MONITORING
PURGING
DISPOSING
SAMPLING

MPDS SERVICES, INCORPORATED

January 24, 1996

Alameda County Health Care Services
1131 Harbor Bay Parkway
Alameda, CA 94502

Attention: Mr. Scott Seery

RE: Unocal Service Station #7376
4191 First Street
Pleasanton, California

Dear Mr. Seery:

Per the request of the Unocal Corporation Project Manager, Mr. Robert A. Boust, enclosed please find our report (MPDS-UN7376-04), dated January 16, 1996 for the above referenced site.

Should you have any questions regarding the reporting of data, please feel free to call our office at (510) 602-5120. Any other questions may be directed to the Project Manager at (510) 277-2334.

Sincerely,

MPDS Services, Inc.

Jarrel F. Crider

/jfc

Enclosure

cc: Mr. Robert A. Boust

2401 Stanwell Drive, Suite 300, Concord, CA 94520
TEL: (510) 602-5120 FAX: (510) 689-1918

Wells MW-1, -2, -3

DATE? Feb. 1988?

REPORT
SUPPLEMENTAL SUBSURFACE ENVIRONMENTAL INVESTIGATION

at

Armour Oil Company
Service Station No. 188
First and Ray Streets
Pleasanton, California

AGS Job No. 87086-3

Report prepared for

Armour Oil Company
P.O. Box 85302
San Diego, California 92138-5302

by

Applied GeoSystems

William R. Short
Project Geologist

Gillian S. Holmes
G.E. 2023

11/03/94

date retrieved from archives by RESNA @ request of ACDEH.

11/03/94
AGS 87086-3

Mr. Byron Armour
Armour Oil Company
P.O. Box 85302
San Diego, California 92138-5302

Subject: Executive Summary of Supplemental Subsurface Environmental Investigation at Armour Oil Company Service Station No. 188, First and Ray Streets, Pleasanton, California.

Mr. Armour:

This report presents the results of our supplemental subsurface environmental investigation at the above-referenced site. The investigation included drilling three soil borings, constructing three monitoring wells, and analyzing soil and ground-water samples for potential hydrocarbon contamination.

Nondetectable to relatively high (greater than 1000 ppm) levels of hydrocarbons were found in laboratory analyses of soil samples collected from the borings. The benzene level in ground water from all three monitoring wells, the toluene and xylene levels in MW-2 and MW-3, and the 1,2,-dichloroethene level in MW-1 are above State of California Department of Health Services recommended maximum concentrations for drinking water. The ground-water level in MW-2 is substantially higher than the ground-water level in MW-1 and MW-3; this suggests that MW-2 may be completed in a different water-bearing zone than MW-1 and

MW-3.

We recommend that additional ground-water monitoring wells be constructed to evaluate the lateral and vertical extent of the contamination. The wells can also be used to evaluate the aquifer characteristics and ground-water conditions in the vicinity of the site.

We recommend that Armour Oil Company submit a copy of this report to Mr. Rick Mueller of the Pleasanton Fire Department at 44 Railroad Street, P.O. Box 520, Pleasanton, California, 94566, and to Mr. Greg Zentner at the California Regional Water Quality Control Board, San Francisco Bay Region at 1111 Jackson Street, Room 6040, Oakland, California 94607. Please do not hesitate to call if you have any questions regarding the content of this report.

Sincerely,
Applied GeoSystems

William R. Short
Project Geologist

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at
Armour Oil Company
Service station No.188
First and Ray Streets
Pleasanton, California

For Armour Oil Company

INTRODUCTION

This report describes the work performed to drill three soil borings and install three ground-water monitoring wells at the Armour Oil Company Service Station located on the corner of First and Ray Streets in Pleasanton, California. Armour Oil Company requested that Applied GeoSystems further evaluate potential hydrocarbon contamination of the soil and ground water at the site. This report describes the work elements conducted during this investigation, presents our interpretations of the data collected, and presents our conclusions and recommendations.

DESCRIPTION OF SITE AND DISCUSSION OF PREVIOUS WORK

The Armour Oil Company Service Station site is located on the northwest corner of the intersection of First Street and Ray Street in Pleasanton, California, as shown on the Site Vicinity Map, Plate P-1. We understand that four 10,000-gallon, underground petroleum product storage tanks were buried at the site. The four storage tanks, which contained gasoline product for retail sale, were located adjacent to one another in the northeast portion of the property.

The four tanks were removed in December 1987 and two 12,000-gallon underground storage tanks were installed in the tank cavity. The Generalized Site Plan, Plate P-2, shows the service station property and approximate locations of the four former storage tanks.

Applied GeoSystems previously drilled three soil borings at the site on June 30, 1987, for UNOCAL Corporation to evaluate potential hydrocarbon contamination at the site prior to a real estate transaction. Two borings (B-1 and B-2) were drilled to approximately 46.5 feet in depth, and one boring (B-3) was drilled to approximately 55 feet in depth. No ground water was encountered during the course of drilling, and the borings were

backfilled from total depth to a few inches below grade with a slurry of neat cement and 5 percent bentonite. The borings were then capped with asphalt to grade. Applied GeoSystems' report AGS 87065-1, dated July 14, 1987, describes the initial investigation and presents our conclusions and recommendations based on the data available at the time. Plate P-2 of this report shows the approximate locations of the three initial borings.

Laboratory analytical results of nine soil samples collected from the initial three boreholes (B-1, B-2, and B-3) showed non-detectable to relatively high levels (1,325 parts per million) of hydrocarbon contamination in the soil recovered from the three borings. The results of these analyses, initially presented in Applied GeoSystems report AGS 87065-1, are presented in Table 1.

TABLE 1
RESULTS OF CHEMICAL ANALYSES
OF SOIL SAMPLES FROM BORINGS B-1, B-2, AND B-3
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California

Sample Number	TVH	Benzene	Ethyl Benzene	Toluene	Xylenes	TEH
S-20-B1	281.9	17.1	17.0	73.6	92.3	NA
S-35-B1	126.13	2.06	0.84	1.02	6.59	1325
S-45-B1	9.36	0.64	0.26	1.06	1.47	NA
S-25-B2	188.8	13.1	6.1	6.3	56.2	NA
S-35-B2	56.81	1.47	1.81	1.58	18.09	NA
S-45-B2	9.09	0.07	0.18	0.26	1.30	NA
S-10-B3	<0.05	<0.05	<0.05	<0.05	<0.05	NA
S-30-B3	7.72	3.95	0.13	0.51	0.85	NA
S-40-B3	180.7	12.4	9.4	47.8	45.1	NA

Results in milligrams/kilogram(mg/kg) = parts per million(ppm)
TVH: Total volatile hydrocarbons
TEH: Total extractable hydrocarbons
NA: Not analyzed
< = indicates less than detection limit for method of analysis used.
Detection limits: 0.05 ppm (TVH - S-35-B1, S-45-B1, S-35-B2, S-45-B2, S-10-B3, B-30-B3)

0.5 ppm (TVH - S-20-B1, S-25-B2, S-40-B3)
5.0 ppm (TEH - S-35-B1)

Based on the laboratory analytical results from the three initial borings, Armour Oil Company contracted with Applied GeoSystems to drill an additional soil boring. Boring B-4 was drilled adjacent to boring B-1 to evaluate the vertical extent of the hydrocarbon contamination. The intent of this work was to encounter either ground water or two successive soil samples (collected at 5-foot intervals) that showed no subjective evidence of hydrocarbon contamination.

Boring B-4 was located in the inferred downgradient direction of ground-water flow from the product tanks. This flow direction was inferred from the general surface topography in the area. Boring B-4 was drilled adjacent to boring B-1 because boring B-1 contained the highest subjective levels of hydrocarbon contamination of the previously drilled borings. Boring B-4 was also located based on the proximity to the tank pit and the inferred direction of ground-water flow.

Boring B-4 was drilled to a depth of approximately 66-1/2 feet. No ground water was encountered and the boring was terminated because no subjective evidence of hydrocarbon contamination was detected in the lowest 10 feet of the boring. The boring was

backfilled from total depth to a few inches below grade with a slurry of neat cement and 5 percent bentonite. The cement was topped with asphalt to grade. The location of boring B-4, with respect to the previous borings and other site features, is shown on the Generalized Site Plan.

Soil samples were collected at 5-foot intervals from the ground surface to total depth in boring B-4. A subjective analysis for the presence of hydrocarbon contamination was performed, and the results were recorded for each soil sample collected from the boring. The sample with the highest subjective level of contamination (S-35-B4) and the sample from the base of the boring (S-65-B4) were analyzed for total volatile hydrocarbons (TVH); the hydrocarbon constituents benzene, ethylbenzene, toluene, and total xylene isomers (BETX); and for total extractable hydrocarbons (TEH). The results of the chemical analyses are presented in Table 2.

Armour Oil Company supplied Applied GeoSystems with a copy of a Petro Tite system test performed at the service station in September 1986. The tank system test results indicated no detectable leaks. A copy of the results of the Petro Tite system test is included in the Appendix of this report.

TABLE 2
RESULTS OF CHEMICAL ANALYSES
OF SOIL SAMPLES FROM BORING B-4
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California

Sample Number	TVH	Benzene	Ethyl Benzene	Toluene	Xylenes	TEH

S-35-B4	100.5	1.4	0.5	0.6	4.4	1835
S-65-B4	0.45	<0.05	<0.05	<0.05	<0.05	<5.0

Results in milligrams/kilogram(mg/kg) = parts per million(ppm)
TVH: Total volatile hydrocarbons
TEH: Total extractable hydrocarbons
< = indicates less than detection limit for method of analysis used.
Detection limits: 0.2 ppm (TVH - S-35-B4) 0.05 ppm (TVH - S-65-B4)
5.0 ppm (TEH)

Personnel at the Pleasanton Fire Department reported that the fire department had in the past been called to the service station in response to an apparently overfilled tank. The fire department reportedly bermed a portion of the station property adjacent to the underground storage tank cluster. Applied Geosystems has no further information regarding this event.

Alameda County Flood Control and Water Conservation District (ACFCWCD) ground-water contour maps show the ground-water surface to be approximately 55 feet below the ground surface in the vicinity of the site; however, ground water was not encountered in the four previously drilled borings. The deepest depth previously explored was approximately 66-1/2 feet in boring B-4. No aquifer materials (such as sand and gravel) were encountered in the lower portion of the boring.

SITE HYDROGEOLOGY

The subject site lies along the western margin of the Amador Valley. The site vicinity is underlain by Quaternary age alluvial deposits which generally consist of unconsolidated, moderately sorted, interbedded, mixtures of clay, sand and gravel (DWR, 1974; Helley and others, 1979). The Amador valley is filled with Quaternary and Pliocene age sedimentary deposits. These deposits contain water of generally good quality and have variable water-yielding properties (DWR, 1974). A generalized stratigraphic section showing the water bearing properties of the units in the Amador Valley is presented in Table 3. Information gathered during Applied GeoSystems investigations indicate that

the subject site is underlain by alluvial deposits which locally consist of interbedded deposits of silty clay, clayey gravel, clayey sand, sandy clay, and clay. Fill, up to approximately 8 feet thick, underlies portions of the site. A more complete description of the near surface stratigraphy is presented on the Logs of Borings, Plates P-5 through P-16. Geologic cross sections constructed through the borings at the site are presented on Plates P-17 and P-18. The locations of the cross sections are shown on Plate P-2.

WELL INVENTORY

An investigation of water wells within a 1/2-mile radius of the site was conducted to evaluate the potential ground-water usage in the vicinity of the site. Information regarding wells in the vicinity of the site was acquired from Zone 7 of the ACFCWCD. **Seven recorded wells are located within approximately a 1/2-mile radius of the site.** Of these seven wells, two are used for cathodic protection, one well is used for ground-water monitoring, and four wells are or may be used for domestic purposes. Available data on the seven wells is presented on Table 4, and approximate locations of the wells are presented on Plate P-3.

TABLE 4
NEAR-BY WATER WELLS
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California

Well Number	Total Depth	Water Level	Screened Interval	Year Constructed	Water Use
16-L-11	NA	NA	NA	1979	DOM?

16-P-5	74	65	65-70	1976	MON				
16-R-1	239	66	70-226	1948	DOM				
21-C-2	182	NA	NA	NA	DOM				
21-C-4	115	56	NA	1911	DOM?	21-E-1	43	43	NA
1977	CAT								
21-G-1	120	100	>95	1974	CAT				

NA = Not available
DOM = Domestic
MON = Monitoring
CAT = Cathodic protection
Depths, water levels, and screened intervals are in feet.
Data from Zone 7 of the Alameda County Flood Control and Water Conservation Department

BOREHOLE DRILLING AND SOIL DESCRIPTION

A well construction permit was acquired from Zone 7 of the ACFCWCD and Zone 7 personnel were notified or our drilling schedule prior to beginning drilling. A copy of the permit is included in the Appendix of this report. Underground Service Alert was contacted to locate utility lines on public property adjacent to the site prior to commencing onsite work.

The ground-water flow direction was inferred to be to the northwest prior to drilling. This flow direction was inferred from the ACFCWCD maps, the regional topography, and the general surface drainage direction in the area. **The three monitoring wells were located based on the inferred northwest flow direction and based on the analytical results from the previous borings.** Boring B-5 (monitoring well MW-1) was drilled east of the underground storage tank cluster to evaluate conditions in the inferred upgradient direction from the tanks. Boring B-6

(MW-2) was drilled near the northwest edge of the tank cluster to evaluate ground-water conditions near the area of highest contamination as discerned from the previous investigations. Boring B-7 (MW-3) was drilled west of the storage tank cluster in the inferred downgradient direction. Locations of the monitoring wells are shown on the Site Vicinity Map, Plate P-1.

Soil borehole drilling and monitoring well construction were observed by an Applied GeoSystems field geologist on December 2, December 3, and December 7, 1987. Borings B-5, B-6, and B-7 were drilled with a Mobile B-61 truck-mounted drill rig operated by Datum Exploration, Inc., of Pittsburg, California. Eight-inch-diameter, continuous-flight, hollow-stem augers were used to drill each boring to total depth. The augers were steam-cleaned prior to each use to reduce the possibility of downhole or cross contamination. Borings B-5, B-6, and B-7 were each drilled to a total depth of approximately 96-1/2 feet., During drilling, the first saturated sample was encountered at approximately 80 feet in each of the three borings.

Soil samples were collected from the boreholes with a California-modified split-spoon sampler. Plate P-4 gives a summary of the Unified Soil Classification System used to identify the soils. Descriptions of earth materials encountered in borings B-5, B-6, and B-7 are presented on the Boring Logs, Plate P-5 through Plate P-16. Plates P-17 and P-18 present geologic cross sections interpreted from soil information collected from the logs of the seven borings from this and prior explorations. Plate P-2 shows the locations of the cross sections.

Each soil sample collected was checked with a Photovac TIP photoionization detector for the presence of hydrocarbons. The results of the measurements are included in the Logs of Borings. Samples containing visible amounts of hydrocarbon product were noted on the Logs of Borings as well. The soil cuttings from the boreholes were placed on and covered with

visqueen following excavation from the boreholes.

Because heaving sands were encountered below the water table, each borehole required reaming prior to monitoring well construction. After reaching total depth, the augers were pulled from the boring, a plug was inserted into the lead auger, and the augers were run back into the boring. Upon reaching total depth, the plug was knocked from the bottom of the lead auger and each well was constructed.

PROCEDURE FOR SOIL SAMPLING

Nineteen soil samples were collected and described from borings
B-5 and B-7 and eighteen soil samples were collected and described from boring B-6 during drilling. These samples, labeled as indicated on the Boring Logs, were collected at 5-foot intervals from the ground surface to total depth. Soil samples were collected by advancing the boring to a point immediately above the sampling depth and then driving a California-modified split-spoon sampler (2.5-inch inside diameter) into the soil through the hollow center of the auger. The sampler was driven 18 inches with a standard 140-pound hammer repeatedly dropped 30

inches. The number of blows to drive the sampler each 6-inch increment was counted and recorded to evaluate the relative consistency of soil materials.

A Photovac TIP photoionization detector was used during sampling to measure the organic vapor concentrations of soil samples. Readings were collected by placing the rubber cup that skirts the intake probe flush with the soil in the brass sleeve immediately after breaking the sampler. The measurements indicate the relative organic vapor concentrations in soil but cannot be used to directly assess the absolute concentrations of hydrocarbon contaminants in the soil. The values of the TIP readings are presented on the boring logs Plates P-5 through P-16.

The samples were removed from the sampler and were immediately sealed in their brass sleeves with aluminum foil, plastic caps, and airtight tape. The samples were then labeled and placed in iced storage for transport to the laboratory. The field geologist initiated a Chain of Custody form and selected samples were delivered to Anametrix, Inc., of San Jose, California, for analytical testing. The soil samples with the highest field readings of hydrocarbon contamination and the samples collected from the deepest unsaturated sample interval were selected for

laboratory analysis to evaluate the maximum level of hydrocarbon contamination in the borings and the potential hydrocarbon contamination near the top of the saturated zone. The completed Chain of Custody Records for the tested samples are included in the Appendix of this report.

CONSTRUCTION OF GROUND-WATER MONITORING WELLS

Three ground-water monitoring wells were constructed at the site in soil borings B-5, B-6, and B-7. The wells, MW-1, MW-2, and
MW-3 were completed with 2-inch inside diameter (I.D.) polyvinyl chloride (PVC) casing. Well casing was set to approximately 95 feet in MW-1 and MW-3 and to approximately 85 feet in MW-6. The casing consists of machine-slotted PVC with 0.020-inch-wide slots set from the total depth of each well to approximately 65 feet in
MW-1 and MW-3 and approximately 55 feet in MW-2. Each well was screened to allow for a potential rise in water elevation as indicated by the ACFCWCD ground-water elevation maps. Blank PVC casing was set from the top of the screened casing to a few inches below the ground surface. All casing joints are flush-threaded and no glues, chemical cements, or solvents were used in

well construction. The top of each casing is covered with a slip cap and the bottom has a threaded end plug.

The annular space of each well was backfilled with No. 3 sorted sand from total depth to approximately 3 feet above the top of the screened casing. A bentonite plug, approximately 2 feet thick, was placed above the sand as a seal against cement entering the sand pack, and the remaining annulus was backfilled with a slurry of neat cement and 5-percent bentonite to a few inches below the top of the casing. Graphic representations of well construction are shown on the right columns of the Logs of Borings.

A locking well cage was cemented into place over each well head, and an aluminum utility box with a PVC apron was concreted into place flush with the surrounding surface grade. Each utility box has a watertight seal to protect the ground-water well against surface-water infiltration and requires a specially designed wrench to open which reduces the possibilities of vandalism to or accidental disturbance of the well.

PROCEDURE FOR DEVELOPING WELLS AND SAMPLING WATER

Following well construction, a subjective water sample was collected from each monitoring well by gently lowering approximately half the length of a clean Teflon bailer past the air/water interface. Each sample was retrieved and inspected for floating product, sheen, and water clarity. **No subjective evidence of floating product or product sheen was detected in the samples from MW-1, MW-2, and MW-3.** Table 5 presents data from subjective analyses conducted from December 1987 to date.

Monitoring wells MW-1 and MW-2 were developed on December 3, 1987, and monitoring well MW-3 was developed on December 8, 1987, by air-surging and pumped to remove suspended sediment. Each of the monitoring wells was then purged by pumping approximately three to five well volumes of water. Following the purge period and after each well recovered to static water level, water samples were collected using a Teflon bailer. Prior to each use, the bailer was thoroughly cleaned with Alconox and water. The bailer was lowered past the air/water interface to collect a representative sample of the formation water.

TABLE 5
CUMULATIVE RESULTS OF SUBJECTIVE ANALYSES
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California

Well	Depth	Product	Floating	Water	Date	Number	to Water	Sheen	Product	Clarity
12-8-87	MW-1	76.07	None	None	Clear	12-8-87	MW-2	64.21	None	None	Clear
12-8-87	MW-3	76.01	None	None	Clear						
02-5-88	MW-1	75.58	None	None	Clear						
02-5-88	MW-2	62.84	None	None	Clear						
02-5-88	MW-3	75.52	None	None	Clear						
02-9-88	MW-1	75.58	None	None	Clear						
02-9-88	MW-2	63.69	None	None	Clear						
02-9-88	MW-3	75.58	None	None	Clear						

All measurements in feet.
Depth measurements in feet below top of casing.

The ground-water samples were transferred to laboratory-cleaned 40-milliliter and 1-liter volatile organic analysis (VOA) sample vials or bottles, and made acidic by adding hydrochloric acid. The containers were then immediately sealed with Teflon-lined caps,

labeled, and placed in iced storage for transport to Anametrix, Inc., of San Jose, California, for testing. The Chain of Custody Records for the water samples are included in the Appendix of this report.

ANALYTICAL RESULTS OF SAMPLES FROM SOIL BORINGS AND MONITORING WELLS

Six soil samples (S-35-B5, S-75-B5, S-35-B6, S-75-B6, S-55-B7, and S-75-B7) were analyzed for both low-to-moderate and high boiling point hydrocarbons (TPH and TEH) and the hydrocarbon constituents benzene, ethylbenzene, toluene, and total xylene isomers (BETX) using gas chromatography with photo- and flame- ionization detection using Environmental Protection Agency (EPA) Methods 8015 and 8020. Three water samples (W-85-MW1, W-75-MW2, and W-85-MW3) were analyzed for TPH using gas chromatography with flame-ionization detection (EPA Method 8015) and for halogenated and aromatic hydrocarbons using gas chromatography and mass spectrometry (EPA Method 624). The results of the chemical analyses are presented in Table 6 and in the Appendix of this report.

TABLE 6
RESULTS OF CHEMICAL ANALYSES
SOIL AND WATER SAMPLES FROM BORINGS B-5, B-6, AND B-7
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California

Sample Number	TPH	Benzene	Ethyl Benzene	Toluene	Xylenes	TEH	
Soil:							mg/kg
MW-1 S-35-B5	<5.000	<0.200	<0.200	<0.200	<0.200	<10.000	east of USTs
S-75-B5	<5.000	<0.200	<0.200	<0.200	<0.200	<10.000	
MW-2 S-35-B6	15.000	0.790	0.200	0.400	<0.200	6,300.0	N.W. edge of UST pit
S-70-B6	<5.000	<0.200	<0.200	<0.200	<0.200	<10.000	
MW-3 S-55-B7	390.000	1.300	14.000	6.200	34.000	220.000	west of USTs
S-75-B7	5.000	<0.200	<0.200	<0.200	<0.200	30.000	
[redacted]							
	TPH	benzene	ethyl benzene	toluene	xylenes	TEH	mg/l
W-85-MW1	0.050	0.058	<0.002	0.008	0.010	2.100	
W-75-MW2	1.800	0.910	0.260	0.800	1.200	0.620	
W-85-MW3	24.000	2.600	0.160	1.300	0.660	2.300	
DHS		0.0007	0.680	0.100	0.620		

Additional compound:

W-85-MW1	1,2-Dichloroethene	0.018
DHS		0.016

[redacted]			TEH
MW-1	50	58	2100
-2	1800	910	620
-3	24,000	2600	230

ug/l

Water results in milligrams/liter(mg/l)=parts per million(ppm)
Soil results in milligrams/kilogram (mg/kg) = (ppm)
TPH: Total petroleum hydrocarbons
TEH: Total extractable hydrocarbons
DHS: State of California, Department of Health Services
recommended maximum concentration for drinking water.
< = indicates less than detection limit for method of analysis used.
Sample designation: S-35-B5
borehole/well number
depth of sample in feet

EVALUATION OF GROUND-WATER FLOW DIRECTION

An evaluation of the ground-water flow direction across the site was made using a Wild NA-24 Auto Level. The leveling instrument was used to measure the differences in elevation between the top of the casing of each of the monitoring wells. Measurements were recorded to the nearest 0.01-foot. The static water level in monitoring wells MW-1, MW-2, and MW-3 were measured to the nearest 0.01-foot using a Solinst electric water-level sounder. The well head and ground-water elevations were combined to calculate the difference in water-level elevation between each well with respect to an arbitrary datum set at the top of the highest well casing. Table 7 presents the tabulated results of the survey using ground-water elevation measurements taken on February 9, 1988.

TABLE 7
GROUND-WATER ELEVATION DIFFERENCES
Armour Oil Company Service Station No. 188
First and Ray Streets
Pleasanton, California
Measured: February 1988

Monitoring Well Number	Top of Casing (C)	Static Water Depth (W)	Water Level Below Datum (C + W)
MW-1	0.00	75.58	75.58
MW-2	1.01	62.68	63.69
MW-3	0.08	75.50	75.58

Measurements in feet.
Depth to static water measured in feet below top of casing. Datum is an arbitrary elevation corresponding to the top of the highest well casing (MW-1).

The substantial difference in ground-water elevations between monitoring well MW-2 and monitoring wells MW-1 and MW-3 suggests that the wells tap different ground-water lenses or aquifers. If the data from wells MW-1, MW-2, and MW-3 are used, the calculated ground-water gradient would be approximately 0.15 (approximately 15 feet per 100 feet) downgradient to the north. A gradient of this magnitude seems unlikely based on the regional topography and geology.

DISCUSSION

The results of analyses on the soil samples collected from the two studies indicate that nondetectable to relatively high (greater than 1000 ppm) levels of hydrocarbon contamination were encountered in soil excavated from the seven borings at the site. As shown in Tables 1, 2, and 5, the levels of contamination generally decrease with depth. As shown on Table 5, analyses of ground-water samples collected from monitoring wells MW-1, MW-2, and MW-3 show benzene levels in all three wells that exceed State of California Department of Health Services recommended maximum concentrations for drinking water. Toluene and xylene levels in MW-2 and MW-3 and the 1,2-dichloroethene level in MW-1 are also over California drinking water standards.

Both relatively volatile and relatively nonvolatile hydrocarbon constituents were detected in the laboratory analyses. The volatile constituent concentrations are measured using the low-to-moderate boiling point analysis (TPH), and the less volatile constituent concentrations are measured using the high boiling point analysis (TEH). The less volatile compounds analyzed in the samples are not generally associated with gasoline product. We understand, based on information supplied by Armour Oil Company, that only gasoline has been sold at the subject service station since its construction by Armour Oil Company in the 1970's.

The substantial difference in ground-water level in MW-2 when compared to the ground-water level in MW-1 and MW-3 suggests that MW-2 may be completed in a different water-bearing zone than MW-1 and MW-3. The absence of appreciable moisture until the 80-foot sample in MW-2 indicates that the ground water encountered in MW-2 may be under confined conditions.

RECOMMENDATIONS

Because appreciable levels of hydrocarbon contamination were encountered in the soil and ground water at the site, we recommend that additional ground-water monitoring wells be constructed. The additional wells should be constructed both on-and off-site to evaluate the lateral and vertical extent of the contamination. The wells can also be used to evaluate the aquifer characteristics and ground-water conditions in the vicinity of the site.

Applied GeoSystems can prepare a work plan of an additional phase of subsurface investigation at Armour Oil Company's request. This work plan should outline the number and locations of additional wells, and the borehole drilling, monitoring well construction, and sampling procedures.

While the above recommendation is being implemented, **we recommend that the ground-water in monitoring wells MW-1, MW-2, and MW-3 be sampled on a quarterly basis.** The wells should be purged of approximately three to five well volumes of water before collecting ground-water samples from below the air/water interface. These samples should be analyzed by modified EPA Methods 8015 for TPH and TEH and by EPA Method 624 for halogenated and aromatic hydrocarbons. The quarterly analyses may show a trend for the ground-water quality at the site.

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental geological practice in California at the time this investigation was performed. This investigation was conducted solely for the purpose of evaluating environmental conditions of the soil and ground water with respect to hydro- carbon product contamination in the vicinity

of the subject property. No soil engineering or geotechnical recommendations are implied or should be inferred. Evaluation of the geologic conditions at the site for the purpose of this investigation is made from a limited number of observation points. Subsurface conditions may vary away from the data points available. Additional work, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of investigation.

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