GW - <u>355</u>

MONITORING REPORTS

DATE: 7/95

TRANSWESTERN PIPELINE COMPANY

Bell Lake Plant Lea County, New Mexico

FINAL

Monitoring Well Installation and Intrinsic Bioremediation Evaluation Report July, 1995

TRANSWESTERN PIPELINE COMPANY

BELL LAKE PLANT LEA COUNTY, NEW MEXICO

FINAL

MONITORING WELL INSTALLATION AND INTRINSIC BIOREMEDIATION EVALUATION REPORT

JULY, 1995

This report was prepared in accordance with the standards of the environmental consulting industry at the time it was prepared. It should not be relied upon by parties other than those for whom it was prepared, and then only to the extent of the scope of work which was authorized. This report does not guarantee that no additional environmental contamination beyond that described in this report exists at the site. July 17, 1995

Mr. Larry Campbell Transwestern Pipeline Company P.O. Box 1717 Roswell, New Mexico 88202-1717

1820-02

Subject: Monitor Well Installation and Intrinsic Bioremediation Evaluation at the Bell Lake Plant, Lea County, New Mexico

Dear Mr. Campbell:

Brown and Caldwell is pleased to submit this letter report to Transwestern Pipeline Company summarizing the results of the monitor well installation and intrinsic bioremediation evaluation conducted at the Bell Lake Plant. The field work was conducted between December 3 and 17, 1994.

Introduction

Brown and Caldwell conducted this project to obtain data on the dissolved phase volatile organic plume down gradient of known impacted areas and to evaluate the feasibility of intrinsic bioremediation and monitoring as a remediation alternative. The Bell Lake Plant is located in Lea County, approximately 25 miles northwest of Jal, New Mexico. Figure 1 is a site location map, identifying the subject property and surrounding area.

Geology

According to the <u>New Mexico Bureau of Mines and Mineral Resources</u>, the site is situated in an area of recent Quaternary alluvial and terrace deposits. The surface materials covering this area of Lea County, New Mexico consist of loosely consolidated sands and gravelly sands. The uppermost stratigraphic unit underlying the site is the Santa Rosa formation. This formation consists of interbedded sandstones and gravels.

The strata encountered to approximately 35 feet below grade during the investigation was loosely consolidated sands and gravelly sands. Below 35 feet, and extending for approximately four feet, is a consolidated sandstone, which is cemented and contains irregular layers of chert. Strata encountered below the cherty sandstone are interbedded siltstones and sandstones to a maximum exploration depth of 100 feet.

Field Activities

During the course of this project, three monitor wells were installed, soil and groundwater samples were collected and the horizontal hydraulic conductivity of the saturated zone was determined using slug tests. One monitor wells was positioned on site and two monitor wells were positioned offsite on adjacent property to the east. Figure 2 depicts the monitor well locations on the adjoining property, as well as previously installed wells on site. Soil borings were drilled using a truck-mounted, air rotary drill rig. Soil samples were collected with a two-foot-long, three-inch-diameter split spoon sampler from a depth of approximately 38 feet, which corresponded to just above a cherty consolidated sandstone, and from just above the groundwater capillary fringe, at typical depth of 90 feet.

Upon removal from the split spoon sampler, half of each sample was placed in a labelled laboratory cleaned jar and placed on ice. The other sample half was placed in a sealable plastic bag. After several minutes, the headspace area in the plastic bag was monitored for organic vapors using an flame ionization detector (FID). The FID readings are shown on the boring logs presented in Appendix A. At the conclusion of sampling, the containerized samples were shipped to Terra Laboratories in League City, Texas for laboratory analysis using chain-of-custody procedures. Upon receipt by the laboratory, the samples were logged in and assigned the numbers shown on the analytical reports presented in Appendix B.

Soil samples from each boring were collected from intervals representative of the aquifer, and submitted for grain size distribution determination to Geotest Engineering, Inc. in Houston, Texas. Additionally, the soil samples from each boring collected from the interval representative of the groundwater capillary fringe were submitted for laboratory counts of total bacteria and bacteria which degrade hydrocarbons. The samples submitted for bacteria counts were placed on ice in laboratory supplied jars, and shipped via common carrier to Advanced Biological Solutions in Deerfield Beach, Florida using chain-of-custody procedures.

Prior to drilling and between each boring, the pilot bit and all other downhole equipment were cleaned with a high pressure steam cleaner. Sampling equipment was cleaned by washing with a laboratory grade detergent solution, rinsing with tap water, and performing a final rinse with distilled water. Soil cuttings derived from drilling activities were placed on plastic sheeting adjacent to each well. Monitor well development and purge water was placed in dehydrator system tanks located at the Bell Lake Plant.

The three monitor wells were installed to a depth of approximately 100 feet. Groundwater was encountered at approximately 90 feet below ground level. The wells were constructed of two-

inch-diameter Schedule 40-PVC with 15 feet of 0.01-inch slotted well screen. The screen was emplaced with the top five feet above groundwater and the lower ten feet of screen in groundwater. Well construction details are included on the boring logs in Appendix A. Monitor wells were developed by manual surging and bailing, with approximately five well volumes of water removed from each well.

The relative elevation of the top of each well casing was determined using a surveying level mounted on a tripod. Prior to sample collection, static water levels were recorded for each monitor well with a dual-interface oil/water probe. All data was recorded to the nearest 0.01 foot. Table 1 presents the top of casing survey elevations, the groundwater depths, and the groundwater elevations. Groundwater elevations are shown on the groundwater gradient map, included as Figure 3. Based on this data, the groundwater beneath the property has a hydraulic gradient of 0.002 feet per foot, to the southeast.

A teflon bailer was used to purge at least three well volumes of groundwater from each well prior to sampling. During purging of monitor wells, at intervals of approximately one well volume, groundwater parameters of temperature, pH, and specific conductance were recorded. When at least three well volumes of water were removed, and two consecutive well volumes yielded measurements for temperature, pH, and specific conductance within 10 percent of each other, the groundwater was considered representative of formation water. A groundwater sample was collected, after water returned to the earlier recorded static level, using a new disposable bailer for each well. Dissolved oxygen, Redox potential and ferrous iron were also measured during groundwater sampling activities. These measurements, along with other groundwater parameters measured during field sampling, are presented on Table 2. The groundwater samples were placed in labelled, laboratory cleaned bottles and placed on ice. At the conclusion of the sampling, the samples were shipped to Terra Laboratories in League City, Texas using chain-of-custody procedures.

On December 17, 1994, hydraulic conductivity tests were performed on two monitor wells, MW-3 and MW-5. Rising head (slug out) tests were performed using a Model SE 1000C Hermit Environmental Data Logger. The slug consisted of a 1.5-inch diameter by 7.5 foot long PVC cylinder attached to a dedicated rope. First, the data logger pressure transducer probe was lowered into the well. Next, the slug was placed in the well and the water level allowed to return to equilibrium. The slug was then removed from the well while simultaneously activating the data logger. The change of height of the water column was recorded at logarithmic time intervals until the well reached equilibrium.

After the data collection process was completed, the saturated hydraulic conductivity of the screened formation was calculated. Graphical solutions and calculations were performed using AQTESOLV, an aquifer test analysis software package.

Analytical Results

Three soil samples from each of the three installed wells were submitted for laboratory analyses during this investigation. A soil sample from above the cherty sandstone layer and a sample from the groundwater capillary fringe were submitted for chemical analyses. Additionally, the groundwater capillary fringe soil sample was submitted for biological analyses. A third soil sample, representative of the aquifer, was submitted for grain size distribution analysis. Submitted soil samples from the groundwater capillary fringe were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020, total petroleum hydrocarbons (TPH) by EPA Method 418.1, pH, ammonia nitrogen, total kjeldahl nitrogen (TKN), and total organic carbon (TOC). Submitted soil samples from the cherty sandstone interval were analyzed for TPH by EPA Method 418.1. Biological analyses consisted of utilizing procedures to count heterotrophic (total) and petrophillic (hydrocarbon degrading) bacteria. Samples submitted for grain size distribution were analyzed utilizing ASTM D422.

Soil sample analytical results for chemical and biological analyses are presented on Table 3. Soil analytical results indicate TPH and BTEX concentrations are below laboratory detection limits for all samples submitted. The results of the geotechnical analysis indicate that the grain size of the aquifer is representative of a fine sand or fine sand with silt. The grain size distribution results from sieve analysis are contained on Table 4. The soil laboratory analytical reports are contained in Appendix B. The geotechnical analytical reports are contained in Appendix C.

Groundwater samples were submitted for laboratory analysis from three existing wells and the three wells installed during the investigation. The groundwater samples were analyzed for BTEX utilizing EPA Method 8020, pH, ammonia nitrogen, TKN, TOC, total dissolved solids, ammonia nitrogen, orthophosphate, chemical oxygen demand, sulfate, nitrate-nitrite, soluble carbon oxygen demand, manganese and manganese dioxide. Biological analyses of the groundwater consisted of procedures to count heterotrophic (total) and petrophillic (hydrocarbon degrading) bacteria.

Groundwater chemical analytical results indicate BTEX constituent concentrations above laboratory detection limits for five of the six monitor wells sampled. Figure 4 shows the BTEX constituent concentration results in micrograms per liter (μ g/L) of the groundwater samples. Total BTEX concentrations ranged from below laboratory detection limit in MW-3 to less than 0.307 milligrams per liter (mg/L) in MW-1. Of the five monitor wells registering BTEX

concentrations, only MW-6 measured below the laboratory detection limit for benzene. Benzene concentrations in the other four monitor wells ranged from 0.006 mg/L to 0.092 mg/L. Groundwater sample analytical results for chemical and biological analyses are presented on Table 5. Full laboratory reports are presented in Appendix D.

Aquifer Testing Results

Hydraulic conductivity is defined as the capacity of a porous medium to transmit water. The results of the slug tests determined that the hydraulic conductivity of the aquifer behind the screened interval in the upgradient well, MW-3, is approximately 2.2 feet per day (7.76×10^4 cm/sec). The hydraulic conductivity measured in MW-5, a well in the downgradient dissolved phase plume, is approximately 1.92 feet per day (6.77×10^4 cm/sec). These hydraulic conductivities indicate that the natural aquifer material is a fine sand or silty sand. This is consistent with the grain size analysis. The slug test and AQTESOLV data are included in Appendix E.

Intrinsic Bioremediation Results

The benzene, toluene, ethylbenzene and total xylenes (BTEX) and dissolved oxygen (DO) concentrations measured at the site indicate that intrinsic bioremediation is occurring. Figure 5 shows a graph of BTEX concentrations plotted against DO measured at different monitor wells at the site. The figure shows an inverse relationship between BTEX levels and dissolved oxygen. This relationship is a clear indication of intrinsic aerobic remediation. The complete laboratory report is presented in Appendix F.

There is a lack of a strong inverse relationship between BTEX levels and anaerobic bioremediation electron acceptors such as manganese dioxide, nitrate, ferric hydroxide (monitored ferrous ion produced) and sulfate measured at the site (Figures 6 through 8). Therefore, the site data does not fully demonstrate intrinsic anaerobic bioremediation. However, dissolved methane was not measured at the site. Dissolved methane is an indication of anaerobic biodegradation with carbon dioxide as the electron acceptor (methanogenisis).

Groundwater analysis indicates a fairly significant chemical oxygen demand (COD) and soluble chemical oxygen demand (SCOD). However, the COD/SCOD may or may not be competing with the hydrocarbon-degrading microbes for dissolved oxygen. This can be determined by analyzing groundwater for Biological Oxygen Demand (BOD) and Total Petroleum Hydrocarbons (TPH). If BOD levels are relatively low, it is doubtful that the apparently abiotic processes will significantly compete with biodegradation for available electron acceptors. If TPH and BOD is

relatively high, archived groundwater samples could be analyzed for VOC's and PAH's to determine if other organics present a preferential food source for the site microorganisms.

Using the BTEX concentrations and levels of the electron acceptors measured at the site, the total BTEX assimilative capacity was calculated. The calculation details are presented in Table 6. These calculations show that the assimilative capacity of the site is 8,541 μ g/L of BTEX which is much higher than the 307 μ g/L, the highest BTEX concentration detected at the site. It is important to note that BTEX assimilative capacity due to dissolved oxygen, 1,939 μ g/L, alone exceeds the maximum BTEX level measured, perhaps explaining the lack of anaerobic bioremediation at the site.

Recommendations

The analytical results indicate that intrinsic bioremediation is occurring. The rate of bioremediation should be monitored to verify that the remediation rate is sufficient to obtain the remediation objective. Thus monitoring is a viable risk management tool and a fairly accurate indicator of the progress of intrinsic bioremediation. It is important to note that the concentration of contaminants are low and the contaminated soils in the source area were excavated and shredded back into the excavation along with clean fill and essential nutrients, in the form of fertilizer, in December 1994.

If you have any questions or require additional information, please call me at (713) 759-0999.

Very truly yours,

BROWN AND CALDWELL

Susanne Richard, REM, REP Project Manager

REFERENCES

1. The New Mexico Bureau of Mines and Minerals, "Geologic Map of New Mexico," 1982, United States Geological Survey

Use or disclosure of data contained on this sheet is subject to the restriction specified at the beginning of this document.

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TABLES

Groundwater Elevation Field Screening Results for Groundwater Samples Analytical Results for Soil Samples Analytical Results for Sieve Analysis Analytical Results for Groundwater Samples Total BTEX Assimilative Capacity Calculation Details

GROUNDWATER ELEVATION

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TABLE 1

Groundwater Elevation¹ December 8, 1994 Transwestern Pipeline Company

Well	тос	Depth to water	GW Elevation		
MW-1	98.15	89.38	8.77		
MW-2 *	97.46	88.15	9.31		
MW-3	102.54	93.08	9.46		
MW-4	98.53	89.90	8.63		
MW-5	97.82	89.33	8.49		
MW-6	97.23	88.65	8.58		

¹Top of casing for MW-1, 2, 3 were surveyed to a concrete corner at the south east corner of the concrete berm around the AST's at the north east section of the property. ²Top of casing for MW-4, 5, 6 were surveyed relative to the Top of casing for MW-1 and surveyed to close the loop. ³The data yields a consistent gradient to the east southeast.

⁴All elevations were measured from the north side of the PVC pipe.

FIELD SCREENING RESULTS FOR GROUNDWATER SAMPLES

Table 2Field Screening Results for Ground Water SamplesBell Lake PlantTranswestern Pipeline Company

Well I.D.	Sample Date	Well Casing	Well	pН	Conductivity	Temperature	Redox	Dissolved	Ferrous
		Volume	Volume No.	1	(uohms)	(Celsius)	(MV)	Oxygen	Iron
]		(gallons)						(mg/L)	(mg/L)
MW-1	12-07-94	4	1	8.56	8,790	68.4			
	2	4	2	8.92	12,210	70.0			
		4	3	8.99	12,460	70.5			
			sample				-349.7	0.83	0.0
MW-2	12-07-94	5	1	7.27	3,830	68.5			
		5	2	7.16	3,800	69.0			
	Į	5	3	7.11	3,780	69.2			
			sample				-123.6	1.40	2.0
MW-3	12-07-94	3	1	7.31	530	70.4			
		3	2	7.32	518	69.9			
		3	3	7.34	508	69.6			
	· · · ·		sample				356.7	6.06	0.0
MW-4	12-07-94	1.5	1	9.61	9,230	65.8			
		1.5	2	9.78	9,280	67.8			
		1.5	3	9.70	9,270	67.4			
			sample				-385.6	1.30	0.0
MW-5	12-07-94	1.5	1	9.38	16,730	67.7			
		1.5	2	9.28	15,810	68.3		J	
		1.5	3	9.22	15,280	68.0			
			sample				-336.7	1.90	0.0
MW-6	12-07-94	1.5	1	8.52	9,840	68.2			
		1.5	2	8.51	9,210	67.6			
		1.5	3	8.51	9,490	68.1		·	
			sample				-200.6	2.15	0.0

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NA - not analyzed

ND - not detected

mg/L-milligrams per Liter

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ANALYTICAL RESULTS FOR SOIL SAMPLES

Table 3Analytical Results for Soil SamplesBell Lake PlantTranswestern Pipeline Company

Location		MW4	MW4	MW5	MW5	MW6	MW6
Depth (feet)		32 - 34	87 - 89	39 - 41	89 - 91	40 - 41	87 - 89
Chemical Analysis							
Parameter	Units						
ТРН	mg/kg	<25	<25	<25	<25	<25	<25
Benzene	mg/kg	NA	<0.005	NA	<0.010	NA	<0.005
Ethylbenzene	mg/kg	NA	<0.005	NA	<0.010	NA	<0.005
Toluene	mg/kg	NA	<0.005	NA	<0.010	NA	<0.005
Xylenes	mg/kg	NA	<0.010	NA	<0.020	NA	<0.010
Total BTEX	mg/kg	NA	<0.025	NA	<0.050	NA	<0.025
Nitrogen - ammonia	mg/kg	NA	19	NA	200	NA	1.1
Nitrogen - Kjeldahl	mg/kg	NA	31	NA	200	NA	<10
рН	s.u.	NA	8.6	NA	8.9	NÁ	8.5
Total organic carbon	percent	NA	0.02	NA	0.02	NA	0.02

NA-Not Analyzed

ND-Not detected

mg/kg-milligram per kilogram

s.u.-standard units

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ANALYTICAL RESULTS FOR SIEVE ANALYSIS

Table 4
Analytical Results for Sieve Analysis
Bell Lake Plant
Transwestern Pipeline Company

Sample I.D.	MW-4	MW-5	MW-6	
Depth (ft.)	94-96	95-97	94-96	
Sieve Size				
7/8	100	100	100	
3/4	100	100	100	
1/2	100	100	100	
3/8	100	100	100	
1/4	100	100	97	
4	100	100	96	
10	100	98	94	
40	99	98	91	
100	9	16	25	
200	3	9	12	
Description	Fine sand	Fine sand with silt	Fine sand with silt	

(1) Analysis performed in accordance with ASTM D 422

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES

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REFERENCES

1. The New Mexico Bureau of Mines and Minerals, "Geologic Map of New Mexico," 1982, United States Geological Survey

Table 5Analytical Results for Groundwater SamplesBell Lake PlantTranswestern Pipeline Company

Location		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	TB-1
Date Sampled		12/7/94	12/7/94	12/7/94	12/7/94	12/7/94	12/7/94	12/8/94
Chemical Analysis	r							
Parameter	Units				+	ļ		
Benzene	mg/L	0.092	0.006	<0.002	0.018	0.009	<0.002	<0.002
Toluene	mg/L	0.050	0.005	<0.002	0.071	0.020	0.003	<0.002
Ethylbenzene	mg/L	0.054	<0.002	<0.002	0.004	0.004	<0.002	<0.002
Total Xylenes	mg/L	<0.111	<0.004	<0.004	0.16	0.064	<0.006	<0.004
Total BTEX	mg/L	<0.307	<0.0017	<0.010	0.253	0.097	<0.013	<0.010
Total Dissolved Solids	mg/L	7100	2600	320	4700	9500	4700	NA
Ammonia-Nitrogen	mg/L	37	6.6	0.44	120	140	160	NA ^T .
Orthophosphate	mg/L	0.3	0.1	0.2	0.6	0.6	0.7	NA
Total Kjeldahl Nitrogen	mg/L	31	5	0.28	83	110	110	NA
Chemical Oxygen Demand	mg/L	420	160	<1	780	1100	560 ;	NA
Sulfate	mg/L	140	51	31	70	49	150	NA
Nitrate-Nitrite	mg/L	0.06	<0.05	3.6	<0.05	<0.05	<0.05	NA
Soluble Chemical Oxygen Demand	mg/L	340	140	<1	720	1100	620	NA
Manganese	ug/L	36	72	8.1	35	2.3	56	NA
Manganese Dioxide	ug/L	46	93	10	45	3.0	72	NA
Heterotrophs (water)	counts/ml	10 6	10 ⁶	10 5	10 ⁵	10 5	10 ⁶	NA
Petrophilic (water)	counts/ml	10 ³	10 ²	10 ²	10 ³	10 ²	10 ¹	NA

mg/L = milligrams per Liter

ug/L = micrograms per Liter

NA = Not Analyzed

counts/ml-counts per milliter

TOTAL BTEX ASSIMILATIVE CAPACITY CALCULATION DETAILS

Electron Acceptor or Process	BTEX Biodegradation Factor (mg/L/mg/L)	Site Background Levels (mg/L)	Expressed BTEX Assimilative Capacity (µg/L)
Dissolved Oxygen (DO)	0.32 / 1.0 DO	6.06	1,939
Nitrate (NO ₃)	0.21 / 1.0 NO ₃	0.44	92
Ferric Hydroxide (Fe(OH) ₃)	1.0 / 21.8 Fe ⁺² produced	0	0
Sulfate (SO ₄)	0.21 / 1.0 SO ₄	31	6,510
Methanogenesis (CH ₄)	1.0 /0.78 CH ₄	Not Analyzed	-
Total Expressed Assimilative Capacity			8,541
Highest Observed Total BTEX Concentration			307

 Table 6

 Total BTEX Assimilative Capacity Calculation Details

Notes:

1. Site background electron acceptor levels are based on analyses of samples from MW-3.

2. The inverse relationship between the quantities of dissolved oxygen and BTEX indicate aerobic biodegradation at the site (see Figure 4).

3. Sulfate and nitrate concentrations do not indicate anaerobic biodegradation at the site (See Figures 6,7).

4. Data indicate that groundwater at the site has enough assimilative capacity to degrade observed concentrations of dissolved-phase BTEX.

FIGURES

Site Location Map Monitoring Well Location Map Groundwater Gradient Map Groundwater BTEX Levels Map Comparison of Dissolved Oxygen and BTEX Concentration in Groundwater Comparison of Manganese Dioxide and BTEX Concentration in Groundwater Comparison of Nitrate and BTEX Concentration in Groundwater Comparison of Sulfate and BTEX Concentration in Groundwater

SITE LOCATION MAP

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MONITORING WELL LOCATION MAP

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GROUNDWATER GRADIENT MAP

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GROUNDWATER BTEX LEVELS MAP



COMPARISON OF DISSOLVED OXYGEN AND BTEX CONCENTRATION IN GROUNDWATER



in Ground Water at Bell Lake Plant

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COMPARISON OF MANGANESE DIOXIDE AND BTEX CONCENTRATION IN GROUNDWATER


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COMPARISON OF NITRATE AND BTEX CONCENTRATION IN GROUNDWATER



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COMPARISON OF SULFATE AND BTEX CONCENTRATION IN GROUNDWATER



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APPENDICES

Boring Logs Laboratory Results Soil Samples Geotechnical Results Laboratory Results Groundwater Samples Slug Test Results Biological Results

APPENDIX A

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BORING LOGS

B R O C A L	WN AND DWELL	ВО	R	I N	G	L	00	3	•				
Project N Soil Bori	Transwestern Pipeline Cor	npany -)	Bell Boring	Lak /Wel	e Pl	ant mbe	 r	Projec	t Numi M	ber: <u>1820</u> W-4	Sh	eet 1 of	 1
Boring	neation: On-site						Elev	ation a	nd Dai	um: 98.5			٦
Drilling (Contractor: GPI	Driller: V	Wes	Cow	ser		Date	Starte	d: 12	2/3/94	Date Finished	: 12/3/94	
Drilling	Fouinment: Mobile Drill	Borehole I	Diame	ter	3.5	11	Com	pleted	<u></u> ი 10	0.0	Water Depth:	89.9	\neg
Sampling	Method: Split Spoon	Deremond	-						<u>.,</u>	WELL CON	STRUCTION		-
Drilling	Method: Air Rotary	Drilling Fl					Type	and D	iamete	r 2" Sche			****
Drining P	Actorial:	Dimilg F					Slot	Circa:	010	Eilter Me	u to i v C		\neg
Dackini r	Material.						Deve	lopme	nt Met	hod: Bail a	nd Surge		-
Logged B		y: AIFe					Faphic	Log	1]			****
Depth (feet) USC Soil Type	Description	- 	Recovery %	Blow Counts	Sample No.	Sample	Lithology	Well	WAO OVM WAR Readings		Remarks	Elevation (feet)	
5 10 15 20 11 15 20 25 30 35 40 45 50 10 10 11 11 12 20 25 30 35 40 45 50 10 10 10 10 10 10 12 30 35 40 45 50 10	SAND, tan, medium-grained SAND SAND SAND, consolidated SANDSTONE, cherty SANDSTONE, semi-consolidated SANDSTONE, tan, semi-consolidated SANDSTONE, pink to tan, semi-consolidated SANDSTONE, semi-consolidated SANDSTONE, semi-consolidated SANDSTONE, semi-consolidated SANDSTONE, semi-consolidated	ed	100		1				2	Top of bentom Top of sand - Top of screen Odor-mercapt	nite - 78 feet 81 feet - 85 feet	95 90 85 80 75 70 65 55 50 45 30 22 20 15 10 15 5	

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Soil Bori	ng 🗌 Monitoring Well 🗴	I	Borin	g/We	il Nu	imbe	r:			V-5 She	et <u>1</u> of
Boring Lo	ocation: Off-site						Elev	ation a	nd Dati	im: 97.8	
Drilling (Contractor: GPI	Driller: V	Ves	Сон	ser		Date	Starte	d: 12/	/3/94 Date Finished:	12/4/94
Drilling E	Equipment: Mobile Drill	Borehole I	Diame	eter:	3.5	11	Dept	h: (fee	t) 99 .	.0 (feet)	88.6
Sampling	Method: Split Spoon		-							WELL CONSTRUCTION	
Drilling N	Method: Air Rotary	Drilling Fl	uid:				of W	e and D	sing:	2" Sched 40 PVC	<u> </u>
Backfill N	Naterial:	<u></u>					Slot	Size:	.010	Filter Material: Sand	
Logged B	y: Al Fear Checked H	By: Al Fe	ar				Deve	elopme	nt Meth	od: Bail and Surge	
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Depth (feet) USC Soil Typ	Description		Recovery %	Blow Counts	Sample No.	Sample	Lithology	Well	WAO WAO Readings	Remarks	Elevation (fee
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	SAND, tan										4480 1444 1444 1455
	SAND, tan										1170 11111165
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Inhhhhhhhh	SANDSTONE, pink to tan, semi-consolidat	ted							ר ז ז	Fop of bentonite - 79 feet Fop of sand - 82 feet Fop of screen - 84 feet	15
and the second sec			100							N	<u></u> [10

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Soil Bor	ing 🗌 Monitoring Well 🗴]	Borin	g/We	ell Nu	mbe	r:		M	W-6	She	et <u>1</u> of _
Boring L	ocation: Off-site		<u> </u>		<u> </u>		Eleva	tion a	nd Da	tum: 97.2	· · · · · · · · · · · · · · · · · · ·	
Drilling	Contractor: GPI	Driller: V	Wes	Cov	vser		Date	Started	i: 12	2/4/94	Date Finished: Water Depth:	12/5/94
Drilling	Equipment: Mobile Drill	Borehole I	Diamo	eter:	3.5	11	Depti	n: (feel	:) 10	0.0	(feet)	88.6
Sampling	g Method: Split Spoon						Туре	and D	iamete		TRUCTION	
Drilling	Method: Air Rotary	Drilling Fl	luid:				of We	ell Cas	ing:	2" Schee	1 40 PVC	
Backfill Logged 1	Material: By: Al Fear , Checked By	y: Al Fe	ar				Slot S Devel	Size: lopmer	.010 ht Met	Filter Ma hod: Bail a	terial: Sand ad Surge	<u> </u>
	· · ·					0	Braphic I	Log				
Depth (feet) USC Soil Ty ₁	Description	÷	Recovery %	Blow Count	Sample No.	Sample	Lithology	Well	MAO OVM WAR Readings		Remarks	Elevation (fee
5 10 15 20 25 30 30 35 40 40 55 50 55 50 55 50 55 70 70 75 30 70 75 30 35 40 40 40 55 50 55 50 55 50 55 70 70 75 30 75 30 70 75 70 70 75 70 70 75 70 70 70 75 70 70 75 70 70 70 70 70 70 70 70 70 70 70 70 70	SAND, tan SAND, tan SAND, tan SAND, tan SAND SANDSTONE, cherty, tan, semi-consolidated SANDSTONE, tan, semi-consolidated SANDSTONE, pink to tan, semi-consolidated SANDSTONE, pink to tan, semi-consolidated SANDSTONE, pink to tan, semi-consolidated SANDSTONE, pink to tan, semi-consolidated	ed ed ed ed ed ed ed ed ed ed ed ed ed e	100		1	X X			3	Top of bentoni Top of sand - 8 Top of screen	ite - 78.5 feet 81 feet - 83 feet	90 85 80 75 70 65 50 80 75 70 66 50 80 80 75 70 66 50 80 80 80 80 80 80 80 80 80 80 80 80 80

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APPENDIX B

LABORATORY RESULTS SOIL SAMPLES

Terra Laboratories, Ltd.

Quality Analytical Services



January 2, 1995

Al Fear Brown and Caldwell 2710 Stemmons Frwy., Suite 1100 Dallas, TX 75207

Re: Six (6) solid samples (Project Name: Bell Lake, Jal,NM) received on 12/07/94

Dear Mr. Fear:

Attached are the final reports of analysis of the samples referenced above as per your analysis and/or method requests. As per Suzanne Richard Ortho-Phosphate was cancelled on Sample ID#'s: MW-4 87-98', MW-5 89-91', and MW-6 87-89'.

The samples were received in good condition and at 1^o Centigrade.

We appreciate this opportunity to serve Brown and Caldwell. Please let me, or Linda McKee, know if there is any other way we can help you.

Sincerely,

Larry D. Wallace Laboratory Director

LAB ANALYSIS REPORT

Report Date: DEC. 27 1994 Page # 1 Brown and Caldwell Reviewed by: TMG 2710 Stemmons Frwy. Stel100 Customer#: 309 Job Number: Dallas , TX 75207 Date Collected: 12/03/94 Attn: Fear, Al Sample Number: 94008500 Time Collected:1130 Project Name: BELL LAKE JAL, N.M. Sample ID: MW-4 87-89' GRAB Date Received: 12/07/94 Test Code Analyte Result Units Method Analyst BTEXS'D BTEX Analysis Prep(Date/Time) 12/09 1652 init. 6-5030 NSH BZ8020S Benzene < 0.005 ppm 6-8020 NSH TOL8020S < 0.005 Toluene ppm6-8020 NSH EBZ8020S Ethylbenzene < 0.005 6-8020 NSH ppm XYLSTLs Total Xylenes < 0.010 6-8020 NSH ppm BTEXTLS Total BTEX < 0.025 ppm 6-8020 ŃSH aaaTFTs aaa-TFT (surr) 96. **o**ło 74-121 NSH 4BFBs 4-BFB (surr) 94. olo 75-115 NSH 418 1S'D TPH Analysis Prep(Date/Time) 12/08 1330 init. 6-3550 MLC TPH'S PHS'D TPH(Total Petroleum Hydrocarbon < 25 2-418.1 mqq MLC Soil pH Analysis(Date/Time) 12/08 1042 init. 6-9045 AM bh'S pH, Soils 8.6 6-9045 AM NH3S'D Ammonia Analysis (D/T) 12/16 1200 init. CJT NH3'S Ammonia-N 19 mg/kg CJT 351′4S Nitrogen, Total Kjeldahl 31 mg/kg 2-351.4 CJT TOCS'D TOC Analysis (Date/Time) 12/15 0500 init. JMR TOC'S TOC (Walkley-Black) 0.02 ÷ ** JMR TKN Analysis (Date/Time) 12/21 1300 [KN'D init. CJT

COMMENTS:

FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit

Preparation and Analysis Method References:

Rw 121= 7194 Jany Othelion

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

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LAB ANALYSIS REPORT

Report Date: DEC. 9 1994	Page # 1	
Brown and Caldwell 2710 Stemmons Frwy. Stell00 Dallas , TX 75207	Reviewed by:TMG Customer#: 309 Job Number:	
Attn: Fear, Al	Date Collected:12/03/94	•
Sample Number: 94008501	Time Collected:0925	
Sample ID: MW-4 32-34' GRAB	Date Received: 12/07/94	
Test Code Analyte	Result Units Method Analyst	-
18_1S'D TPH Analysis Prep(Date/Time) TPH'S TPH(Total Petroleum Hydrocarbon	12/08 1330 init. 6-3550 MLC < 25 ppm 2-418.1 MLC	
COMMENTS:		
 FOOTNOTES: MI - Surrogate recovery is not Dil.Fx Minimum dilution require ppm = mg/L(Liquid), mg/kg(Solid init = date & time initiated B= Preparation and Analysis Method References 1: ASTM: American Society for Testing 2. EPA-600/4-79-020, Methods for Chemican 1978 (revised 1983). 3. EPA-600/4-82-057, Methods for Organia & Industrial Wastewater, 1982. 4. HACH: Test Methods, accepted by EPA 5. SM: Standard Methods for the Examination edition. 6. SW: SW-846, Test Methods for Evaluation Update I, July 1992. 	reportable due to matrix interferences ired to allow acceptable quantitation i) ppb = ug/L(Liquid), ug/kg(Soil) =found in blank J=>mdl< reporting limit s: and Materials, 1984. cal Analysis of Water and Wastes, ic Chemical Analysis of Municipal A in November, 1983. nation of Water and Wastewater, 18th ation of Solid Waste, Third edition. Mui2[z=2/24] $Mui2[z=2/24]$ $Mui2[z=2/24]$	
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LAB ANALYSIS REPORT

Page # 1 Report Date: DEC. 27 1994 Brown and Caldwell Reviewed by: TMG 2710 Stemmons Frwy. Stel100 Customer#: 309 Dallas , TX 75207 Job Number: Attn: Fear, Al Date Collected:12/04/94 Time Collected:1220 Sample Number: 94008502 Project Name: BELL LAKE JAL, N.M. Sample ID: MW-5 89-91 GRAB Date Received: 12/07/94 Analyte Test Code Result Units Method Analyst _____ ______ BTEXS'D BTEX Analysis Prep(Date/Time) 12/12 0932 init. 6-5030 NSH < 0.010 BZ8020S Benzene ppm 6-8020 NSH TOL8020S Toluene < 0.010 ppm 6-8020 NSH EBZ8020S Ethylbenzene XYLSTLs Total Xylenes < 0.010 ppm 6-8020 NSH Total Xylenes < 0.020 ppm 6-8020 NSH BTEXTLS Total BTEX < 0.050 ppm 6-8020 NSH · 010 aaaTFTs aaa-TFT (surr) 102. 74-121 NSH 4-BFB (surr) 75-115 6-3550 % 4BFBs 96. NSH 418_1S'D TPH Analysis Prep(Date/Time) . 12/08 1330 init. MLC TPH'S TPH(Total Petroleum Hydrocarbon < 25 ppm 2-418.1 MLC PHS'D Soil pH Analysis(Date/Time) 12/08 1042 pH'S pH, Soils 8.9 6-9045 init. AM 6-9045 AM NH3S'D Ammonia Analysis (D/T) 12/16 1200 init. CJT NH3'S Ammonia-N 200 mg/kg CJT Nitrogen, Total Kjeldahl TOC Analysis (Date/Time) 200 351′4S mg/kg 2-351.4 CJT TOCS'D 12/15 0500 init. JMR TOC'S TOC (Walkley-Black) 0.02 % JMR 12/21 1300 TKN'D TKN Analysis (Date/Time) init. CJT COMMENTS: BTEX Dil.Fx. X 5 FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit Rui :- 127/94 Preparation and Analysis Method References: Jany Collace ASTM: American Society for Testing and Materials, 1984. 1. EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 2. 1978 (revised 1983). EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal з.

- & Industrial Wastewater, 1982. 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

LAB ANALYSIS REPORT

Report Date: DEC. 9 1994 Page # 1 Reviewed by: TMG Brown and Caldwell 2710 Stemmons Frwy. Stel100 Customer#: 309 Dallas , TX 75207 Job Number: Attn: Fear, Al Date Collected: 12/04/94 Sample Number: 94008503 Time Collected:0850 Project Name: BELL LAKE JAL, N.M. Sample ID: MW-5 39-41 Date Received: 12/07/94 GRAB Test Code Units Analyte Result Method Analyst 18 1S'D TPH Analysis Prep(Date/Time) 12/08 1330 init. 6-3550 MLC TPH'S TPH(Total Petroleum Hydrocarbon < 25 ppm 2-418.1 MLC COMMENTS: FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil)

init = date & time initiated B=found in blank J=>mdl< reporting limit

Preparation and Analysis Method References:

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- 3. EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

Kany Desteller

TERRA LABORATORIES, LTD. 2525 SOUTH SHORE BLVD, SUITE 100 LEAGUE CITY, TX 77573 713/334-5052 FAX 713/334-3116 LAB ANALYSIS REPORT Report Date: DEC. 27 1994 Page # 1 Brown and Caldwell Reviewed by: TMG 2710 Stemmons Frwy. Stel100 Customer#: 309 Job Number: Dallas , TX 75207 Attn: Fear, Al Date Collected:12/05/94 Time Collected:1115 Sample Number: 94008504 Project Name: BELL LAKE JAL, N.M. Sample ID: MW-6 87-89 GRAB Date Received: 12/07/94 Result Test Code Analyte Units Method Analyst BTEXS'D BTEX Analysis Prep(Date/Time) 12/09 1711 init. 6-5030 NSH < 0.005 ppm < 0.005 ppm < 0.005 ppm BZ8020S Benzene 6-8020 NSH 6-8020 TOL8020S Toluene < 0.005 NSH EBZ8020S Ethylbenzene < 0.005 6-8020 NSH ppm ppm s XYLSTLs Total Xylenes < 0.010 6-8020 NSH 6-8020 Total BTEX < 0.025 BTEXTLS NSH aaa-TFT (surr) 95. 0 aaaTFTs 74-121 NSH 94. % 75-115 12/08 1330 init. 6-3550 2-418.1 4-BFB (surr) 4BFBs NSH 418_1S'DTPH Analysis Prep(Date/Time)12/08TPH'STPH(Total Petroleum Hydrocarbon < 25</td>PHS'DSoil pH Analysis(Date/Time)12/08pH'SpH, Soils8.5 MLC 2-418.1 MLC ppm Soil pH Analysis(Date/Time) 12/08 1042 init. 6-9045 AM 6-9045 AM NH3S'D Ammonia Analysis (D/T) 12/16 1200 init. CJT 1.1 NH3′S Ammonia-N mg/kq CJT 351'4S TOCS'D Nitrogen, Total Kjeldahl < 10 mg/kg TOC Analysis (Date/Time) 12/15 0500 init. mg/kg 2-351.4 CJT JMR TOC (Walkley-Black) 0.02 TOC'S 2 * * JMR TKN Analysis (Date/Time) 12/21 1300 init. rkn'd TMG COMMENTS: FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx. - Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit 12 w 2/27/94 Preparation and Analysis Method References: 1. ASTM: American Society for Testing and Materials, 1984. 2. EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983). EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.

- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

LAB ANALYSIS REPORT

Report Date: DEC. 9 1994

Page # 1

Brown and Caldwell 2710 Stemmons Frwy. Stell00 Dallas , TX 75207 Reviewed by:TMG Customer#: 309 Job Number:

Attn: Fear, Al

Sample Number: 94008505 Project Name: BELL LAKE JAL, N.M. Sample ID: MW-6 40-41 GRAB Date Collected: 12/05/94

Time Collected:0950

Date Received: 12/07/94

Test Code	Analyte	Result	Units	Method	Analyst
18_1S'D TPH Analysi	s Prep(Date/Time)	12/08 1330	init.	6-3550	MLC
PH'S TPH(Total P	etroleum Hydrocarbon	< 25	ppm	2-418.1	MLC

COMMENTS:

FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit

Preparation and Analysis Method References:

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- 3. EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

Kur izle7/94 Sarry Sillice

Report To: Brown and Caldwell Terra Laboratories Sample No(s). 94008500 - 94008505

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2				Precision		Accu	гасу
Analyte	<u>Units</u>	<u>Blank</u>	Orig	Dup	<u>RPD(%)</u>	<u>MSR(%)</u>	LCSR(%)
BTEX (Batch 12099	4S) Sampl	e No. 94	1008633 S _I	oike			
MTBE	ppb	< 5	29	25	15	125	
Benzene	ppb	< 5	32	21	41*	75	84
Toluene	ppb	< 5	21	14	40*	100	88
Ethylbenzene	ppb	< 5	35	27	26*	85	81
Xylenes	ppb	< 10	102	67	41*	75	88
*LCS passes for all an	alytes; comp	ounds a	re non-dete	ct for all sa	imples except	spike sample.	
TPH (Batch A12089	4S)						
Sample No. 94008505	mg/kg	< 25	< 25	< 25	-		90
pH (Batch 120894S)			X				
Sample No. 94008481	pH Units		6.62	6.62	-		
Ammonia Nitrogen (Batch 1216	594S)					
Sample No.94008500	mg/kg	< 0.1	15.3	18.7	20	97	100
BTEX (Batch 121294	4S) Sample	: No. 94	008641 Sp	ike			
MTBE	ppb	< 5	20	21	5	100	
Benzene	dad	< 5	21	22	5	105	98
Toluene	ppb	< 5	25	25	0	110	101
Ethylbenzene	ppb	< 5	22	22	0	110	93
Xylenes	ррb	< 10	64	64	0	105	101
TOC (Batch 1215948	5)						
Sample No. 94008500	70	< 0.1	0.02	< 0.01	-	71*	90
*Matrix interference w	ith spike rec	overy; L	CS is withi	n acceptab	le limits		

TKN (Batch 122794S)

Sample No. 94008500 mg/kg < 0.1 31.4 27.6

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Ru 1151957 Jarry O Meter

Terra Laboratories, Ltd.

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TERRA LABORATORIES LTD.

2525 South Shore Blvd.

League City, Texas 77573

(713) 334-5052

Fax: (713) 334-3116

CHAIN OF CUSTODY

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12/3/14	925			Х	MW-	4	32 - 3	4			\times													- 8501
12/4/14	1220			Х	MW-	5	89-9	1		2	Х	X	XI,	×Þ	\overline{X}	X								- 8502
12/4/14	850			Х	MW-	5 .	39 - 4	'1		1	X					Τ								- 8503
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Collected by:	AIF	ear Fear	I	J	Dat 12	»: 6/94	Time: G3	Oam	Received by Te			U	M	1/1	1		Dat	10: 2-7	-94	Time	: 7.4/0	2	Ternarks	
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Relinquished	by:			_	Dat	9;	Time:		Received by:								Da	te:		Time):			

APPENDIX C

GEOTECHNICAL RESULTS

Job No. 94G817

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APPENDIX D

LABORATORY RESULTS GROUNDWATER SAMPLES

Terra Laboratories, Ltd.

Quality Analytical Services

AJF LOPY

January 3, 1995

Jack Cooper Brown and Caldwell 1415 Louisiana, Suite 2500 Houston, TX 77002

Re: Seven (7) liquid samples (Project Name: Bell Lake) received on 12/09/94

Dear Mr. Cooper:

Attached are the final reports of analysis of the samples referenced above as per your analysis and/or method requests. As per Suzanne Richards BTEX by Method 8020 was analyzed in place of Volatiles by Method 8260 and Nitrate-Nitrite was analyzed in place of Nitrite. The analysis for Manganese was subcontracted to Chester LabNet. Manganese Dioxide concentrations are calculated from the Manganese results, and are as follows:

Sample	<u>MnO2 (ug/L)</u>
94008625	10
94008626	46
94008627	93
94008628	3.0
94008629	72
94008630	45

The samples were received in good condition and at 0^o Centigrade.

We appreciate this opportunity to serve Brown and Caldwell. Please let me, or Linda McKee, know if there is any other way we can help you.

Sincerely,

Larry D. Wallace Laboratory Director

JAN- (6-95 FRI 12:43 BROWN AN	ID CALDWELL	FAX NO	7590952	P	. 03
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	LA	B ANALYSIS	REPORT	Page # '	1	
Report Da	te: DEC. 20 1004				-	
fown and 15 Loui iouston	Caldwell siana, Suite 2500 , TX 77	002		Reviewed by Customer#: Job Number:	:JMH 309	
tn: Coo	per, Jack [']			Date Collect	ed:12/07/	94
Sample Nu	mber: 94008626			Time Collect	ed:1610	
roject N ample ID	ame: BELL LAKE : MW-1			Date Receive	ed: 12/09/9	94
Test Cod	e Analyte		Result	Units	Method	Analyst
TEXW'D	BTEX Analysis Prep(Da	ate/Time)	12/14 192	1 init.	6-5030	NSH
BZ8020W	Benzene	•	.092	ppm	6-8020	NSH
OL8020W	Toluene	•	.050	mqq	6-8020	NSH
BZ8020W	Ethylbenzene		.054	ppm	6-8020	NSH
XYLSTLW	Total Xylenes		< 0.111	mqq	6-8020	NSH
TEXTLW	Total BTEX		< 0.307	ppm	6-8020	NSH
aaTFTw	aaa-TFT (surr)	τ.	MI	· *	82-114	NSH
-∍BFBw	4-BFB (surr)		98.	*	85-115	NSH
TDS'D	TDS Analysis (Date/T:	ime)	12/14 071	5 init.	2-160.1	JMR
DS'RES	TDS (Total Dissolved S	Solids)	7100	mg/L	2-160.1	JMR
SPO4W'D	OrthoPO4 Analysis Dat	te/Time	12/09 140	0 init.		AM
0P04'W	Orthophosphate		0.3	mg/L	2-365.2	AM
KN'D	TKN Analysis (Date/T:	ime) ·	12/28 093	0 init.	_	JMR
rkn' wj	Total Kjeldahl Nitro	gen (31 .	mg/L	2-351.4	JMR
COD'D	COD Analysis (Date/T:	ıme)	12/21 160	0 init.		CJT
:ODppm	Chemical Oxygen Demar	1d (~ (~)	420	mg/L	4-8000	CJT
O3NO2'D	Nitrate-Nitrite Analy	ysis (D/T)	12/20 100	0 init.		CJT
NO3NO2	Nitrate-Nitrite N	-	.06	mg/L	2-353.3	TMG
504 ' D	Sultate Analysis (D/2	r)	12/28 083	U init.		DPP
Gulfate	Sulfate		140	mg/L	2-375.4	DPP

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LAB ANALYSIS REPORT

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Report Date: DEC. 29 1994	, , ,	: .) 1 2		Page # 2		
Brown and Caldwell	: . ⁻			Revi	ewed by:J	MH	
Houston , TX	77002	÷		Job	Number: 3	09	
Actn: Cooper, Jack		•1	2 F 1	Date	Collecte	d:12/07/	94
Sample Number: 94008626 Project Name: BELL LAKE				Time	Collecte	d:1610	
Sample: ID: MW-1				Date	Received	: 12/09/	94
Test Códe Analyt	2	 =	Result	****	Units	Method	Analyst
NH3W'D Ammonia Analysis NH3ISEW Ammonia-Nitrogen	(D/T)		12/20 140 37	00	init. mg/L	2-350 3	JMH
SCLCOD'D Soluable COD Analy	ysis (Date	∍/Tim	12/21 160	00	init.	2-330.3	CJT
SCODppm Soluable Carbon O	cygen Dema	and	340	r	ng/L	4-8000	CJT
SUBCON'D Date subcontracted	ACCED TO:		Cnester	00		· .	JMH
COMMENTS: BTEX Dil. Factor	X 10,NH3	> TKI	N, Anal. F	Repeat	ed, Susp	ect. Inte	erie
FOOTNOTES: MI - Surrogate re Dil.Fx Minimum ppm = mg/L(Liquid init = date & tim	covery is dilution 1), mg/kg ne initiat	s not requi (Solid ted B=	reportabl ired to al 1) ppb = u found in	le due llow a 1g/L(I blan)	e to matr acceptable Liquid), u c J=>mdl<	ix interf e quantit 1g/kg(Soi reportir	Terences Lation 1) Ng limit
Preparation and Analysis Met	hod Refer	rences	3: .				

- 1. ASTM: American Society for Testing and Materials, 1984.
- 2. EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- 3. EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

Kw 1/2/95 Jarry O shallan

FROM PERCEPTIVE SCIENTIFIC INSTRUMENTS, INC.

TERRA LABORATORIES, LTD. 2525 SOUTH SHORE BLVD, SUITE 100 LEAGUE CITY, TA //5/5 713/334-5052 FAX 713/334-3116 LEAGUE CITY, TX 77573 1771 LAB ANALYSIS REPORT 1.2.5 Report Date: DEC. 29 1994 Page # 1 Brown and Caldwell : , Reviewed by: JMH 1415 Louisiana, Suite 2500 Houston , TX Customer#: 309 77002 Job Number: Attn: Cooper, Jack Date Collected:12/07/94 Sample Number: 94008627 Time Collected: 1640 Project Name: BELL LAKE Sample ID: MW-2 Date Received: 12/09/94 Test Code Analyte Result Units Method Analyst _____ BTEXW'D BTEX Analysis Prep(Date/Time) 12/15 1108 init. 6-5030 NSH BZ8020W · Benzene .006 ppm 6-8020 TMG TOL8020W Toluene ppm ppm .005 6-8020 TMG EBZ8020W Ethylbenzene XYLSTLw Total Xylenes BTEXTLw Total BTEX < 0.002 6-8020 NSH 6-8020 < 0.004 ppm NSH < 0.017 ppm 6-8020 NSH 82-114 azaTFTw aaa-TFT (surr) c40 040 101. NSH 4BFBw 4-BFB (surr) TDS'D TDS Analysis MI 85-115 NSH 12/14 0715 init. 2600 mg/L TDS Analysis (Date/Time) 2-160.1 JMR TDS'RES TDS (Total Dissolved Solids) 2 - 160.1JMR Ammonia Analysis (D/T) NH3W'D 12/20 1400 init. JMH NH3ISEW Ammonia-Nitrogen 6.6 mg/L 2-350.3 JMH OrthoPO4 Analysis Date/Time OPO4W'D 12/09 1400 init. AM oPO4'W Orthophosphate 0.1 mg/L 2-365.2 AM TKN'D TKN Analysis (Date/Time) 12/28[.]0930 init. JMR TKN'WJ Total Kjeldahl Nitrogen 5 mg/L 2-351.4 JMR

12/21 1600 init.

mg/L

mg/L

160

< 0.05

Ku 1/2/95 Jarry Dullar

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2-353.3 CJT

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FROM PERCEPTIVE SCIENTIFIC INSTRUMENTS, INC.

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NO3NO2

01.02.1995 03:08

COD Analysis (Date/Time)

Nitrate-Nitrite N

Chemical Oxygen Demand

MO3NO2'D Nitrate-Nitrite Analysis (D/T) 12/20 1000 init.

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1 2525 2525 713/	ERRA LABORATO SOUTH SHORE B LEAGUE CITY, 334-5052 FAX	RIES, LTD. LVD, SUITE TX 77573 713/334-31	100 16		
	LAB ANALYSIS	REPORT	:		
Report Date: DEC. 29 1994			Page # 2		
Brown and Caldwell 1415 Louisiana, Suite 2500 Houston , TX	77002		Reviewed by: Customer#: 3 Job Number:	MH 809	
Attn: Cooper, Jack	1 1		Date Collecte	d:12/07/9	94
Sample Number: 94008627			Time Collecte	d:1640	
Sample ID: MW-2	- - -		Date Received	l: 12/09/9	94
Test Code Analyt	e '.	Result	Units	Method	Analyst
SO4'D Soluable COD Analysis Sulfate Soluable COD Analy SCODppm Soluable Carbon On	(D/T) ysis (Date/Tir xygen Demand	12/28 08 51 n 12/21 16 140	30 init. mg/L 00 init. mg/L	2-375.4 4-8000	DPP DPP CJT CJT
SUBCON'D Date subcontracted	acted to: 1:	Chester 12/15 12	00		HML JMH
COMMENTS: NH3 > TKN, Anal.	Repeated, Sug	pected Int	terference		·
FOOTNOTES: MI - Surrogate re Dil.Fx Minimum	ecovery is not dilution requ	reportablined to a	le due to matr llow acceptabl	ix interf e quantit	erences

ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil)
init = date & time initiated B=found in blank J=>mdl< reporting limit</pre>

Preparation and Analysis Method References:

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- ASTM: American Society for Testing and Materials, 1984. 1.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 2. 1978 (revised 1983).
- EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal з. & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- SM: Standard Methods for the Examination of Water and Wastewater, 18th 5. edition.
- SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. G. Update I, July 1992.

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		TERRA LABORATO	DRIES, LTD.	¥.,		
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	· · · ·	LEAGUE CITY,	<u> </u>	•	t 1 .	24.4
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	÷÷ k	LAB ANALYSIS	S REPORT	•	· · · ·	·-
11					• •	
Report D	ate: DEC: 29 1994	. *	·	Page # 1	1	•
Bròwn an	d Caldwell		· ·	Reviewed by	JMH	
1415 Lou	isiana, Suite 2500) .	(Customer#:	309	
Houston	, TX	77002	1	Job Number:		
					•	
Attn: Co	oper, Jack]	Date Colleci	ced:12/07/	94
	3141	· · · · · · · · · · · · · · · · · · ·			•	
Sample N	umber: 94008625		7	Time Collect	ed:1530	
Project	Name: BELL LAKE				:	
Sample I	D: MW-3		· · ·]	Date Receive	ed: 12/09/	94
		+ a	Pogult	Thite	Mathad	3 M A]
Test Co	de Anary		REBUIL		Method	Analysc
BUEXMID	BTEX Analysis Pr	cep(Date/Time)	12/15 104	8 init.	6-5030	NSH
878020W	Benzene		< 0.002	maa	6-8020	NSH
TOT 8020W	Toluene		< 0.002	maa	6-8020	NSH
EBZ8020W	Ethylbenzene		< 0.002	maa	6-8020	NSH
XYLSTLW	Total Xylenes		< 0.004	maa	6-8020	NSH
BTEXTLW	Total BTEX	ť	< 0.010	mqq	6-8020	NSH
zaaTFTw	aaa-TFT (surr)		99. '	\$ ⁻	82-114	NSH
4BFBW	4-BFB (surr)		98.	00	85-115	NSH
TDS'D	TDS Analysis (Da	te/Time)	12/14 0719	5 init.	2-160.1	JMR
TDS'RES	TDS (Total Dissol	ved Solids)	320	mg/L	2-160.1	JMR
NHEW'D	Ammonia Analysis	(D/T)	12/20.1400) init.		JMH
RHBISEW	Ammonia-Nitrogen	l	0.44	mg/L	2-350.3	JMH
DPO4W'D	OrthoPO4 Analysi	s Date/Time	12/09 1400) init.		AM
0204'W	Orthophosphate		0.2	mg/L	2-365.2	AM
TKN'D	TKN Analysis (Da	te/Time)	12/28 0930) init.		JMR
TKN'WJ	Total Kjeldahl N	litrogen	.28	mg/L	2-351.4	JMR
000 1 0 -	COD Analysis (Da	te/Time)	12/21 1600) init.	•	CJT
CODppm	Chemical Oxygen	Demand	< 1	mg/L	4-8000	CJT
\$04'D	Sulfate Analysis	(D/T)	12/28 0830) init.		DPP
Sulfate	Sulfate		31 .	mg/L	2-375.4	DPP

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FROM PERCEPTIVE SCIENTIFIC INSTRUMENTS, INC.

LAB ANALYSIS REPORT

Report Date: DEC. 29 1994

Attn: Cooper, Jack

Sample Number: 94008625

Sample ID: MW-3

Project Name: BELL LAKE

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Brown and Caldwell 1415 Louisiana, Suite 2500 Houston , TX 77002

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Reviewed by:JMH Customer#: 309 Job Number:

Page # 2

Date Collected:12/07/94

Time Collected:1530

Date Received: 12/09/94

Test Cod	e Analyte	Result	Units	Method	Analyst
NO3NO2'D NO3NO2 SOLCOD'D SCODppm LAB'NAME SUBCON'D	Nitrate-Nitrite Analysis (D/T) Nitrate-Nitrite N Soluable COD Analysis (Date/Tim Soluable Carbon Oxygen Demand Analyses subcontracted to: Date subcontracted:	12/20 1000 3.6 12/21 1600 < 1 Chester 12/15 1200	init. mg/L init. mg/L	2-353.3 4-8000	CJT CJT CJT CJT JMH JMH

COMMENTS: NH3 > TKN, Anal. Repeated, Suspected Interference

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FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit</pre>

Preparation and Analysis Method References:

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

Kw 1/2/95 Harry Dullan

LAB ANALYSIS REPORT

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Page # 1

Reviewed by: JMH

Customer#: 309

Brown and Caldwell 1415 Louisiana, Suite 2500 Houston , TX 77002

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Attn: Cooper, Jack Sample Number: 94008630 Project Name: BELL LAKE Sample ID: MW-4

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Report Date: DEC. 29 1994

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Job Number: Date Collected:12/07/94 **..**..

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Time Collected: 1855

Date Received: 12/09/94

	Test Cod	e Analyte	Result	Units	Method	Analyst
	ETEXW'D	.BTEX Analysis Prep(Date/Time)	12/15 1208	init.	6-5030	NSH
	EZ8020W	Benzene	.018	ppm	6-8020	NSH
	TOL8020W	Toluene .	.071	ppm	6-8020	NSH
	2BZ8020W	Ethylbenzene	.004	ppm	6-8020	TMG
	XYLSTLW	Total Xylenes	.16	ppm	6-8020	NSH
	BTEXTLW	Total BTEX	0.253	ppm	6-8020	NSH
	caaTFTw	aaa-TFT (surr)	98.	*	82-114	NSH
	4BFBw	4-BFB (surr)	MI	010	85-115	NSH
	TDS'D	TDS Analysis (Date/Time)	12/14 0715	init.	2-160.1	JMR
	TDS'RES	TDS (Total Dissolved Solids)	4700	mg/L	2-160.1	JMR
	HH3W'D	Ammonia Analysis (D/T)	12/20.1400	init.		JMH
	NHBISEW	Ammonia-Nitrogen	120	mg/L	2-350.3	JMH
i	cPO4W'D	OrthoPO4 Analysis Date/Time	12/09 1400	init.		AM
i	0PO4'W	Orthophosphate	0.6	mg/L	2-365.2	AM
	WKN'D	TKN Analysis (Date/Time)	12/28 0930	init.		JMR
	TKN'WJ	Total Kjeldahl Nitrogen	83	mg/L	2-351.4	JMR
	COD'D	COD Analysis (Date/Time)	12/21 1600 :	init.		CJT
	CODppm	Chemical Oxygen Demand	780	mg/L	4-8000	CJT
	MO3NO2'D	Nitrate-Nitrite Analysis (D/T)	12/20 1000	init.		CJT
	1-03N02	Nitrate-Nitrite N	< 0.05	mg/L	2-353.3	CJT

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LAUR CENERITYE SUTENITETE INSTRUMENTS, INC.

LAB ANALYSIS REPORT

Report Date: DEC. 29 1994 Page # 2 Frown and Caldwell Reviewed by: JMH Customer#: 309 1415 Louisiana, Suite 2500 Houston , TX, 77002 Job Number: Date Collected:12/07/94 Attn: Cooper, Jack ÷., Sample Number: 94008630 Time Collected:1855 Project Name: BELL LAKE Sample ID: MW-41 Date Received: 12/09/94 14. 6ž. Analyte Result Units Method Analyst Test Code _____ SO4'D' Sulfate Analysis (D/T) 12/28 0830 init. DPP SulfateSulfate70mg/L2-375.4SOLCOD'DSoluableCOD Analysis(Date/Tim 12/21 1600init.SCODppmSoluableCarbonOxygenDemand720mg/L4-8000LAB'NAMEAnalysessubcontracted to:ChesterChester1000 2-375.4 DPP CJT CJT JMH 12/15 1200 SUBCON'D Date subcontracted: JMH COMMENTS: NH3 > TKN, Anal. Repeated, Suspected Interference FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit Preparation and Analysis Method References: ASTM: American Society for Testing and Materials, 1984. 1. EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 2. 1978 (revised 1983). EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal з. & Industrial Wastewater, 1982. HACH: Test Methods, accepted by EPA in November, 1983. 4. SM: Standard Methods for the Examination of Water and Wastewater, 18th 5. edition. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. 6. Update I, July 1992.

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LAB ANALYSIS REPORT

Report Date: DEC. 29 1994 . •

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Sample ID: MW-5

Trown and Caldwell 1415 Louisiana, Suite 2500 Houston , TX 77002 · · · . Attn: Cooper, Jack 1. Sample Number: 94008628 Project Name: BELL LAKE

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Page # 1

Reviewed by: JMH Customer#: 309 Job Number:

Date Collected:12/07/94

Time Collected:1740

Date Received: 12/09/94

Test Cod	le Analyte	Result	Units	Method	Analyst
BTEXW'D	BTEX Analysis Prep(Date/Time)	12/15 1128	init.	6-5030	NSH
BZ8020W	Benzene	.009	ppm	6-8020	TMG
TOL8020W	Toluene	.020	mqq	6-8020	NSH
EBZ8020W	Ethylbenzene	.004	ppm	6-8020	TMG
XYLSTLw	Total Xylenes	.064	ppm	6-8020	NSH
BTEXTLW	Total BTEX	0.097	ppm	6-8020	NSH
aaaTFTw	aaa-TFT (surr)	100.	જ	82-114	NSH
43FBw	4-BFB (surr)	MI	oto	85-115	NSH
TDS'D	TDS Analysis (Date/Time)	12/14 0715	init.	2-160.1	JMR
TDS'RES	TDS(Total Dissolved Solids)	9500	mg/L	2-160.1	JMR
MH3W'D	Ammonia Analysis (D/T)	12/20 1400	init.		JMH
NH3ISEW	Ammonia-Nitrogen	140	mg/L	2-350.3	JMH
oPO4W'D	OrthoPO4 Analysis Date/Time	12/09 1400	init.		AM
CPO4'W	Orthophosphate	0.6	mg/L	2-365.2	AM
TEN'D	TKN Analysis (Date/Time)	12/28 0930	init.		JMR
TKN'WJ	Total Kjeldahl Nitrogen	110	mg/L	2-351.4	JMR
COD'D	COD Analysis (Date/Time)	12/21 1600	init.		CJT
CODppm	Chemical Oxygen Demand	1100	mg/L	4-8000	CJT
NO3NO2'D	Nitrate-Nitrite Analysis (D/T)	12/20 1000	init.		CJT
NO3NO2	Nitrate-Nitrite N	< 0.05	mg/L	2-353.3	CJT

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LAB ANALYSIS REPORT

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Report Date: DEC. 29 1994 Brown and Caldwell

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1415 Louisiana, Suite 2500 Houston , TX

Attn: Cooper, Jack

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Sample Number: 94008628 Project Name: BELL LAKE Sample ID: MW-5: IA: Sample ID: MW-5: Reviewed by:JMH Customer#: 309 Job Number:

Page # 2

Date Collected:12/07/94

Time Collected:1740

Date Received: 12/09/94

Test Coo	de datio	Analyte		Resul	lt	Units	Method	Analyst
SO4'D Sulfate SOLCOD'D SCODppm LAB'NAME SUBCON'D	Sulfate Sulfate Soluable Soluable Analyses Date sul	Analysis (D/T) COD Analysis Carbon Oxygen s subcontracted contracted:	(Date/Tim Demand to:	12/28 49 12/21 1100 Cheste 12/15	0830 1600 2r 1200	init. mg/L init. mg/L	2-375.4 4-8000	DPP DPP CJT CJT JMH JMH

COMMENTS: NH3 > TKN, Anal. Repeated, Suspected Interference

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FCOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J->mdl< reporting limit</pre>

Preparation and Analysis Method References:

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- 3. EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 5. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

Ken 1/2/95 Jarry Della

TERRA LABORATORIES, LTD.						
2525 SOUTH SHORE BLVD, SUITE 100						
LEAGUE CITY, TX 77573						
713/334-5052 FAX 713/334-3116						

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LAB ANALYSIS REPORT

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Report Date: DEC. 29 1994
Brown and Caldwell
1415 Louisiana, Suite 2500
Houston

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Attn: Cooper, Jack Sample Number 194008629 Project Name: BELL LAKE Sample ID: MW-6 Reviewed by:JMH Customer#: 309

Page # 1

Date Collected:12/07/94

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Time Collected:0000

Date Received: 12/09/94

Test Cod	le Analyte	Result	Units	Method	Analyst
BTEXW'D BZ8020W TOL8020W EBZ8020W	BTEX Analysis Prep(Date/Time) Benzene Toluene Ethylbenzene	12/15 1148 < 0.002 .003 < 0.002	init. ppm ppm ppm	6-5030 6-8020 6-8020 6-8020 6-8020	NSH NSH TMG NSH
XYLSTLW	Total Xylenes	< 0.006	ppm	6-8020	NSH
BTEXTLW	aaa-TFT (surr)	< 0.013 106.	ppm %	6-8020. 82-114	NSH NSH
4BFBw	4-BFB (surr)	MI	4	85-115	NSH
TDS'D	TDS Analysis (Date/Time)	12/14 0715	init.	2-160.1	JMR
TDS'RES NH3W'D	TDS(Total Dissolved Solids) Ammonia Analysis (D/T)	4700 12/20 1400	mg/L init.	2-160.1	JMR JMH
NH3ISEW oP04W'D	Ammonia-Nitrogen OrthoPO4 Analysis Date/Time	160 12/09 [.] 1400	mg/L init.	2-350.3	JMH AM
oPO4'W TKN'D	Orthophosphate TKN Analysis (Date/Time)	0.7 12/28 0930	mg/L init.	2-365.2	AM JMR
TKN'WJ COD'D	Total Kjeldahl Nitrogen COD Analysis (Date/Time)	110 12/21 1600	mg/L init.	2-351.4	JMR CJT
CODppm 1103N02 ' D	Chemical Oxygen Demand Nitrate-Nitrite Analysis (D/T)	560 12/20 1000	mg/L init.	4-8000	TCD TCD
NO3NO2	Nitrate-Nitrite N	< 0.05	mg/L	2-353.3	CJT

Kw 1/2/95 Jarry D Hallan

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EKOW REKEELINE POIENIILIE INPIKOVENIO' INC.
TERRA LABORATORIES, LTD. 2525 SOUTH SHORE BLVD, SUITE 100 LEAGUE CITY, TX 77573 713/334-5052 FAX 713/334-3116

LAB ANALYSIS REPORT

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Report Date: DEC. 29 1994			· · ·	Page # :	2	•
Brown and Caldwell			Re	viewed by	: JMH	
Houston , TX	77002	. ł:	Jol	stomer#: > Number:	309	
Attn: Cooper, Jack	. : • .	•••	Dat	ce Collect	ed:12/07/	94
Sample Number: 94008629			Tit	ne Collect	ced:0000	-
Sample ID: MW-6	- :.		Dat	e Receive	ed: 12/09/	94
Test Code Analyt	e ·	Res	ult	Units	Method	Analyst
SO4'D Sulfate Analysis	(D/T) · ····	12/2	8 0830	init.		DPP
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LAB'NAME Analyses subcontr	acted to:	Ches	ster		. · · .	JMH
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FOOTNOTES: MI - Surrogate recovery is not reportable due to matrix interferences Dil.Fx.- Minimum dilution required to allow acceptable quantitation ppm = mg/L(Liquid), mg/kg(Solid) ppb = ug/L(Liquid), ug/kg(Soil) init = date & time initiated B=found in blank J=>mdl< reporting limit</pre>

Preparation and Analysis Method References:

- 1. ASTM: American Society for Testing and Materials, 1984.
- EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, 1978 (revised 1983).
- 3. EPA-600/4-82-057, Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, 1982.
- 4. HACH: Test Methods, accepted by EPA in November, 1983.
- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

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TERRA LABORATORIES, LTD. 2525 SOUTH SHORE BLVD, SUITE 100 LEAGUE CITY, TX 77573 713/334-5052 FAX 713/334-3116

LAB ANALYSIS REPORT

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- 5. SM: Standard Methods for the Examination of Water and Wastewater, 18th edition.
- 6. SW: SW-846, Test Methods for Evaluation of Solid Waste, Third edition. Update I, July 1992.

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BROWN AND CALDWELL

Suite 2500 1415 Louisiana Houston, Texas 77002 (713) 759-0999 • FAX (713) 759-0952 Unless otherwise indicated or obvious from the nature of the transmittal, the information contained in this facsimile message is confidential information intended for the use of the individual or entity named below. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us at the

FAX TRANSMITTAL COVER SHEET

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Summary of Analytical Results

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Sumary of Analytical Results

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TERRA LABORATORIES LTD. League City, Yexes 77573 (713) 334-5052

2525 South Shore Blvd.

Fax: (713) 334-3118

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APPENDIX E

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SLUG TEST RESULTS



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APPENDIX F

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BIOLOGICAL RESULTS

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<u>Advanced</u>

Biological

<u>Solutions, Inc.</u>

Environmental Services

1701 West Hillsboro Boulevard, Suite 103 Deerfield Beach, Florida 33442 TEL (305) 428-3880 FAX (305) 428-2102

VIABLE COUNTS

PREPARED FOR: BROWN & CALDWELL

BELL LAKE

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JANUARY 11, 1995

PREPARED BY: ADVANCED BIOLOGICAL SOLUTIONS INC. 1701 W. HILLSBORO BLVD. SUITE 103 DEERFIELD BEACH, FLORIDA 33442

INTRODUCTION

Advanced Biological Solutions Inc. was retained by Brown & Caldwell to determine the total number of heterotrophs and petrophilic bacteria in six groundwater samples. Groundwater samples were received by ABS with the intent of reflecting the range of contaminant conditions at the site.

COMPARATIVE MICROBIAL ENUMERATION METHODOLOGY

The comparative enumeration assay provides information about the extent to which viable adapted microbial populations are present at the site. Additionally, the assay provides data about the relative number of organisms capable of degrading the target contaminant. This data is important in deciding if further investigation of bioremediation as a treatment alternative is merited. The assay results also provide a baseline for later analysis of whether biodegradation has been enhanced through applied treatments, if such an option is pursued.

A modified version of the National Environmental Technology Applications Center method was utilized for all bacterial counts. Viable counts to determine the concentration of the heterotrophic and petrophilic bacteria were made on each sample. Ten fold extinction dilution counts were determined using 9 ml of either sterile nutrient broth for heterotrophs or sterile Bushnell-Haas broth for petrophilic bacteria (petroleum degraders). Gasoline was added to the Bushnell-Haas medium at 1% (V/V). The tubes were incubated at 24-28 degrees Centigrade for 72 hours for heterotrophs and 14 days for petrophilics.

Viable counts of aerobic heterotrophs and petroleum degraders in soil and water samples

Sample Number BELL LAKE	Aerobic Heterotrophs	: *	Petroleum Degraders
Water MW-1	10 ⁶		10 ³
Water MW-2	10 ⁶		10 ²
Water MW-3	105		10 ²
Water MW-4	105		10 ³
Water MW-5	105		10 ²
Water MW-6	106		101

NOTES:

1. Nutrient broth was utilized for aerobic heterotrophs

- 2. Minimal media was utilized for petroleum degraders using commercial gasoline as a carbon and energy source. Gasoline concentration was 1% (V/V). Ten fold extinction dilution viable counts were determined.
- 3. Viable counts are expressed per ml for water and per gram for soils

2525 South Shore Blvd.

League City, Texas 77573

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TORIES-LTD. (713) 334-5052 Fax: (713)

Fax: (713) 334-3116

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TOTAL HYDROCARBON DEGRADERS/TOTAL HETEROTROPHS BY MOST PROBABLE NUMBER (MPN) METHOD

The following are general descriptions of microbial methods used by NETAC's Bioremediation Product Evaluation Center (BPEC) for conducting microbial analyses to determine the number of heterotrophic and hydrocarbon degrading organisms in a given sample. These methods are part of the protocols used to determine the efficacy of all spill response bioremediation products.

FRESHWATER ENVIRONMENTS

Dilutions:

Remove 0.5 ml of water from each sample to be tested and add it to a tube of 4.5 mL sterile of Phosphate buffer. This is the 10^{-1} dilution. Using sterile technique, mix and perform serial dilutions to (0.5 mL of previous dilution to 4.5 mL of sterile phosphate buffer) 10^{-9} dilution. NOTE: All of the following MPN methods are incubated in a 24 well multiple well plate such as catalog number 25820-24 Corning Cell Wells disposable cell culture plate. Volumes indicated are reflective of a 3.4 mL cell volume.

Total Heterotrophic Organisms:

Prepare sufficient tryptic soy broth (TSB) per page 1027, 10th edition Difco Manual, to fill the number of wells required for the test (1.0 mL/well).

Using sterile technique, add 1.0 mL of TSB to each well.

Label the top of the MFN plate with the appropriate dilution for each row of wells.

Add 0.1 mL of fluid from each dilution tube to each well in the appropriate row, starting with the most dilute.

Incubate the MPN plates at 20°C or other prescribed temperature.

After an incubation period of two to aix days, add 100 μ l of p-iodonitrotetrazolium violet (50 mg/10 mL deionized water) to each well to determine growth. Development of a pink or purple color upon standing for 20 minutes is considered a positive test. View plates against a white background to determine if color is present. Note: Prepared tetrazolium dye may be stored in the refrigerator in an amber bottle until used.

Record the number of positive wells and the dilutions at which they occur. Base counts on the six wells in each row. Enter the data into computarized enumeration method such as the "MPN Calculator" software program (version 2.3 or higher), by Albert J. Klee, U.S. EPA, Office of Research and Development, Risk Reduction Engineering Laboratory, Cincinnati, OH.

Total Hydrocarbon Degrading Organisms:

Prepare sufficient sterile Bushnell-Haas (B-H) broth per page 184, 10th coltion of Difco Manual, to fill the number of wells required for the test.

Using sterile technique, add 1.75 mL of B-H broth to each well.

Label the top of the plate with the proper dilution for each row.

Add 0.1 mL of fluid from each dilution tube to each well in the appropriate row, starting with the most dilute.

After adding the fluid to all the wells, add 20 μ L of filter sterilized #2 diesel fueloit to the top of each well.

Incubate each plate at 20°C or other prescribed temperature.

After 14 days of incubation, add 100 mL of p-iodotetrazolium violet dye (50 mg/10 mL of deionized water) to each well to determine growth. Development of a purple or pink color upon standing for 45 minutes constitutes a positive test. View plates against a white background to determine if color is present.

Record the number of positive wells and the dilutions at which they accur. Base counts on five wells/row. Enter the data into computerized enumeration method such as the "MPN Calculator" software program (version 2.3 or higher), by Albert J. Klee, U.S. EPA, Office of Research and Development, Risk Reduction Engineering Laboratory, Cincinnati, OH.

Soll or Sand Studies Test for Hydrocarbon Degrading Organisms:

Place 1 gram of sample to be analyzed in 99 mL of phosphate buffer pH 7.2-7.5 (Standard Methods for the Examination of Waste and Wastewater, 1988, p. 9-31). Sonicate mixture for 15 seconds, and proceed with the above noted procedure.

MARINE ENVIRONMENTS

Dilutions:

Prior to sacrificing each Tier II test flask, 0.5 mL of water is removed and added to a test tube of 4.5 mL of sterile phosphate builder (1:10 dilution). Using sterile technique, mix and perform serial dilutions (0.5 mL of previous dilution to 4.5 mL of sterile phosphate buffer) to 10⁻⁹ dilution.

Total Hatarotrophic Organisms:

Label the top of a 24 well disposable cell culture place (e.g., cat. no. 25820-24 Corning Cell Wells) with the appropriate sample identification and the appropriate dilution sequence per row of wells.