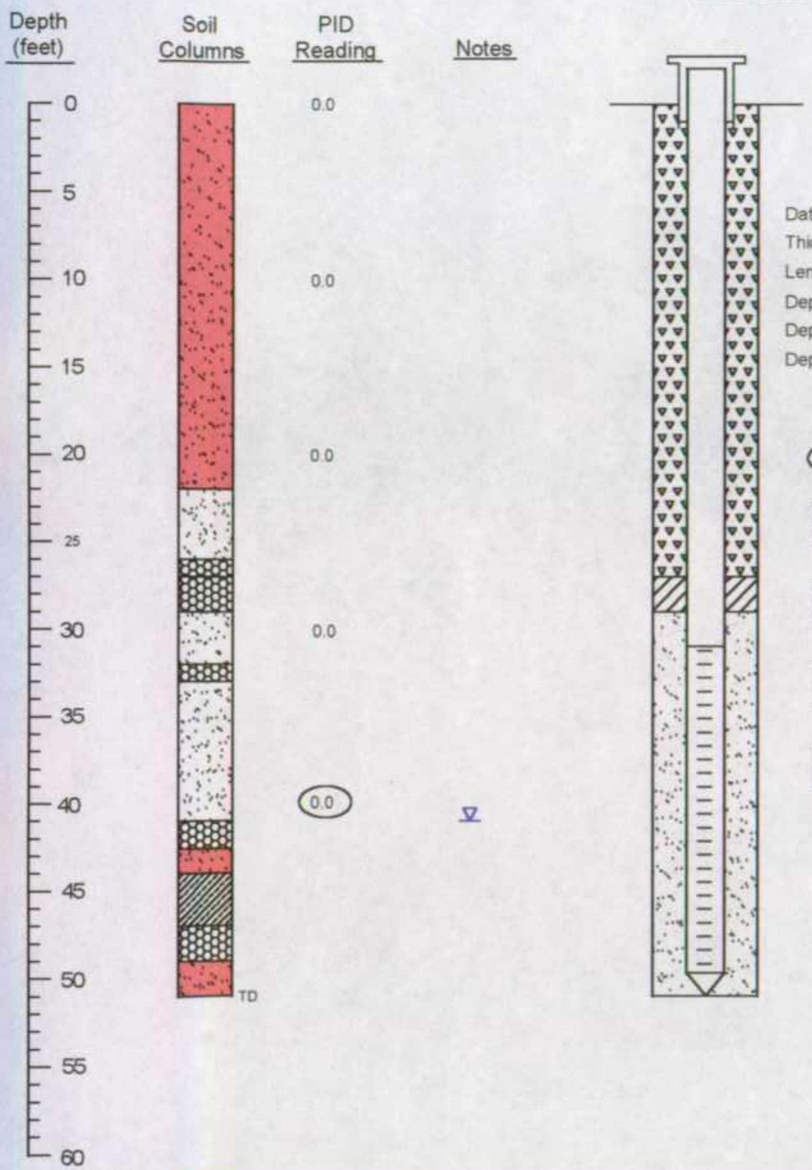
Monitoring Well - 7

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

Monitoring Well MW-8



Monitoring Well Details

Date Drilled 10 - 26 - 99
Thickness of Bentonite Seal 2.0 ft
Lenght of PVC Well Screen 20 ft
Depth of PVC Well 52 ft
Depth of Exploratory Well 52 ft
Depth to Ground Water 42 ft

○ Indicates samples selected for laboratory analysis.

▿ Grout Surface Seal

▨ Bentonite Pellet Seal

░ Sand Pack

☰ Screen

Legend

🟥 Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules

░ Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules

▨ Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability

▧ Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.

▦ Caliche

▼ Indicates the PSH level measured on date.
▽ Indicates the ground water level measured on date.
PID Head-space reading in ppm obtained with a photo-ionization detector.
ND Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

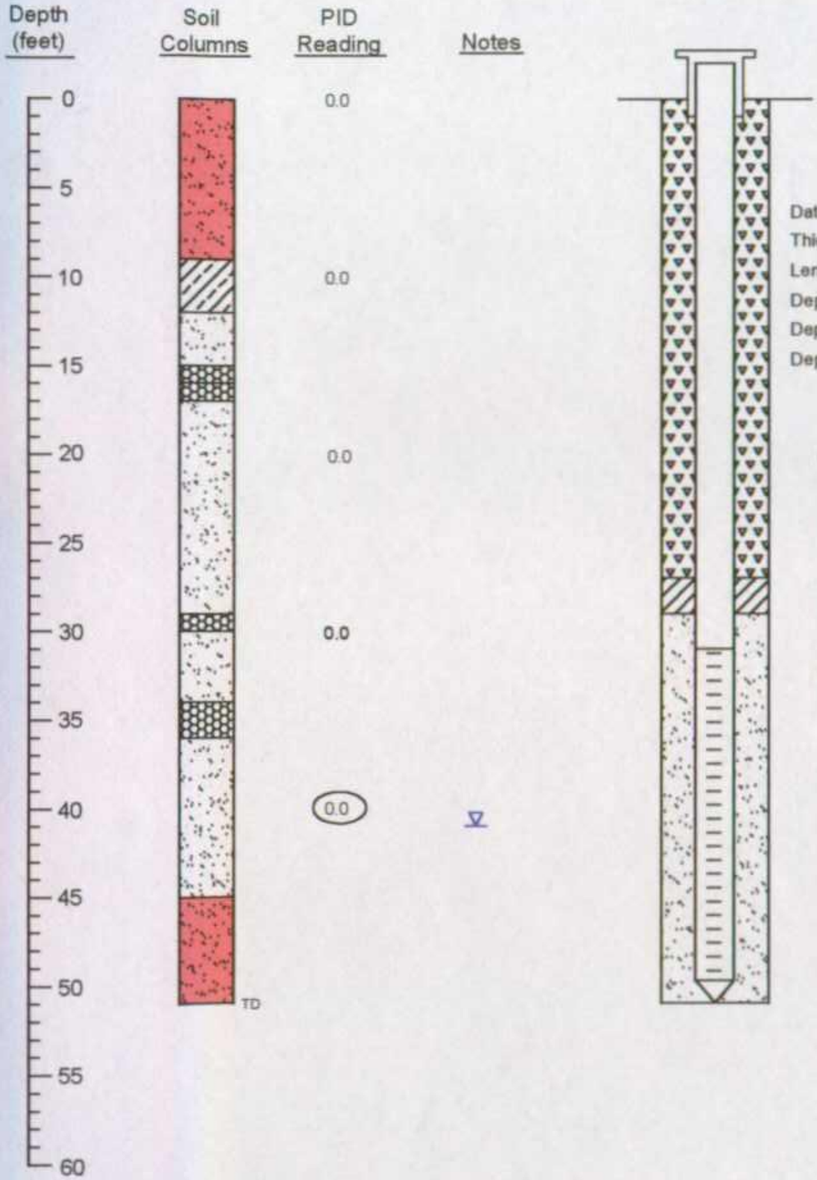
Monitoring Well - 8

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

Monitoring Well MW-9



Monitoring Well Details

Date Drilled	10 - 26 - 99
Thickness of Bentonite Seal	2.0 ft
Lenght of PVC Well Screen	20 ft
Depth of PVC Well	52 ft
Depth of Exploratory Well	52 ft
Depth to Ground Water	42 ft

○	Indicates samples selected for laboratory analysis.
▽	Grout Surface Seal
▨	Bentonite Pellet Seal
☐	Sand Pack
☰	Screen

Legend

🟥	Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules
☐	Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules
▨	Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability
▨	Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.
▦	Caliche

▼	Indicates the PSH level measured on date.
▽	Indicates the ground water level measured on date.
PID	Head-space reading in ppm obtained with a photo-ionization detector.
ND	Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

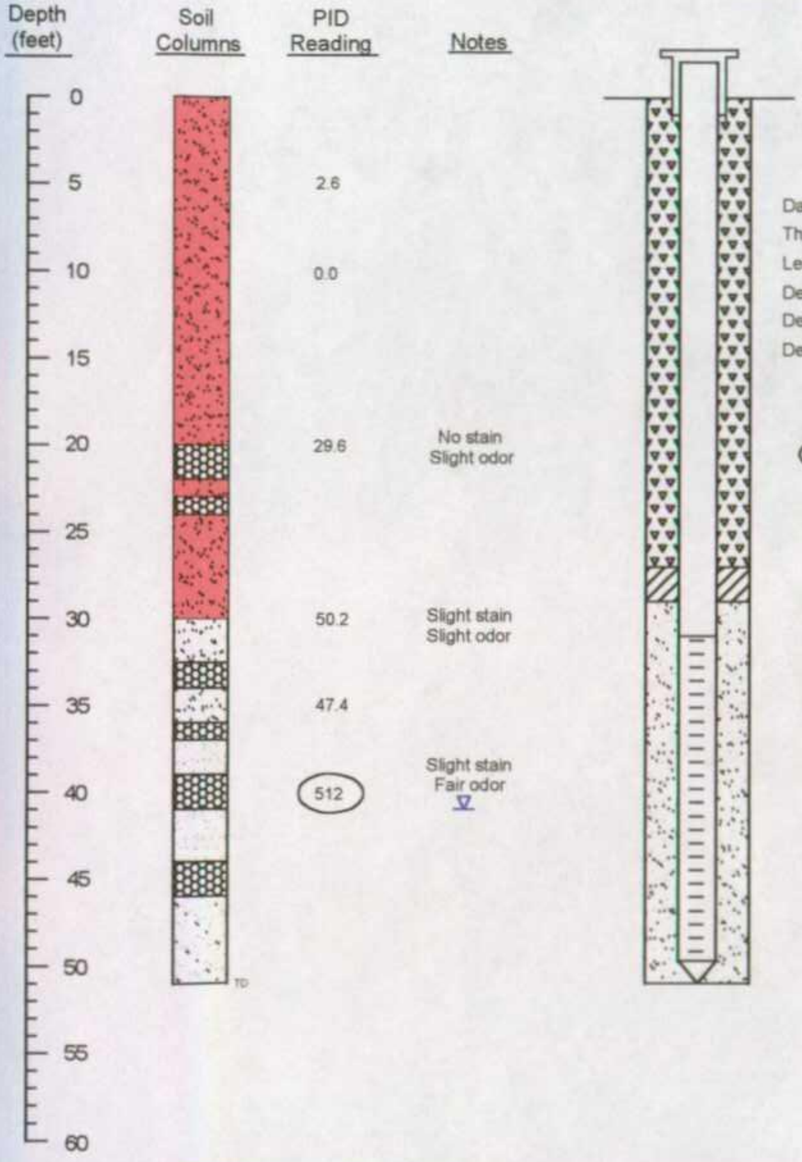
Monitoring Well - 9

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

Monitoring Well MW-10



Monitoring Well Details

Date Drilled	10 - 26 - 99
Thickness of Bentonite Seal	2.0 ft
Lenght of PVC Well Screen	20 ft
Depth of PVC Well	52 ft
Depth of Exploratory Well	52 ft
Depth to Ground Water	42 ft

○	Indicates samples selected for laboratory analysis.
▽	Grout Surface Seal
▨	Bentonite Pellet Seal
░	Sand Pack
☰	Screen

Legend

🟥	Sand - (SP) - Brown, Red, very fine grained, well sorted silty calcareous w/ caliche nodules.
░	Sand - (SP) - White, very fine grained well sorted, silty, calcareous w/ caliche nodules.
▨	Sandstone - Red, Brown, very fine grained, calcareous w/ caliche matrix, hard, low porosity, low permeability.
▧	Clay - (CL) - Brown, Tan, sandy, moist, grading to sand with clay matrix.
▦	Caliche
▼	Indicates the PSH level measured on date.
∇	Indicates the ground water level measured on date.
PID	Head-space reading in ppm obtained with a photo-ionization detector.
ND	Indicates the consfluent was not detected

Legend

1. The monitoring well was installed on date using air rotary dailing techniques.
2. The well was constructed with 2" ID, 0.010 inch jactory slotted, threaded joint, schedule 40 PVC pipe.
3. The well is protected with a locked slick up steel cover and a compression cap.
4. The lines between material types shown on the profile log represent approxiate boundaries. Actual transitions may be gradual.
5. The depths indicated are referenced from the ground surface.

Boring Log And Monitoring Well Details

Monitoring Well - 10

EOTT Energy Corp. TMN 98 - 05A Lea County, NM

Environmental Technology Group, Inc.

Scale: NTS	Prep By: RS	Checked By: JT
November 10, 1999	ETGI Project # EOT 1026C	

APPENDIX B

ENVIRONMENTAL
LAB OF , INC.

"Don't Treat Your Soil Like Dirt!"

ETGI
ATTN: MR. JESSE TAYLOR
P.O. BOX 4845
MIDLAND, TEXAS 79704
FAX: 915-520-4310
FAX: 505-392-3760(Ken Dutton)

Sample Type: Soil
Sample Condition: Intact/Iced
Project #: TNM 98-05A
Project Name: None Given
Project Location: Lea County, N.M.

Sampling Date: 10/25/99
Receiving Date: 10/30/99
Analysis Date: 11/01/99

ELT#	FIELD CODE	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYLBENZENE (mg/kg)	m,p-XYLENE (mg/kg)	o-XYLENE (mg/kg)
21144	MW-5 (50-52)	<0.100	0.122	<0.100	<0.100	<0.100
21145	MW-6 (38-40)	<0.100	<0.100	<0.100	<0.100	<0.100
21146	MW-7 (20-22)	<0.100	<0.100	<0.100	<0.100	<0.100
21147	MW-8 (38-40)	<0.100	<0.100	<0.100	<0.100	<0.100
21148	MW-9 (38-40)	<0.100	<0.100	<0.100	<0.100	<0.100
21149	MW-10 (40-42)	0.620	1.79	1.11	1.40	0.696
21150	MW-7 (40-42)	<0.100	<0.100	<0.100	<0.100	<0.100
	% IA	91	89	89	89	89
	% EA	93	86	88	88	89
	BLANK	<0.100	<0.100	<0.100	<0.100	<0.100

METHODS: SW 846-8021,5030

Raland K. Tuttle

11-5-99
Date

ENVIRONMENTAL
LAB OF , INC.

"Don't Treat Your Soil Like Dirt!"

ETGI
ATTN: MR. JESSE TAYLOR
P.O. BOX 4845
MIDLAND, TEXAS 79704
FAX: 505-392-3760 (Ken Dutton)
FAX: 915-520-4310

Sampling Date: 10/25/99
Receiving Date: 10/30/99
Analysis Date: 11/01/99

Sample Type: Soil
Sample Condition: Intact/Iced
Project #: TNM 98-05A
Project Name: None Given
Project Location: Lea County, N.M.

ELT#	FIELD CODE	GRO C6-C10 mg/kg	DRO >C10-C25 mg/kg
21144	MW-5 (50-52)	<10	29
21145	MW-6 (38-40)	<10	<10
21146	MW-7 (20-22)	<10	<10
21147	MW-8 (38-40)	<10	<10
21148	MW-9 (38-40)	<10	<10
21149	MW-10 (40-42)	271	444
21150	MW-7 (40-42)	<10	<10
	% INSTRUMENT ACCURACY	115	106
	% EXTRACTION ACCURACY	115	104
	BLANK	<10	<10

Methods: EPA SW 846-8015M GRO/DRO

Raland K Tuttle
Raland K.Tuttle

11-5-99
Date

Environmental Lab of Texas, Inc. 12600 West I-20 East Odessa, Texas 79763
(915) 563-1800 FAX (915) 563-1713

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

COC: 027

Project Manager: Jesse Taylor
Phone #: (915) 664-9166
FAX #: (915) 520-4310
Company Name & Address: ETGI
P.O. BOX 4845 MIDLAND TX 79704
Project #: TNM 98-05A
Project Name : ——
Project Location: LEA COUNTY NM
Sampler Signature: Ken Dutton

ANALYSIS REQUEST

LAB # (LAB USE ONLY)	FIELD CODE	# CONTAINERS	Volume/Amount	MATRIX: WATER	MATRIX: SOIL	MATRIX: AIR	MATRIX: SLUDGE	MATRIX: OTHER	PRESERVATIVE METHOD: HCL	PRESERVATIVE METHOD: HNO3	PRESERVATIVE METHOD: ICE	PRESERVATIVE METHOD: NONE	PRESERVATIVE METHOD: OTHER	SAMPLING: DATE (1999)	SAMPLING: TIME	BTEX 8020/[redacted]	TPH 418.1	TCLP Metals Ag As Ba Cd Cr Pb Hg Se	Total Metals Ag As Ba Cd Cr Pb Hg Se	TCLP Volatiles	TCLP Semi Volatiles	TDS	RCI	TPH 8015 DRO/GRO
	MW-5 (50'52)	1	4oz		X						X			10-25	0900	X								X
	MW-6 (38'-40)	1												10-25	1015									
	MW-7 (20-22')	1												10-25	1130									
	MW-8 (38-40)	1												10-26	0910									
	MW-9 (38'-40)	1												10-26	1620									
	MW-10 (40-42)	1												10-26	1300									
	MW-7 (40'-42)	1												10-25	1150									

Relinquished by:	Date:	Time:	Received by:
Ken Dutton	30 OCT 99	1420	Roland K
			Received by Laboratory:

REMARKS
FAX Results to
Ken Dutton @
(505) 392-3760

INVOICE: LENNAH FROST PO1015M

ENVIRONMENTAL LAB OF , INC.

"Don't Treat Your Soil Like Dirt!"

ENVIRONMENTAL TECHNOLOGY GROUP, INC.
ATTN: MR. JESSE TAYLOR
P.O. BOX 4845
MIDLAND, TEXAS 79704
FAX: 505-392-3760

Sample Type: Water
Sample Condition: Intact/ Iced/HCl
Project #: TNM 98-05A
Project Name: EOT 1015C
Project Location: Eunice, N.M.

Sampling Date: 11/29/99
Receiving Date: 12/02/99
Analysis Date: 12/2 & 12/3/99

ELT#	FIELD CODE	BENZENE (mg/L)	TOLUENE (mg/L)	ETHYLBENZENE (mg/L)	m,p-XYLENE (mg/L)	o-XYLENE (mg/L)
21930	MW-3	0.003	0.003	0.001	0.001	<0.001
21931	MW-4	0.002	0.002	0.009	0.005	0.001
21932	MW-5	<0.001	<0.001	<0.001	<0.001	<0.001
21933	MW-6	<0.001	<0.001	<0.001	<0.001	<0.001
21934	MW-7	<0.001	<0.001	<0.001	<0.001	<0.001
21935	MW-8	0.004	0.003	0.001	0.002	<0.001
21936	MW-9	0.013	0.009	0.002	0.003	0.001

% IA	101	96	97	97	95
% EA	96	95	96	97	96
BLANK	<0.001	<0.001	<0.001	<0.001	<0.001

METHODS: EPA SW 846-8021B,5030

Raland K Tuttle
Raland K. Tuttle

12-7-99
Date

Environmental Lab of Texas, Inc.

12600 West I-20 East Odessa, Texas 79763
(915) 563-1800 FAX (915) 563-1713

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

044

Project Manager: Jesse Taylor

Phone #: (915) 164-9166

FAX #: (505) 392-3760

Company Name & Address: ETGI
PO BOX 4845 Midland TX 79704

Project# NAME: TNM 98-05A

Project [redacted]: # EOT 1015C

Project Location: Eunice, NM

Sampler Signature: Simon Casas

LAB # (LAB USE ONLY)	FIELD CODE	# CONTAINERS	Volume/Amount	MATRIX: WATER	SOIL	AIR	SLUDGE	OTHER	PRESERVATIVE METHOD: HCL	HNO3	ICE	NONE	OTHER	SAMPLING: DATE 1999	TIME
21930	MW 3	2	✓	X					X		X			11-29	1450
21931	MW 4	2	✓												1435
21932	MW 5	5	✓.5 ✓L												1338
21933	MW 6	6													1423
21934	MW 7	5													1414
21935	MW 8	5													1440
21936	MW 9	5	↓	↓					↓		↓			↓	1400

ANALYSIS REQUEST

LAB #	BTEX 8112(1) [redacted]	TPH 418.1	TCLP Metals Ag As Ba Cd Cr Pb Hg Se	Total Metals Ag As Ba Cd Cr Pb Hg Se	TCLP Volatiles	TCLP Semi Volatiles	TDS (160.1)	RCI	Anions (300.0)	Cations (6010) SM 4500 CO2D	PAH (8100) or (8270)	Heavy Metal ICP scan (6010)
21930	X											
21931												
21932							X		X	X	X	X
21933												
21934												
21935												
21936	↓						↓		↓	↓	↓	↓

Relinquished by: Simon Casas	Date: 12-2-99	Time: 0900	Received by:
Relinquished by:	Date:	Time:	Received by:
Relinquished by:	Date: 12-7-99	Time: 1320	Received by Laboratory:

REMARKS: Mail Results - K. Dutton

Invoice : Lennah Frost 1015M