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MONITORING WELL INSTALLATION, GROUND WATER SAMPLING AND BIOVENTING PILOT TEST

BLOOMFIELD CRUDE STATION

BLOOMFIELD, NEW MEXICO

Prepared for:

GIANT INDUSTRIES ARIZONA, INC.

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Project 6171

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Executive Summary

This report summarizes the data collected and chronicled in various reports since 1994 during soil and ground water site investigations at Giant Industries Arizona, Inc.'s (Giant) former Crude Station in Bloomfield, New Mexico. Site activities have resulted in the installation of five ground water monitoring wells MW-1 through MW-5 during 1994 and 1995, and the excavation of over 12,924 cubic yards of hydrocarbon impacted soil in 2000. Hydrocarbon impacted soil and ground water appeared to be related to Giant's crude oil storage operations associated with a former 55,000-barrel steel tank designated 967-D. Impacted soil above New Mexico Oil Conservation Division standards remain at the Crude Station. The current investigation described herein included the following activities:

- The installation of two additional off-site ground water monitoring wells, MW-6 and MW-7,
- ground water sampling and analysis for benzene, toluene, ethyl benzene, xylene (BTEX), major ions, and total dissolved solids (TDS), from all monitoring wells and the preparation of a new potentiometric surface contour map,
- a bioventing pilot test completed in June 2001 to look at the feasibility of hydrocarbon removal through in-situ bioremediation, and
- a historical record search to acknowledge the existence of additional sites adjacent to and in the near vicinity of this site.

Ground water elevation measurements and ground water samples were collected from monitoring wells MW-3 through MW-5 on May 10, 2001. Giant abandoned monitoring well MW-1 during the excavation of the tank pad in August 2000 and monitoring well MW-2 was not sampled due to phase separated hydrocarbons (PSH) within the well. Monitoring wells MW-6 and MW-7 were installed on May 17, 2001 and developed on May 21, 2001 and the ground water was sampled on May 23, 2001. New Mexico Water Quality Control Commission (WQCC) BTEX constituents were not detected in the ground water from MW-3, MW-4, and MW-5. WQCC benzene standards were exceeded in the ground water samples collected from MW-6 and WQCC standards for benzene and xylenes were exceeded in the ground water samples collected from MW-7. WQCC standards for total dissolved solids were exceeded in all montioring wells including upgradient well MW-3. The WQCC standard for chloride was exceeded in MW-3 only. Sulfate concentrations are also above the WQCC standard at all locations sampled. In general, the ground water at the site is unsuitable for domestic supply, due to high concentrations of both sulfate and total dissolved solids (TDS). Toluene was not detected in the ground water from MW-7 which is uncharacteristic of onsite impacted ground water from MW-2 based on historical data. This may indicate a potentially different hydrocarbon source of impact for each of the wells.

The ground water at the site appears to flow to approximately forty-five degrees south of west at approximately 0.015-ft/ft gradient and has not changed with the addition of new data from MW-6 and MW-7. MW-7 does not appear to be directly downgradient of Giant's operations.

Giant initiated the bioventing pilot test on June 20, 2001 by injecting air into three levels within the vadose zone. Oxygen, carbon dioxide, and volatile hydrocarbon concentrations in the soil gas from within the pore space in each zone was monitored. Air injection ceased on June 21, 2001 and respiration rates of the biologic activity were monitored for an additional five days through June 26, 2001. The 14 percent decrease in oxygen along with the 50 percent increase in carbon dioxide concentrations measured in the soil gas during the five days following the air-injection, indicates significant biologic activity at the site. During the five days following the pilot test approximately nine-pounds of hydrocarbons were mineralized to carbon dioxide and water. Based upon the results of the pilot test, which indicate that the site has sufficient permeability to be a candidate for this treatment method, the proposed model is to implement bioventing for site restoration.

West of the former tank site is a City of Bloomfield Electrical Substation and two well sites (Jan Redding #1 and Cook #1E) owned and operated by Manana Gas. Historical research of this area indicate that several oil and possibly gas wells, and associated pits, may have once been operational in this area, such as the Bishop #1 and Bishop #3, the Hare #1, and the Kittell #1. The potential exists that these operations may have impacted in the ground water from monitoring well MW-7.

1.0 Introduction

This report summarizes the data collected and chronicled in various reports since 1994 during soil and ground water site investigations at Giant Industries Arizona, Inc.'s (Giant) former Crude Station in Bloomfield, New Mexico (Figure 1). The current investigation is centered on the following:

- The installation of two additional off-site ground water monitoring wells, MW-6 and MW-7.
- Ground water sampling and analysis for benzene, toluene, ethyl benzene, xylene (BTEX), major ions and total dissolved solids (TDS) and the preparation of a new potentiometric surface contour map.
- A bioventing pilot test completed in June 2001 to look at the feasibility of hydrocarbon removal through in-situ bioremediation.
- A historical record search to acknowledge the existence of additional sites adjacent to and in the near vicinity of this site.

The former crude station has previously been the focus of a subsurface investigation where activities have included the removal of a 55,000-barrel tank, numerous soil borings and sampling, installation of seven ground water monitoring wells, excavation and off-site land farming of hydrocarbon impacted soil, and ground water sampling. The area of focused investigation is where the former crude oil storage tank numbered 967-D was located. A more detailed historical account of the former Crude Station is in a report previously submitted to the New Mexico Oil Conservation Division (NMOCD) titled Comprehensive Report For The Bloomfield Crude Station, dated January 2000.

Ground water samples have been collected intermittently and submitted for laboratory analyses since 1994 from five ground water monitor wells (Figure 2), installed during 1994 and 1995. The laboratory results of samples collected from two of the three onsite ground water monitor wells demonstrated no detectable levels of benzene, toluene, ethyl benzene, or xylenes (BTEX), as summarized in Table 1 and Appendix A, which indicates that the ground water in the vicinity of these wells has not been impacted by petroleum hydrocarbons. The ground water monitor well located on the western perimeter of the site (MW-2) has exhibited phase-separated-hydrocarbons (PSH) since 1994 (Appendix B).

The ground water from the two-downgradient monitor wells has been sampled and submitted for laboratory analyses. Downgradient well, numbered MW-4 and MW-5 have exhibited no detectable levels of BTEX.

TABLE 1
SUMMARY OF GROUND WATER ANALYTICAL RESULTS FOR BTEX
1994-1999

NM WQCC Standards		Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	TPH (mg/l)
		10	750	750	620	None
MW-1 (see note)	Sep-94	NS	NS	NS	NS	NS
	Apr-95	NS	NS	NS	NS	NS
	Sep-99	NS*	NS*	NS*	NS*	NS*
	Dec-99	NS*	NS*	NS*	NS*	NS*
MW-2	Sep-94	640	600	82	690	5
	Apr-95	220	280	53	430	3
	Sep-99	NS**	NS**	NS**	NS**	NS**
	Dec-99	NS**	NS**	NS**	NS**	NS**
MW-3	Sep-94	ND	ND	ND	ND	ND
	Apr-95	ND	ND	ND	ND	ND
	Sep-99	ND	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND	ND
MW-4	Sep-94	2.1	ND	ND	1.2	ND
	Apr-95	ND	ND	ND	ND	ND
	Sep-99	ND	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND	ND
MW-5	Sep-94	NS	NS	NS	NS	NS
	Apr-95	ND	ND	ND	ND	NS
	Sep-99	ND	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND	ND

Note: MW-1 was not completed in ground water and was subsequently abandoned

ND = Not Detected
NS = Not Sampled
NS* = Insufficient sample volume
NS** = Sample not collected due to product in well

Laboratory analyses and field screening tests of soil samples collected on-site at various depths from 1994 through 2000, condensed into table-format and located in Appendix C, indicate various levels of hydrocarbon impact to the soil from slightly beneath ground surface down to seventeen-feet beneath ground surface (bgs). Select maps from historical reports have been included in Appendix D to reference previous sample activities.

The pilot test approved by the NMOCD and conducted by Giant during the week of June 18, 2001 involved an in-situ bioventing study. In-situ bioventing includes the delivery of oxygen through air movement in the soil pore spaces found above the water table. The impacted areas identified at this site are predominately located in the native soils above ground water, with the exception of the western edge of this site. This pilot test was accomplished by injecting ambient air through monitoring points screened at five-foot, ten-foot, and fifteen-foot bgs. The levels of oxygen, carbon dioxide, and volatile organic compounds were then monitored at each depth (shallow, intermediate, and deep) at the point of injection (BV1) and in a radius of ten-foot increments out to thirty-foot (Figure 3).

1.1 Physical Setting

Giant owns the property referred to as the former Crude Station on the southwest corner of Blanco Boulevard and Fifth Street in the City of Bloomfield, San Juan County, New Mexico. The site occupies approximately 5.5 acres within the N1/2, NW1/4, NW1/4 of Section 22, Township 29 North, Range 11 West. A regional location map is shown in Figure 1. A 55,000-barrel crude oil storage tank was previously located on this site within an earthen berm, which occupied approximately 100,000 square feet on the west side of the former Crude Station.

The geography, hydrogeology and geology of the site are described in a report previously submitted to the New Mexico Oil Conservation Division (NMOCD) titled Site Assessment for the Bloomfield Crude Station, dated May 1995.

The current physical setting at the site is an open excavated area where approximately 12,924 cubic yards of hydrocarbon impacted soil was removed and 6,048 cubic yards of clean backfill was replaced in August 2000. Ground water was encountered in the excavation at approximately 15 feet beneath ground surface. The excavation is double fenced and locked, one chain link fence surrounding the site perimeter and another chain link fence surrounding the excavation. The limits of excavation are shown in Figure 3.

The earthen berms that surrounded the former Tank 967D have been partially removed during the tank decommissioning in 1996 and during remedial excavation work in 2000. The berms were approximately 340-feet by 280-feet in size. As detailed in the October 2000 report, titled Report for Remedial Excavation - Work Performed During August 2000 For The Bloomfield Crude Station, the area beneath the western edge of the tank pad, exposed during excavation, exhibited the most highly impacted soils. The excavation began on the east side of the tank pad and proceeded to the west; midway across the tank pad PSH were observed on the ground water along the southern edge of the excavation. Test holes used to define the limits of migration indicated that "significant amounts of overburden" would have to be removed to excavate additional hydrocarbon impacted soil and excavation ceased. A portion of the center of the excavation was left open to allow Giant to recover PSH (Appendix D).

West of the former tank site is a City of Bloomfield Electrical Substation and two well sites (Jan Redding #1 and Cook #1E) owned and operated by Manana Gas (Figure 2). To the West of the electric substation and the Manana well sites, on the corner of North Frontier and Blanco Boulevard, is a vacant lot. What appears to be a monument, located on this lot, may indicate a previous well site that has been plugged and abandoned. Historical research of this area indicate that several oil and possibly gas wells, and associated pits, may have once been operational on this lot, such as the Bishop #1 and Bishop #3, the Hare #1, and the Kittell #1 (Figure 2).

1.2 Site Chronology

The former Crude Station has had numerous owners since the late 1920s. A ground water investigation was initiated by Giant, the current owner, in 1994. Giant has conducted soil and ground water investigations pursuant to decommissioning tank 967-D.

Background Information:

- The site was originally leased for oil exploration and production on September 6, 1929.
- Since 1929 the site has been owned and leased by several companies that operated various process units and tanks on or near the site, including refining operations. Aerex Refining, Plateau Refining, Shell Oil Company, El Paso Products, Malco, and Clayton Investment of Thriftway Marketing are known to have operated refining or other businesses on or near the property.
- Estimated date of construction for Tank 967-D was 1957.

- Tank 967-D was closed in 1994.
- Tank 967-D was removed in late 1995 through early 1996.
- Several buildings, a 10,000-bbl tank, and 2,500-bbl tank remain at the site (Appendix D).

A chronological listing of investigative and remedial activities from 1994 through 2000 is included in Appendix E for reference.

Current Activities:

- On May 17, 2001 the additional ground water monitoring wells, numbered MW-6 and MW-7, were installed. MW-6 was installed down-gradient of the site, south of the Manana well locations and MW-7 was installed cross-gradient of the site west of the Manana well location. (Figure 2, Appendix F)
- The newly installed ground water monitor wells, MW-6 and MW-7, were developed, according the NMOCD guidelines and specifications in the previous correspondence, on May 21, 2001.
- Monitor wells MW-6 and MW-7 were sampled, according the NMOCD guidelines and specifications in the previous correspondence, on May 23, 2001 (Appendix G).
- A new survey with the top of casing elevations was obtained, properly positioning and identifying each of the ground water monitor wells MW-2 through MW-7 with other surface features on May 31, 2001.
- Monitoring points were installed on June 12-13th for the bioventing pilot test (Appendix F).
- GEM initiated the pilot test on June 20, 2001 (Appendix H).
- A historical record search is initiated in order to acknowledge the existence of additional sites adjacent to and in the vicinity of this site (Appendix I).

2.0 Methods of Monitoring Well Installation, Ground Water Sampling and Biovent Pilot Test

Giant installed ground water monitor wells MW-6 and MW-7 on May 17, 2001, at the locations shown on Figure 2.

Ground water elevation measurements and ground water samples were collected from monitoring wells MW-3 through MW-5 on May 10, 2001. Giant abandoned monitoring well MW-1 during the excavation of the tank pad in August 2000 and Monitoring well MW-2 was not sampled due to PSH within the well. Monitoring wells MW-6 and MW-7 were developed on May 21, 2001 and the ground water was sampled on May 23, 2001. The elevations at the top of casing on all of the monitoring wells were surveyed on May 30, 2001.

Giant initiated the bioventing pilot test on June 20, 2001 by injecting air into three levels within the vadose zone. Oxygen, carbon dioxide, and volatile hydrocarbon concentrations from within the pore space of the soil in each zone was monitored. Air injection ceased on June 21, 2001 and respiration rates of the biologic activity were monitored for an additional five days, through June 26, 2001.

2.1 Monitor Well Installation

Giant installed and developed ground water monitoring wells MW-6 and MW-7 at the locations shown on Figure 2. Boreholes for MW-6 and MW-7 were completed using a CME 75-drill rig equipped with 4.25-inch inside-diameter hollow-stem augers. Drilling equipment and sampling tools were decontaminated prior to use at each boring location. Decontamination included cleaning the drilling equipment with an Alconox™ soap solution followed by a potable water rinse.

Golden Environmental Management's (GEM's) field geologist described the lithology of the soil at each well location on individual "Record of Subsurface Exploration" forms, included in Appendix F. The borings were advanced to approximately 10-feet beyond where ground water was first encountered. Fifteen feet of well screen was placed across the water table interface with approximately 5 feet of the well screen above the water table and 10-feet of the well screen below the water table. The annular space was filled with 10-20 grade silica sand surrounding the well screen to approximately 3-feet above the top of the screen. Bentonite chips (3/8-inch), hydrated with 5 gallons of potable

water, filled the annular space 2-feet above the sand pack. The remaining annular space was grouted to the surface using a neat cement slurry containing approximately 5-percent bentonite. Each well was fitted with locking caps and set in a flush-to-surface vault in a concrete pad that is sloped to drain water away from the well. Details of well construction are given on the "Well Installation Records" included in Appendix F.

Monitoring wells MW-6 and MW-7 were developed on May 21, 2001, by dropping a Teflon™ bailer inside the well to surge water back and forth through the well screen. Five- gallons of potable water was introduced into monitoring well MW-6 due to the low yield and high clay content of the formation. Following removal of potable water and surging, the wells were bailed until the produced water was free of sediment and a minimum of three casing volumes of ground water was removed. Well development information for both wells was recorded on "Well Development and Purging Data" forms, included in Appendix G.

2.2 Ground Water Sampling

The ground water from monitoring wells MW-3, MW-4, and MW-5 was purged and sampled, and submitted for laboratory analysis on May 10 and 11, 2001. On May 23, 2001, more than 24 hours after the wells were developed, the ground water from MW-6 and MW-7 was purged, sampled, and submitted for laboratory analysis. The pH, temperature and electric conductivity were measured during purging. The wells were considered purged when ground water samples bailed from the wells was no longer silty and the temperature, pH, and conductivity readings stabilized (Appendix G).

Ground water samples were collected in pre-preserved, 40-milliliter (ml) glass volatile organic analysis vials (VOA vials) with Teflon™-lined caps for analysis by EPA Methods 8021 modified for aromatic hydrocarbons. Two additional pre-preserved VOA vials were filled for analysis for total petroleum hydrocarbons by EPA Method 8015 Modified at MW-3, MW-4, and MW-5. These samples were stored on ice and transported for analysis to Pinnacle Laboratories located in Albuquerque, New Mexico following strict chain-of-custody procedures.

A one-gallon plastic bottle was filled with ground water for analysis of major cations and anions, TDS and an ion balance by various EPA methods. These samples were stored on ice and transported for analysis to Inter-Mountain Laboratories located in Farmington, NM following strict chain-of-custody procedures. Water sampling data were recorded on "Well Development and Purging Data" forms included in Appendix G.

United Field Services of Farmington, New Mexico surveyed the top-of-casing elevations at all monitoring wells and plotted the well locations on a 1-inch equals 100-feet scale 50-foot by 50-foot grid map.

The depth to the top of ground water was measured and each well was checked for the presence of PSH several times during May and July of 2001 using a KECK™ oil/water interface probe. Depth-to-water measurements were subtracted from the top of casing elevations for each well to determine the elevation of the potentiometric surface. The potentiometric surface where PSH were found was calculated using product density of 0.7 water. The potentiometric surface elevation data was plotted on the site map and whole number isoelevation contours interpolated between wells. A table that comprehensively summarizes the ground water elevations is included in Appendix J.

2.3 Bioventing Pilot Test

To conduct the pilot test, four three-level monitoring points were installed using a hand auger. Soil samples from five-foot intervals were collected and screened using standard headspace techniques. The monitoring points were installed in a line ten feet apart as shown on Figure 3. Each monitoring point was constructed of one-inch diameter polyvinyl chloride (PVC) pipe, with one foot of .010-inch slotted screen, and an end cap. As described on the on the "Record of Subsurface Exploration" and the "Monitor Well Installation" forms in Appendix F, four-inch diameter borings were advanced to approximately sixteen-feet bgs and the deep monitoring points were installed with the screen placed from fourteen- to fifteen-feet bgs. A 10-20 grade silica sand was placed in the deep interval surrounding the screen to approximately one-foot above the screen. A one-foot thick quick-gel (bentonite) plug was placed above the sand. Additional 10-20 grade silica sand was then placed to the level the intermediate monitoring points were installed. The sand filled the annular space to one-foot above the intermediate screen set from ten- to eleven-foot bgs. Quick-gel was placed above the intermediate interval sand pack to a thickness of 1-foot. The shallow monitoring points (third interval) was then installed with 10-20 grade silica sand one-foot above shallow level screen, from five- to six-feet bgs. Quick-gel was placed from the top of the sand pack to the ground surface. The quick-gel were hydrated at each interval by pouring one gallon of potable water into the intermediate and shallow monitoring points.

To initiate the pilot test a rotary vane air compressor, capable of supplying enough air to exchange the soil pore space gas a minimum of once every 24 hours, was attached to a manifold that connected the shallow, intermediate and deep screens at bioventing

monitoring point numbered BV-1. The flow rate was adjusted by a series of valves on the manifold as shown in Picture 1 located in Appendix K. Air flow to each screened interval was continuously measured by inline King ™ air flow meters with a flow range of 4 to 40 standard cubic feet per minute (scfm).

Soil permeability was observed by measuring flow conditions experienced during the injection startup. The following flow rates were observed according to the combination of open and closed valves:

- With all valves open, the airflow followed the path of least resistance into the shallow zone at 20-scfm.
- When the valves to the shallow and intermediate zones were closed, flow to the deep zone was measured at 17-scfm.
- With the valves to the shallow zone closed and the intermediate and deep zones open, the final airflow was measured at 8-scfm to the intermediate zone and 9-scfm to the deep zone.

Once air injection was initiated, carbon dioxide, oxygen, and ionizable hydrocarbon concentrations were collected from each level of the monitoring points numbered BV-2, BV-3 and BV-4 (Figure 3).

Immediately after air injection ceased, pressure readings from each monitoring point depth were collected using magnehelic gauges. Measurements were recorded continuously until the pressure at each level returned to atmospheric pressure. Once the pressure stabilized, the carbon dioxide, oxygen, and ionizable hydrocarbon measurements from each monitoring point resumed and continued for approximately five days.

3.0 Results

Concentrations of BTEX were not detected in the ground water from MW-3, MW-4, and MW-5. Slightly elevated concentrations of benzene was detected in the ground water samples collected from MW-6 and elevated benzene and xylenes were found in the ground water samples collected from MW-7.

The ground water at the site appears to flow to approximately forty-five degrees south of west at approximately 0.015-ft/ft gradient (Figure 4).

Changes in the concentrations of oxygen, carbon dioxide, and hydrocarbons were recorded during the pilot test at all monitoring points.

3.1 Ground Water Monitoring

Laboratory analytical results indicate concentrations of BTEX above the NMWQCC standards in ground water samples collected from MW- 6 and MW-7 during the May 2001 ground water sampling. BTEX was not detected in the in the ground water samples collected from MW-3, MW-4, and MW-5. Laboratory results are summarized below in Table 2 and the laboratory analytical reports are included in Appendix L.

TABLE 2
GROUND WATER SAMPLING MAY 2001 BTEX ANALYTICAL RESULTS

Well	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Total Xylenes µg/L
MW-3	<0.5	<0.5	<0.5	<0.5
MW-4	<0.5	<0.5	<0.5	<0.5
MW-5	<0.5	<0.5	<0.5	<0.5
MW-6	12	15	13	83
MW-7	2,400	<10	380	2,800
NMWQCC Standards	10	750	750	620

µg/L = micrograms per liter NMWQCC = New Mexico Water Quality Control Commission Results that exceed NMWQCC standards are in bold

The results of the general chemistry analysis indicate high conductivity [2,160 microhms per centimeter (µmhos/cm) to 7,000 µmhos/cm] in all of the samples. Total dissolved solids (TDS) were also found to be high (1,710 mg/L to 5,230 mg/L) in samples from

MW-2, MW-3 (upgradient), MW-4, MW-5, MW-6 and MW-7. The NMWQCC standard for TDS in a domestic water supply is 1,000 mg/L. These results indicate a poor quality of ground water for potable use. The samples from all of the wells exceed the NMWQCC domestic water supply standard for sulfate. The standard for sulfate is 600 mg/L, MW-3 (upgradient), MW-4, MW-5, MW-6, and MW-7 samples contained 2,250 mg/L, 2,680 mg/L, 1,230 mg/L, 2,780 mg/L and 642 mg/L respectively. The sample taken from MW-3 contained 1,320 mg/L chloride, which exceeds the NMWQCC domestic water supply standard for chloride of 250 mg/L. These results are shown in Table 3 and on the laboratory analytical reports in Appendix L.

TABLE 3
GROUND WATER SAMPLING MAY 2001 GENERAL CHEMISTRY ANALYTICAL RESULTS

Analyte	Units	MW-3	MW-4	MW-5	MW-6	MW-7	WQCC
Lab pH	s.u.	7.3	7.1	6.7	6.9	6.7	6-9
Conductivity	µmhos/cm	4,500	5,090	7,000	5,470	2,160	No Std.
TDS	mg/L	3,960	4,630	5,230	4,580	1,710	1,000
Alkalinity as $CaCO_3$	mg/L	459	490	757	740	600	No Std.
Bicarbonate as HCO_3	mg/L	559	597	923	903	732	No Std.
Carbonate as CO_3	mg/L	<1	<1	<1	<1	<1	No Std.
Hydroxide	mg/L	<1	<1	<1	<1	<1	No Std.
Chloride	mg/L	78	77	1,320	80	52	250
Sulfate	mg/L	2,250	2,680	1,230	2,780	642	600
Calcium	mg/L	423	500	700	534	296	No Std.
Magnesium	mg/L	40.4	52.5	63.2	53.3	25.6	No Std.
Potassium	mg/L	2.5	4.2	5.6	6.3	1.6	No Std.
Sodium	mg/L	711	900	924	1,030	234	No Std.

s.u. = standard units µmhos/cm = micromhos per centimeter mg/L = milligrams per liter WQCC = New Mexico Water Quality Control Commission Standard No Std. = No Standard

The potentiometric surface elevation data collected during May and July are presented below in Table 4. As previously described, the ground water elevation was corrected using a product density of 0.7 water to properly reflect the estimated elevation at MW-2. As shown in figure 4, the ground water at the site appears to flow to approximately forty-five degrees south of west at a gradient of approximately 0.015 ft/ft.

TABLE 4
2001 WATER LEVEL ELEVATIONS

Well	5/23/01 Potentiometric Surface Elevation	7/03/01 Potentiometric Surface Elevation	5/23/01 Product Thickness	7/03/01 Product Thickness
MW-2	5470.07	5469.52	0.56	0.84
MW-3	5473.01	5472.67	None	None
MW-4	5470.05	5469.75	None	None
MW-5	5465.25	5465.25	None	None
MW-6	5468.00	5467.88	None	None
MW-7	5468.09	5468.31	None	None

Potentiometric surface elevation is given in feet above mean sea level MW-2 elevation is corrected for product thickness Product thickness is given in feet

3.2 BIOVENTING PILOT TEST

Oxygen, carbon dioxide, and ionizable hydrocarbon readings collected during the bioventing pilot test are presented in Appendix M, as are graphical depictions of the data. For this discussion, the changes in average concentrations of carbon dioxide, oxygen, and hydrocarbons are addressed from:

INITIAL READINGS → END-OF-INJECTION READINGS → END-OF-MONITORING READINGS

As presented in Table 4, titled "Respiration Test Averages From Beginning to End of Injection and End of Test", respiration monitoring indicated a relatively low (14.5 percent) initial oxygen concentration in the soil gas prior to air injection. Immediately following the period of air injection, the average concentration of oxygen in the soil gas increased by 18 percent from 14.59 percent to 17.27 percent oxygen then decreased by 14 percent to 14.9 percent oxygen at the end of the monitoring period. Oxygen decreases from the initial readings to end-of-injection readings were observed in the shallow monitoring intervals of bioventing monitoring points BV-3 and BV-4, the two monitoring points furthest from the injection point. All other bioventing monitoring point intervals showed similar to average trends.

TABLE 5
RESPIRATION TEST AVERAGES FROM BEGINNING TO END OF INJECTION AND AT END OF TEST

	Initial			End-Of-Injection			End-Of-Test		
	% O_2	ppm HC	% CO_2	% O_2	ppm HC	% CO_2	%O_2	ppm HC	% CO_2
BV-1									
Shallow	19.8	1115	0.412	19.9	19.4	0.05	15.2	27.7	0.15
Intermediate	13.6	61.1	1.0	19.5	50.1	0.07	15.7	93.4	3.51
Deep	8.5	91	0.19	20.2	28.5	0.08	16.8	10.7	0.06
BV-2									
Shallow	16.6	17.8	0.444	18.1	94.6	1.0	13.5	10.4	1.0
Intermediate	15.2	425	2.4	17.2	528	0.46	14.4	310	1.0
Deep	15.7	139	1.3	20.3	327	0.09	15.0	117	0.24
BV-3									
Shallow	15.7	3.1	1.2	13.8	2100	2.1	12.8	998	3.8
Intermediate	14.0	243	1.1	17.1	323	1.0	14.8	144	1.0
Deep	20.5	2.9	0.03	20.1	33.8	0.34	17.2	40.6	0.81
BV-4									
Shallow	13.6	12.4	1.5	11.5	1926	4.9	13.3	1258	3.7
Intermediate	13.4	97.9	1.3	15.2	181	2.1	16	159	3.2
Deep	8.5	67	0.42	14.3	518	1.0	14.1	279	1.3
Average									
Total	14.59	105.47	0.94	17.27	510.8	1.1	14.9	286.4	1.65
Shallow	16.42	11.10	0.89	15.83	1035	2.01	13.7	571.0	2.16
Intermediate	14.05	206.75	1.45	17.25	270.5	0.91	15.23	176.6	2.18
Deep	13.3	75	0.48	18.7	227	0.38	15.8	112	0.6

Hydrocarbon concentrations increased by 384 percent from a pre-injection average of 105 parts per million (ppm) to 510 ppm at the end-of-injection reading and then decreased by 44 percent to 286 ppm at the end of monitoring reading. All bioventing monitoring point intervals showed similar trends.

Carbon dioxide concentrations increased by 17 percent from a pre-injection average of 0.94 percent to 1.10 percent at the end-of-injection; then increased by 50 percent to 1.65 percent at the end-of-monitoring. Although all monitoring intervals reflected similar increases in carbon dioxide from the end-of-injection to the end-of-monitoring periods, the intermediate and deep monitoring intervals showed contrary to average decreases in the concentration between initial and end-of-injection readings.

The results of the pressure decline that was monitored immediately following the completion of air injection is presented graphically in Appendix M. Pressure readings decreased at all monitoring point intervals and then dropped to atmospheric pressure within 66 minutes following the end of injection.

4.0 Conclusions

4.1 Ground Water Monitoring

The ground water sampling and analyses for 2001 indicate the contaminant plume in the ground water at Giant's former Crude Station has not changed substantially since this investigation began in 1994. Laboratory analyses of ground water samples from MW-3, MW-4 and MW-5 remain below the detectable levels for BTEX. The installation of MW-6 and MW-7 indicate BTEX impacted ground water above NMWQCC standards at those locations. Benzene exceeded the 10 parts per billion (ppb) NMWQCC standard by 2 ppb at MW-6. All other hydrocarbon constituents were well beneath standards. Analysis of the ground water from MW-7 showed benzene and xylene concentrations exceed the NMWQCC standards. Toluene was not detected in the ground water from MW-7 which is uncharacteristic of onsite ground water from MW-2 based on a comparison of historical dissolved phase hydrocarbon concentrations from the 1994 and 1995 analytical results (Appendix A). This may indicate a potentially different hydrocarbon source of impact for each of the wells.

The NMWQCC standards for sulfate and total dissolved solids are exceeded at all monitoring wells including the upgradient well MW-3. The NMWQCC standard for chloride in ground water is exceeded in upgradient MW-3. The elevated levels of these parameters are indicators of the typically poor quality of the shallow ground water at the site.

Plotting the potentiometric surface contours, including information from the newly installed wells MW-6 and MW-7, does not indicate a change in the ground water direction or gradient from what has previously been reported. Based on this information, MW-7 is not directly downgradient of Giant's former tank or it's bermed area, Figure 4.

Review of the NMOCD records in the regional Aztec, New Mexico office indicate that there were several oil and gas wells in the immediate vicinity of MW-7. One of the wells, the Bishop #3, was drilled in 1925 and apparently shut-in in 1953, appears to have been plugged and abandoned in 1983. These wells may have had reserve or production pits that could potentially be the source of the impact at MW-7. There are several unmarked pipes protruding from the ground near MW-7 that may be monuments for abandoned wells though they are not marked as such. In addition, there are several areas void of vegetation on this lot and near these unmarked pipes.

Manana Gas operates natural gas wells upgradient of MW-7. Although no pits are evident at this time, research has not yet been conducted to determine whether production pits formerly existed near the existing meter runs or elsewhere on the site.

4.2 BIOVENT PILOT TEST

The 14 percent decrease in oxygen along with the 50 percent increase in carbon dioxide concentrations measured in the soil gas during the five days following the air-injection, indicates significant biologic activity at the site. During the five days following the pilot test approximately nine-pounds of hydrocarbons were mineralized to carbon dioxide and water. The data and variables used to quantify the biological reduction of the hydrocarbons to their basic mineral constituents are as follows:

- Thirty-feet radius of influence
- Fifteen-feet column of soil
- Thirty-five percent void space (filled with soil gas)
- 14,837 cubic feet of soil gas
- 17.29 percent oxygen at end of injection (2562 cubic feet)
- 14.9 percent oxygen at end of monitoring (2211 cubic feet)
- 351 cubic feet of oxygen consumed
- The density of oxygen is 0.089207 pounds per cubic foot (standard conditions)
- 31.4 pounds of oxygen was consumed
- 3.5 mg of oxygen are required to mineralize 1 mg fuel hydrocarbons based on the stoichiometric relationship usually employed to represent the oxidation of fuel hydrocarbons to carbon dioxide and water: $C_6H_{14} + 9\ (½)\ O2 \rightarrow 6CO_2 + 7H_2O$ (AFCEE, 1996)

- Results in 9 pounds of hydrocarbons consumed

5.0 Recommendations

As a result of the pilot test described in this report, the analytical data referenced from previous reports and recently obtained, the following treatment method and monitoring plan is recommended:

- Implement bioventing at the site to reduce the hydrocarbon concentrations in soil below NMOCD standards. Injection wells should be used on the perimeter of the impacted soil to prevent migration of hydrocarbon containing soil gas. Space injection wells 60-feet on center with an injection rate of approximately 25 cubic feet per minute. Air should be injected at a depth of 10- to 15-feet bgs. Delineation of impacted soil will proceed with the installation of injection wells and monitoring points.

- Develop an aggressive product recovery plan to remove the PSH from the ground water in the vicinity of MW-2. Following removal of product, sample MW-2 annually until BTEX levels are below New Mexico ground water standards, then sample quarterly for closure.

- Conduct annual ground water sampling for BTEX at monitoring wells MW-3, MW-4, and MW-5.

- Conduct quarterly ground water sampling for BTEX at MW-6 until the ground water is below standards for four consecutive quarters or as required by the NMOCD.

- Abandon MW-7.

- Use the western fence line between Manana Gas and Giant's property as the western boundary of Giant's liability for remediation.

- Submit and annual report to the NMOCD that presents the data collected and site activities during the previous year's activity

7.0 References

1. AFCEE, 1996, A General Evaluation of Bioventing for Removal Action at Air Force / Department of Defense Installations Nationwide. General Engineering Evaluation / Cost Analysis (EE/CA). U.S. Air Force Center for Environmental Excellence, Technology Transfer Division, Brooks Air Force Base, San Antonio, Texas

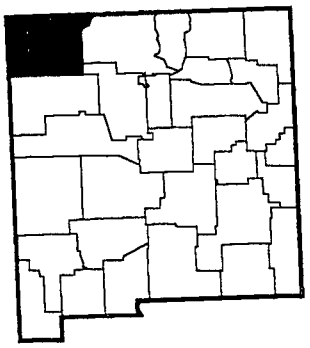
2. Giant Industries Arizona, Inc., 2000, Comprehensive Report For The Bloomfield Crude Station

3. Giant Industries Arizona, Inc., 1995, Site Assessment for the Bloomfield Crude Station

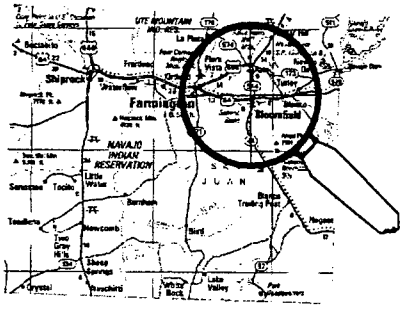
Figure 1

SITE LOCATION MAP

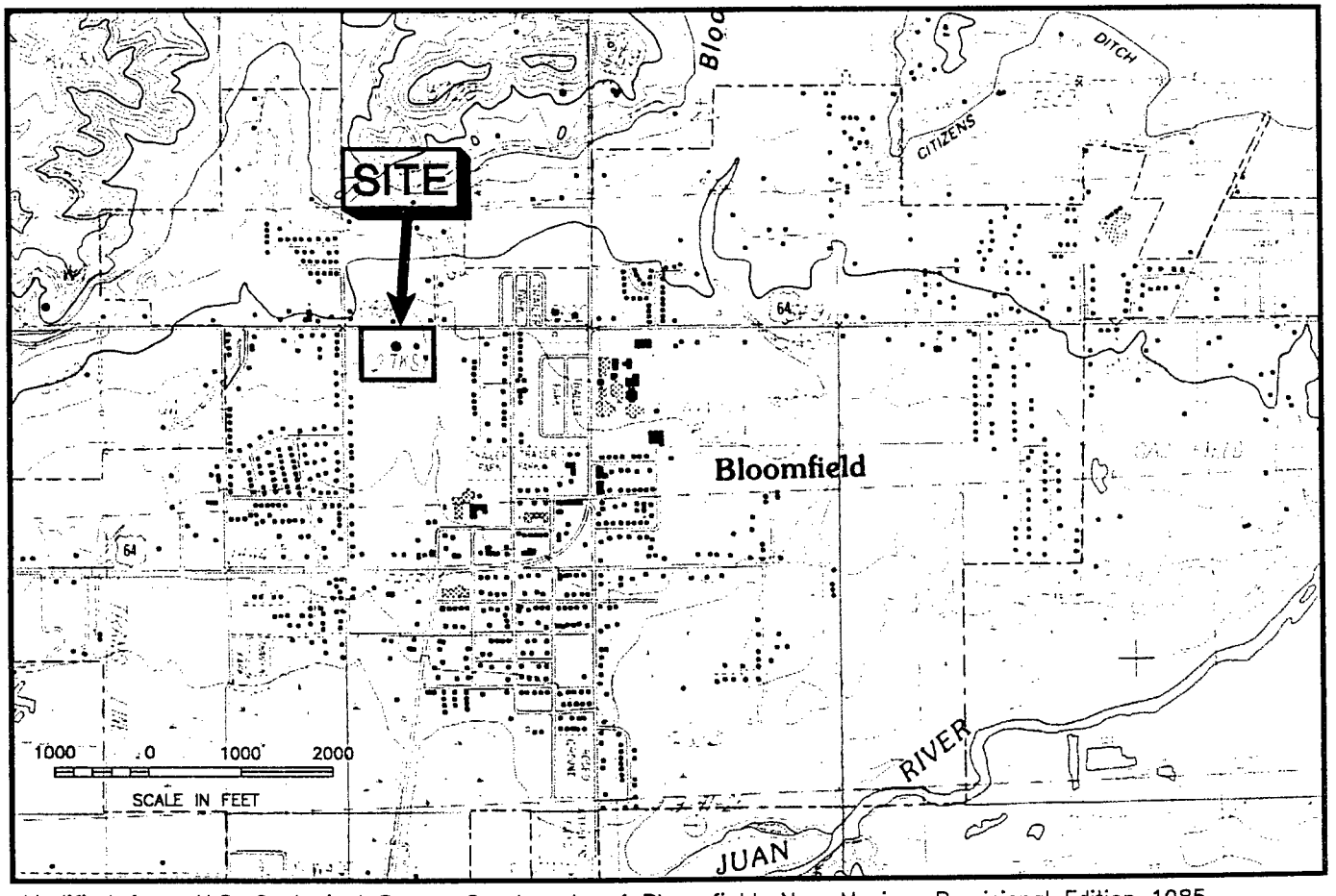
NEW MEXICO



SAN JUAN COUNTY



AREA IN DETAIL



Modified from U.S. Geological Survey Quadrangle of Bloomfield, New Mexico, Provisional Edition 1985.

SCALE IS VARIABLE

N

D:\DRAW\GOLDEN\6171A

Golden Environmental GEM Management

TITLE:

GIANT INDUSTRIES ARIZONA, INC.
BLOOMFIELD, NEW MEXICO
SITE LOCATION MAP

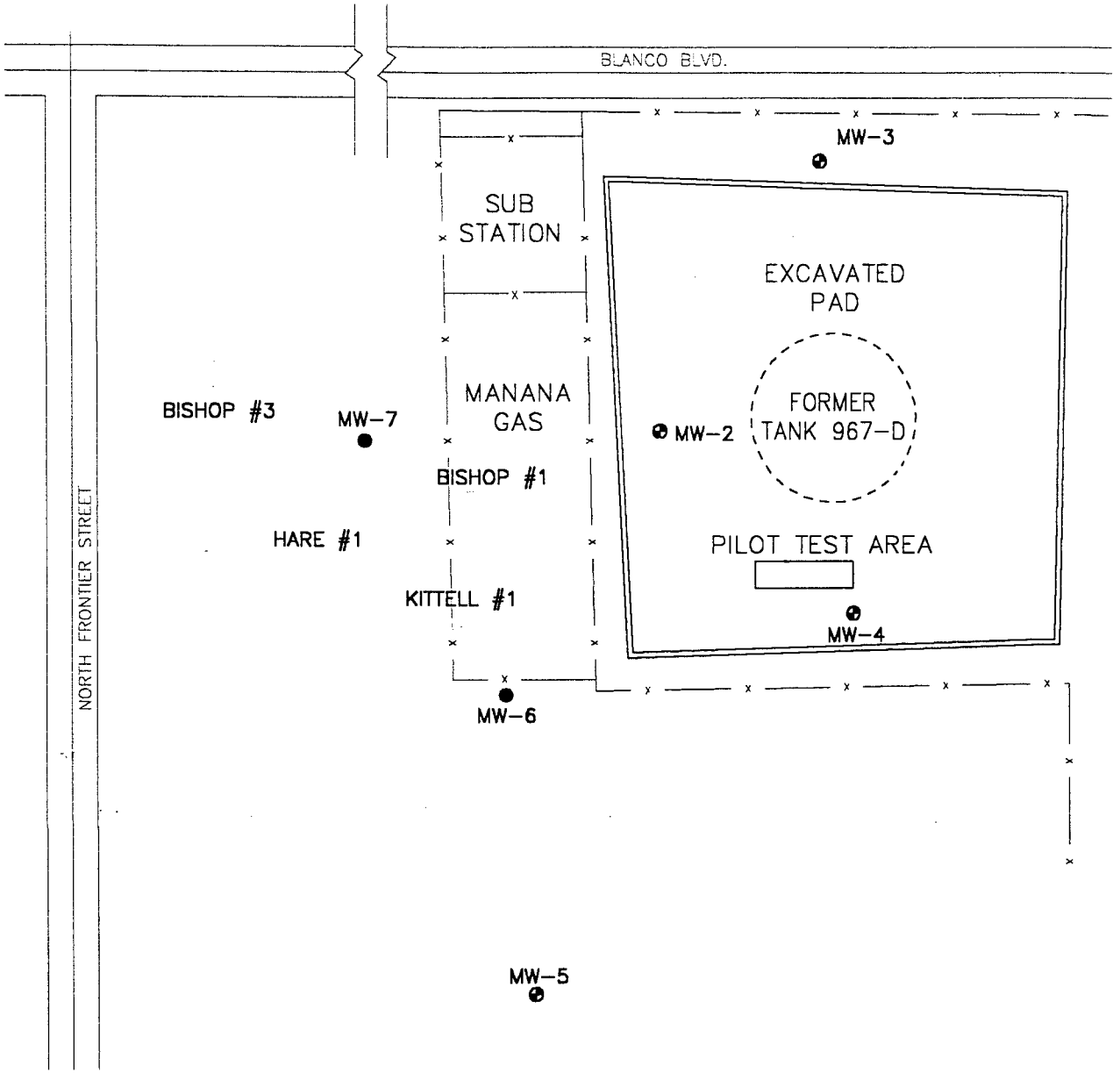
DWN: CJG	DES.:
CHKD:	APPD:
DATE: 07/11/01	REV.: 0

PROJECT NO.: 6171
GIANT INDUSTRIES
BLOOMFIELD, NM

FIGURE 1

Figure 2

SITE MAP



LEGEND

- FENCE LINE
- MW-1 APPROXIMATE LOCATION OF MONITOR WELL & NUMBER
- NEW GROUND WATER MONITOR WELLS INSTALLED
- APPROXIMATE LOCATION OF HISTORICAL OIL & GAS WELLS
- EARTHEN BERM

0 100 FEET

N

D:\DRAW\GOLDEN\61718

Golden Environmental GEM Management

TITLE: GIANT INDUSTRIES ARIZONA, INC. BLOOMFIELD, NEW MEXICO SITE MAP

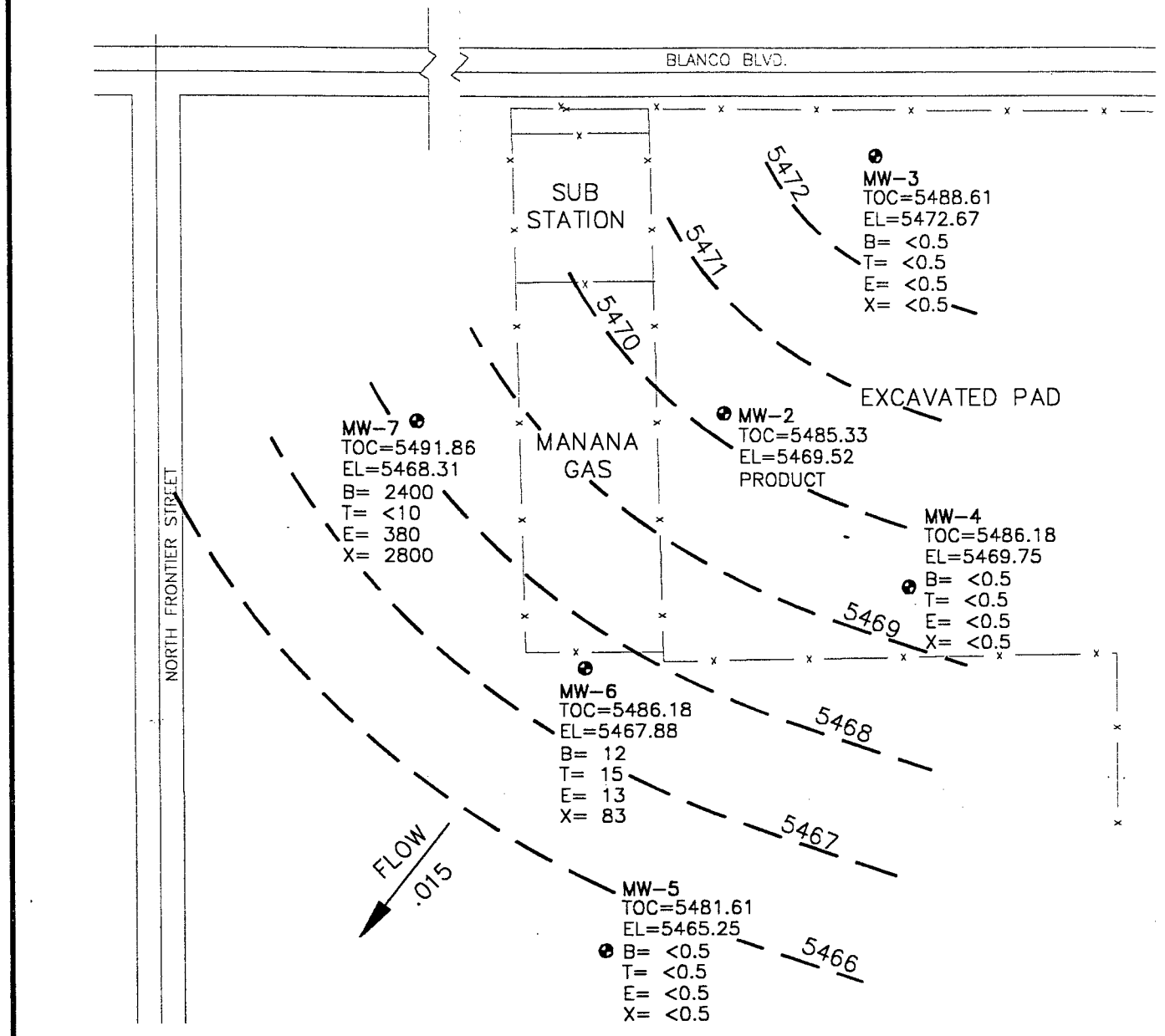
DWN: CJG	DES.:
CHKD:	APPD:
DATE: 07/11/01	REV.: 1

PROJECT NO.: 6171
GIANT INDUSTRIES BLOOMFIELD, NM

FIGURE 2

Figure 3

GROUND WATER GRADIENT MAP



LEGEND

×——×	FENCE LINE
MW-2 5467.99	APPROXIMATE LOCATION OF MONITOR WELL AND NUMBER
	APPROXIMATE GROUND WATER GRADIENT
	POTENTIOMETRIC SURFACE OF GROUND WATER
TOC	TOP OF CASING ELEVATION
EL	GROUND WATER ELEVATION
B	BENZENE IN ug/L
T	TOLUENE IN ug/L
E	ETHYLBENZENE IN ug/L
X	TOTAL XYLENES IN ug/L

0 100 FEET N

D:\DRAW\GOLDEN\6171C

Golden Environmental GEM Management

TITLE:

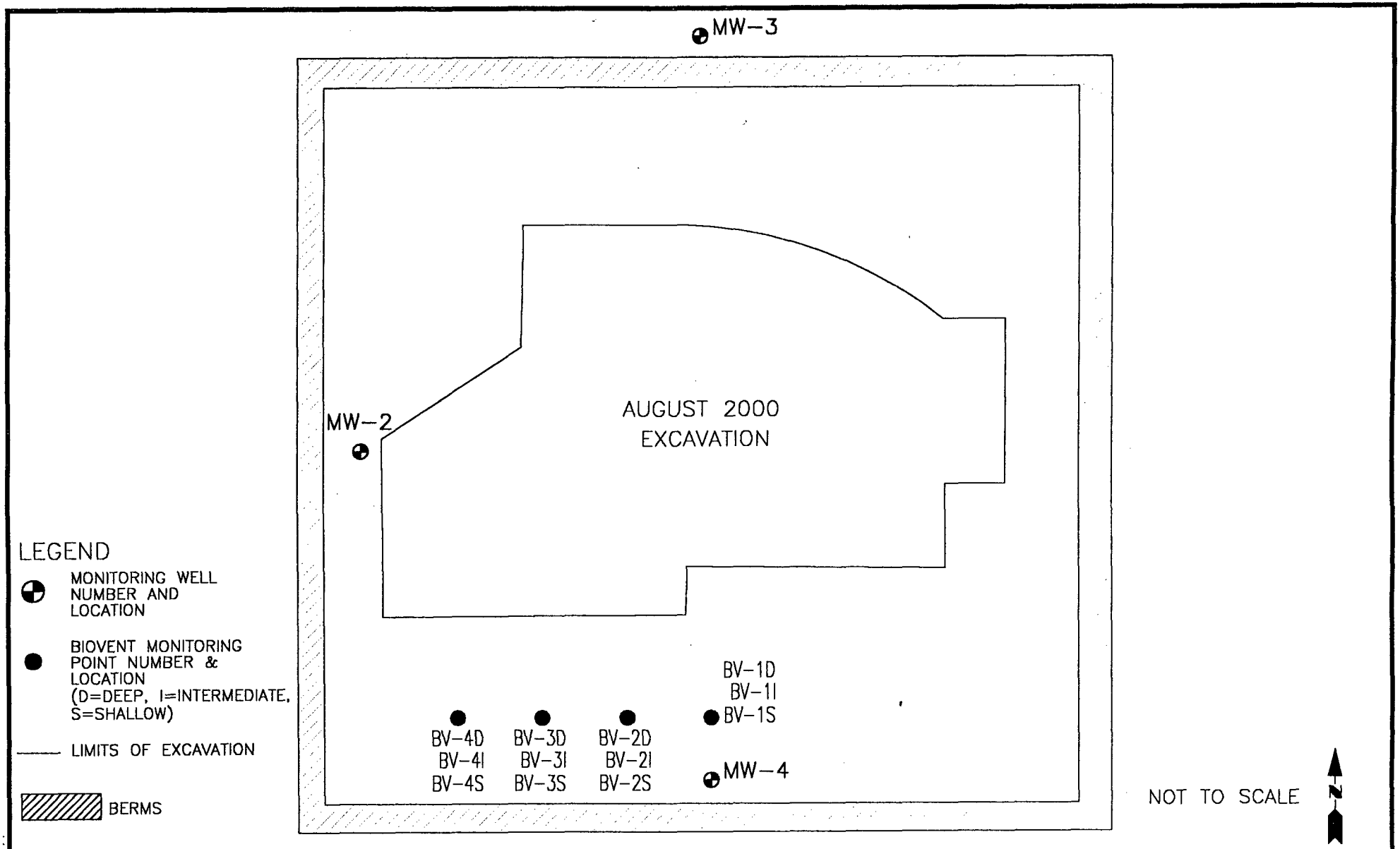
GROUND WATER GRADIENT MAP

JULY 9, 2001

DWN:	DES.:	PROJECT NO.: 6171
CJG		GIANT INDUSTRIES BLOOMFIELD, NM
CHKD:	APPD:	
DATE: 07/11/01	REV.: 1	FIGURE 3

Figure 4

BIOVENTING PILOT TEST



Golden Environmental GEM Management

TITLE:

GIANT INDUSTRIES ARIZONA, INC.
BLOOMFIELD, NEW MEXICO
BIOVENT PILOT TEST

DWN:	DES.:	PROJECT NO.: 6171
CJG		GIANT INDUSTRIES BLOOMFIELD, NM
CHKD:	APPD:	
DATE: 07/11/01	REV.: 1	FIGURE 4

APPENDIX A

COMPREHENSIVE SUMMARY OF GROUND WATER ANALYSES

Summary of Ground Water Analytical Results For BTEX
September 1994 Through May 2001

NM WQCC Standards		Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
		10	750	750	620
MW-1 (see note)	Sep-94	NS	NS	NS	NS
	Apr-95	NS	NS	NS	NS
	Sep-99	NS*	NS*	NS*	NS*
	Dec-99	NS*	NS*	NS*	NS*
	May-01	NS*	NS*	NS*	NS*
MW-2	Sep-94	640	600	82	690
	Apr-95	220	280	53	430
	Sep-99	NS**	NS**	NS**	NS**
	Dec-99	NS**	NS**	NS**	NS**
	May-01	NS**	NS**	NS**	NS**
MW-3	Sep-94	ND	ND	ND	ND
	Apr-95	ND	ND	ND	ND
	Sep-99	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND
	May-01	ND	ND	ND	ND
MW-4	Sep-94	2.1	ND	ND	1.2
	Apr-95	ND	ND	ND	ND
	Sep-99	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND
	May-01	ND	ND	ND	ND
MW-5	Sep-94	NS	NS	NS	NS
	Apr-95	ND	ND	ND	ND
	Sep-99	ND	ND	ND	ND
	Dec-99	ND	ND	ND	ND
	May-01	ND	ND	ND	ND
MW-6•	May-01	12	15	13	83
MW-7•	May-01	2,400	ND	380	2,800

Note:

MW-1 was not screened within the aquifer
µg/L = micrograms per liter
ND = Not Detected
NS = Not Sampled
NS* = Insufficient sample volume
NS** = Sample not collected due to product in well
• = Groundwater monitor wells recently installed in May 2001

Summary of Ground Water Analytical Results For General Water Chemistry 1994 and 2001

		Lab pH (su)	Conductivity (µmhos/cm)	TDS (mg/L)	Alkalinity ($CaCO_3$) (mg/L)	Hardness ($CaCO_3$) (mg/L)	Sodium Absorption Ratio	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Hydroxide (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
NMWQCC		**6-9**	**No Std**	**1,000**	**No Std**	**No Std**	**No Std**	**No Std**	**No Std**	**No Std**	**250**	**600**	**No Std**	**No Std**	**No Std**	**No Std**
MW2	1994*	6.6	4,920	***3,049***	957	NT	11.785	1,170	0	0	***1,050***	245	325	30	1.4	828
	2001	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**	NS**
MW3	1994*	7.1	4,250	***3,413***	521	NT	8.147	635	0	0	48	***1,920***	439	37	1.4	661
	2001	7.3	4,500	***3,960***	459	1,220	NT	559	<1	<1	78	***2,250***	423	40.4	2.5	711
MW4	1994*	7.0	5,420	***4,389***	576	NT	10.886	703	0	0	175	***2,470***	439	53	3.5	907
	2001	7.1	5,090	***4,630***	490	1,460	NT	597	<1	<1	77	***2,680***	500	52.5	4.2	900
MW5	1994*	6.9	6,000	***4,410***	775	NT	8.84	945	0	0	***996***	***1,390***	634	51	6.6	861
	2001	6.7	7,000	***5,230***	757	2,010	NT	923	<1	<1	***1,320***	***1,230***	700	63.2	5.6	924
MW6	2001•	6.9	5,470	***4,580***	740	1,550	NT	903	<1	<1	80	***2,780***	534	53.3	6.3	1,030
MW7	2001•	6.7	2,160	***1,710***	600	843	NT	732	<1	<1	52	***642***	296	25.6	1.6	234

* = MW2, MW3, and MW4 were sampled in September 1994; MW5 was sampled in April 1995

• = Groundwater monitor wells recently installed in May 2001

NS** = Sample not collected due to product in well

s.u. = standard units

µmhos/cm = micromhos per centimeter

mg/L = milligrams per liter

WQCC = New Mexico Water Quality Control Commission Standard

No Std. = No Standard

GROUNDWATER SAMPLING RESULTS FOR
POLYNUCLEAR AROMATIC HYDROCARBONS (EPA 610)
September 1994

Units: µg/L	MW-3	MW-2	MW-4
Naphthalene	<0.50	8.9	<0.50
Acenaphthylene	<1.0	<1.0	<1.0
Acenaphthene	<0.50	<0.50	<0.50
Fluorene	<0.10	1.2	<0.10
Phenanthrene	<0.05	1.8	<0.05
Anthracene	<0.05	<0.05	<0.05
Fluoranthene	<0.10	1.2	<0.10
Pyrene	<0.10	<0.10	<0.10
Benzo(a)Anthracene	<0.10	<0.10	<0.10
Chrysene	<0.10	0.17	<0.10
Benzo(b)Fluoranthene	<0.10	<0.10	<0.10
Benzo(k)Fluoranthene	<0.10	<0.10	<0.10
Benzo(a)Pyrene	<0.10	<0.10	<0.10
Dibenzo(a,h)Anthracene	<0.20	<0.20	<0.20
Benzo(g,h,i)Perylene	<0.10	<0.10	<0.10
Indeno(1,2,3-CD)Pyrene	<0.10	<0.10	<0.10
1-Methylnaphthalene	<0.30	5.9	<0.30
2-Methylnaphthalene	<0.30	5.8	<0.30

µg/L = micrograms per liter

GROUNDWATER SAMPLING RESULTS FOR PRIORITY POLLUTANT METALS
September 1994

Well	Silver mg/L	Arsenic mg/L	Beryllium mg/L	Cadmium mg/L	Chromium Mg/L
MW-3	<0.01	<0.005	<0.004	<0.0005	<0.01
MW-2	<0.01	<0.005	<0.004	<0.0005	0.010
MW-4	<0.01	<0.005	<0.004	<0.0005	<0.01
NMWQCC Standard	0.05	0.1	No std.	0.01	0.05

	Copper mg/L	Mercury mg/L	Nickel mg/L	Lead mg/L	Antimony Mg/L
MW-3	<0.01	<0.0002	<0.02	<0.002	<0.05
MW-2	0.012	<0.0002	<0.02	<0.002	<0.05
MW-4	<0.01	<0.0002	<0.02	<0.002	<0.05
NMWQCC Standard	1	0.002	0.2	<0.05	No std.

	Selenium mg/L	Thallium mg/L	Zinc mg/L
MW-3	<0.005	<0.005	0.023
MW-2	<0.005	<0.005	0.032
MW-4	<0.005	<0.005	0.026
NMWQCC Standard	0.05	No std.	10

mg/L = milligrams per liter

NMWQCC = New Mexico Water Quality Control Commission

No std. = No NMWQCC standard

APPENDIX B

COMPREHENSIVE SUMMARY OF PHASE SEPERATED HYDRODCARBONS AND RECOVERY

Summary of Phase-Separated Hydrocarbon Monitoring and Recovery
In Ground Water Monitoring Well MW-2
May 1995 – July 2001

Date	Depth to Product	Depth to Water	Product Thickness	Volume Removed (gallons)
May 4, 1995	NA	NA	NA	9 (includes purge water)
September 30, 1999	15.00	17.48	2.47	2.75
November 16, 1999	14.65	17.00	2.35	2.0
December 14, 1999	14.66	16.76	2.10	5.0
May 11, 2001	14.69	16.77	1.96	2.5
May 21, 2001	15.10	15.65	0.55	0
May 23, 2001	15.13	15.69	0.56	0
July 3, 2001	15.48	16.32	0.84	0
July 9, 2001	15.54	16.43	0.89	1.1
Total Gallons of Product Removed Since 1999 =				13.35

APPENDIX C

COMPREHENSIVE SUMMARY OF SOIL ANALYSES

Summary of Soil SamplesAnalytical and Field Screening Results
March 1994 through August 2000

March 15, 1994 - Tank 967D Closure

RESULTS OF TPH ANALYSES OF THE SOIL SAMPLES COLLECTED FROM THE EXCAVATION EAST OF THE FORMER TANK 967D			
Sample ID	**C6 - C10 Range mg/kg**	**C10 – C22 Range mg/kg**	**C22 – C36 Range mg/kg**
Sample 1	16,000	9,300	7,600
Sample 2	22,000	14,000	12,000
• mg/kg – milligrams per kilogram			

RESULTS OF BTEX ANALYSES OF THE SOIL SAMPLES COLLECTED FROM THE EXCAVATION EAST OF THE FORMER TANK 967D				
Sample ID	**Benzene ug/l**	**Toluene ug/l**	**Ethyl Benzene ug/l**	**Total Xylenes ug/l**
Sample 1	1,800	2,500	630	4,700
Sample 2	2,300	3,600	640	4,800
• ug/l - micrograms per liter				

March 29, 1994 – Tank 967D Closure

RESULTS OF FIELD HEADSPACE READING OF SOIL SAMPLES COLLECTED FROM THE EXCAVATION EAST OF THE FORMER TANK 967D	
Sample Depth	**Reading**
0.5 feet	180 ppm
1.0 feet	192 ppm
3.0 feet	220 ppm
3.0 feet	180 ppm
• ppm – parts per million (mg/kg)	

September 19, 1994 – Phase 1 Site Characterization

RESULTS OF THE PHASE 1 SITE CHARACTERIZATION - TPH ANALYSES AND FIELD SCREENING			
Sample ID (Location-Depth)	**C6 - C18 Range mg/kg**	**C12 - C36 Range mg/kg**	**Field Screening NDU**
SB-1 (9.0 feet)	15	33	465
SB-2 (12.5 feet)	1,300	1,300	432
SB-3 (11.0 feet)	490	830	383
SB-4 (16.5 feet)	4,900	3,200	305
SB-5 (17.0 feet)	3,400	2,200	187
SB-6 (5.0 feet)	180	78	236
SB-7 (12.3 feet)	2,000	1,500	176
SB-8 (12.0 feet)	550	410	202

- mg/kg – milligrams per kilogram
- NDU- Needle Deflection Unit on HNu photoionization detector is approximately equivalent to parts per million

April 24, 1995 – Phase 2 Site Characterization

RESULTS OF THE PHASE 2 SITE CHARACTERIZATION - FIELD HEADSPACE SCREENING	
Sample ID (Location-Depth)	**Field Screening NDU**
SB-9*	0
SB-10 (14.0 feet)	>2,000
SB-11 (10.0 feet)	>2,000
SB-12 (10.0 feet)	>2,000
SB-13*	0
SB-14*	<5
SB-15 (15.0 feet)	382
SB-16 (14.0 feet)	1,142
SB-17 (16.0 feet)	1,601
SB-18 (17.0 feet)	435
SB-19*	<5
SB-20*	<5
SB-21*	<5

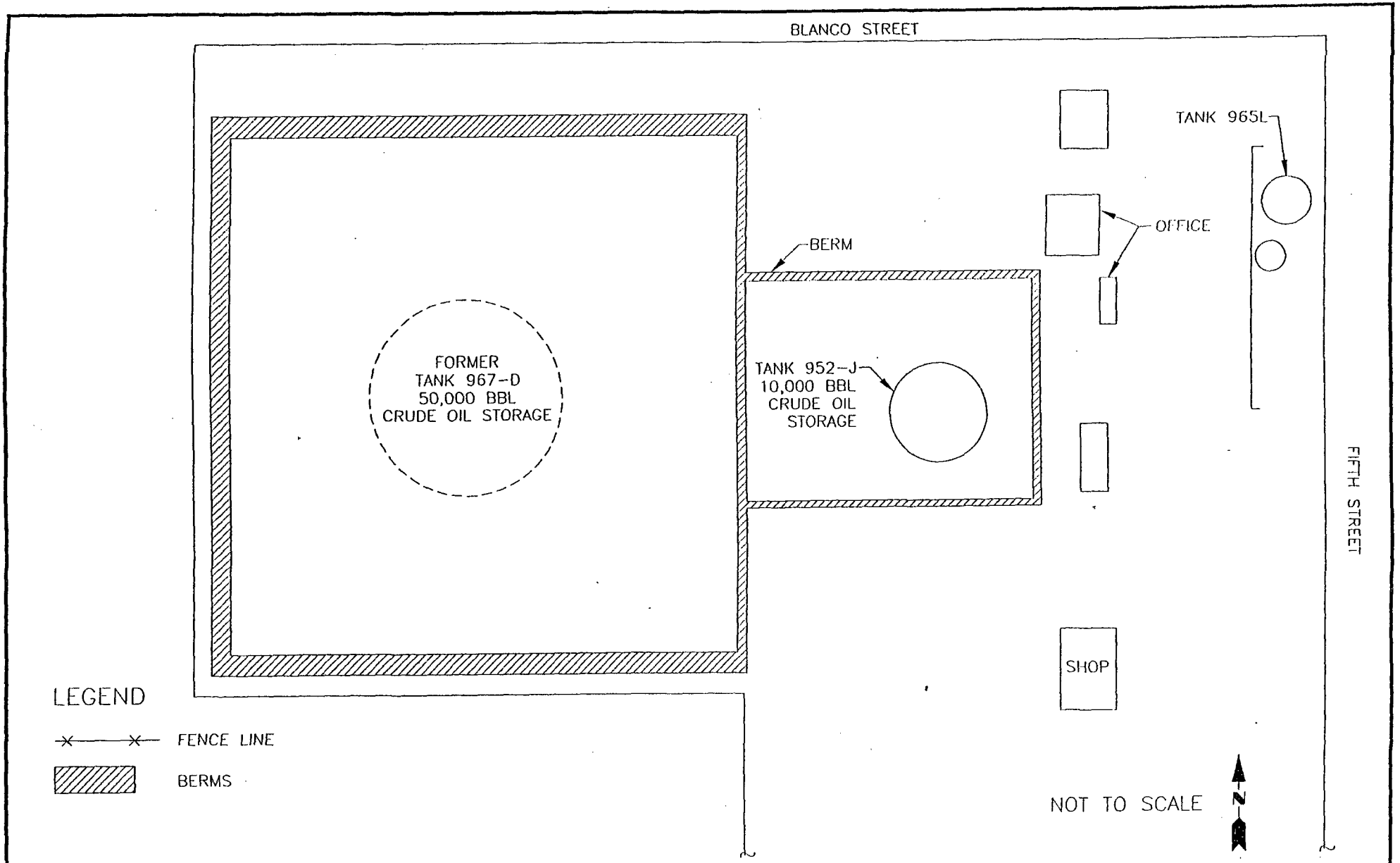
- * - average field headspace reading over entire sampling interval
- NDU- Needle Deflection Unit on HNu photoionization detector is approximately equivalent to parts per million

August 2000 – Soil Samples from Remedial Excavation Work

Sample Number	Sample Location	Sample Depth (Feet)	PID Reading (ppm)	Laboratory Analysis (ppm)
SS-1	South Wall – 90' North of MW-4, 40' West of East Wall	7	1,789	10,900
SS-2	East Wall – 60' East of Tank North/South Centerline	6	1,167	1,130
SS-3	North Wall – 50' North of Tank East/West Centerline	7	1,037	459
SS-4	Bottom – 37' and 18.5' West of East Wall	11	3.2	*ND
SS-5	Bottom – 49' North of South Wall SS-1	11	>2,200	No Lab Sample
SS-6	Center of East Wall	4.5	1,493	No Lab Sample
SS-7	Center of East Wall	6.5	901	No Lab Sample
SS-8	Center of East Wall	9.5	246	No Lab Sample
SS-9	Bottom–30', 60', and 90' from South Wall and 11' East of Centerline	9	13.2	200
SS-10	Bottom – 30', 60', and 90' from South Wall on Tank Centerline	11	13.1	60
SS-11	South Wall – 90' North of MW-4 on Tank Centerline	7	1,986	8,610
SS-12	North Wall – 120' North of South Wall on Tank Centerline	7	1,374	392
SS-13	Bottom – 30', 60', and 90' from South Wall and 26' West of Tank Centerline	14	Not Recorded	290
SS-14	West Wall – 10', 25', and 39' from North Wall	7, 8, 11	661	4,130
SS-15	Bottom – 40' West of Tank Centerline	18	2,525	No Lab Sample

APPENDIX D

REFERENCED FIGURES FROM HISTORICAL REPORTS



PHILIP SERVICES CORP

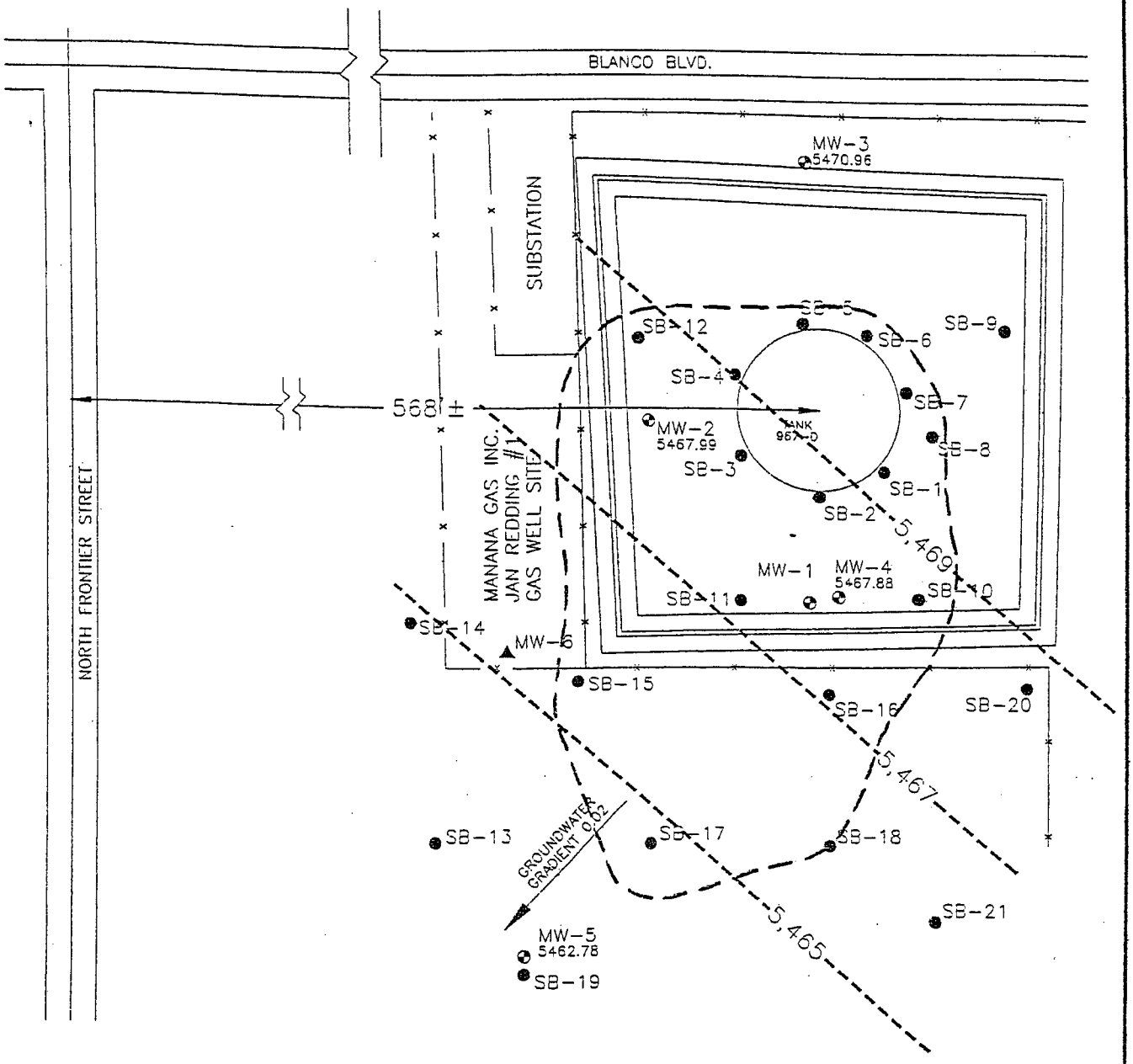
TITLE:
GIANT INDUSTRIES ARIZONA, INC.
BLOOMFIELD, NEW MEXICO
SITE LAYOUT

DWN:	DES.:
TMM	
CHKD:	APPD:
DATE:	REV.:
1/3/00	1

PROJECT NO.: 62800075
GIANT INDUSTRIES
BLOOMFIELD, NM

FIGURE 2

COL 625\00075A-001



LEGEND

×——×	FENCE LINE
MW-2 5467.99	APPROXIMATE MONITORING WELL LOCATION, NUMBER AND ELEVATION
▲ MW-6	PROPOSED MONITORING WELL LOCATION
— — —	ESTIMATED BOUNDARY OF IMPACTED SOILS
— 5,469 —	APPROXIMATE EQUIPOTENTIAL LINE (DEC. 14, 1999)

0 100 FEET

N

NOTE: MW-2 water level corrected for product thickness.

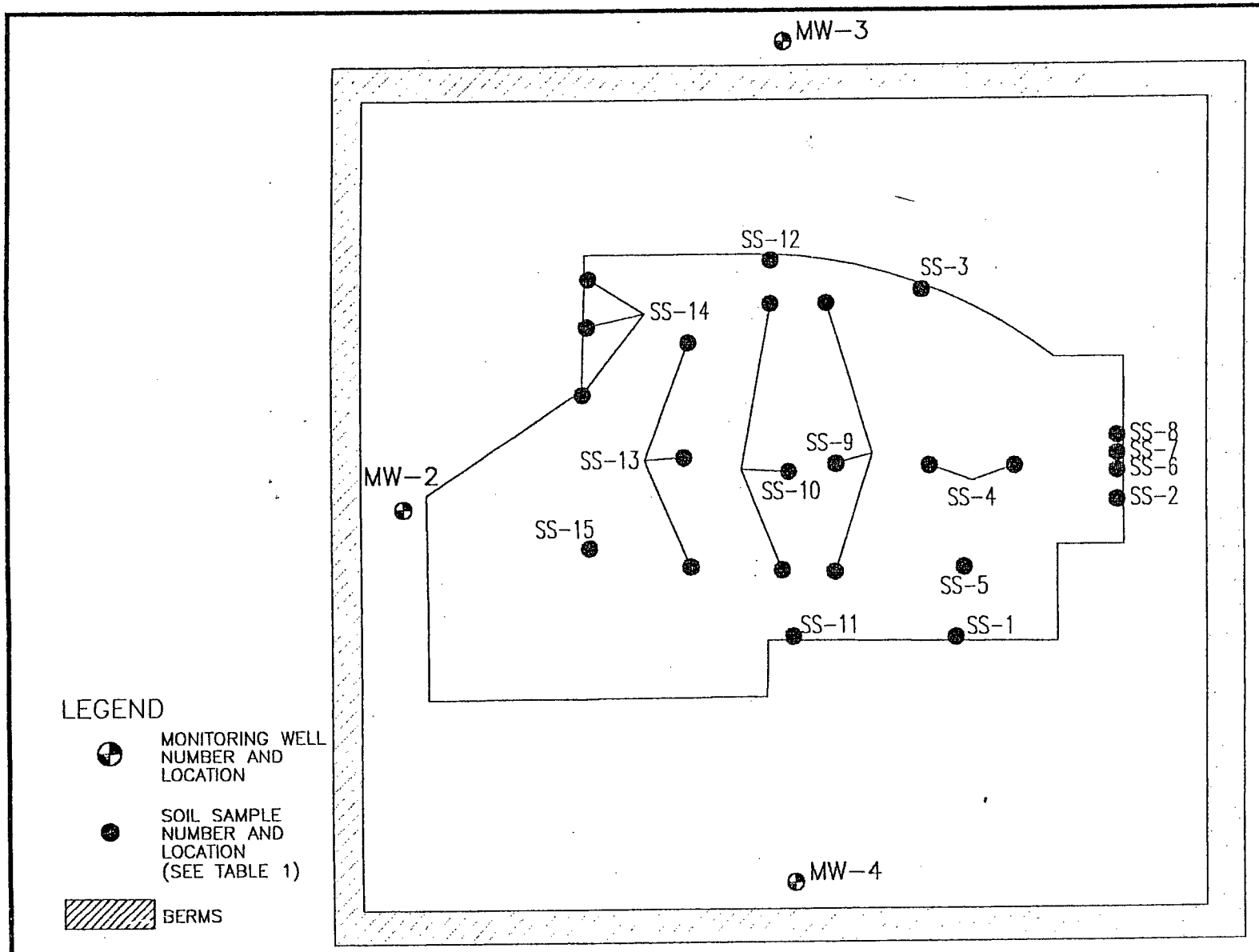
004
628/1
COL.

PHILIP SERVICES CORP

TITLE:

GROUNDWATER GRADIENT MAP

DWN: TMM	DES.:	PROJECT NO.: 62800075	
CHKD:	APPD:	GIANT INDUSTRIES BLOOMFIELD, NM	
DATE: 1/3/00	REV.: 1	FIGURE 4	



PHILLIPS SERVICES

TITLE:

GIANT INDUSTRIES ARIZONA, INC.
BLOOMFIELD, NEW MEXICO
EXCAVATION SAMPLE LOCATIONS

DWN:	DES.:	PROJECT NO.: 62800075
CJG		GIANT INDUSTRIES BLOOMFIELD, NM
CHKD:	APPD:	
DATE: 09/26/00	REV.: 1	FIGURE 3

CDL 828\000750-001

APPENDIX E

CHRONOLOGY OF INVESTIGATIVE AND REMEDIAL ACTIVITIES

Chronology of Investigative and Remedial Activities From 1994 through Present

- 1994 - Giant excavated an area east of Tank 967-D to a depth of approximately 12-feet below ground surface to investigate the presence of hydrocarbons.
- 1994 - Soil samples were collected from the excavation and analyzed for total petroleum hydrocarbons (TPH) and BTEX (Appendix C).
- 1994 - Giant notified the NMOCD that hydrocarbons were found in the subsurface soil at the site.
- 1994 - Additional verification samples were collected from several locations within the excavation. The samples were analyzed using a photoionization detector (PID) and are summarized Appendix C.
- 1994 - Giant submitted the tank closure investigation report titled Initial Site Assessment and Characterization Plan, dated May 9, 1994, to the NMOCD and proposed to delineate the hydrocarbon impact by drilling, sampling and by visual observation.
- 1994 - Giant submitted a letter to the NMOCD, dated June 23, 1994, specifying the site characterization work plan described in the May 9, 1994 report.
- 1994 - In a letter dated August 19, 1994, NMOCD approved the work plan submitted by Giant.
- 1994 - Giant contracted site characterization services, which included soil borings, soil sampling, ground water monitor well installation and ground water sampling.
- 1994 – Ground water monitor wells numbered MW-1 through MW-4 were installed upgradient, downgradient, and cross-gradient of the former tank (Figure 2).
- 1995 - A report titled Site Assessment and Proposed Action Plan for the Bloomfield Crude Station, Bloomfield, New Mexico, dated January 1995, was submitted to the NMOCD describing the second phase of investigations.
- 1995 - The NMOCD approved the recommendations for phase two of the investigation as described in the January 1995 report.
- 1995 – Giant submitted the technical approach to the NMOCD to begin the next phase of investigation on March 23, 1995.
- 1995 - The NMOCD approved the next phase of investigation on April 24, 1995.
- 1995 - Additional soil borings, SB-9 through SB-21, were conducted in April 1995. Field headspace readings were taken with a PID on soil samples collected from all of the borings and hydrocarbons were detected in seven of the thirteen new soil borings (Appendix C).
- 1995 - A downgradient ground water monitor well, numbered MW-5, was installed off-site, in May 1995 (Figure 2). Ground water samples were collected from the newly installed well and from three of the four existing on-site wells (Appendix A).
- 1995 - A report titled Site Assessment for the Bloomfield Crude Station, Bloomfield, New Mexico was prepared in May 1995.
- 1995 - A letter from the NMOCD, dated August 9, 1995, stated that the remediation plan in the May 1995 report was lacking and requested a remedial action work plan

for the contaminated soil and groundwater to be submitted to the NMOCD by October 6, 1995.

- 1995 - Giant received a proposal for a pilot test and remedial system design and installation at the Bloomfield Crude Station in August 1995, which included removal of free product and the in-situ bioventing.
- 1995 - A deadline extension from the NMOCD was acknowledged by Giant on October 5, 1995, allowing the remedial action work plan to by submitted by November 6, 1995.
- 1995 - The Remedial Action Work Plan was submitted to the NMOCD on November 3, 1995.
- 1995 - The Remedial Action Work Plan was conditionally approved by the NMOCD on December 8, 1995. Conditions included submittal of a work plan for installation of an additional monitoring well, additional water sampling, submission of annual reports and the results of the pilot test with final design proposal by March 1, 1996.
- 1995 - During process cleaning on December 12, 1995, Tank 967-D caught fire and burned hydrocarbons and tank bottoms within the tank. Lead based paint chips from the tank exterior impacted the soil around the tank. Due to fire, the subsurface investigation was suspended.
- 1996 - The impact from the fire was addressed through April which included general cleanup, removal of the lead and hydrocarbon impacted soils, and the damaged tank 967-D was removed. Giant pursued closure of the site lead issues with the New Mexico Environment Department from 1996 through June 1999.
- 1996 - The report titled Bloomfield Crude Station, Tank Removal Operations Report dated August 1996 which summarized tank removal operations, sampling, and the disposition of all waste generated during site activities was submitted to the NMOCD. Based on the results of the clean-up and lead investigation, Giant requested closure of the remedial activities completed at the site.
- 1999 - Giant submitted another report titled Giant Industries Arizona, Inc., Soil Lead Survey - Bloomfield Crude Station, Bloomfield, New Mexico to the NMOCD on April 28, 1999. This document detailed the results of the tank fire investigation and requested closure of the soil lead remedial actions.
- 1999 - On June 21, 1999 the NMOCD granted closure and requested a work plan to completely define the extent of soil and ground water contamination at the site.
- 1999 - Giant submitted the Work Plan for the Giant Bloomfield Crude Station to the NMOCD on September 27, 1999. Considering the time span between the tank fire and this submittal, Giant's work plan included a request to re-evaluate the remedial strategies best suited for the Bloomfield Crude Station.
- 1999 - NMOCD approved the September 27 work plan on October 29, 1999 and requested a comprehensive report on the site.
- 1999 - Subsurface investigations which included the collection of ground water elevations to estimate the ground water gradient, collecting ground water samples, and conducting product recovery from monitor well numbered MW-2 continued through December.
- 2000 - Giant submitted the Comprehensive Report for the Bloomfield Crude Station dated January 2000 to the NMOCD, detailing the past and current investigations and

identified the remedial alternative for hydrocarbon source removal as excavation of the soil in the vicinity of MW-2 and beneath the tank pad.

- 2000 - Giant received conditional approval of the proposed work plan in a letter from the NMOCD, dated May 19, 2000, and requesting a comprehensive report by August 31, 2000.
- 2000 - Excavation of approximately 12,924 cubic yards of hydrocarbon impacted soil were removed and hauled to Giant's permitted landfarm in August 2000.
- 2000 - The Report for Remedial Excavation Work Performed During August 2000 was submitted to the NMOCD in October 2000 which included a recommendation for an in-situ bioventing pilot test for site restoration.
- 2001 - In correspondence dated February 7, 2001 from the NMOCD, the proposed pilot test was approved, two additional ground water monitor wells are requested and a comprehensive report on the site investigations and pilot test are requested by July 1, 2001.
- 2001 – Due to closure of a former contractor's area office, prohibiting Giant from obtaining pertinent records and files, the NMOCD granted Giant a 30-day extension.

APPENDIX F

RECORD OF SUBSURFACE EXPLORATION AND MONITOR WELL INSTALLATION FORMS

RECORD OF SUBSURFACE EXPLORATION

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name: Giant Crude Station
Project Number: Phase
Project Location: SE ¼ Blanco Aztec Field, NM

Elevation:
Borehole Location: Due South of Mobil Gas Location
GWL Depth:
Logged By: M Lee
Drilled By: ACPI
Date/Time Started: 0745 hrs 5-17-01
Date/Time Completed: 1700 hrs 5-17-01

Well Logged By: NEE: Golden Env
Personnel On-Site: ACPI: Hoskins
Contractors On-Site: ACPI
Client Personnel On-Site:

Drilling Method: HSA
Air Monitoring Method: PID

Depth (Feet)	Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0			0-5' Sand Med yellow Brown, unconsolidated, V fine to medium grain size.						NA
5			5-10' clay, Med. yellow brown			0	0		
10			10-15' Sand As above w/color change to grey with a slight HC odor at 15'.			0	0		
15			15-20' Interbedded Sand and clay as			0	0		
20		SS 100%	above. split spoon sample			0	0		
25			15-21' clay w/ minor silt uncon. wet on outside of spoons			0	0		
30			TD = 30'						
35									
40									

Comments: BH-1 MW-6 One soil sample to check lithology. No analytical.

Geologist Signature:

MONITORING WELL INSTALLATION RECORD

Borehole # BH-1
Well # MW-6
Page 1 of 1

Golden Environmental Services
906 San Juan Blvd. Ste. 906
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name Giant Crude Station
Project Number _____ Cost Code _____
Project Location 5½ Blanco, Bloomfield, NM

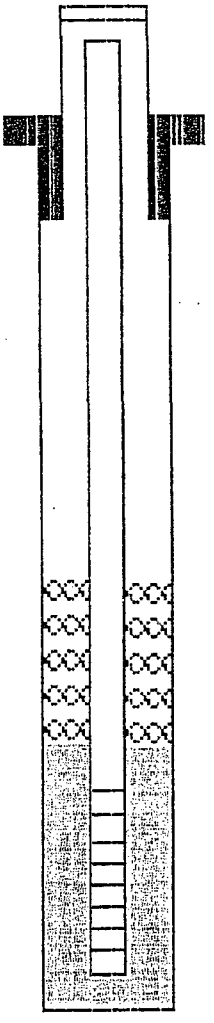
Elevation _____
Well Location Immediately South of Manifold
GWL Depth 18.17' bgs
Installed By ACPI
HSA

Date/Time Started 0745 5-17-01
Date/Time Completed 1200 5-17-01

On-Site Geologist M. Nicosia; Golden
Personnel On-Site _____
Contractors On-Site Acpi: K Padilla, JT
Client Personnel On-Site _____

Depths in Reference to Ground Surface

Item	Material	Depth (feet)
Top of Protective Casing	Flush Mt. Vault	0
Bottom of Protective Casing	NA	
Top of Permanent Borehole Casing	NA	
Bottom of Permanent Borehole Casing	NA	
Top of Concrete	Quickcrete	0
Bottom of Concrete	"	2'
Top of Grout	Portland 5% bent	2'
Bottom of Grout	"	11'2"
Top of Well Riser	Sch 40 2" Dia	0
Bottom of Well Riser	"	14'3"
Top of Well Screen	.010 slot PVC	14'3"
Bottom of Well Screen	2" Diameter	29'1"
Top of Peltonite Seal	3/8 bent	11'2"
Bottom of Peltonite Seal	3/8 bent chips	13'3"
Top of Gravel Pack	10-20 Silica	13'3"
Bottom of Gravel Pack	"	
Top of Natural Cave-In	NA	
Bottom of Natural Cave-In	NA	
Top of Groundwater		18'
Total Depth of Borehole		30



Top of Protective Casing 0
Top of Riser 0
Ground Surface 0
Top of Seal 11'2"
Top of Gravel Pack 13'3"
Top of Screen 14'3"
Bottom of Screen 29'1"
Bottom of Borehole 30

Comments: 2 bags 10-70 Silica Sand, 1 bag 3/8 bent chips, 15' pvc 2" sch 40, 15'. 010" slotted screen sch 40.

Geologist Signature _____

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

RECORD OF SUBSURFACE EXPLORATION

Page of

Project Name: Giant Crude Station
Project Number: Phase
Project Location: 5th & Blanco, Bloomfield NM

Elevation:
Borehole Location: Due West of Manna bros
GWL Depth: 25.1 BGS
Logged By: M Nee
Drilled By: ACPI
Date/Time Started: 1220 hrs 5-17-01
Date/Time Completed: 1700 hrs 5-17-01

Well Logged By: M Nee
Personnel On-Site: [illegible]
Contractors On-Site: [illegible] ACPI
Client Personnel On-Site:
Drilling Method: HSA
Air Monitoring Method: PID

Depth (Feet)		Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0				0-35' silty to fine sand. Med yellowish brown, unconsolidated. Clay in cuttings from 15' bgs. Cuttings from 22' have swampy odor. Grey HC in soil cuttings coming from 25' bgs.						NA
5							0	0		
10							0	0		
15							0	0		
20							0	0		
25							0	0		
30							0	0		
35				TD = 35'						
40										

Comments: BH-2 MW-7 No soil sampling

Geologist Signature: [signature]

7/6/2001\DRILLOG

MONITORING WELL INSTALLATION RECORD

Borehole # BH-2
Well # MW-7
Page 1 of 1

Golden Environmental Services
906 San Juan Blvd. Ste. 906
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name Giant Crude Station
Project Number 6171 Cost Code
Project Location 5th & Bloomfield Bloomfield

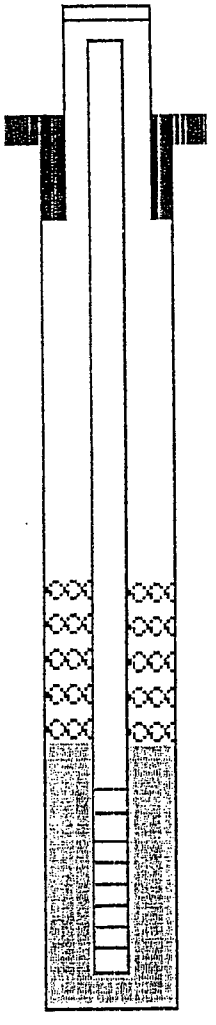
Elevation
Well Location Due West Monroe Gas Well
GWL Depth 25'11" bgs
Installed By ACPI (Envirotech)

On-Site Geologist M NEE: Golden
Personnel On-Site
Contractors On-Site ACPI: K Bedilk TJ
Client Personnel On-Site

Date/Time Started 1220hrs 5-12-01
Date/Time Completed 1200hrs 5-17-01

Depths in Reference to Ground Surface

Item	Material	Depth (feet)
Top of Protective Casing	Flush Mount Vault	0
Bottom of Protective Casing	NA	
Top of Permanent Borehole Casing	NA	
Bottom of Permanent Borehole Casing	NA	
Top of Concrete	Quickcrete	0
Bottom of Concrete	"	2'
Top of Grout	Portland w 5% Bent.	2'
Bottom of Grout		5'6"
Top of Well Riser	2" diam, sch 40 PVC	0
Bottom of Well Riser	"	13'2"
Top of Well Screen	2" diam sch 40 .010 slotted pvc	13'2"
Bottom of Well Screen	"	33'2"
Top of Peltonite Seal	3/8 bent chips	8'8"
Bottom of Peltonite Seal	3/8 bent chips	11'
Top of Gravel Pack	10-20 grade silica	11'
Bottom of Gravel Pack	"	33'
Top of Natural Cave-In	NA	
Bottom of Natural Cave-In	NA	
Top of Groundwater		25'
Total Depth of Borehole		36'



Top of Protective Casing 0
Top of Riser 0
Ground Surface 0
Top of Seal 8'8"
Top of Gravel Pack 11'
Top of Screen 13'2"
Bottom of Screen 33'2"
Bottom of Borehole

Comments: BH-1 MW-6 well set on flush mount Vault set in conc pad, 1bag 10-20 silica 1 bag 3/8 bent chips 20' 2" diam pvc .010 screen

Geologist Signature

RECORD OF SUBSURFACE EXPLORATION

Borehole #1

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name: Giant Crude Station Pilot Test
Project Number: 1017 Phase: 3
Project Location: Bloomfield, NM

Elevation:
Borehole Location: 12' N of MW-4
GW Depth: >15'
Logged By: C. Mnez - Tech
Drilled By: C. Mnez - Tech
Date/Time Started: 06-12-01 @ 1400
Date/Time Completed: 06-12-01 @ 1630

Well Logged By: C. Mnez - Technician
Personnel On-Site: C. Mnez / Martin Nee
Contractors On-Site: n/a
Client Personnel On-Site: NA

Drilling Method: Hand Auger
Air Monitoring Method: PID

Depth (Feet)	Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0			Sand, med to fine, loose Brown		3				
5	5'		Sandy clay Lt grey turning grey		6.5			13.5	
10	5'		Clayey Sand, grey		13			322.0	
15	5'		sandy clay, grey		14			2.5	
			wet sand, grey BOH at 16'		16				
20									
25									
30									
35									
40									

Comments: Field headspace readings were taken at 5', 10' and 15'
Observed mild hydrocarbon odor between 3-6.5' bgs and more distinct hydrocarbon odor below 6.5'

Geologist Signature

MONITORING WELL INSTALLATION RECORD

Borehole # 1
Well # BV-1
Page 2 of 2

Golden Environmental Management, Inc.
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name Giant Crude Station Pilot Test
Project Number 6171 Cost Code 3
Project Location Bloomfield, NM

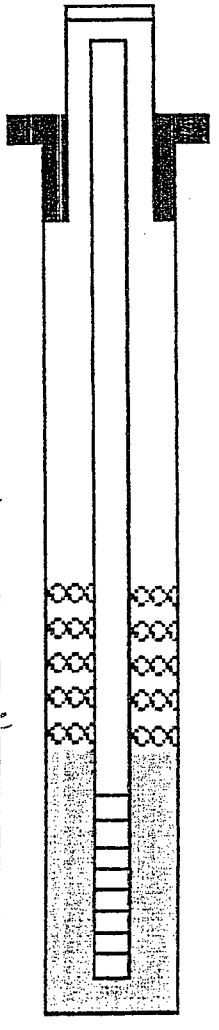
Elevation
Well Location 12' N of MW-4
GWL Depth >15'
Installed By C. Maez - Technician

On-Site Geologist Martin Nee
Personnel On-Site C. Maez, M. Nee
Contractors On-Site NA
Client Personnel On-Site NA

Date/Time Started 06-12-01 @ 1400
Date/Time Completed 06-12-01 @ 1630

Depths in Reference to Ground Surface

Item	DEPTH ~~Material~~ D	I	S	MATERIAL ~~Depth~~ (feet)
Top of Protective Casing				
Bottom of Protective Casing				
Top of Permanent Borehole Casing				
Bottom of Permanent Borehole Casing				
Top of Concrete				
Bottom of Concrete				
Top of Grout				
Bottom of Grout				
Top of Well Riser	+2"	+2"	+18"	1" PVC
Bottom of Well Riser	-14'	-10'	-5'	1" PVC
Top of Well Screen	-14'	-10'	-5'	1" PVC
Bottom of Well Screen	-15'	-11'	-6'	1" PVC
Top of Peltonite Seal	-13'	-8'	0	Bentonite Powder
Bottom of Peltonite Seal	-12'	-9'	-4'	Bentonite Powder
Top of Gravel Pack	-12'	-9'	-4'	10-20 Sand
Bottom of Gravel Pack	-16'	-13'	-8'	10-20 Sand
Top of Natural Cave-In	—	—	—	
Bottom of Natural Cave-In	—	—	—	
Top of Groundwater	>16'	—	—	
Total Depth of Borehole	-16'	-13'	-8'	



Top of Protective Casing NA
Top of Riser NA
Ground Surface NA
Top of Seal NA
Top of Gravel Pack NA
Top of Screen NA
Bottom of Screen NA
Bottom of Borehole NA

Comments: 3-1 inch diameter monitoring points installed in 1-borehole at 3 depths
D - Deep (0-15') I - Intermediate (0-10') S - Shallow (0-5') See above for screened intervals.

Geologist Signature

RECORD OF SUBSURFACE EXPLORATION

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Page 1 of 1 Borehole #2

Project Name: Giant Crude Station Pilot Test
Project Number: 10171 Phase: 3
Project Location: Bloomfield NM

Elevation:
Borehole Location: 10' W of BV-1
GW Depth: >16'
Logged By: C. Mnez - Technician
Drilled By: C. Mnez - Technician
Date/Time Started: 01-13-01 @ 0730
Date/Time Completed: 01-13-01 @ 0945

Well Logged By: C Mnez - Technician
Personnel On-Site: C Mnez / M Nez
Contractors On-Site: NA
Client Personnel On-Site: NA

Drilling Method: Hand Auger
Air Monitoring Method: PID

Depth (Feet)	Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0			Sand turning to sandy clay Brown						
5	5'							1.3	
					6'				
			moist clayey sand lt grey		8.6'				
			hard clay, Brown		9.6'			4.2	
10	5'		clayey sand, brownish grey to/d.		11'				
			fine clayey sand, brown		12'				
			sandy clay, light grey		13.8'				
15	5'		Sand, brown		16'			0.7	
			Bott at 16'						
20									
25									
30									
35									
40									

Comments: Field headspace readings were taken at 5', 10', and 15'. Hydrocarbon odor observed at 6' bgs to 8' bgs. No odor between 8' and 11'. At 11' a slight odor and at 12.6' bgs soil lens black with strong hydrocarbon odor. No odor observed below 13.8'

Geologist Signature

MONITORING WELL INSTALLATION RECORD

Borehole # 2
Well # BV-2
Page 2 of 2

Golden Environmental Management, Inc.
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name Giant Crude Station Pilot Test
Project Number 6171 Cost Code 3
Project Location Bloomfield, NM

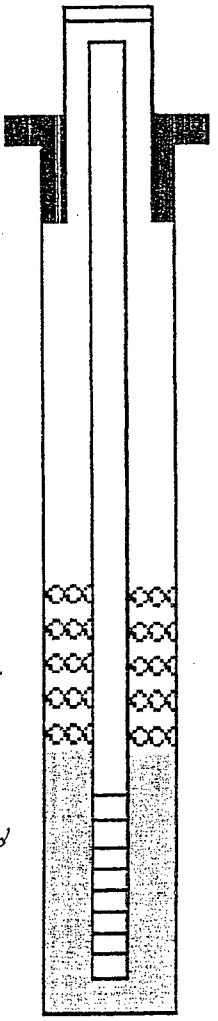
Elevation
Well Location 10' W of BV-1
GWL Depth >16'
Installed By C. Maez - Technician

On-Site Geologist Martin Nee
Personnel On-Site C. Maez / M. Nee
Contractors On-Site NA
Client Personnel On-Site NA

Date/Time Started 06-13-01 @ 0730
Date/Time Completed 06-13-01 @ 0945

Depths in Reference to Ground Surface

Item	DEPTH Material D	I	S	MATERIAL Depth (feet)
Top of Protective Casing				
Bottom of Protective Casing				
Top of Permanent Borehole Casing				
Bottom of Permanent Borehole Casing				
Top of Concrete				
Bottom of Concrete				
Top of Grout				
Bottom of Grout				
Top of Well Riser	+2"	+2"	+18"	1" PVC
Bottom of Well Riser	-14'	-10'	-5'	1" PVC
Top of Well Screen	-14'	-10'	-5'	1" PVC
Bottom of Well Screen	-15'	-11'	-6'	1" PVC
Top of Peltonite Seal	-13'	-8'	0	Bentonite Powder
Bottom of Peltonite Seal	-12'	-9'	-4'	Bentonite Powder
Top of Gravel Pack	-12'	-9'	-4'	10-20 Silica Sand
Bottom of Gravel Pack	-16'	-13'	-8'	10-20 Silica Sand
Top of Natural Cave-In	—	—	—	
Bottom of Natural Cave-In	—	—	—	
Top of Groundwater	>-16'	—	—	
Total Depth of Borehole	-16'	-13'	-8'	



Top of Protective Casing NA
Top of Riser NA
Ground Surface NA
Top of Seal NA
Top of Gravel Pack NA
Top of Screen NA
Bottom of Screen NA
Bottom of Borehole NA

Comments: 3-1 inch diameter monitoring points installed in 1 borehole at 3-depths D-Deep (0-15') I-Intermediate (0-13') S-Shallow (0-5') See above for screened intervals

Geologist Signature _____

RECORD OF SUBSURFACE EXPLORATION

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Page 1 of 2 Borehole 3

Project Name Giant Crude Station Pilot Test
Project Number 1a171 Phase 5
Project Location Bloomfield NM

Elevation
Borehole Location 10' W of BV-2
GWL Depth >16'
Logged By C Mnez - Technician
Drilled By C Mnez - Technician
Date/Time Started 06-13-01 at 0945
Date/Time Completed 06-13-01 at 1200

Well Logged By C Mnez - Technician
Personnel On-Site C Mnez / Mnee.
Contractors On-Site N/A
Client Personnel On-Site n/a

Drilling Method Hand Auger
Air Monitoring Method PID

Depth (Feet)	Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0			Sand, medium, loose Brown		2				
			Sandy clay, brown		4				
5	5'		Sand to sandy clay, brown		5.8			0.2	
			Clayey sand, grey		7.8				
			Sand, sandy clay, grey		9.0				
10	5'		Clayey sand, grey		11.5			20.1	
			Clayey sand, brown		14.0				
15	5'		Wet clayey sand BOH at 16'		16.0			1.7	
20									
25									
30									
35									
40									

Comments: Field headspace readings were taken at 5', 10', and 15'. No hydrocarbon odor was detected from ground surface to 5.8' bgs. From 5.8' to 7.8' a mild pungent (onion-like) odor was observed. At 9.0' bgs a layer with an oily, liquid appearance, moderate yellow-green in color was observed. No hydrocarbon odor was observed in boring.

Geologist Signature

7/5/2001\DRILLOG

MONITORING WELL INSTALLATION RECORD

Borehole # 3
Well # BV-3
Page 2 of 2

Golden Environmental Management, Inc.
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

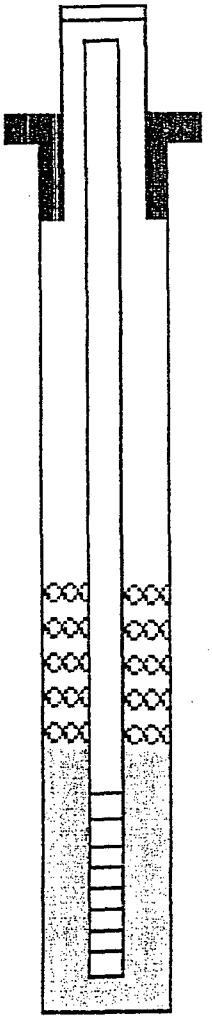
Project Name Giant Crude Station Pilot Test
Project Number 6171 Cost Code 3
Project Location Bloomfield, NM

Elevation
Well Location 10' W of BV-2
GWL Depth >16'
Installed By CMnez - Technician

Date/Time Started 06-13-01 @ 0945
Date/Time Completed 06-13-01 @ 1200

On-Site Geologist MNee
Personnel On-Site CMnez / MNee
Contractors On-Site NA
Client Personnel On-Site NA

Depths in Reference to Ground Surface	~~Depth~~ Material			~~Material~~ Depth (feet)
Item	D	I	S	
Top of Protective Casing				
Bottom of Protective Casing				
Top of Permanent Borehole Casing				
Bottom of Permanent Borehole Casing				
Top of Concrete				
Bottom of Concrete				
Top of Grout				
Bottom of Grout				
Top of Well Riser	+2"	+2"	+18"	1" PVC
Bottom of Well Riser	-14'	-10'	-5'	1" PVC
Top of Well Screen	-14'	-10'	-5'	1" PVC
Bottom of Well Screen	-15'	-11'	-6'	1" PVC
Top of Peltonite Seal	-13'	-8'	0	Bentonite Powder
Bottom of Peltonite Seal	-12'	-9'	-4'	Bentonite Powder
Top of Gravel Pack	-12'	-9'	-4'	10-20 Silica Sand
Bottom of Gravel Pack	-16'	-13'	-8'	10-20 Silica Sand
Top of Natural Cave-In	—	—	—	
Bottom of Natural Cave-In	—	—	—	
Top of Groundwater	>16'	—	—	
Total Depth of Borehole	-16'	-13'	-8'	



Top of Protective Casing NA
Top of Riser NA
Ground Surface NA
Top of Seal NA
Top of Gravel Pack NA
Top of Screen NA
Bottom of Screen NA
Bottom of Borehole NA

Comments: 3-1" diameter monitoring points installed in 1-borehole at 3 depths
D - Deep (0-15') I - Intermediate (0-10') Geologist Signature _____
S - Shallow (0-5') See above for screened intervals.

RECORD OF SUBSURFACE EXPLORATION

Golden Environmental Management, Inc
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

 Borehole #4

Project Name Giant Crude Station Pilot Test
Project Number 6171 Phase II
Project Location Bloomfield NM

Elevation
Borehole Location 10' W of BV-3
GWL Depth >16'
Logged By CMinez - Technician
Drilled By CMinez - Technician
Date/Time Started 06-13-01 @ 1200
Date/Time Completed 06-13-01 @ 1415

Well Logged By CMinez - Technician
Personnel On-Site CMinez/Minder
Contractors On-Site n/a
Client Personnel On-Site NA

Drilling Method Hand Auger
Air Monitoring Method PID

Depth (Feet)	Sample Interval	Sample Type & Recovery (inches)	Sample Description Classification System: USCS	USCS Symbol	Depth Lithology Change (feet)	Air Monitoring Units: NDU BZ	BH	S	Drilling Conditions & Blow Counts
0			Sand, med., loose Brown		2.0				
5	5'		Sandy clay Brown		5.6			0.9	
			Sandy clay, grey		7.5				
10	5'		Clayey sand and sandy clay, grey		±1.0			157.0	
			Clay, greyish green		12.0				
			Clayey sand, brown		14.0				
15	5'		wet sandy clay, brown		16.0			1.1	
			BOH at 16'						
20									
25									
30									
35									
40									

Comments: Field headspace readings were taken at 5', 10', and 15'.
Observed 'mild hydrocarbon odor between 5.6' and 11.0' bgs.

Geologist Signature

MONITORING WELL INSTALLATION RECORD

Borehole # 4
Well # BV-4
Page 2 of 2

Golden Environmental Management, Inc.
906 San Juan Boulevard, Suite D
Farmington, New Mexico 87401
(505) 566-9116 FAX (505) 566-9120

Project Name Giant Crude Station Pilot Test
Project Number 6171 Cost Code 3
Project Location Bloomfield NM

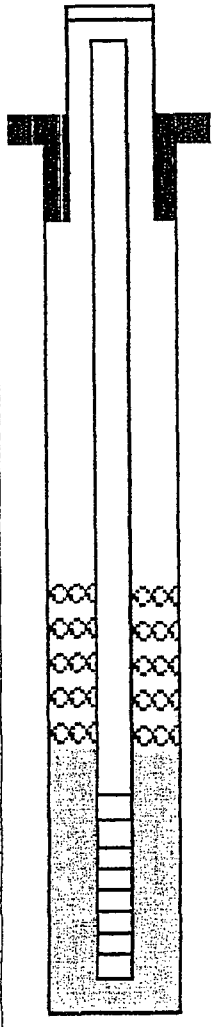
Elevation
Well Location 10' W of BV-3
GWL Depth >16'
Installed By CMaez - Technician

Date/Time Started 06-13-01 @ 1200
Date/Time Completed 06-13-01 @ 1415

On-Site Geologist Martin Nee
Personnel On-Site CMaez/MNee
Contractors On-Site NA
Client Personnel On-Site NA

Depths in Reference to Ground Surface

Item	~~Material~~ Depth D	I	S	~~Depth~~ Material (feet)
Top of Protective Casing				
Bottom of Protective Casing				
Top of Permanent Borehole Casing				
Bottom of Permanent Borehole Casing				
Top of Concrete				
Bottom of Concrete				
Top of Grout				
Bottom of Grout				
Top of Well Riser	+2"	+2"	+18"	1" PVC
Bottom of Well Riser	-14'	-10'	-5'	1" PVC
Top of Well Screen	-14'	-10'	-5'	1" PVC
Bottom of Well Screen	-15'	-11'	-6'	1" PVC
Top of Peltonite Seal	-13'	-8'	0	Bentonite Powder
Bottom of Peltonite Seal	-12'	-9'	-4'	Bentonite Powder
Top of Gravel Pack	-12'	-9'	-4'	10-20 Silica Sand
Bottom of Gravel Pack	-16'	-13'	-8'	10-20 Silica Sand
Top of Natural Cave-In	—	—	—	
Bottom of Natural Cave-In	—	—	—	
Top of Groundwater	>-16'	—	—	
Total Depth of Borehole	-16'	-13'	-8'	



Top of Protective Casing NA
Top of Riser NA
Ground Surface NA
Top of Seal NA
Top of Gravel Pack NA
Top of Screen NA
Bottom of Screen NA
Bottom of Borehole NA

Comments: 3-1 inch diameter monitoring points installed in 1-borehole at 3-depths
D = Deep (0-15') I = Intermediate (0-10') S = Shallow (0-5') See above for screened intervals

Geologist Signature _____

APPENDIX G

WELL DEVELOPMENT AND PURGING DATA FORMS

Well Development and Purging Data

oject No. 6171 Development ☐

ask No. 1 Purging ☑

Page 1 of 1

ell No. MW 2 Site Name/Identification Crude Station Site Address Bloomfield, NM

ient/Project Name GiaNT Sampling /BioVent Pilot Test Project Manager MARTIN NEE

evelopment Criteria
3 to 5 Casing Volumes of Water Removal
abilization of Indicator Parameters
☐ Other

Water Volume Calculation
Initial Depth of Well (feet) 18.73
Initial Depth to Water (feet) 16.77
Height of Water Column in Well (feet) 1.96
Diameter (inches): Well ____ Gravel Pack ____

Item	Water Volume in Well: Cubic Feet	Water Volume in Well: Gallons	Gallons to be Removed
Well Casing			
Gravel Pack			
Drilling Fluids			
Total			

Instruments — Serial No. (if applicable)
☐ PH Meter
☐ DO Monitor
☐ Conductivity Meter
☐ Temperature Meter
☐ Other

Water Disposal
Drum onsite

ethods of Development
mp
Centrifugal
Submersible
Peristaltic

Bailer
☑ Bottom Valve
☐ Double Check Valve
☐ Stainless-steel Kemmerer

Other

Sampling Activities
Type of Container ____ No. of Containers ____
Parameters Sampled For

ter Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5-11-01	13.20		X					1.25		2.5					
						18.71									

he date and time that the development criteria are met.

nents THIS WELL HAD PRODUCT Depth TO product 14.69 Did NOT Sample
illed Approximately 4.25 gal Bailed well Dry

loper's Signature (s) [signature] Date 5-11-01 Reviewer [signature] Date 5/15/01

Well Development and Purging Data

oject No. 6171 Development ☐

isk No. 1 Purging ☑

Page 1 of 1

ell No. MW 3 Site Name/Identification Crude Station Site Address Bloomfield, NM

ient/Project Name Grant Sampling/BioVent Pilot Test Project Manager MARTIN NEE

evelopment Criteria

(3) to 5 Casing Volumes of Water Removal

Stabilization of Indicator Parameters

☐ Other

Water Volume Calculation

Initial Depth of Well (feet) 18.74

Initial Depth to Water (feet) 15.45

Height of Water Column in Well (feet) 3.29

Diameter (inches): Well 4" Gravel Pack

Item	Water Volume in Well		Gallons to be Removed
	Cubic Feet	Gallons	
Well Casing	3.29	2.14X3	6.42
Gravel Pack			
Drilling Fluids			
Total			6.42

Instruments / **Serial No. (if applicable)**

☑ PH Meter — Hydac

☐ DO Monitor

☑ Conductivity Meter — Hydac

☑ Temperature Meter — Hydac

☐ Other

Water Disposal

ethods of Development

Pump	Bailer
Centrifugal	☑ Bottom Valve
Submersible	☐ Double Check Valve
Peristaltic	☐ Stainless-steel Kemmerer

Other

Sampling Activities

Type of Container ____ No. of Containers ____

Parameters Sampled For

ter Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5/10/01	853		X				1.25	1.25			20.9	5.88	2.370		Clear, no odor
	1358		X				1.25	2.50			17.9	5.95	2250		cloudy, no odor
	1430					1.3									

he date and time that the development criteria are met.

ments After Bailing Approximately 2.50 gal Bailed well Dry Let Recover collected samples 1445 BTEX TPH GEN. Chem.

loper's Signature (s) Brian T. Mayo Date ____ Reviewer [illegible] Date 5/15/01

Well Development and Purging Data

Project No. 6171 Development ☐
Task No. 1 Purging ☑
Well No. MW4 Site Name/Identification Crude Station Site Address Bloomfield N.M.
Client/Project Name GiaNT Sampling/Biovent Pibt Test Project Manager MARTIN NEE

Page 1 of 1

Development Criteria
☐ 3 to 5 Casing Volumes of Water Removal
☐ Stabilization of Indicator Parameters
☐ Other

Water Volume Calculation
Initial Depth of Well (feet) 26.21
Initial Depth to Water (feet) 15.97
Height of Water Column in Well (feet) 10.24
Diameter (inches): Well 4" Gravel Pack

Item	Water Volume in Well: Cubic Feet	Water Volume in Well: Gallons	Gallons to be Removed
Well Casing	10.24	6.66x3	20.04
Gravel Pack			
Drilling Fluids			
Total			20.04

Instruments
	Serial No. (if applicable)
☑ PH Meter	Hydac
☐ DO Monitor	
☑ Conductivity Meter	Hydac
☑ Temperature Meter	Hydac
☐ Other	

Methods of Development
Pump
☐ Centrifugal
☐ Submersible
☐ Peristaltic

Bailer
☑ Bottom Valve
☐ Double Check Valve
☐ Stainless-steel Kemmerer

☐ Other

Water Disposal

Sampling Activities
Type of Container ____ No. of Containers ____
Parameters Sampled For

Water Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5-10-00	1249		x				4	4			22.9	6.26	2460		Cloudy. Septic odor
	1255		x				4	8			20.4	6.07	2259		Cloudy Gray Septic odor
	1305		x				4	12			21.7	6.22	2230		no change
	1404					16.65									

Circle the date and time that the development criteria are met.

Comments After Bailing Approximately 12 gal Bailed well Dry Let Recover Collected Samples @ 1425 BTEX, TPH, GEN. Chem

Developer's Signature (s) Chris Mary Date 5-10-00 Reviewer [illegible] Date 5/15/00

Well Development and Purging Data

roject No. 6171 Development ☐

ask No. 1 Purging ☑

Page 1 of 1

/ell No. MW 5 Site Name/Identification Crude Station Site Address Bloomfield, NM

lient/Project Name Giant Sampling/Bio Vent Pilot Test Project Manager MARTIN NEE

evelopment Criteria

- ☐ 3 to 5 Casing Volumes of Water Removal
- ☑ Stabilization of Indicator Parameters
- ☐ Other

Water Volume Calculation

Initial Depth of Well (feet) 24.6

Initial Depth to Water (feet) 16.14

Height of Water Column in Well (feet) 8.46

Diameter (inches): Well ____ Gravel Pack ____

Item	Water Volume in Well		Gallons to be Removed
	Cubic Feet	Gallons	
Well Casing	8.46	5.52X3	16.56
Gravel Pack			
Drilling Fluids			
Total			16.56

Instruments

Serial No. (if applicable)

- ☑ PH Meter — Hydac
- ☐ DO Monitor
- ☑ Conductivity Meter — Hydac
- ☑ Temperature Meter — Hydac
- ☐ Other

Water Disposal

ethods of Development

ump

- Centrifugal
- Submersible
- Peristaltic

Bailer

- ☑ Bottom Valve
- ☐ Double Check Valve
- ☐ Stainless-steel Kemmerer

Other

Sampling Activities

Type of Container ____ No. of Containers ____

Parameters Sampled For

ater Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5-20-01	1526		X				3.5	3.5			21.3	6.19	3620		Cloudy, slight odor
	1534		X				3.5	7			21.1	6.07	3170		" "
	1541		X				3.5	10.5			20.7	5.99	2900		" "
	1550		X				3.5	14			20.1	5.91	2980		" "
	1558		X				3.5	17.5			19.9	5.90	2960		no Change

e the date and time that the development criteria are met.

nments Sampled for BTEX 1550 TpH, GEN. Chem.

eloper's Signature (s) Date 5-10-01 Reviewer Date

PINNACLE LABORATORIES

Pinnacle Laboratories Inc.

CHAIN OF CUSTODY

DATE: _____ PAGE: ___ OF ___

PLI Accession #:

SHADED AREAS ARE FOR LAB USE ONLY.

PLEASE FILL THIS FORM IN COMPLETELY.

PROJECT MANAGER: MARTIN NEE

COMPANY: GOLDEN ENVIRONMENTAL MNGT.
ADDRESS: 606 SAN JUAN BLVD
Farmington NM.
PHONE: 505-566-9116 87401
FAX: 505-566-9120

BILL TO: GIANT
COMPANY: GIANT
ADDRESS: P.O. BOX 159
Bloomfield NM. 87413

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB I.D.
GIANT - MW 3	5-10-01	1445	H_2O	
GIANT MW 4	5-10-01	1425	H_2O	
GIANT MW 5	5-10-01	1550	H_2O	
TRIP Blank	5/2/01	1600	H_2O	

Petroleum Hydrocarbons (418.1) TRPH	(MOD.8015) Diesel/Direct Inject	TPH	(M8015) Gas/Purge & Trap	8021 (BTEX)/8015 (Gasoline) MTBE	8021 (BTEX) ☐ MTBE ☐ TMB ☐ PCE	8021 (TCL)	8021 (EDX)	8021 (HALO)	8021 (CUST)	504.1 EDB ☐ / DBCP ☐	8260 (TCL) Volatile Organics	8260 (Full) Volatile Organics	8260 (CUST) Volatile Organics	8260 (Landfill) Volatile Organics	Pesticides /PCB (608/8081/8082)	Herbicides (615/8151)	Base/Neutral/Acid Compounds GC/MS (625/8270)	Polynuclear Aromatics (610/8310/8270-SIMS)	General Chemistry:		Priority Pollutant Metals (13)	Target Analyte List Metals (23)	RCRA Metals (8)	RCRA Metals by TCLP (Method 1311)	Metals:		NUMBER OF CONTAINERS
		X			+																						3
		X			+																						3
		X			+																						3
					X																						3

PROJECT INFORMATION	
PROJ. NO.:	
PROJ. NAME:	
P.O. NO.:	
SHIPPED VIA:	

SAMPLE RECEIPT	
NO. CONTAINERS	
CUSTODY SEALS	Y/N/NA
RECEIVED INTACT	
BLUE ICE/ICE	

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS

(RUSH) ☐ 24hr ☐ 48hr ☐ 72hr ☐ 1 WEEK (NORMAL) ☐

CERTIFICATION REQUIRED: ☐ NM ☐ SDWA ☐ OTHER

METHANOL PRESERVATION ☐

COMMENTS: FIXED FEE ☐

please send shipping labels

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.
Signature: Time: 0903	Signature: Time:
Printed Name: Date: Chris Neel 5-14-01	Printed Name: Date:
Company: G.E.M.	Company:
See reverse side (Force Majeure)	
RECEIVED BY: 1.	**RECEIVED BY: (LAB) 2.**
Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:
Company:	Pinnacle Laboratories Inc.

Del Mar Analytical
2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
1014 E. Cooley Dr., Suite A Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
16525 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (602) 785-0043 FAX (602) 785-0851
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9689

GB- 9275

CHAIN OF CUSTODY FORM

Quote #: _____ Page 1 of 1

Client Name/Address:	Project/PO Number:
Project Manager:	Phone Number:
Sampler:	Fax Number:

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date/Time	Preservatives	Analysis Required	Special Instructions
[illegible]	W	[illegible]	1		—	[illegible]	
[illegible]	W	[illegible]	1		—	[illegible]	
[illegible]	W	[illegible]	2		—	[illegible]	

Relinquished By:	Date /Time:	Received by:	Date /Time:	Turnaround Time: (Check)
				same day _____ 72 hours _____
Relinquished By:	Date /Time:	Received by:	Date /Time:	24 hours _____ 5 days _____
				48 hours _____ normal _____
Relinquished By:	Date /Time:	Received in Lab by:	Date /Time:	Sample Integrity: (Check)
				intact _____ on ice _____

Note: By relinquishing samples to Del Mar Analytical, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

COC-GB

WELL OBSERVATION DATA

Project Name Giant Sampling/Bio Vent Pilot Test Project No. 6171

Project Manager Martin Nee Cost Code

Client Company GIANT Date 5-11-01

Site Name GIANT Crude Station

Well or Piezometer	Time	Reason Not Measured	Depth to Floating Product (Feet)	Depth to Water (Feet)	Depth to Sinking Product (Feet)	Total Well Depth (Feet)	Floating Product Thickness	Sinking Product Thickness	Comments
MW 3	1224			15.50					
MW 4	1219			16.05					
MW 5	1243			16.32					
MW 2			14.69	16.72			1.96		

Reason Not Measured: D = Dry; O = Obstructed; N = Not Accessible

Comments

Signature Chris A May Date 5-11-01

Well Development and Purging Data

Project No. 6171 | Development ☑ | Purging ☐ | Page 1 of 1

Task No. 1 | Well No. MW 6 | Site Name/Identification Crude Station | Site Address Bloomfield N.M.

Client/Project Name GIANT Sampling/Biovent Pilot Test | Project Manager MARTIN NEE

Development Criteria
- ☑ 3 to 5 Casing Volumes of Water Removal
- ☐ Stabilization of Indicator Parameters
- ☐ Other

Water Volume Calculation
- Initial Depth of Well (feet) 29.41
- Initial Depth to Water (feet) 18.18
- Height of Water Column in Well (feet) 11.23
- Diameter (inches): Well ____ Gravel Pack ____

Item	Water Volume in Well: Cubic Feet	Water Volume in Well: Gallons	Gallons to be Removed
Well Casing	11.23	1.83 x 3	5.49
Gravel Pack			
Drilling Fluids			
Total			

Instruments / **Serial No. (if applicable)**
- ☑ PH Meter — Hydac
- ☐ DO Monitor
- ☑ Conductivity Meter — Hydac
- ☑ Temperature Meter — Hydac
- ☐ Other

Water Disposal
On Site

Methods of Development

Pump: Centrifugal; Submersible; Peristaltic

Bailer: ☑ Bottom Valve; ☐ Double Check Valve; ☐ Stainless-steel Kemmerer

Other

Sampling Activities
Type of Container VOA plastic 2 Liter | No. of Containers 3
Parameters Sampled For BTEX, TDS, Gen. Chem

Water Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5-21-01			X					7							Added 5 gal Bailed 7 gal. Cleaning out Sediment
5-23-01	0933		X				1.25	1.25			21.9	6.78	4320		Cloudy Brown
	0936		X				1.25	2.50			18.9	6.91	4740		no odor " "
	0941		X				1.25	3.75			17.6	6.99	5090		no Change
5-23-01	1006					23.97									

* the date and time that the development criteria are met.

Comments: After Bailing Approximately 3.75 gal Bailed well Dry Let Recover Collected Samples BTEX, TDS, Gen. Chem. 1015 / Developing Added 5 gal Bailed 7 gal water coming in to well Clear

Developer's Signature (s) [signature] Date 5-23-01 Reviewer [signature] Date 5/25/01

Well Development and Purging Data

oject No. 6171 — Development ☑ — Page 1 of 1

isk No. 1 — Purging ☐

ell No. MW 7 — Site Name/Identification Crude Station — Site Address Bloomfield N.M.

ient/Project Name Giant Sampling/Biovent Pilot Test — Project Manager Martin NEE

evelopment Criteria

☑ 3 to 5 Casing Volumes of Water Removal
☐ Stabilization of Indicator Parameters
☐ Other

Water Volume Calculation

Initial Depth of Well (feet) 33.50
Initial Depth to Water (feet) 23.77
Height of Water Column in Well (feet) 9.73
Diameter (inches): Well 2" Gravel Pack

Item	Water Volume in Well: Cubic Feet	Water Volume in Well: Gallons	Gallons to be Removed
Well Casing	9.73	1.58 x 3	4.74
Gravel Pack			
Drilling Fluids			
Total			

Instruments — **Serial No. (if applicable)**

☑ PH Meter — Hydac
☐ DO Monitor
☑ Conductivity Meter — Hydac
☑ Temperature Meter — Hydac
☐ Other

ethods of Development

mp
Centrifugal
Submersible
Peristaltic

Bailer
☑ Bottom Valve
☐ Double Check Valve
☐ Stainless-steel Kemmerer

Other

Water Disposal

On Site

Sampling Activities

Type of Container — No. of Containers
Parameters Sampled For

ater Removal Data

Date	Time	Development Method: Pump	Development Method: Bailer	Removal Rate (gal/min)	Intake Depth (feet)	Ending Water Depth (feet)	Water Volume Removed (gallons): Increment	Water Volume Removed (gallons): Cumulative	Product Volume Removed (gallons): Increment	Product Volume Removed (gallons): Cumulative	Temperature (°C)	pH	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Comments
5-21-01	1317		X			28.41		7							Development Cleaning sediment out of well
5-23-01	0942		X				1	1			17.4	7.03	1770		Cloudy, Brown, Sheen Product odor
	0946		X				1	2			16.9	6.80	1940		Cloudy, Spotty Sheen product odor
	0949		X				1	3			16.7	6.80	1900		
	0953		X				1	4			16.5	6.90	1890		
	0957		X				1	5			16.4	6.84	1990		no change
5-23-01	0910					23.94									

le the date and time that the development criteria are met.

mments Sampled for BTEX, TDS, Gen. Chem. 0910

veloper's Signature (s) — Date — Reviewer 5/25/01 — Date

Pinnacle Laboratories Inc.

CHAIN OF CUSTODY

DATE: 5-23-01 PAGE: 1 OF 1

PLL #: 0105444

PLEASE FILL THIS FORM IN COMPLETELY. SHADED AREAS FOR PLL USE ONLY.

PROJECT MANAGER:	Lisa Winn
COMPANY:	GOLDEN ENVIRONMENTAL MKT.
ADDRESS:	906 San Juan BLVD Farmington N.M. 87401
PHONE:	(505) 566-9116
FAX:	(505) 566-9120
BILL TO:	GIANT (Tim Kinney)
COMPANY:	GIANT
ADDRESS:	P.O. Box 159 Bloomfield N.M. 87413

SAMPLE ID	DATE	TIME	MATRIX	# CONT.
GIANT MW 6	5/23/01	1015	H_2O	4
GIANT MW 7	5/23/01	0910	H_2O	4
Trip Blank	5/22/01	1600	H_2O	2

ANALYSIS REQUEST

Petroleum Hydrocarbons (418.1) TRPH	(MOD.8015) Diesel/Direct Inject		(M8015) Gas/Purge & Trap	8021 (BTEX)/8015 (Gasoline) MTBE	8021 (BTEX) ☐ MTBE ☐ TMB ☐ PCE	8021 (TCL)	8021 (EDX)	8021 (HALO)	8021 (CUST)	504.1 EDB ☐ / DBCP ☐	8260 (TCL) Volatile Organics	8260 (Full) Volatile Organics	8260 (CUST) Volatile Organics	8260 (Landfill) Volatile Organics	Pesticides /PCB (608/8081/8082)	Herbicides (615/8151)	Base/Neutral/Acid Compounds GC/MS (625/8270)	Polynuclear Aromatics (610/8310/8270-SIMS)	General Chemistry:		Priority Pollutant Metals (13)	Target Analyte List Metals (23)	RCRA Metals (8)	RCRA Metals by TCLP (Method 1311)	Metals:		
					X																					
					X																					
					X																					

PROJECT INFORMATION

PROJ. NO.:

PROJ. NAME:

P.O. NO.:

SHIPPED VIA

SAMPLE RECEIPT

NO. CONTAINERS	5
CUSTODY SEALS	Y/N/(NA)
RECEIVED INTACT	Y/N
COOLER ICE	Y/N

PRIOR AUTHORIZATIONS REQUIRED FOR HIGH/LOW DILUTIONS

(RUSH) ☐ 24hr ☐ 48hr ☐ 72hr ☐ 1 WEEK (NORMAL) ☒

CERTIFICATION REQUIRED: ☐ NM ☐ SDWA ☐ OTHER

METHANOL PRESERVATION ☐

COMMENTS: FIXED FEE ☐

RELINQUISHED BY:

Signature: Time: 1400

Printed Name: Chris Mercz Date: 5/23/01

Company: GEM

See reverse side (Force Majeure)

RECEIVED BY:

Signature: Time:

Printed Name: Date:

Company:

RELINQUISHED BY:

Signature: Time:

Printed Name: Date:

Company:

RECEIVED BY LAB:

Signature: Time: 1400

Printed Name: Date:

Company:

Inter- Mountain Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location	ANALYSES / PARAMETERS
GIANT	CRUDE Station Bloomfield NM.	
Sampler: (Signature) Ron A May	**Chain of Custody Tape No.**	**Remarks**

Sample No./ Identification	Date	Time	Lab Number	Matrix	No. of Containers	GEN. CHEM.	TDS			
GIANT MW 6	5-23-01	1015		H_2O	1	x	x			
GIANT MW 7	5-23-01	0910		H_2O	1	x	x			

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Ron A May	5-23-01	1155			
Relinquished by: (Signature)	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**
Relinquished by: (Signature)	**Date**	**Time**	**Received by laboratory: (Signature)**	**Date**	**Time**
				5/23/01	11 55

Inter-Mountain Laboratories, Inc.

☐ 555 Absaraka, Sheridan, Wyoming 82801, Telephone (307) 674-7506

☐ 1633 Terra Avenue, Sheridan, Wyoming 82801, Telephone (307) 672-8945

☐ 1701 Phillips Circle, Gillette, Wyoming 82718, Telephone (307) 682-8945

☐ 2506 West Main Street, Farmington, NM 87401, Telephone (505) 326-4737

☐ 11183 State Hwy. 30, College Station, TX 77845, Telephone (979) 776-8945

72682

WELL OBSERVATION DATA

Project Name GIANT monitor wells Project No. 6171-1

Project Manager Martin NEE Cost Code

Client Company Giant Date 5-21-2001

Site Name Giant Crude Station

Well or Piezometer	Time	Reason Not Measured	Depth to Floating Product (Feet)	Depth to Water (Feet)	Depth to Sinking Product (Feet)	Total Well Depth (Feet)	Floating Product Thickness	Sinking Product Thickness	Comments
MW 4	1059			16.13					
MW 2	11 10		15 10	15.65			.55		
MW 3	11 21			15.60					
MW 5	11 36			16.36					

Reason Not Measured: D = Dry; O = Obstructed; N = Not Accessible

Comments

Signature Chris A. May Date 5-21, 2001

WELL OBSERVATION DATA

Project Name GIANT Sampling Project No. 6171-2

Project Manager Martin NEE Cost Code

Client Company GIANT Date 5-23-01

Site Name GIANT Crude Station

Well or Piezometer	Time	Reason Not Measured	Depth to Floating Product (Feet)	Depth to Water (Feet)	Depth to Sinking Product (Feet)	Total Well Depth (Feet)	Floating Product Thickness	Sinking Product Thickness	Comments
MW 5	1003			16.38					
MW 3	10 30			15.62					
MW 4	10 34			16.14					
MW 2	10 38		15.13	15.69			.56		

Reason Not Measured: D = Dry; O = Obstructed; N = Not Accessible

Comments

Signature Date 5/23/01

WELL OBSERVATION DATA

Project Name Giant

Project No. 6171

Project Manager Martin NEE

Cost Code

Client Company GIANT

Date 7-3-01

Site Name GIANT Crude Station

Well or Piezometer	Time	Reason Not Measured	Depth to Floating Product (Feet)	Depth to Water (Feet)	Depth to Sinking Product (Feet)	Total Well Depth (Feet)	Floating Product Thickness	Sinking Product Thickness	Comments
MW 7	1506			23.62					
MW 6	1511			18.27					
MW 5	1515			16.29					
MW 3	1522			15.90					
MW 2	1531		15.48	16.32			0.84		
MW-4	1527			16.33					

Reason Not Measured: D = Dry; O = Obstructed; N = Not Accessible

Comments

Signature Chris A May

Date 7-3-01

WELL OBSERVATION DATA

Project Name GIANT Crude Station Project No. 6101

Project Manager Martin NES Cost Code

Client Company GIANT Date 7-9-01

Site Name GIANT Crude Station

Well or Piezometer	Time	Reason Not Measured	Depth to Floating Product (Feet)	Depth to Water (Feet)	Depth to Sinking Product (Feet)	Total Well Depth (Feet)	Floating Product Thickness	Sinking Product Thickness	Approximate product Recovery Comments Gallons
MW7	0950			23.55					
MW6	0956			18.30					
MW5	0901			16.36					
MW3	0912			15.94					
MW4	0918			16.43					
MW2	0930		15.54	16.43					1.10

Reason Not Measured: D = Dry; O = Obstructed; N = Not Accessible

Comments Bailed approximately 2.75 gal. of that 1.65 water

Signature [signature] Date 7-9-01

APPENDIX H

FIELD NOTES AND PILOT TEST DATA

Bioventing Well BV-1 Shallow Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	11.15	0.412	1.98
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	na	na	na
End Injection	1.09	0.194	0.05	1.99
	1.12	0.112	0.058	2
	1.19	0.158	0.041	2
	1.22	0.085	0.091	2
	1.26	0.145	0.036	1.96
	1.30	0.137	0.057	1.95
22-Jun	1.84	0.302	0.077	1.85
	1.97	0.288	0.047	1.81
	2.15	0.376	0.047	1.75
23-Jun	2.74	0.951	0.071	1.68
	2.88	0.408	0.085	1.68
	3.10	0.483	0.077	1.68
24-Jun	3.72	0.433	0.073	1.65
	3.90	0.541	0.074	1.63
	4.11	0.259	0.096	1.72
25-Jun	4.77	0.552	0.092	1.56
	5.11	0.36	0.116	1.56
26-Jun	5.81	0.211	0.109	1.52
	6.06	0.277	0.15	1.52

ppm = parts per million

Bioventing Well BV-1 Intermediate Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	6.11	1	1.36
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	na	na	na
End Injection	1.09	0.501	0.07	1.95
	1.12	0.704	0.074	1.96
	1.19	1.08	0.067	1.96
	1.22	1.01	0.082	1.99
	1.26	0.831	0.065	1.91
	1.30	0.629	1.51	1.89
22-Jun	1.84	2.6	1.7	1.67
	1.97	2.66	1.36	1.64
	2.15	3.89	1.64	1.62
23-Jun	2.74	2.66	1.7	1.55
	2.88	3.75	1.71	1.5
	3.10	3.17	1.63	1.53
24-Jun	3.72	3.53	2.95	1.5
	3.90	3.63	2.11	1.5
	4.11	2.02	2.38	1.53
25-Jun	4.77	5.1	2.82	1.45
	5.11	1.74	1.95	1.63
26-Jun	5.81	1.41	3.31	1.46
	6.06	0.934	3.51	1.57

ppm = parts per million

Bioventing Well BV-1 Deep Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	9.11	0.19	0.85
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	na	na	na
End Injection	1.09	0.285	0.08	2.02
	1.12	0.403	0.062	1.91
	1.19	0.444	0.03	1.95
	1.22	0.176	0.058	1.92
	1.26	0.451	0.057	1.72
	1.30	0.306	0.043	1.73
22-Jun	1.84	0.513	0.052	1.3
	1.97	0.429	0.029	1.14
	2.15	0.557	0.064	1.11
23-Jun	2.74	1.59	0.052	1.07
	2.88	0.489	0.072	1.08
	3.10	0.393	0.079	1.23
24-Jun	3.72	0.417	0.038	1.4
	3.90	0.349	0.037	1.36
	4.11	0.18	0.032	1.49
25-Jun	4.77	0.294	0.046	1.46
	5.11	0.233	0.074	1.54
26-Jun	5.81	0.107	0.059	1.68
	6.06			

ppm = parts per million

Bioventing Well BV-2 Shallow Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	ppm/10000	%
6/20/2001	-0.12	0.178	0.444	16.6
	0.00			
Begin Pilot Test	0.00	3.12	2.4	13.4
	0.04	4.06	5.1	10.6
	0.07	6.8	1.8	11.2
	0.09	12.02	2.2	11.6
	0.11	13.72	2.8	10.7
	0.13	15.74	2.8	11.2
	0.25	18.34	2.9	11.5
	0.40	20.25	2.4	12
21-Jun	0.75	12.61	2.8	18.1
	0.91	11.75	2.4	18.7
	1.03	12.55	1	18.7
End Injection	1.09	9.46	1	18.1
	1.12	9.62	1.1	17.7
	1.19	10.75	1.9	17.5
	1.22	13.08	1.1	17.3
	1.26	10.6	1.2	17.6
	1.30	12.03	1	17.3
22-Jun	1.84	18.63	1.3	16.8
	1.97	15.85	1	16.3
	2.15	17.73	1	15.7
23-Jun	2.74	18.52	1.4	15.2
	2.88	16.1	0.921	16
	3.10	15.58	1	15.7
24-Jun	3.72	16.84	1.3	15
	3.90	12.72	3.8	14
	4.11	12.93	1.2	14.8
25-Jun	4.77	3.38	1	14.8
	5.11	3.29	1	15.1
26-Jun	5.81	0.957	1	14
	6.06	1.04	1	13.5

ppm = parts per million

Bioventing Well BV-2 Intermediate Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
		ppm/100	%	%
6/20/2001	-0.12	4.25	2.4	15.2
	0.00			
Begin Pilot Test	0.00	5.67	1.7	11.7
	0.04	9.54	2	14.9
	0.07	8.69	1	15.4
	0.09	8.49	1	16.4
	0.11	11.48	1	16.4
	0.13	10.02	1	16.8
	0.25	21.27	1	17.7
	0.40	24.33	1	18.4
21-Jun	0.75	5.59	1	18.6
	0.91	8.48	0.526	18.9
	1.03	9.45	0.896	18.5
End Injection	1.09	5.28	0.464	17.2
	1.12	7.08	0.827	16.8
	1.19	6.44	1	14.4
	1.22	6.92	0.101	13.9
	1.26	5.56	0.451	13.7
	1.30	18.47	1	13.8
22-Jun	1.84	9.57	1	13.7
	1.97	8.45	0.774	13.5
	2.15	9.74	1	14.2
23-Jun	2.74	11.91	1	13.2
	2.88	4.92	0.58	14.4
	3.10	9.52	1	14
24-Jun	3.72	19.57	1	14.4
	3.90	9.52	1	13.7
	4.11	3.1	1	14.7
25-Jun	4.77	2.59	0.847	16.2
	5.11	3.42	1	14.3
26-Jun	5.81	4.88	1	14.8
	6.06	3.1	1	14.4

ppm = parts per million

Bioventing Well BV-2 Deep Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	ppm/10000	%/10
6/20/2001	-0.12	1.39	1.3	1.57
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	10.34	0.096	2.05
End Injection	1.09	3.27	0.094	2.03
	1.12	3.14	0.099	2.01
	1.19	3.46	0.102	1.95
	1.22	3.31	0.086	1.91
	1.26	4.16	0.088	1.87
	1.30	3.53	0.102	1.83
22-Jun	1.84	4.13	0.1	1.42
	1.97	4.12	0.116	1.39
	2.15	5.75	0.109	1.27
23-Jun	2.74	7.26	0.099	1.19
	2.88	7.53	0.133	1.13
	3.10	4.86	0.115	1.28
24-Jun	3.72	5.74	0.109	1.24
	3.90	6.58	0.113	1.35
	4.11	2.4	0.091	1.24
25-Jun	4.77	1.92	0.082	1.6
	5.11	2.01	0.138	1.45
26-Jun	5.81	1.19	0.128	1.32
	6.06	1.17	0.243	1.5

ppm = parts per million

Bioventing Well BV-3 Shallow Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%
6/20/2001	-0.12	0.031	1.2	15.7
	0.00			
Begin Pilot Test	0.00	1.16	3.5	11.5
	0.04	3.06	3.1	10.2
	0.07	4.54	3.6	10.2
	0.09	6.1	4.6	10.5
	0.11	7.81	4.5	10.2
	0.13	9.91	4.9	10.6
	0.25	17.78	5.9	9.3
	0.40	19.89	7.6	11.9
21-Jun	0.75	22.2	2.7	13.7
	0.91	22.37	3.5	15.9
	1.03	21.61	5.2	12.5
End Injection	1.09	21.01	2.1	13.8
	1.12	20.84	2.8	14.2
	1.19	22.03	3.1	14.2
	1.22	22.88	3.3	12.7
	1.26	22.27	2.7	13.4
	1.30	23.14	4.1	13
22-Jun	1.84	23.22	2.7	13.2
	1.97	23.08	2.8	12.8
	2.15	23.39	1.7	13.3
23-Jun	2.74	20.25	4.7	12.7
	2.88	22.2	2	13.6
	3.10	21.52	2.2	12.9
24-Jun	3.72	21.1	4.6	13.2
	3.90	22.54	3.2	12.6
	4.11	19.21	2.6	13
25-Jun	4.77	19.36	3.3	12.8
	5.11	15.22	2.8	12.9
26-Jun	5.81	14.52	3.1	12.3
	6.06	9.88	3.8	12.8

ppm = parts per million

Bioventing Well BV-3 Intermediate Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%
6/20/2001	-0.12	2.43	1.1	14
	0.00			
Begin Pilot Test	0.00	4.72	3.1	13.9
	0.04	3.64	2.2	15.2
	0.07	3.77	2.5	15.5
	0.09	5.81	2	16.3
	0.11	5.79	2.9	16.5
	0.13	5.34	2.8	16.8
	0.25	16.15	1.4	17.1
	0.40	7.02	1.7	19.2
21-Jun	0.75	4.84	1.3	18.9
	0.91	3.78	1	18.3
	1.03	15.99	1	18.4
End Injection	1.09	3.23	1	17.1
	1.12	4.24	1	16.5
	1.19	4	2.7	14.8
	1.22	16.2	1	14.4
	1.26	3.26	1	14.7
	1.30	3.24	1	14.2
22-Jun	1.84	7.22	1	15.4
	1.97	6.32	1	14.4
	2.15	5.08	1	14.4
23-Jun	2.74	3.44	1	13.9
	2.88	5.68	1	14.2
	3.10	4.98	1	14.6
24-Jun	3.72	6.83	1	15.2
	3.90	5.75	0.985	15.3
	4.11	1.54	1	14.2
25-Jun	4.77	1.75	1	14.3
	5.11	1.2	1	15.3
26-Jun	5.81	1.25	1	15.6
	6.06	1.44	1	14.8

ppm = parts per million

Bioventing Well BV-3 Deep Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%
6/20/2001	-0.12	0.029	0.027	2.05
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	2.19	0.447	1.98
End Injection	1.09	0.338	0.336	2.01
	1.12	0.464	0.921	2.02
	1.19	0.373	0.488	1.87
	1.22	0.955	0.563	1.79
	1.26	5.56	0.451	1.76
	1.30	2.9	0.412	1.71
22-Jun	1.84	1.18	0.601	1.71
	1.97	0.997	0.623	1.52
	2.15	1.59	0.827	1.63
23-Jun	2.74	1.69	0.478	1.73
	2.88	1.06	0.467	1.67
	3.10	1.07	0.335	1.6
24-Jun	3.72	1.54	0.096	1.6
	3.90	2.06	0.108	1.56
	4.11	0.517	0.677	1.73
25-Jun	4.77	0.42	0.753	1.74
	5.11	0.96	0.51	1.67
26-Jun	5.81	1.45	0.504	1.73
	6.06	0.406	0.81	1.72

ppm = parts per million

Bioventing Well BV-4 Shallow Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	0.124	1.5	13.6
	0.00			
Begin Pilot Test	0.00	0.193	2.1	14.3
	0.04	1.3	1.6	12.7
	0.07	2.46	1.7	10.9
	0.09	3.46	3.2	10.4
	0.11	4.1	3.3	9.6
	0.13	4.88	2.9	10.4
	0.25	12.44	6.4	9.8
	0.40	17.94	9.9	13.3
21-Jun	0.75	20.25	6	10
	0.91	19.47	5.3	10.7
	1.03	19.36	5.6	10.7
End Injection	1.09	19.26	4.9	11.5
	1.12	19.36	5.4	11.6
	1.19	19.57	5.8	11.9
	1.22	20.42	5.9	11.9
	1.26	20.5	4.5	11.1
	1.30	21.18	5	11.5
22-Jun	1.84	20.67	5.2	11.4
	1.97	19.63	5.3	11.4
	2.15	20.93	5.6	11.5
23-Jun	2.74	20.08	5.6	11.8
	2.88	19.98	5	12.3
	3.10	19.36	4.9	12.5
24-Jun	3.72	19.1	5	12.5
	3.90	10.65	5.2	13.2
	4.11	17.26	4.8	12.9
25-Jun	4.77	16.52	3.2	12.6
	5.11	15.07	3.2	13.2
26-Jun	5.81	13.97	4.9	13.2
	6.06	12.58	3.7	13.3

ppm = parts per million

Bioventing Well BV-4 Intermediate Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	0.979	1.3	1.34
	0.00			
Begin Pilot Test	0.00	1.02	1	1.62
	0.04	1.2	1.2	1.51
	0.07	1.2	3.3	1.48
	0.09	1.41	1.4	1.48
	0.11	1.64	3.7	1.49
	0.13	1.86	2.1	1.5
	0.25	2.76	2.5	1.45
	0.40	2.36	2.5	1.75
21-Jun	0.75	1.69	3.2	1.72
	0.91	1.97	9.4	1.65
	1.03	3.97	3	1.53
End Injection	1.09	1.81	2.1	1.52
	1.12	1.98	2.2	1.59
	1.19	2.49	2.5	1.67
	1.22	3.73	2.8	1.46
	1.26	5.2	5.5	1.42
	1.30	6.39	2.1	1.55
22-Jun	1.84	3.72	1.7	1.55
	1.97	8.01	4.1	1.53
	2.15	6.21	2	1.54
23-Jun	2.74	6.54	3.2	1.6
	2.88	3.06	1.5	1.62
	3.10	4.98	2	1.49
24-Jun	3.72	6.51	2.3	1.52
	3.90	6.64	1.6	1.52
	4.11	3.72	3.9	1.52
25-Jun	4.77	1.6	3.2	1.5
	5.11	1.68	3.8	1.51
26-Jun	5.81	1.41	1.3	1.67
	6.06	1.59	3.2	1.6

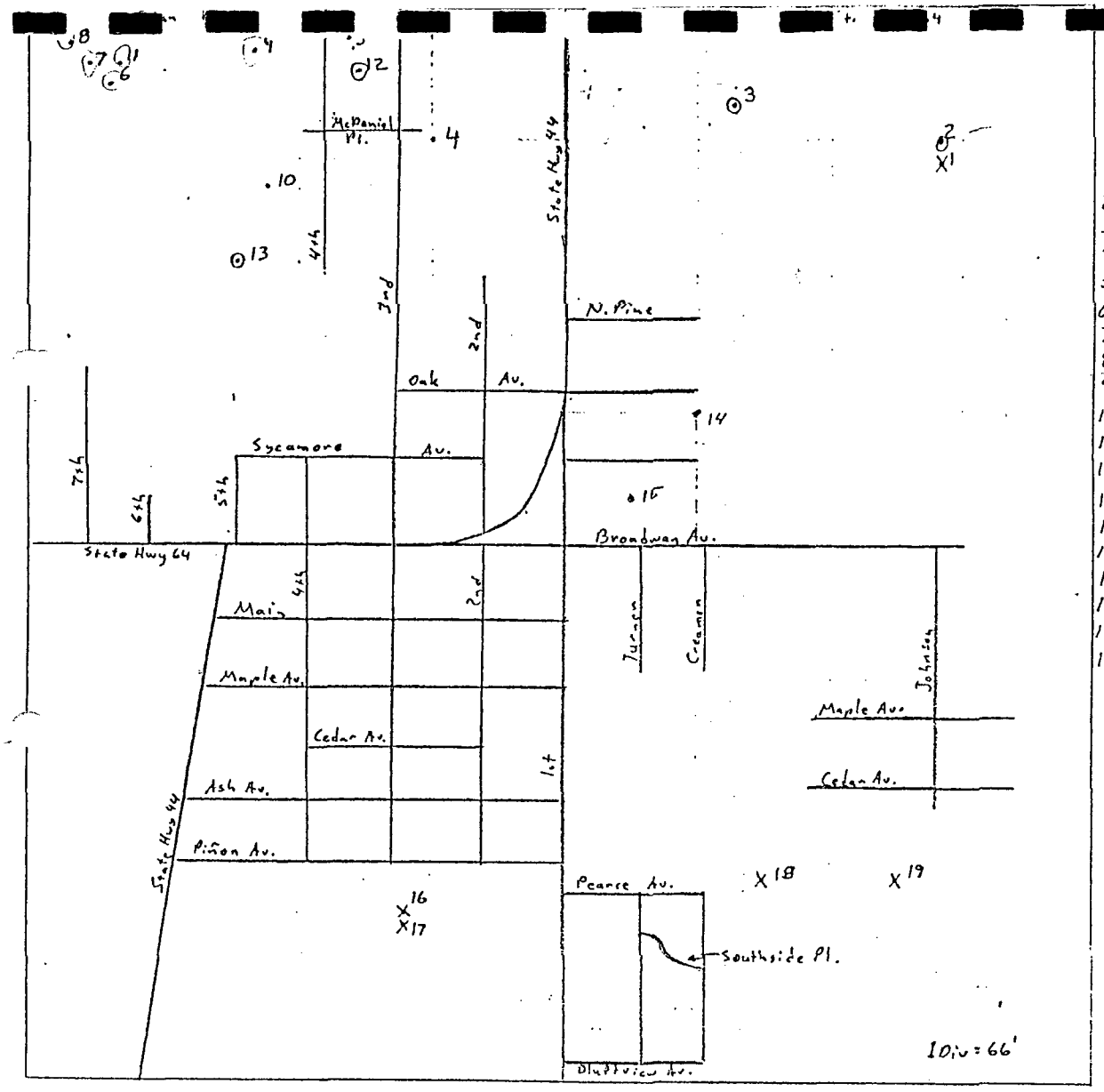
ppm = parts per million

Bioventing Well BV-4 Deep Zone	T ime in Days from Beginning of Pilot Test	Hydrocarbon Concentraion	Carbon Dioxide Concentration	Oxygen Concentration
Units		ppm/100	%	%/10
6/20/2001	-0.12	0.674	0.415	0.85
	0.00	na	na	na
Begin Pilot Test	0.00	na	na	na
	0.04	na	na	na
	0.07	na	na	na
	0.09	na	na	na
	0.11	na	na	na
	0.13	na	na	na
	0.25	na	na	na
	0.40	na	na	na
21-Jun	0.75	na	na	na
	0.91	na	na	na
	1.03	9.01	1	1.72
End Injection	1.09	5.18	1	1.43
	1.12	6.44	1	1.49
	1.19	6.39	1.6	1.54
	1.22	6.09	2.5	1.46
	1.26	6.19	1.3	1.42
	1.30	10.71	1	1.55
22-Jun	1.84	9.87	2	1.42
	1.97	8.85	2.1	1.34
	2.15	8.77	3.3	1.27
23-Jun	2.74	9.51	1.3	1.36
	2.88	6.14	1	1.38
	3.10	6.7	1.2	1.32
24-Jun	3.72	8.43	5.5	1.32
	3.90	9.31	1	1.31
	4.11	3.77	1.8	1.31
25-Jun	4.77	3.8	2.7	1.39
	5.11	3.69	3	1.07
26-Jun	5.81	3.71	2	1.37
	6.06	2.79	1.3	1.41

ppm = parts per million

APPENDIX I

HISTORICAL RECORDS



X Producers
⊙ Reported as P+A
• Wells reported as drille records

1.	Mañana Gas Inc.	Finch
2.	Melborne Pet. Corp.	M.T.
3	" " "	R.L.
4.	Frank Webber	?
5.	Finley & Johansen	Hare
6.	Haney & Smith	Kitte
7.	Mid Continent Oil	Hare
8	Smith & Miley	Bish
9	Bloomfield O&G	Grace
10	Nat'l Petro. Co.	?
11	A.E. Haney	Bish
12.	Vincent & Goodnum	Refi
13.	Page & Davis	Salm
14.	Finley & Johanson	Fee
15.	Bloomfield O&G	S.W
16	Kimbell Oil Co.	Cook
17	"	Cook*
18	John C. Pickett	Gara
19.	Kimbell Oil Co.	Hart

(Form C-102)
(Revised 7/1/52)

NEW MEXICO OIL CONSERVATION COMMISSION

Santa Fe, New Mexico

MISCELLANEOUS NOTICES

Submit this notice in TRIPLICATE to the District Office, Oil Conservation Commission, before the work specified is to begin. A copy will be returned to the sender on which will be given the approval, with any modifications considered advisable, or the rejection by the Commission or agent, of the plan submitted. The plan as approved should be followed, and work should not begin until approval is obtained. See additional instructions in the Rules and Regulations of the Commission.

Indicate Nature of Notice by Checking Below

Notice of Intention to Change Plans		Notice of Intention to Temporarily Abandon Well		Notice of Intention to Drill Deeper	
Notice of Intention to Plug Well	X	Notice of Intention to Plug Back		Notice of Intention to Set Liner	
Notice of Intention to Squeeze		Notice of Intention to Acidize		Notice of Intention to Shoot (Nitro)	
Notice of Intention to Gun Perforate		Notice of Intention (Other)		Notice of Intention (Other)	

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

Bloomfield, New Mexico (Place) November 6, 1953 (Date)

Gentlemen:

Following is a Notice of Intention to do certain work as described below at the

The Aerex Company (Company or Operator) Bishop Well No. 3 in D (Unit)

NW ¼ NW ¼ (40-acre Subdivision) of Sec. 22, T. 29N, R. 11W, NMPM., Bloomfield-Farmington Pool

San Juan County.

FULL DETAILS OF PROPOSED PLAN OF WORK

(FOLLOW INSTRUCTIONS IN THE RULES AND REGULATIONS)

This well drilled in 1925 by The Bloomfield Oil & Gas Company, and was completed at a total depth of 700' in the Farmington sandstone.
8-1/4" casing was set at 690'. 10-1/2" set at approximately 200'.
Initial production was approximately 10 barrels oil per day. In 1926 the Fidelity Oil Company purchased this well from the Bloomfield Oil & Gas Co. In Sept. 1929 the Fidelity Oil Company went into receivership and A. C. & Virginia Kittell received title through court order. In 1930 title was transferred to The Aerex Company and they are the present owners. Production at present estimated at 1/2 barrel oil per day.

We propose to pull pipe, plug and abandon as follows: Place 10-sack regular cement plug from 700 to 650, pull all casing, put cement plug in top and leave marker 4' above ground level.

Approved 11-7, 1953
Except as follows:

The Aerex Co Inc.
Company or Operator

By A C Kittell

Position President

Send Communications regarding well to:

Name

Address

Approved
OIL CONSERVATION COMMISSION

By Edward C. Arnold

Title Oil & Gas Inspector, District #3

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

NO. OF COPIES RECEIVED		
DISTRIBUTION		
SANTA FE		
FILE		
U.S.		
LAND OFFICE		
OPERATOR		

OIL CONSERVATION DIVISION

P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

Form C-103
Revised 10-1-

5a. Indicate Type of Lease
State ☐ Fee ☒

5. State Oil & Gas Lease No.

SUNDRY NOTICES AND REPORTS ON WELLS

(DO NOT USE THIS FORM FOR PROPOSALS TO DRILL OR TO DEEPEN OR PLUG BACK TO A DIFFERENT RESERVOIR. USE "APPLICATION FOR PERMIT —" (FORM C-101) FOR SUCH PROPOSALS.)

7. Unit Agreement Name

OIL WELL ☐ GAS WELL ☒ OTHER-

Name of Operator: Smith + Miley / State of NM Oil Conservation Division RFA Program.

8. Farm or Lease Name: Bishop

Address of Operator: 1000 Rio Brazos Rd. Aztec N.M. 87410

9. Well No.: 3

Location of Well
UNIT LETTER D, 200 FEET FROM THE North LINE AND 200 FEET FROM THE West LINE, SECTION 22 TOWNSHIP 29 N RANGE 11 W NMPM.

10. Field and Pool, or Wildcat: Bloomfield Farmington

15. Elevation (Show whether DF, RT, GR, etc.): 5490

12. County: SJ

Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:		SUBSEQUENT REPORT OF:	
PERFORM REMEDIAL WORK ☐	PLUG AND ABANDON ☐	REMEDIAL WORK ☐	ALTERING CASING ☐
TEMPORARILY ABANDON ☐		COMMENCE DRILLING OPNS. ☐	PLUG AND ABANDONMENT ☒
PULL OR ALTER CASING ☐	CHANGE PLANS ☐	CASING TEST AND CEMENT JOB ☐	
OTHER ☐		OTHER ☐	

Describe Proposed or Completed Operations (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work) SEE RULE 1103.

1. Clean hole to TD 540'
2. Set cement plug 35 sks (Class B 2% CaCl) 540' - 440'.
3. Come out of hole to 380'
4. Set cement plug 53 sks 380' - 230'.
5. Come out of hole. Watch Fluid level for 1 hr. It did not drop any.
6. Pull out of hole to 160'
7. Set cement plug 47 sks from 160-50'
8. Set 10 sks top plug 25'-0
9. Install dry hole marker
10. Clean location and fill pits.

RECEIVED
OCT 13 1982
OIL CON. COM.
DIST. 3

I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED Pete Lambert TITLE Area Manager DATE 10-10-82

APPROVED BY Jeff A. Edmister TITLE DEPUTY OIL & GAS INSPECTOR, DIST. #3 DATE 10-10-82

CONDITIONS OF APPROVAL, IF ANY:

STATE OF NEW MEXICO
ENERG. AND MINERALS DEPA..MENT
OIL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

983-7909

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO 87410
(505) 334-6178

DIVISION APPROVED PLUGGING PROGRAM

well file

Smith & Miley
Bishop #3
~~A~~-22-29N-11W

Downhole Equipment - 10" at 115'
Hole Size Unknown
Total Depth 699'

8" 1. Clean out hole to 699'. 540

2. Set a cement plug 699' - 599'. 540 440 35 sks

3. Come out of hole to 400'.

8" 4. Set a cement plug 400' - 250'. 53 sks

5. Come out of hole. Watch fluid level for one hour. If fluid level does not drop significantly, go to step #6. If fluid level drops 30' or more wait five more hours and tag plug. If plug is below 300' fill to 250'.

6. Come out of hole to 160'

7. Set a cement plug 160' - 50' 47 sks

8. Set a top plug and marker with ten sacks of cement. 25'

9. Fill pits, clean and level location.

1.18 cuft/sk 8" 2.0645 ft/cuft.

[illegible] 10" 2.0820 25'

TD 540'

APPENDIX J

COMPREHENSIVE SUMMARY OF GROUND WATER ELEVATIONS

Summary of Ground Water Elevation
September 1994 through July 2001

WATER LEVEL ELEVATIONS				
Well ID	**Date Measured**	**Measured DTW**	**TOC Elevation**	**Groundwater Elevation**
MW-1*	NA	NA	NA	NA
MW-2	September 22, 1994	13.28	5483.04	5469.076
	October 31, 1994	12.66		5470.29
	April 27, 1995	13.15		5469.5
	May 4, 1995	NA		NA
	September 30, 1999	17.48		5467.29
	November 16, 1999	17.00		5467.69
	December 14, 1999	16.76		5467.75
	May 11, 2001	16.77	5485.33	5469.93
	May 21, 2001	15.65		5470.06
	May 23, 2001	15.69		5470.07
	July 3, 2001	16.32		5469.60
	July 9, 2001	16.43		5469.52
MW-3	September 22, 1994	13.02	5486.21	5473.19
	October 31, 1994	12.39		5473.82
	April 27, 1995	12.98		5473.23
	May 4, 1995	12.68		5473.53
	September 30, 1999	15.81		5470.40
	November 16, 1999	15.41		5470.80
	December 14, 1999	15.25		5470.96
	May 11, 2001	15.50	5488.61	5473.11
	May 21, 2001	15.60		5473.01
	May 23, 2001	15.62		5472.99
	July 3, 2001	15.90		5472.71
	July 9, 2001	15.94		5472.67
MW-4	September 22, 1994	14.38	5483.88	5469.50
	October 31, 1994	14.01		5469.87
	April 27, 1995	13.73		5470.15
	May 4, 1995	13.67		5470.21
	September 30, 1999	16.21		5467.67
	November 16, 1999	15.51		5468.37
	December 14, 1999	16.00		5467.88
	May 11, 2001	16.05	5486.18	5470.13
	May 21, 2001	16.13		5470.05
	May 23, 2001	16.14		5470.04
	July 3, 2001	16.33		5469.85
	July 9, 2001	16.43		5469.75

WATER LEVEL ELEVATIONS

Well ID	Date Measured	Measured DTW	TOC Elevation	Groundwater Elevation
MW-5	September 22, 1994	NA	5479.41	NA
	October 31, 1994	NA		NA
	April 27, 1995	NA		NA
	May 4, 1995	14.38		5465.03
	September 30, 1999	16.93		5462.48
	November 16, 1999	16.52		5462.89
	December 14, 1999	16.63		5462.78
	May 11, 2001	16.32	5481.61	5465.29
	May 21, 2001	16.36		5465.25
	May 23, 2001	16.38		5465.23
	July 3, 2001	16.29		5465.32
	July 9, 2001	16.36		5465.25
MW-6	May 23, 2001	18.18	5486.18	5468.00
	July 3, 2001	18.27		5467.91
	July 9, 2001	18.30		5467.88
MW-7	May 23, 2001	23.77	5491.86	5468.09
	July 3, 2001	23.62		5468.24
	July 9, 2001	23.55		5468.31

Notes:

Measuring points are marked by a notch in top of well casing

NA = Not Available

MW-1* = Water levels for MW-1 are not included because this well is not screened in the aquifer

TOC = Top of Casing

DTW = Depth to Water

Water Elevation = (Surveyed Well Casing Elevation) – (DTW)

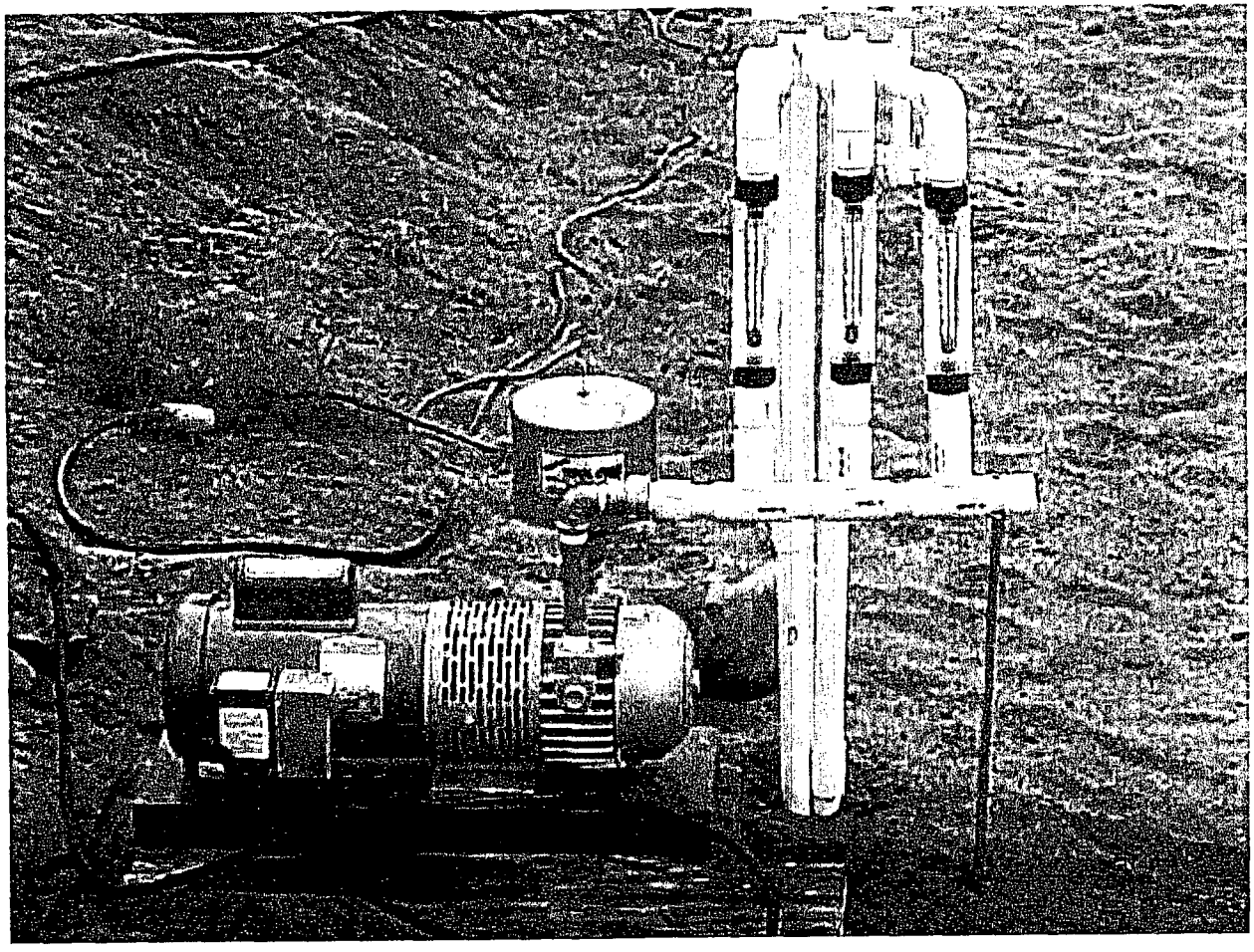
Water level elevation is given in feet above mean sea level

MW-2 water level is corrected for product thickness using a specific gravity of 0.7

APPENDIX K

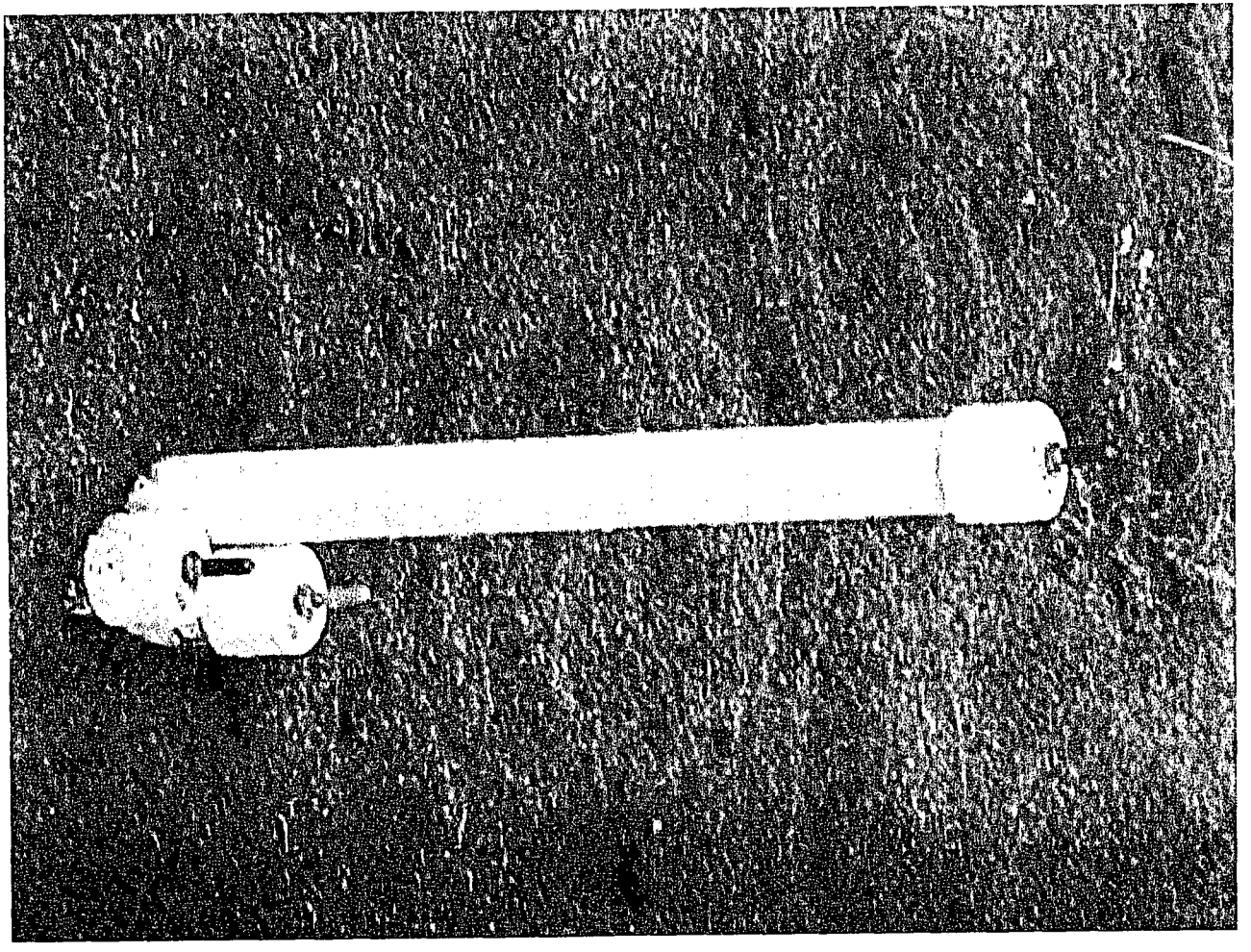
BIOVENT PILOT TEST PHOTOGRAPHS

Picture 1
Crude Station Bioventing Pilot Test

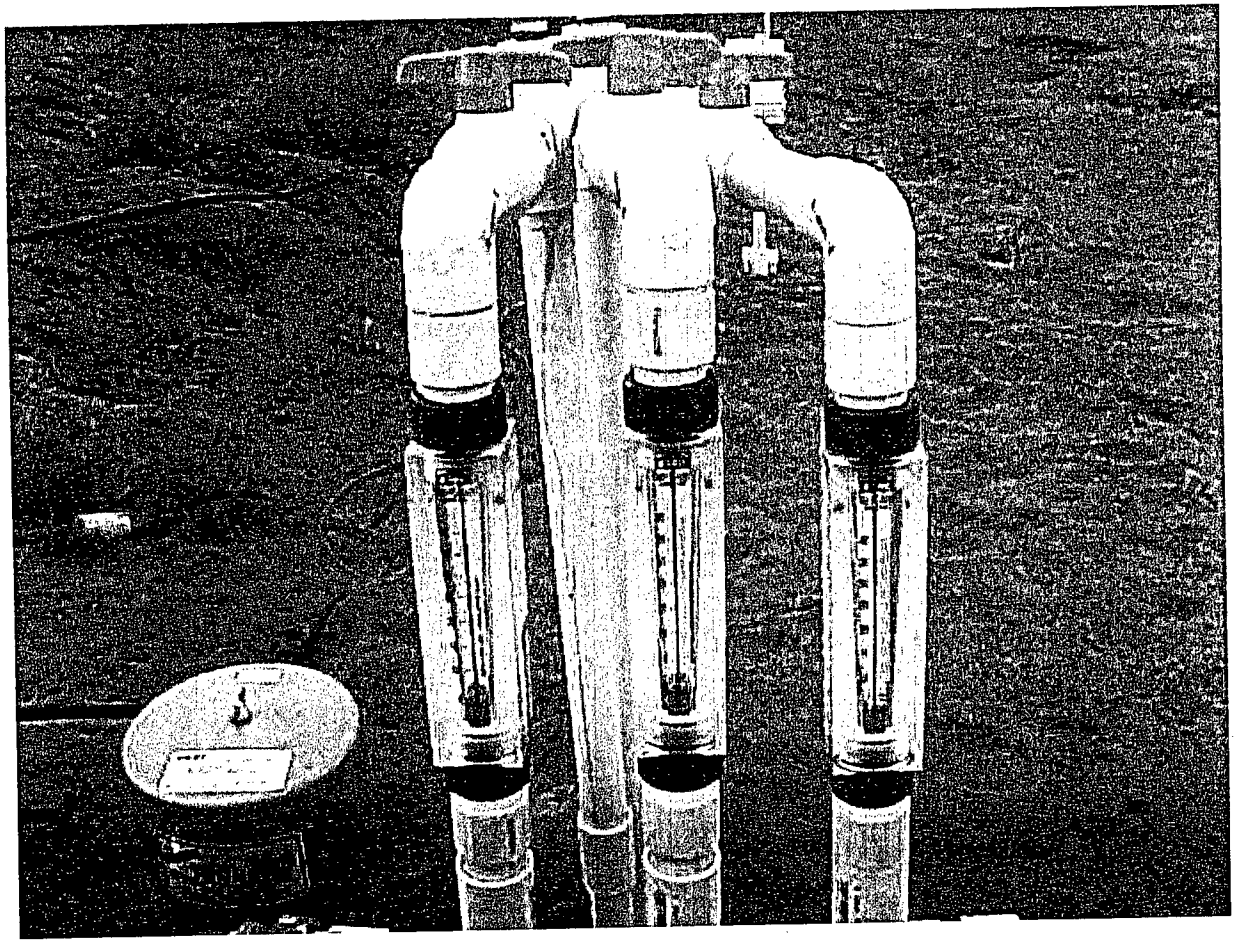


Picture 2
Crude Station Bioventing Pilot Test

Picture 3
Crude Station Bioventing Pilot Test

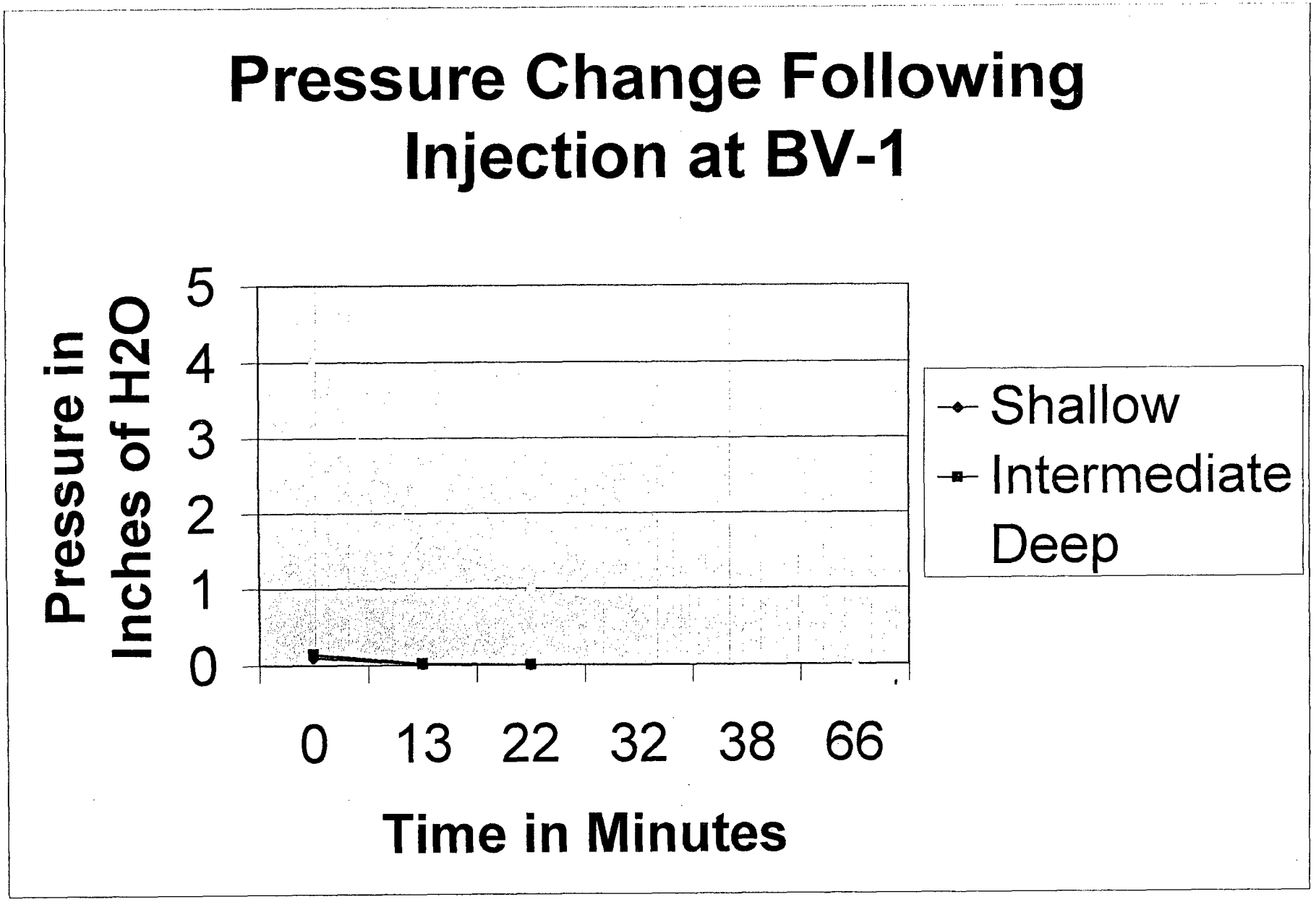


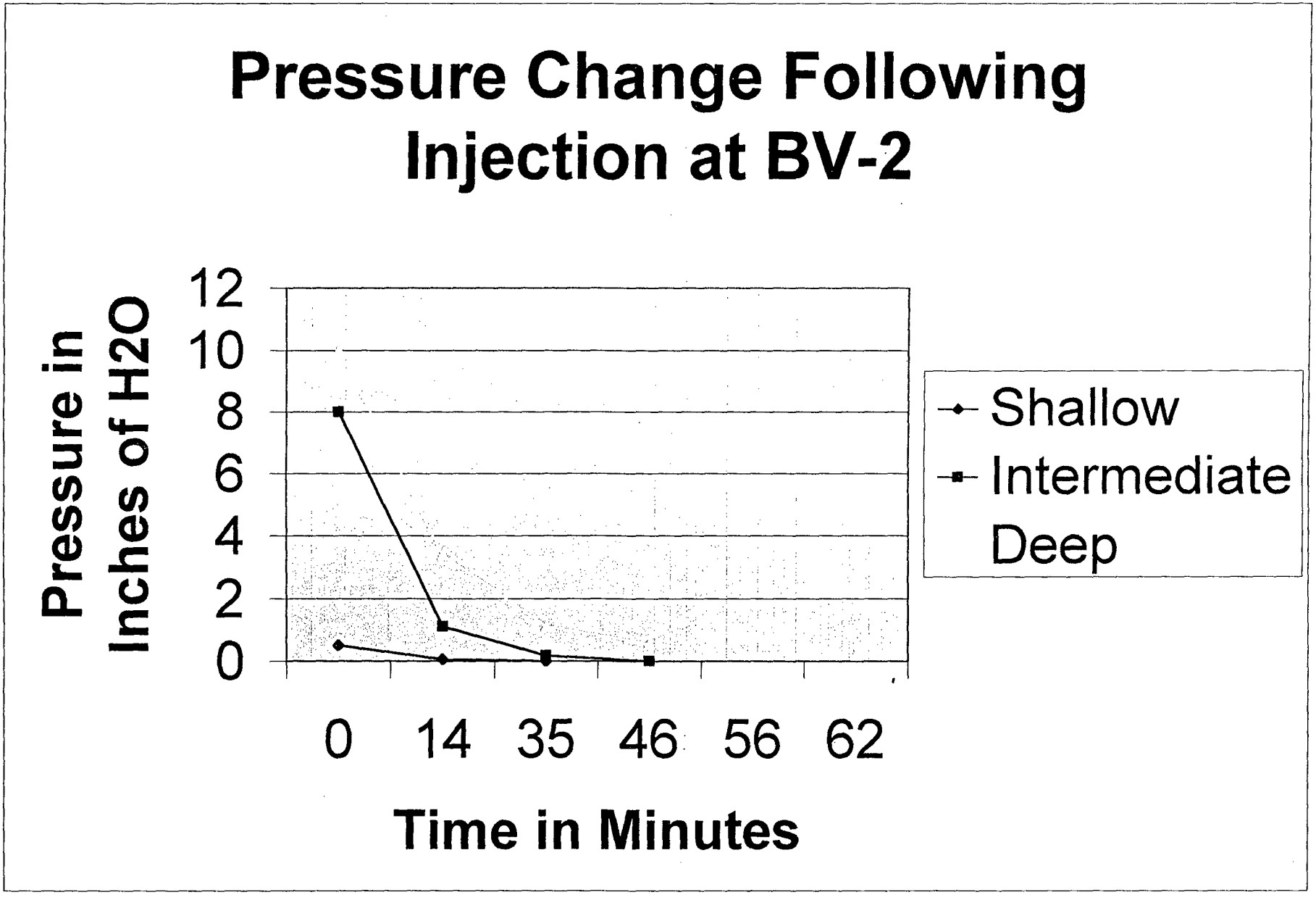
Picture 4
Crude Station Bioventing Pilot Test

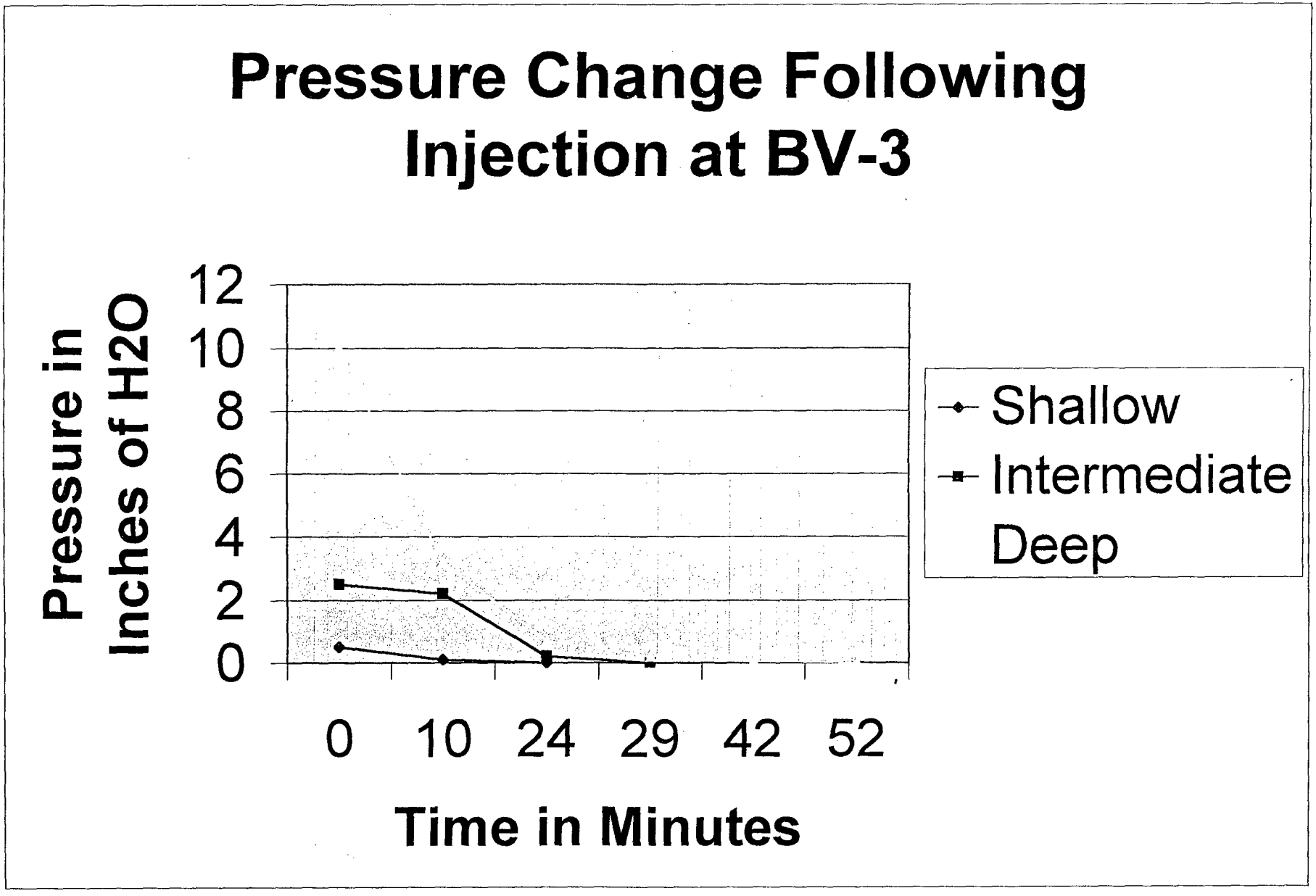


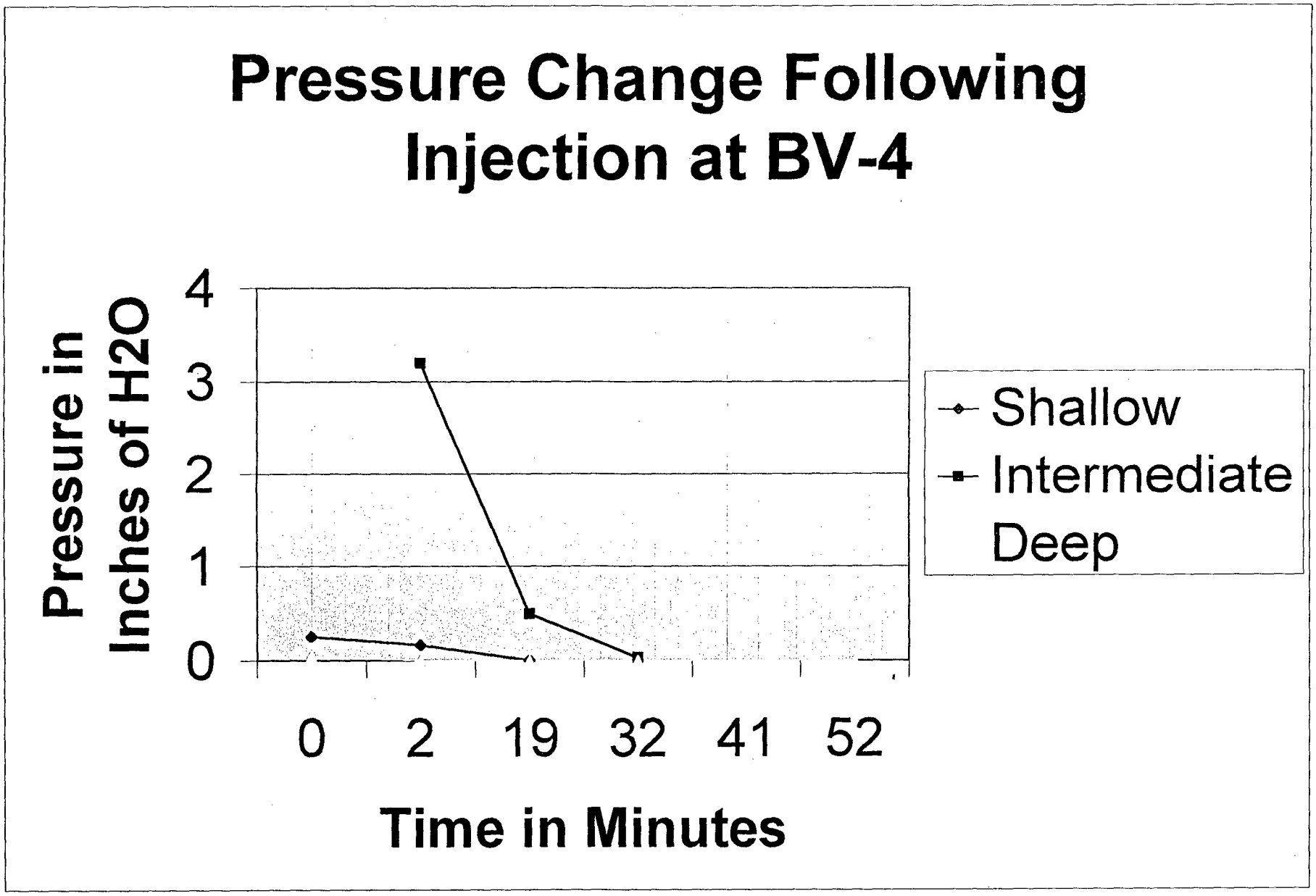
APPENDIX M

GRAPHICAL ILLUSTRATIONS OF BIOVENT DATA

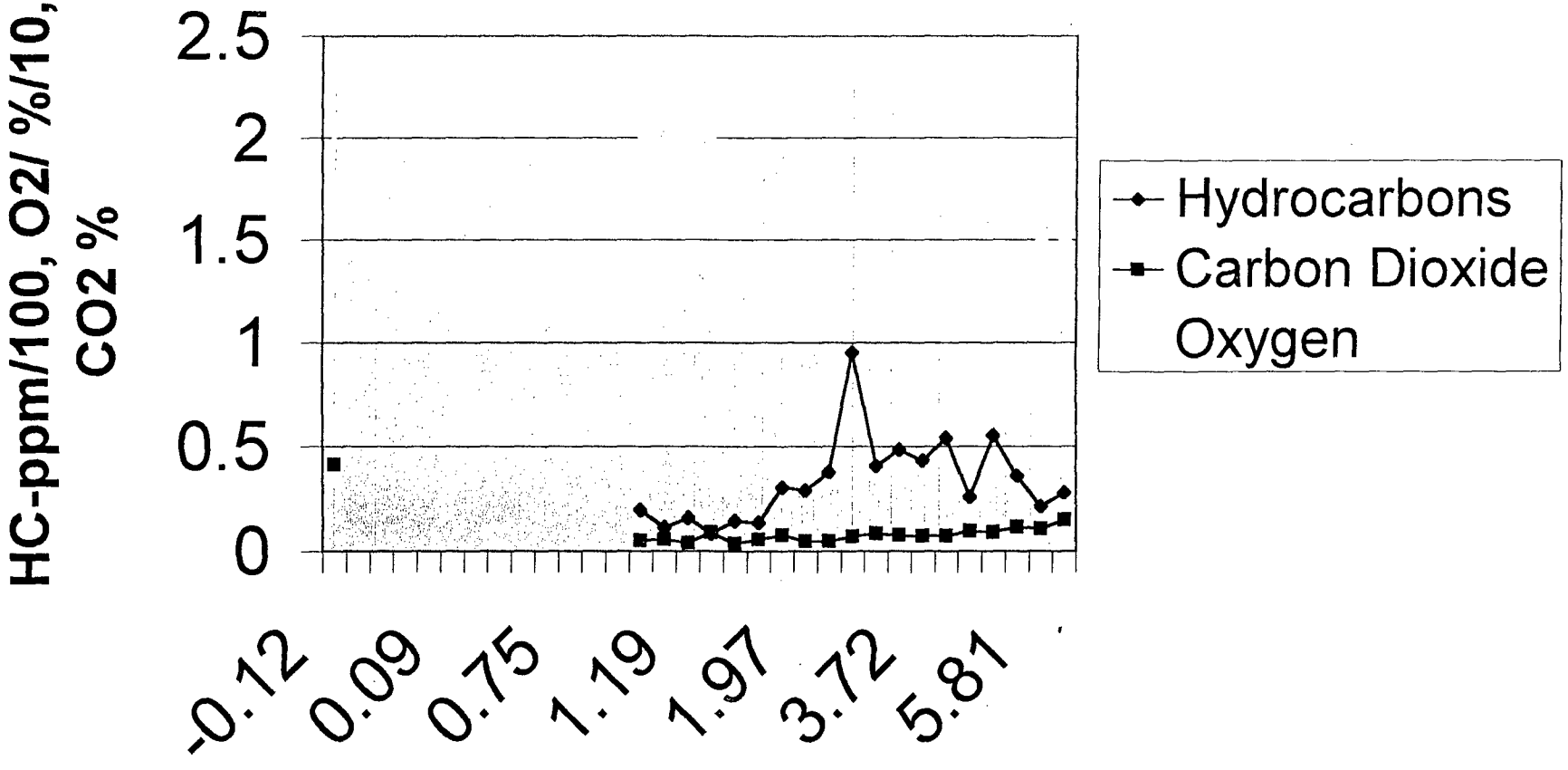

Pressure Change Following Injection at BV-1
Pressure in Inches of H2O
5
4
3
2
1
0
0
13
22
32
38
66
Time in Minutes
Shallow
Intermediate
Deep


Pressure Change Following Injection at BV-2
Pressure in Inches of H2O
12
10
8
6
4
2
0
0
14
35
46
56
62
Time in Minutes
Shallow
Intermediate
Deep


Pressure Change Following Injection at BV-3
Pressure in Inches of H2O
12
10
8
6
4
2
0
0
10
24
29
42
52
Time in Minutes
Shallow
Intermediate
Deep

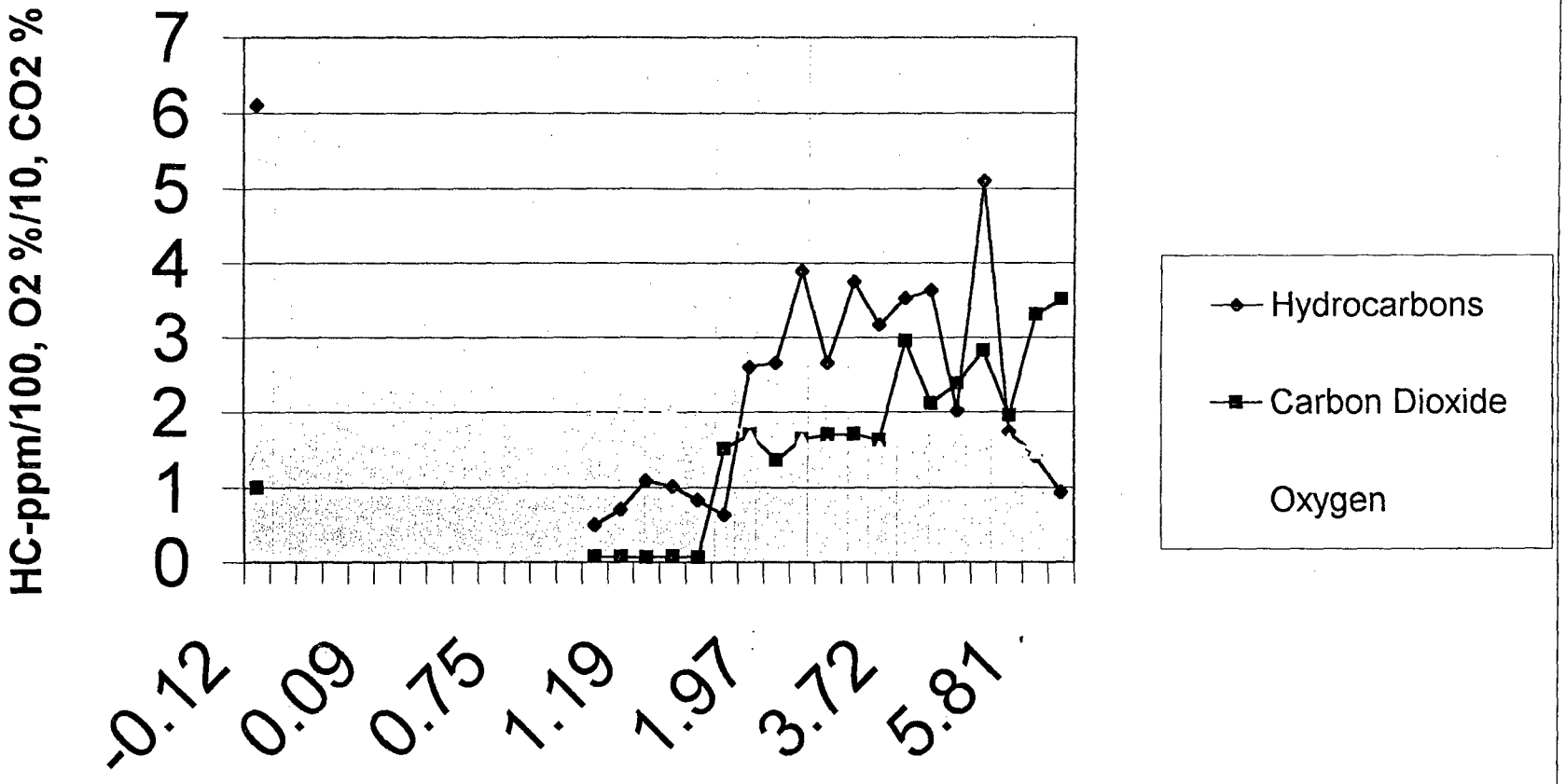

Pressure Change Following Injection at BV-4
Pressure in Inches of H2O
4
3
2
1
0
0
2
19
32
41
52
Time in Minutes
Shallow
Intermediate
Deep

Monitor Point BV-1 Shallow

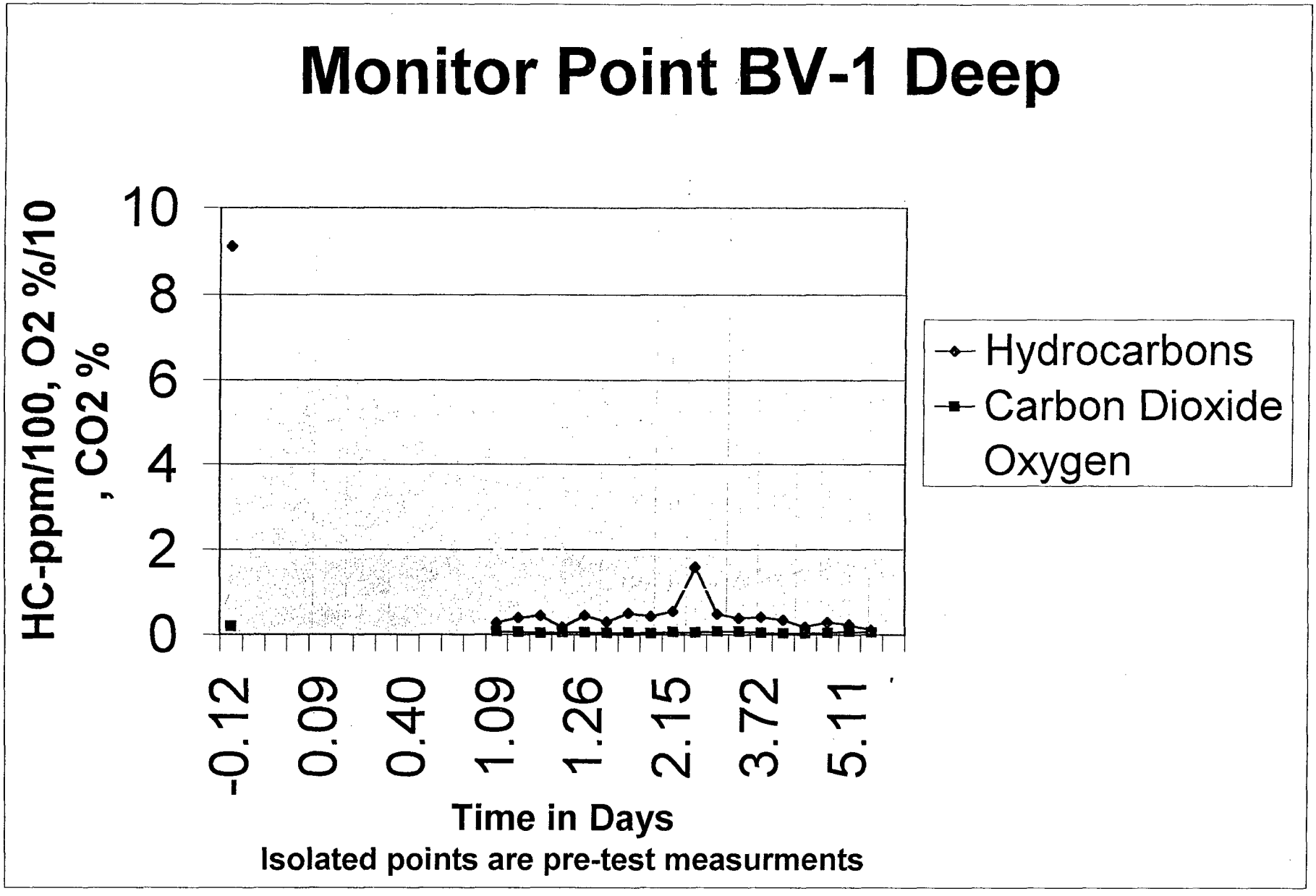


Isolated points are pre-test measurments

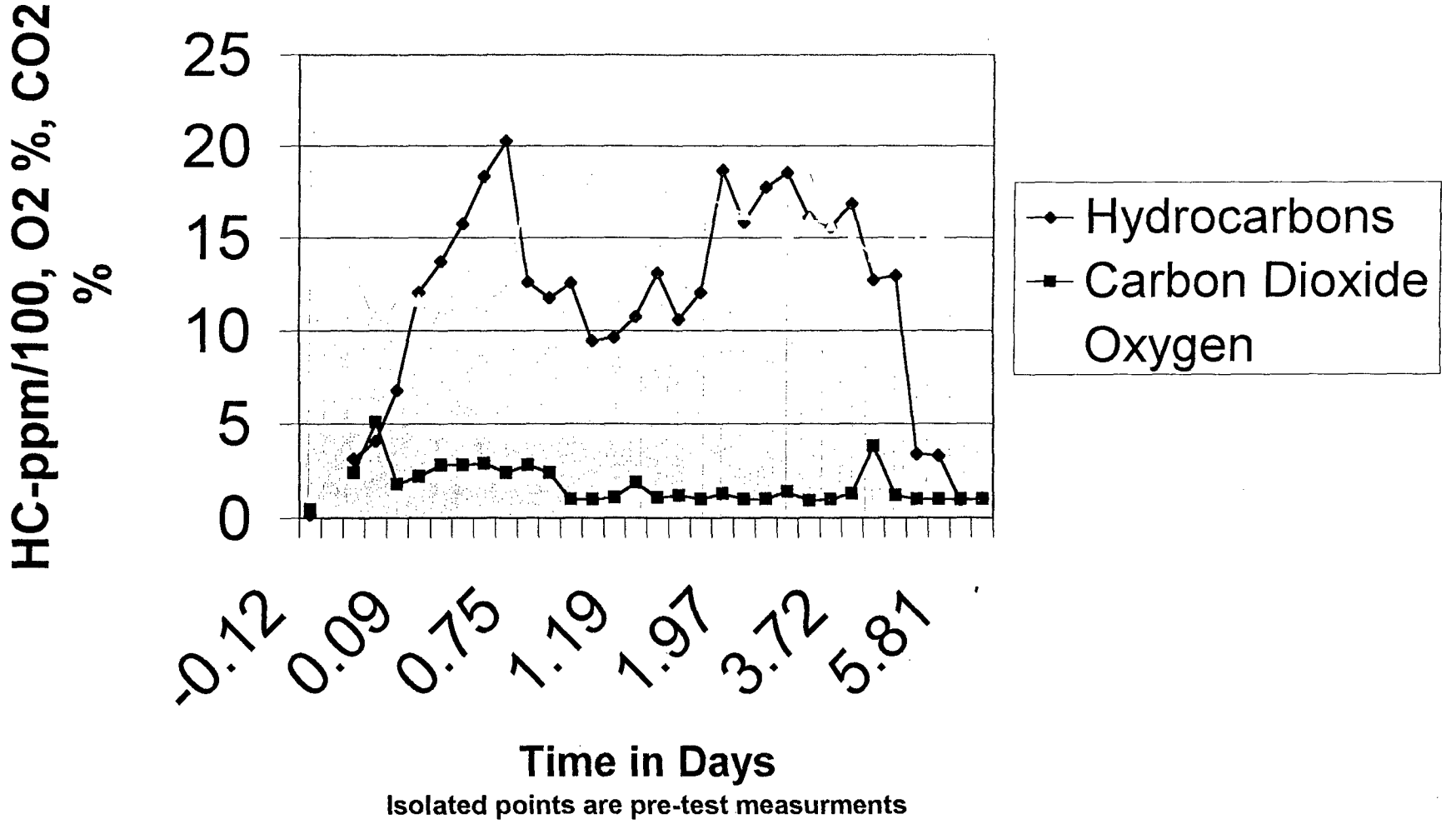
Monitor Point BV-1 Intermediate



Isolated points are pre-test measurments

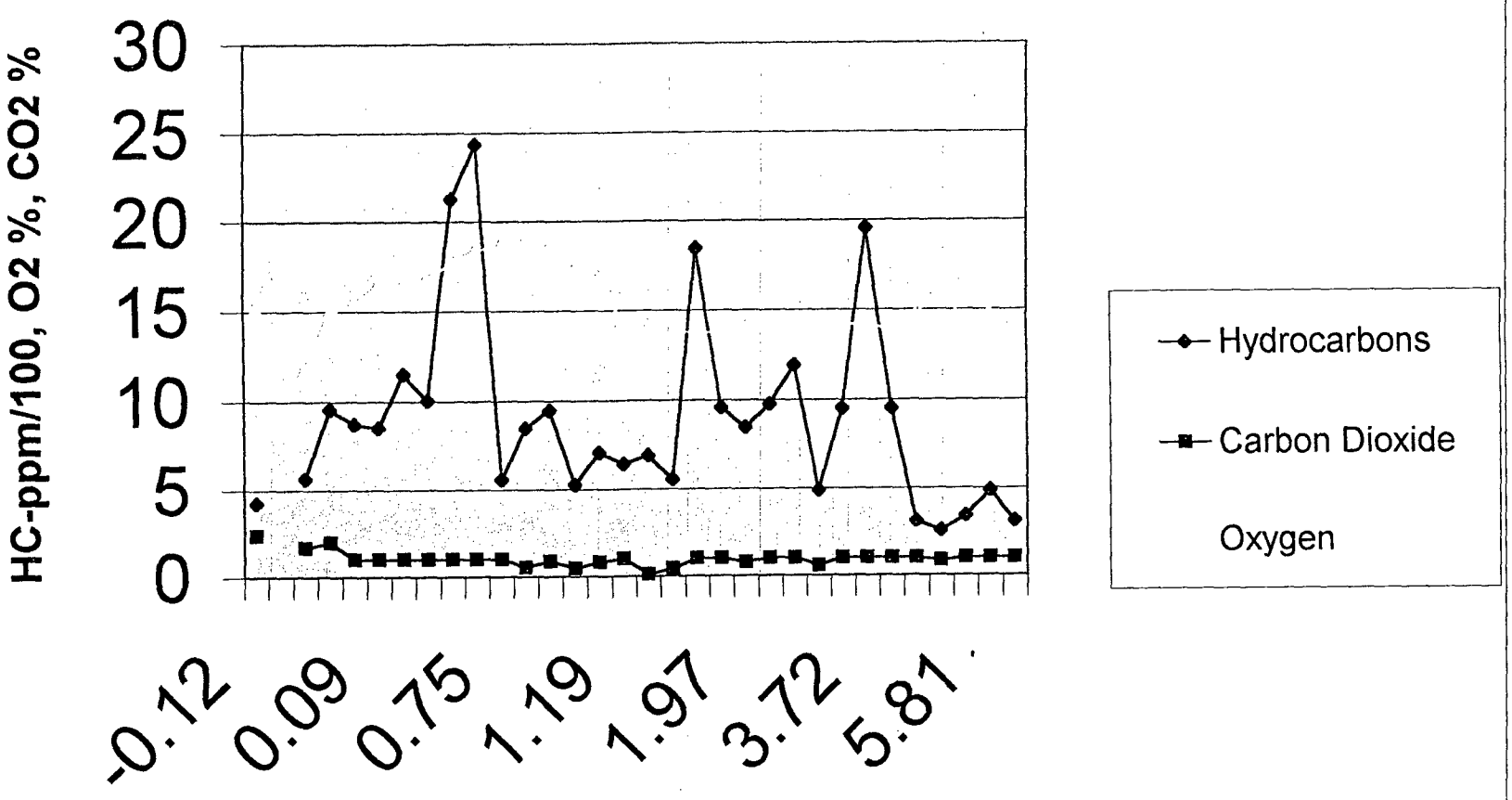

Monitor Point BV-1 Deep
HC-ppm/100, O2 %/10 , CO2 %
10
8
6
4
2
0
-0.12
0.09
0.40
1.09
1.26
2.15
3.72
5.11
Time in Days
Isolated points are pre-test measurments
Hydrocarbons
Carbon Dioxide
Oxygen

Monitor Point BV-2 Shallow



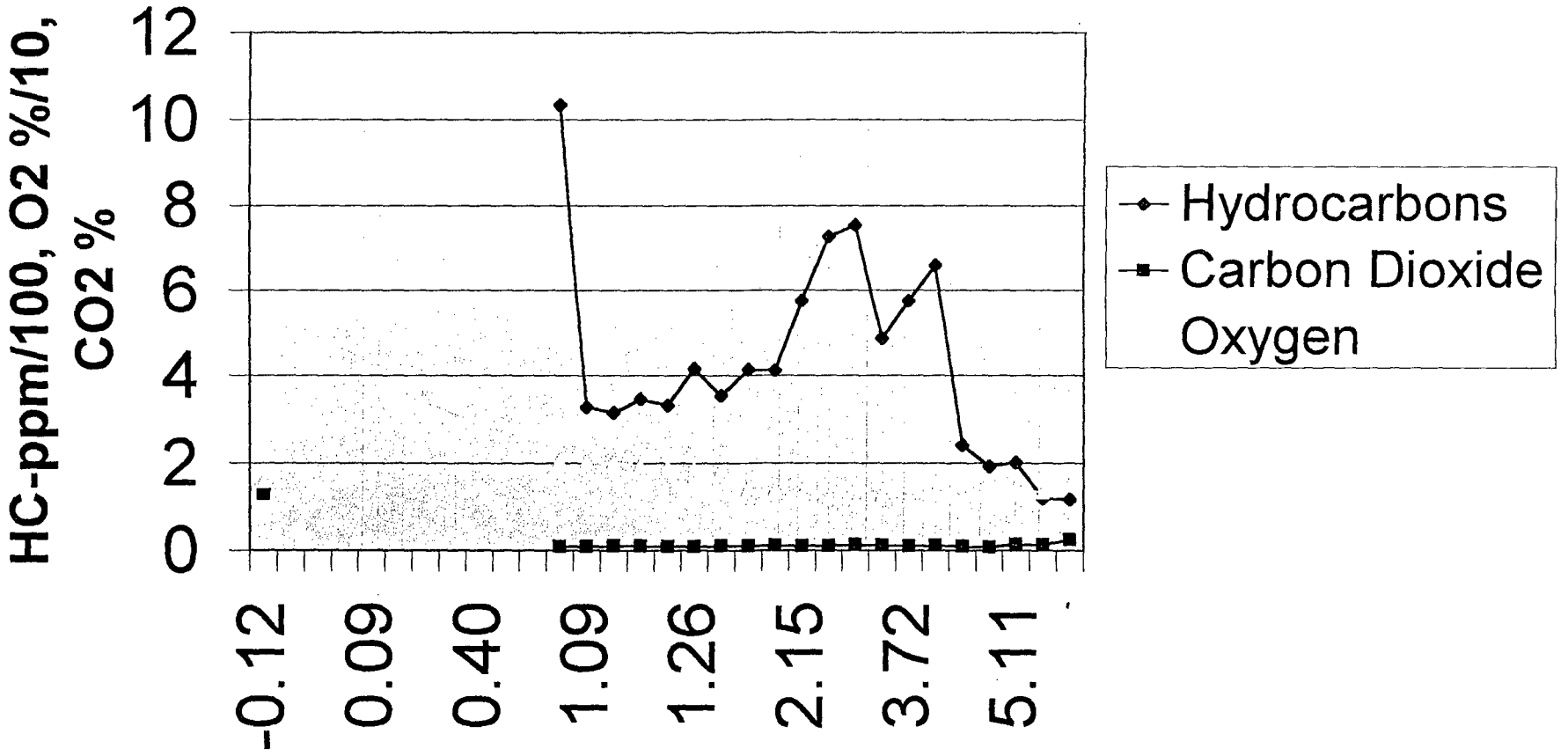
Isolated points are pre-test measurments

Monitor Point BV-2 Intermediate



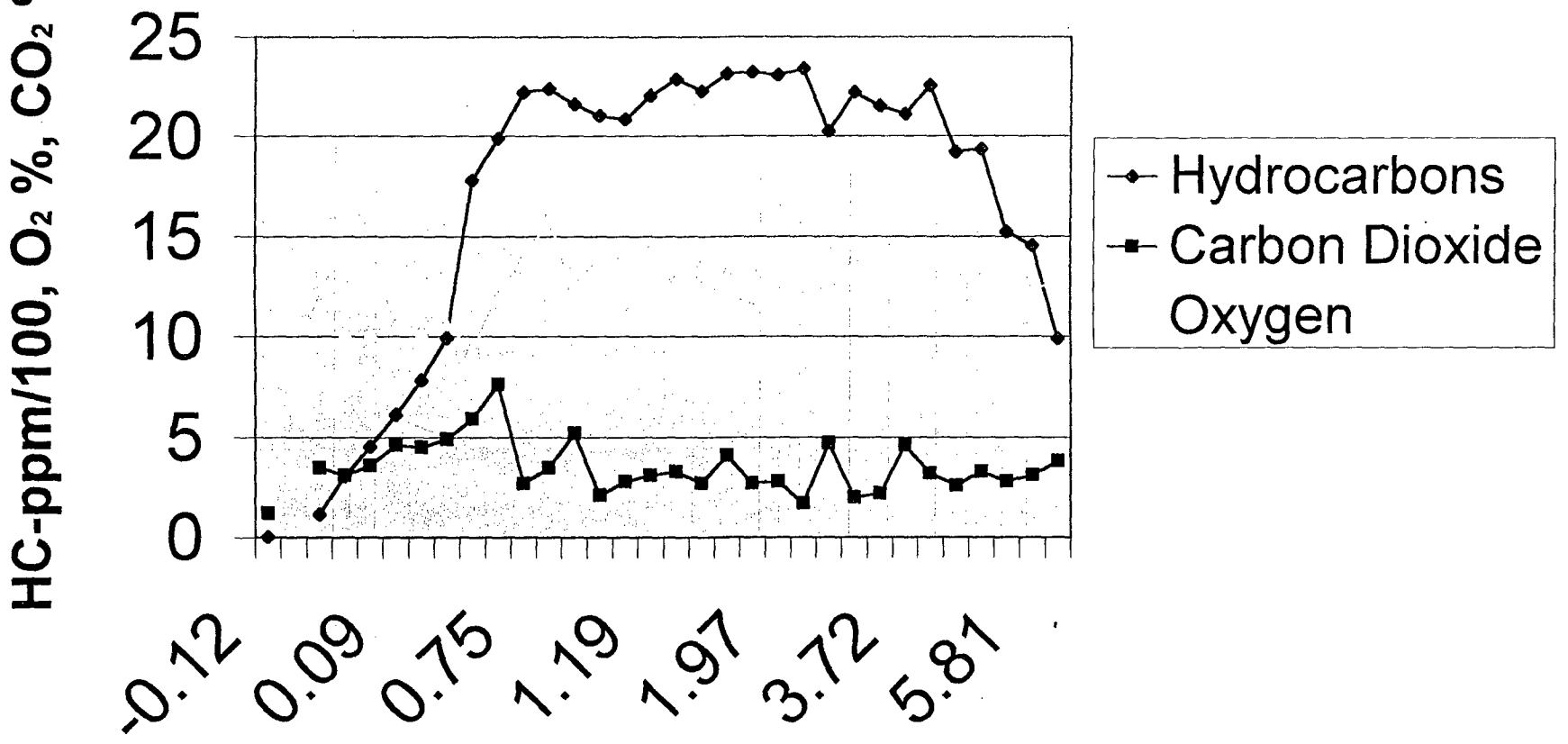
Isolated points are pre-test measurments

Monitor Point BV-2 Deep



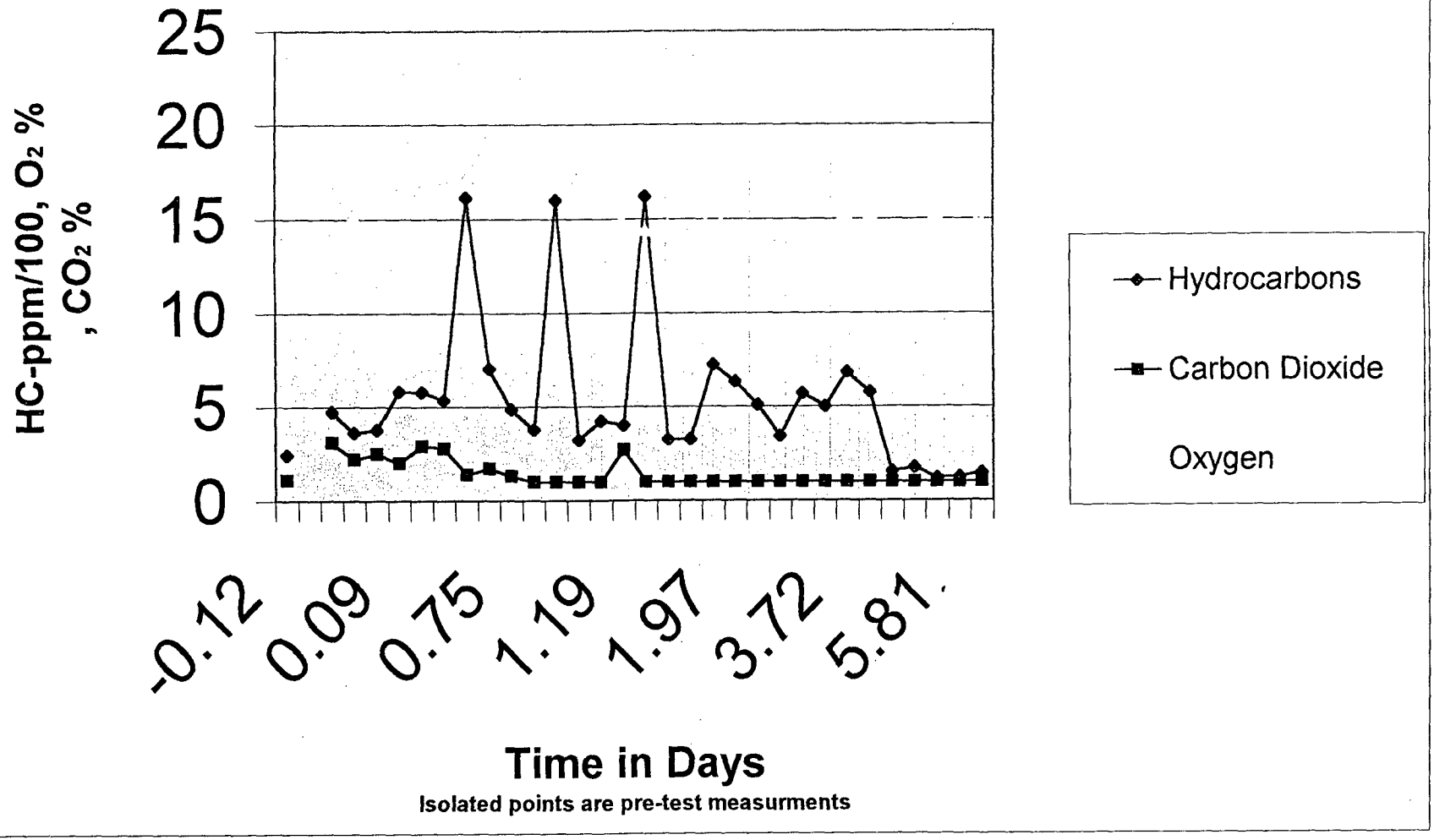
Isolated points are pre-test measurments

Monitor Point BV-3 Shallow



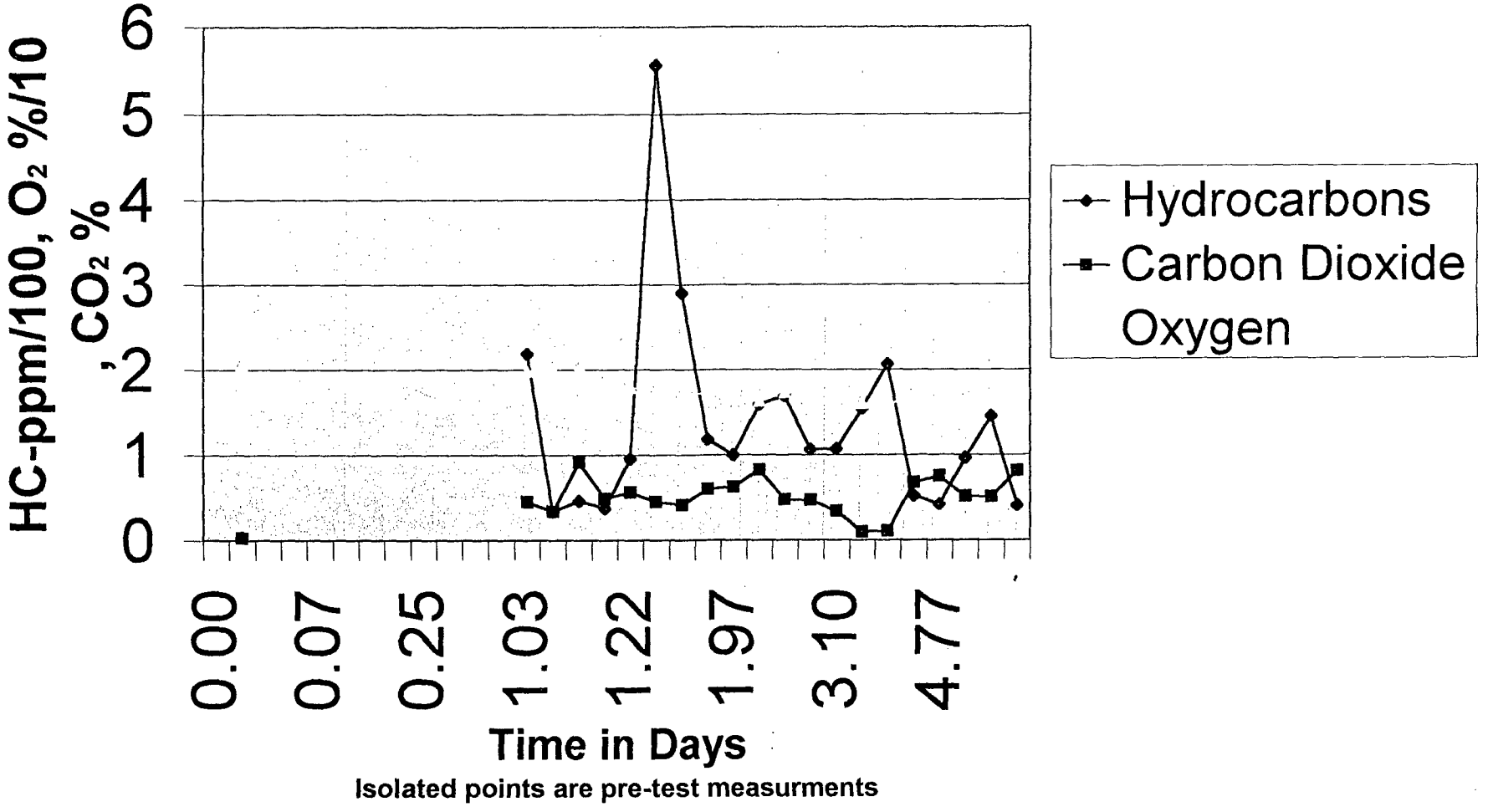
Isolated points are pre-test measurments

Monitor Point BV-3 Intermediate



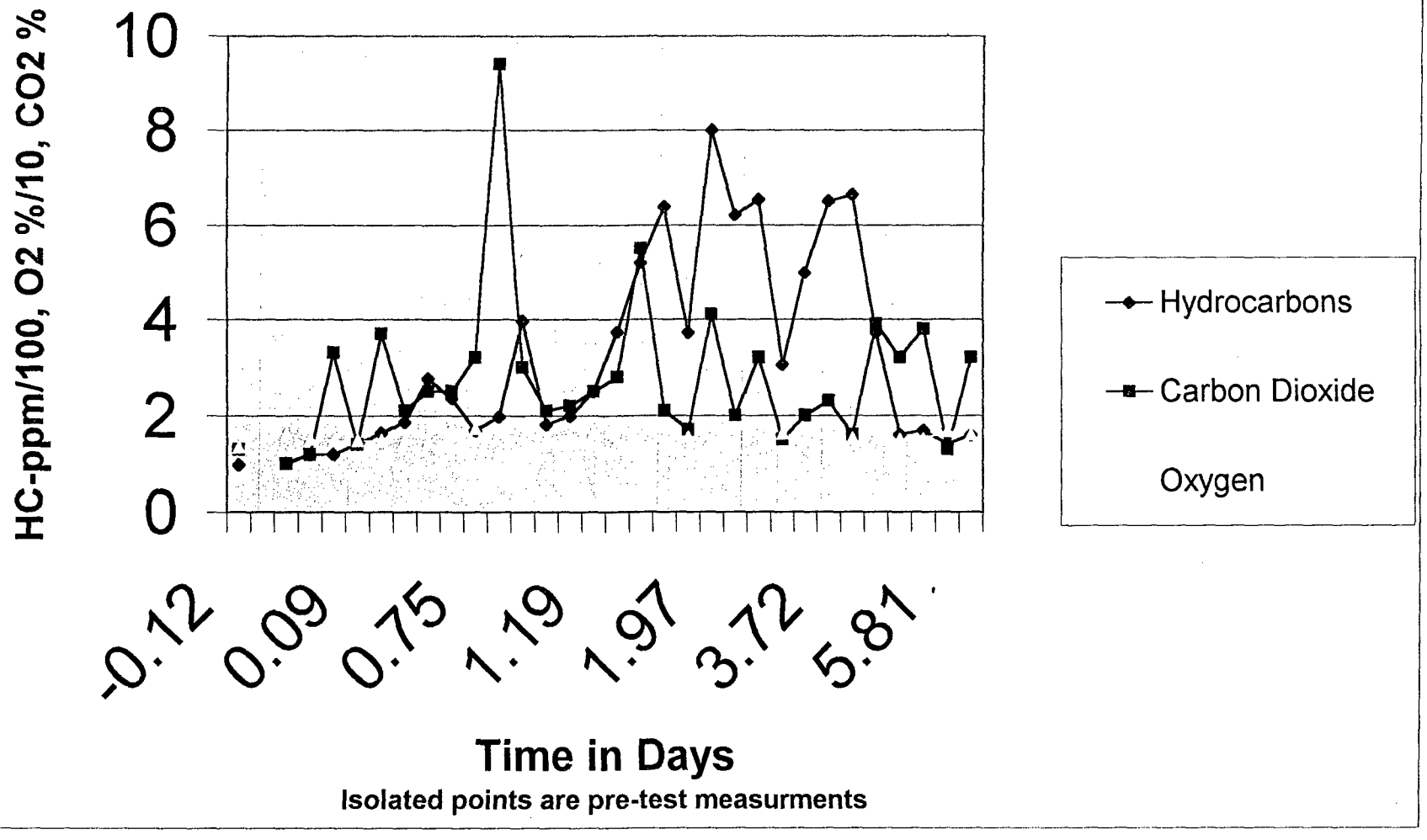
Isolated points are pre-test measurments

Monitor Point BV-3 Deep



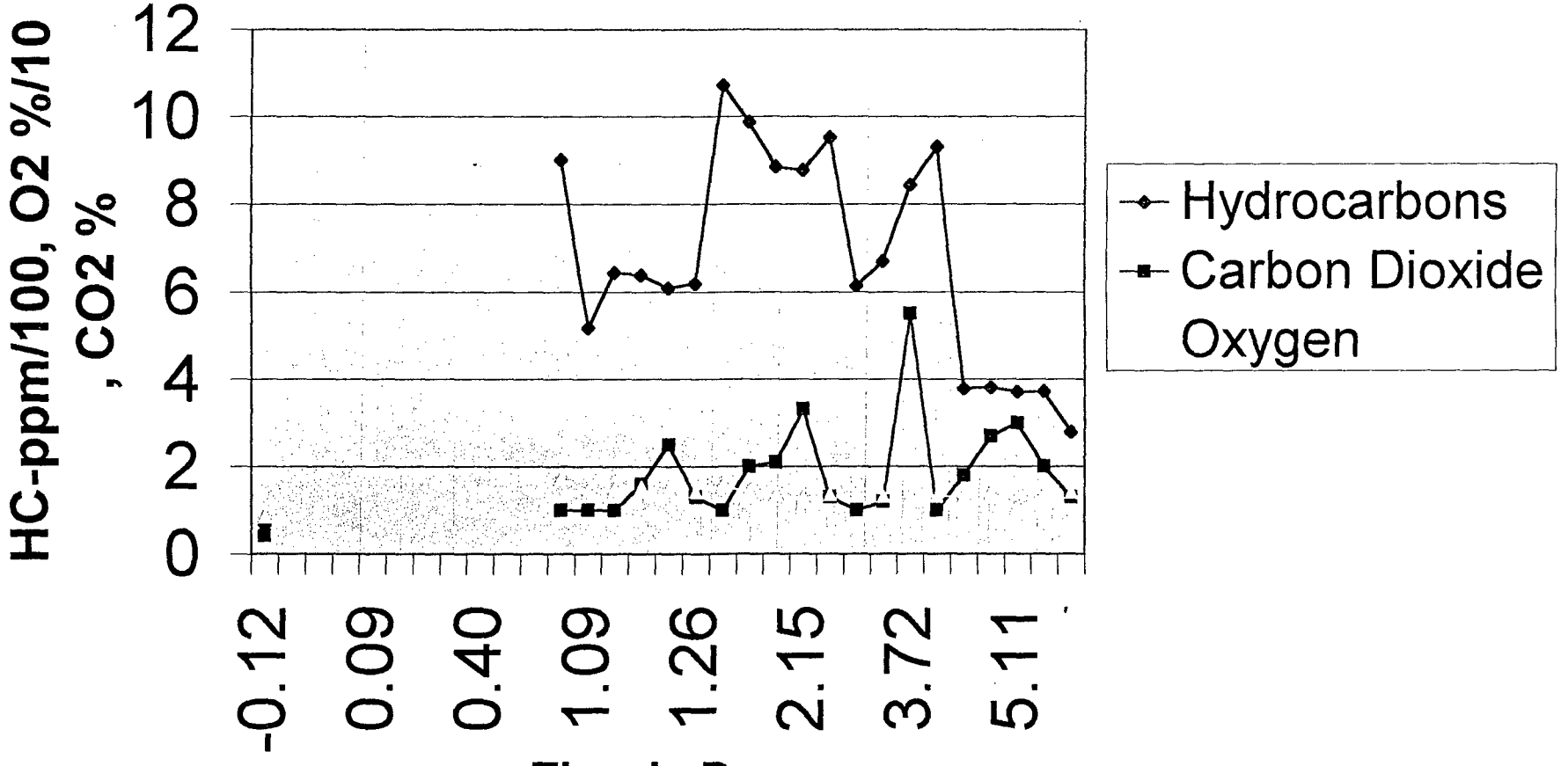
Isolated points are pre-test measurments

Monitor Point BV-4 Intermediate



Isolated points are pre-test measurments

Monitor Point BV-4 Deep



Isolated points are pre-test measurments