GeoStrategies Inc.

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October 29, 1993

Alameda County Health Agency
Division of Hazardous Materials
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94521

Attention: Ms. Pamela Evans

Reference: **UNOCAL Service Station No. 5760**
376 Lewelling Boulevard
San Lorenzo, California

Ms. Evans:

As requested by Ms. Tina Berry of the UNOCAL Corporation, we are forwarding a copy of the Work Plan dated October 28, 1993 for the above referenced location. This work plan presents plans for an aquifer test at this site.

If you have questions or comments, please call.

GeoStrategies Inc. by,

Cliff M. Garratt
Project Manager

enclosure

cc: Ms. Tina Berry, UNOCAL Corporation
Mr. Richard Hiett, RWQCB - San Francisco Bay Region

:ellenu\809final.wp

2140 WEST WINTON AVENUE • HAYWARD, CALIFORNIA 94545 • (510) 352-4800
601 UNIVERSITY AVENUE • SUITE 150 • SACRAMENTO, CALIFORNIA 95825 • (916) 568-7500

GeoStrategies Inc.

WORK PLAN

UNOCAL Service Station No. 5760
376 Lewelling Boulevard
San Lorenzo, California

780990-16

October 28, 1993

GeoStrategies Inc.

October 28, 1993

UNOCAL Corporation
Post Office Box 5155
San Ramon, California 94583

Attention: Ms. Tina Berry

Reference: **WORK PLAN**
UNOCAL Service Station No. 5760
376 Lewelling Boulevard
San Lorenzo, California

Ms. Berry:

GeoStrategies Inc. (GSI) is pleased to present this Work Plan for an aquifer test at the above referenced site (Plate 1). GSI proposes conducting an aquifer test to assess the technical feasibility of hydrocarbon plume control using groundwater extraction techniques. The proposed work will be performed in accordance with the Regional Water Quality Control Board (RWQCB) and Alameda County Department of Environmental Health (ACDEH) guidelines. This work plan was prepared at the request of UNOCAL Corporation.

SITE BACKGROUND

The underground gasoline storage tanks were replaced during November and December 1987 (Plate 2). Hydrocarbons were detected in the soils beneath the tanks. One well (U-1) was installed in February 1988 to assess groundwater conditions (Woodward-Clyde, 1988). Benzene was detected in this well at concentrations above the Maximum Contaminant Levels (MCL).

780990-16

Three additional groundwater monitoring wells (U-2 through U-4) were installed in August 1990 to assess extent of the hydrocarbon impact to groundwater beneath the site (GeoStrategies Inc., 1990). Four off-site groundwater monitoring wells (U-5 through U-8) were installed in March 1992 to further delineate the extent of the hydrocarbon plume (GeoStrategies Inc., 1992). One off-site groundwater monitoring well (U-9) was installed in May 1993 to complete down-gradient delineation of hydrocarbon impact to the groundwater beneath the site (GeoStrategies Inc., 1993).

HYDROGEOLOGIC CONDITIONS AND SITE GEOLOGY

The site is located approximately 500 feet north of San Lorenzo Creek. Soils beneath the subject site are Holocene-age alluvial deposits consisting of unconsolidated, moderately sorted fine sand, silt, and clayey silt with a few thin beds of coarse sand (Helley and Lajoie, 1979).

Available boring logs indicate vadose zone lithology to be depositional in nature, primarily consisting of a silty sand to sand zone between 5 and 20 feet in thickness. This more permeable zone overlays a clay and/or silt (fines) zone between 5 and 15 feet in thickness. The upper water bearing zone appears to consists of a fairly horizontally continuous sand layer between 2 and 15 feet in thickness. This permeable zone appears to thicken to the south and west. The upper water bearing zone is underlain by a fines rich zone approximately 5 to 10 feet in thickness which appears to be laterally continuous. A falling head permeability test of this basal zone, collected from approximately 30 feet bgs in boring U-2, suggests that this zone may act as a local aquitard. Please refer to generalized cross-sections presented on Plates 3 through 5.

Groundwater was first encountered between 15 to 21 feet below ground surface (bgs) in the exploratory borings. The variation in first observed water levels is likely due to local and regional changes in annual precipitation and resulting groundwater recharge. The shallow water-bearing zone appears to be unconfined. Third quarter 1993 monitoring data indicate groundwater to be between 15 and 19 feet (bgs).

Historically, groundwater beneath the site flows consistently to the west. Historical water table gradients have ranged from 0.002 to 0.006. The third quarter 1993 potentiometic map is presented on Plate 6.

HISTORICAL CHEMICAL DATA

Soil contamination appears confined in the area around Wells U-1 and U-3 (Table 1). Hydrocarbon odors were noted in a sample collected from approximately 15 feet bgs, boring U-1. Free product was observed on the sample at 20 feet bgs. TPH-Gasoline was detected in boring U-3 at 15 and 20 feet bgs at 2.9 and 640 parts per million (ppm) respectively. Benzene was detected in the soil sample collected from boring U-3 at 20 feet bgs at a concentration of 4.5 ppm. Available data suggests soil contamination to be at approximately 15 to 20 feet bgs. It should be noted that the apparent soil contamination noted above is currently within the saturated zone. Soil samples from well borings U-2 and U-4 through U-9 did not contain TPH-Gasoline or benzene.

Floating product has only been observed in Well U-1. Measurements of product thickness range from 0.01 to 0.36 feet. However, a product skimmer installed in January 1992 was removed in November 1992 because no floating product had been recovered. Floating product has never been observed in the other wells.

Historically, benzene concentrations in groundwater samples collected from Wells U-1 and U-3 range from 1,200 to 6,100 ppb (Table 2). Benzene concentrations in offsite down-gradient Well U-6 range from 27 to 160 ppb. Benzene has not been detected in wells U-2, U-4, U-5, and U-7 through U-9. The dissolved hydrocarbon plume appears to be delineated (Plate 7).

TECHNICAL RATIONALE

Technical rationale for this phase of the investigation includes the following:

- Available data suggests that soil contamination appears to be confined to the area adjacent to borings U-1 and U-3. This zone of contaminated soil may be the source of the observed dissolved plume beneath the site.

- The vertical extent of soil contamination appears to have been confined to the capillary fringe during recent drought conditions. The creation of a significant cone of depression may facilitate the use of other remediation methods.

- The dissolved hydrocarbon plume appears to be delineated beneath the site. Performing an aquifer test would facilitate evaluation of potential extraction well placement in order to achieve hydrologic control of the known hydrocarbon plume.

SCOPE OF INVESTIGATION

GSI proposes that the following tasks be performed in conjunction with the current soil and groundwater investigation being conducted at this site:

TASK 1: Perform an 8 hour step-drawdown test (step test) to determine the optimum pumping rate to be used during the constant rate pump. Well U-1 will be used as the extraction well.

TASK 2: A 24 hour constant rate pump test will be performed using Well U-1 as the extraction well. Data collected during the test will be used to evaluate the aquifer characteristics; transmissivity, storativity and hydraulic connectivity. Additionally drawdown data will be used to evaluate the feasibility of using a vapor extraction system as a soil remediation method.

TASK 3: Prepare and submit a technical report summarizing field activities, data evaluation, conclusions and recommendation.

If you have questions or comments, please call.

GeoStrategies Inc. by,

Robert C. Mallory
FOR
Ellen C. Fostersmith
Geologist

Stephen J. Carter
Project Manager
RG 5577

REGISTERED GEOLOGIST
STEPHEN J. CARTER
No. 5577
STATE OF CALIFORNIA

Plate 1. Vicinity Map
Plate 2. Site Plan
Plate 3. Cross-Section A - A'
Plate 4. Cross-Section B - B'
Plate 5. Cross-Section C - C'
Plate 6. Potentiometric Map
Plate 7. Benzene Isoconcentration Map

QC Review: CMG

780990-16

REFERENCES

GeoStrategies Inc., 1990, *Well Installation Report;* Report No. 7809-3, dated November 16, 1990.

GeoStrategies Inc., 1992, *Well Installation Report;* Report No. 7809-10, dated June 15, 1992.

GeoStrategies Inc., 1993, *Well Installation Report;* Report No. 780907-15, dated August 9, 1993.

Helley, E.J. and others, 1979, *Flatland Deposits of the San Francisco Bay Region, California - Their Geology and Engineering Properties, and Their Importance to Comprehensive Planning;* U.S. Geological Survey Professional Paper 943.

Woodward-Clyde Consultants, 1988, *Well Installation Report;* Report No. 8820011A-0015, dated March 25, 1988.

TABLE 1

SOIL ANALYSES DATA

WELL I.D.	SAMPLE DATE	ANALYZED DATE	TPH-G (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)
U-2-15	06-Aug-90	16-Aug-90	<1	<0.005	<0.005	<0.005	0.006
U-2-20	06-Aug-90	16-Aug-90	<1	<0.005	<0.005	<0.005	0.006
U-3-15	06-Aug-90	16-Aug-90	**2.9**	<0.005	<0.005	**0.29**	<0.005
U-3-20	06-Aug-90	16-Aug-90	**640**	**4.5**	**37**	**22**	**110**
U-3-29	06-Aug-90	16-Aug-90	<1	<0.005	**0.017**	**0.009**	**0.045**
U-4-15	06-Aug-90	16-Aug-90	<1	<0.005	<0.005	<0.005	<0.005
U-4-20	06-Aug-90	16-Aug-90	<1	<0.005	<0.005	<0.005	<0.005
U-5-16.5	12-Mar-92	16-Mar-92	<1	<0.005	<0.005	<0.005	<0.005
U-6-16.5	13-Mar-92	13-Mar-92	<1	<0.005	<0.005	<0.005	<0.005
U-7-16.0	13-Mar-92	16-Mar-92	<1	<0.005	<0.005	<0.005	<0.005
U-8-16.5	12-Mar-92	16-Mar-92	<1	<0.005	<0.005	<0.005	<0.005
U-9-4.5	25-May-93	28-May-93	<.50	<.0050	<.0050	<.0050	<.0050
U-9-11.5	25-May-93	28-May-93	<.50	<.0050	<.0050	<.0050	<.0050

TPH-G = Total Petroleum Hydrocarbons calculated as Gasoline.
PPM = Parts Per Million.

Notes: 1. All data shown as <x are reported as ND (none detected).

TABLE 2

HISTORICAL GROUNDWATER QUALITY DATABASE

SAMPLE DATE	SAMPLE POINT	TPH-G (PPB)	BENZENE (PPB)	TOLUENE (PPB)	ETHYLBENZENE (PPB)	XYLENES (PPB)
09-Feb-88	U-1	93000.	3600.	11000.	----	20000.
20-Mar-90	U-1	36000.	2100.	5500.	1900.	9300.
05-Jun-90	U-1	46000.	2300.	5500.	2500.	11000.
24-Aug-90	U-1	27000.	1200.	1800.	1400.	5500.
05-Dec-90	U-1	Floating Product 0.10 ft				
04-Mar-91	U-1	Floating Product 0.05 ft				
03-Jun-91	U-1	Floating Product 0.06 ft				
19-Sep-91	U-1	Floating Product 0.04 ft				
04-Dec-91	U-1	Floating Product 0.36 ft				
05-Mar-92	U-1	Floating Product 0.02 ft				
07-Apr-92	U-1	**				
06-Aug-92	U-1	Floating Product 0.01 ft				
20-Nov-92	U-1	Floating Product 0.02 ft				
12-Feb-93	U-1	70000	2200	8400	3100	18000
04-Jun-93	U-1	35000	1300	5700	900	9200
09-Sep-93	U-1	**67000**	**2900**	**18000**	**6200**	**32000**
23-Aug-90	U-2	<50.	<0.5	<0.5	<0.5	<0.5
05-Dec-90	U-2	<50	<0.3	<0.3	<0.3	<0.3
04-Mar-91	U-2	<50.	<0.5	0.9	<0.5	2.6
03-Jun-91	U-2	<30	<0.30	<0.30	<0.30	<0.30
19-Sep-91	U-2	<30	<0.30	<0.30	<0.30	<0.30
04-Dec-91	U-2	<30	<0.30	<0.30	<0.30	<0.30
05-Mar-92	U-2	<30	<0.30	0.36	<0.30	<0.30
07-Apr-92	U-2	<50	<0.5	<0.5	<0.5	<0.5
06-Aug-92	U-2	<50	<0.5	<0.5	<0.5	<0.5
20-Nov-92	U-2	<50	<0.5	<0.5	<0.5	<0.5
12-Feb-93	U-2	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-2	<50	<0.5	<0.5	<0.5	<0.5
09-Sep-93	U-2	<50	<0.5	<0.5	<0.5	<0.5
23-Aug-90	U-3	110000.	4400.	13000.	2800.	17000.
05-Dec-90	U-3	69000	1900	3500	1600	9800
18-Jan-91	U-3	51000.	1700.	3100.	1500.	7500.
04-Mar-91	U-3	84000.	1400.	10000.	2900.	17000.

TABLE 2

HISTORICAL GROUNDWATER QUALITY DATABASE

SAMPLE DATE	SAMPLE POINT	TPH-G (PPB)	BENZENE (PPB)	TOLUENE (PPB)	ETHYLBENZENE (PPB)	XYLENES (PPB)
03-Jun-91	U-3	130000	5800	19000	4600	24000
19-Sep-91	U-3	61000	3300	9700	2800	15000
04-Dec-91	U-3	75000	2500	6100	1900	11000
05-Mar-92	U-3	160000	5300	15000	5400	26000
07-Apr-92	U-3	97000	6100	16000	5400	28000
06-Aug-92	U-3	140,000	5,100	13,000	5,000	23,000
20-Nov-92	U-3	50000	3200	4700	1900	10000
12-Feb-93	U-3	80000	3700	9400	3700	18000
04-Jun-93	U-3	92000	2900	8700	4300	20000
09-Sep-93	U-3	**110000**	**2800**	**10000**	**6500**	**31000**
23-Aug-90	U-4	<50.	<0.5	1.0	<0.5	1.8
05-Dec-90	U-4	<50	<0.3	<0.3	<0.3	<0.3
18-Jan-91	U-4	<50.	<0.5	<0.5	<0.5	<0.5
04-Mar-91	U-4	<50.	<0.5	<0.5	<0.5	<0.5
03-Jun-91	U-4	<30	<0.30	<0.30	<0.30	<0.30
19-Sep-91	U-4	<30	<0.30	<0.30	<0.30	<0.30
04-Dec-91	U-4	<30	<0.30	<0.30	<0.30	<0.30
05-Mar-92	U-4	<30	<0.30	<0.30	<0.30	<0.30
07-Apr-92	U-4	<50	<0.5	<0.5	<0.5	<0.5
06-Aug-92	U-4	<50	<0.5	<0.5	<0.5	<0.5
20-Nov-92	U-4	<50	<0.5	2.5	<0.5	<0.5
12-Feb-93	U-4	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-4	<50	<0.5	<0.5	<0.5	<0.5
09-Sep-93	U-4	<50	<0.5	<0.5	<0.5	<0.5
07-Apr-92	U-5	<50	<0.5	<0.5	<0.5	<0.5
06-Aug-92	U-5	<50	<0.5	<0.5	<0.5	<0.5
20-Nov-92	U-5	<50	<0.5	<0.5	<0.5	<0.5
12-Feb-93	U-5	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-5	<50	<0.5	<0.5	<0.5	<0.5
09-Sep-93	U-5	<50	<0.5	<0.5	<0.5	<0.5
07-Apr-92	U-6	6600	90	<0.5	820	1200
06-Aug-92	U-6	9200	160	<0.5	360	150
20-Nov-92	U-6	NA				
12-Feb-93	U-6	2600	27	<0.5	120	51

TABLE 2

HISTORICAL GROUNDWATER QUALITY DATABASE

SAMPLE DATE	SAMPLE POINT	TPH-G (PPB)	BENZENE (PPB)	TOLUENE (PPB)	ETHYLBENZENE (PPB)	XYLENES (PPB)
04-Jun-93	U-6	13000	100	38	450	320
09-Sep-93	U-6	**6300 + +**	**29**	<5	**120**	**34**
07-Apr-92	U-7	<50	<0.5	<0.5	<0.5	<0.5
06-Aug-92	U-7	<50	<0.5	<0.5	<0.5	<0.5
20-Nov-92	U-7	<50	<0.5	<0.5	<0.5	<0.5
12-Feb-93	U-7	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-7	<50	<0.5	<0.5	<0.5	<0.5
09-Sep-93	U-7	<50	<0.5	<0.5	<0.5	<0.5
07-Apr-92	U-8	<50	<0.5	<0.5	<0.5	<0.5
06-Aug-92	U-8	<50	<0.5	<0.5	<0.5	<0.5
12-Feb-93	U-8	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-8	<50	<0.5	<0.5	<0.5	<0.5
09-Sep-93	U-8	<50	<0.5	<0.5	<0.5	<0.5
04-Jun-93	U-9	2100 +	<2.5	<2.5	<2.5	<2.5
09-Sep-93	U-9	**1200 +**	<1.0	<1.0	<1.0	<1.0

TPH-G = Total Petroleum Hydrocarbons calculated as Gasoline
PPB = Parts Per Billion
N/A = Not Accessible

** = Product Skimmer installed in well
\+ = The concentration reported as gasoline is primarily due to the presence of a discrete hydrocarbon peak not indicative of standard gasoline.
+ + = The concentration reported as gasoline for sample U-6 is primarily due to the presence of a combination of gasoline and a discrete peak not indicative of gasoline.

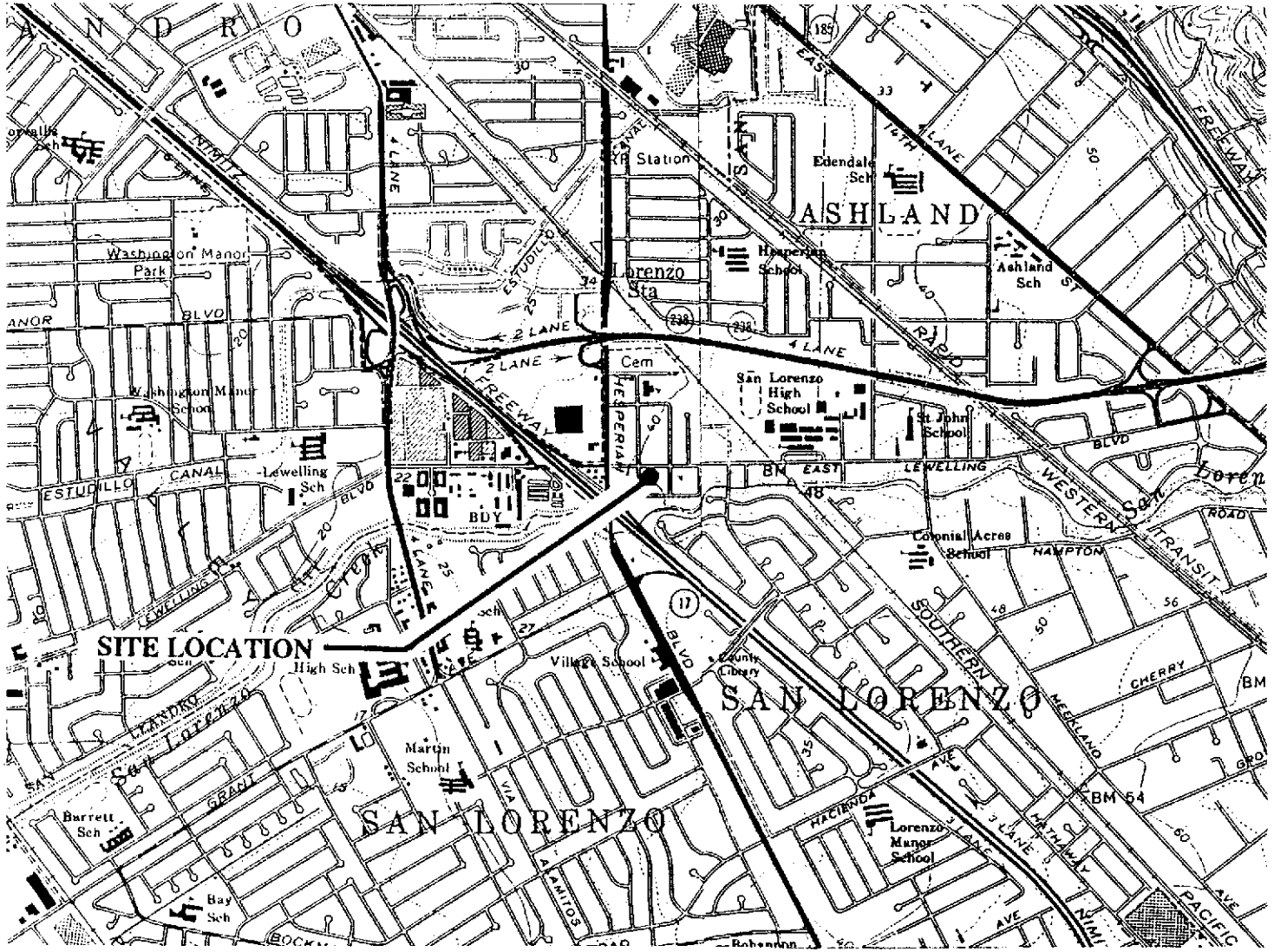
Notes:
1. All data shown as <x are reported as ND (none detected).
2. Ethylbenzene and xylenes were combined prior to March 1990.
3. Laboratory values are reported in units of ug/L, which generally are synonymous with parts per billion (ppb).

TABLE 3

FIELD MONITORING DATA

WELL NO.	MONITORING DATE	CASING DIA. (IN)	TOTAL WELL DEPTH (FT)	WELL ELEV. (FT)	DEPTH TO WATER (FT)	PRODUCT THICKNESS (FT)	STATIC WATER ELEV. (FT)	PURGED WELL VOLUMES	pH	TEMP (F)	CONDUCTIVITY (uMHOS/cm)
U-1	09-Sep-93	3	30.5	40.51	17.77	---	22.74	5	6.96	69.6	1099
U-2	09-Sep-93	3	30.0	41.62	18.68	---	22.94	5	7.00	66.0	708
U-3	09-Sep-93	3	25.0	39.64	17.04	---	22.60	5	7.08	70.6	1360
U-4	09-Sep-93	3	28.0	40.53	16.89	---	23.64	6	6.75	69.6	1530
U-5	09-Sep-93	2	30.0	39.61	16.90	---	22.71	5	7.19	70.9	1274
U-6	09-Sep-93	2	30.0	37.94	15.56	---	22.38	5	7.00	71.4	1130
U-7	09-Sep-93	2	35.0	37.49	15.23	---	22.26	5	6.75	66.6	877
U-8	09-Sep-93	2	35.0	38.94	16.38	---	22.56	5	7.33	72.2	863
U-9	09-Sep-93	2	28.7	37.88	15.79	---	22.09	5	7.07	69.5	1169

Notes: 1. Static water elevations referenced to Mean Sea Level (MSL). Depth to water measured from surveyed top of box.
2. Physical parameter measurements represent stabilized values.



N

0 2000

Scale in Feet

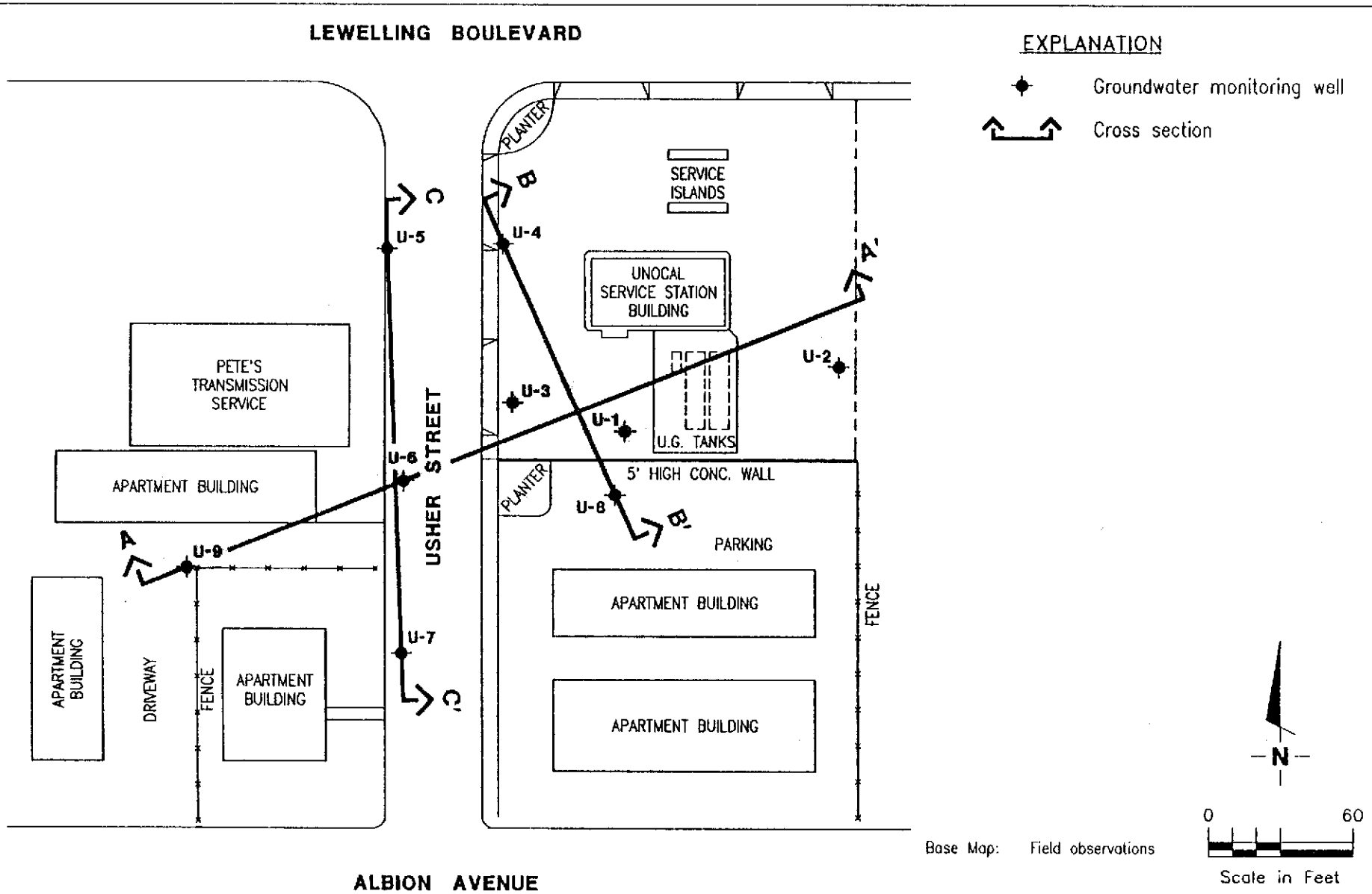
Base Map: USGS Topographic Map

GeoStrategies Inc.

VICINITY MAP
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE 1

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
7809		2/91	



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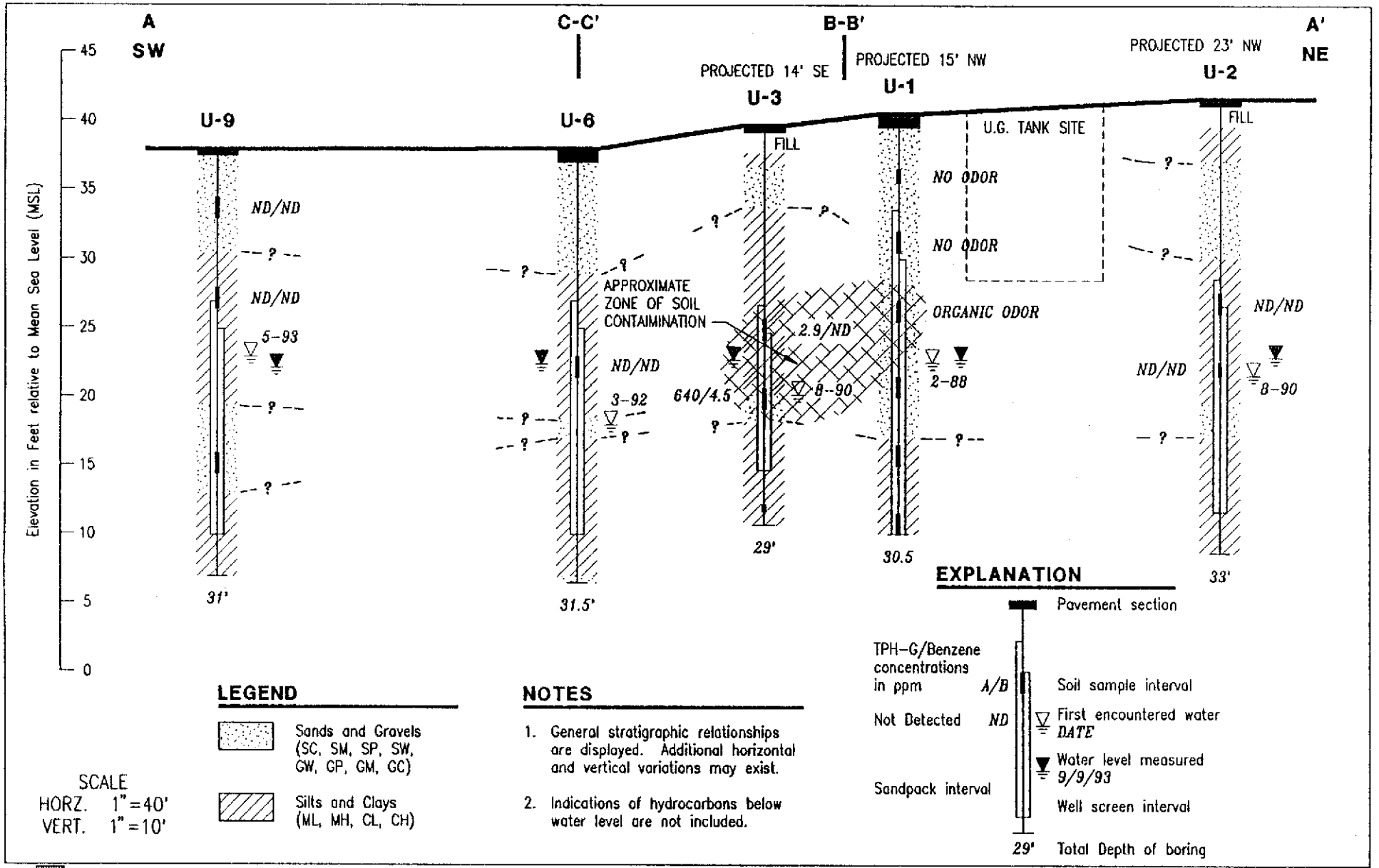
SITE PLAN
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE
2

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	

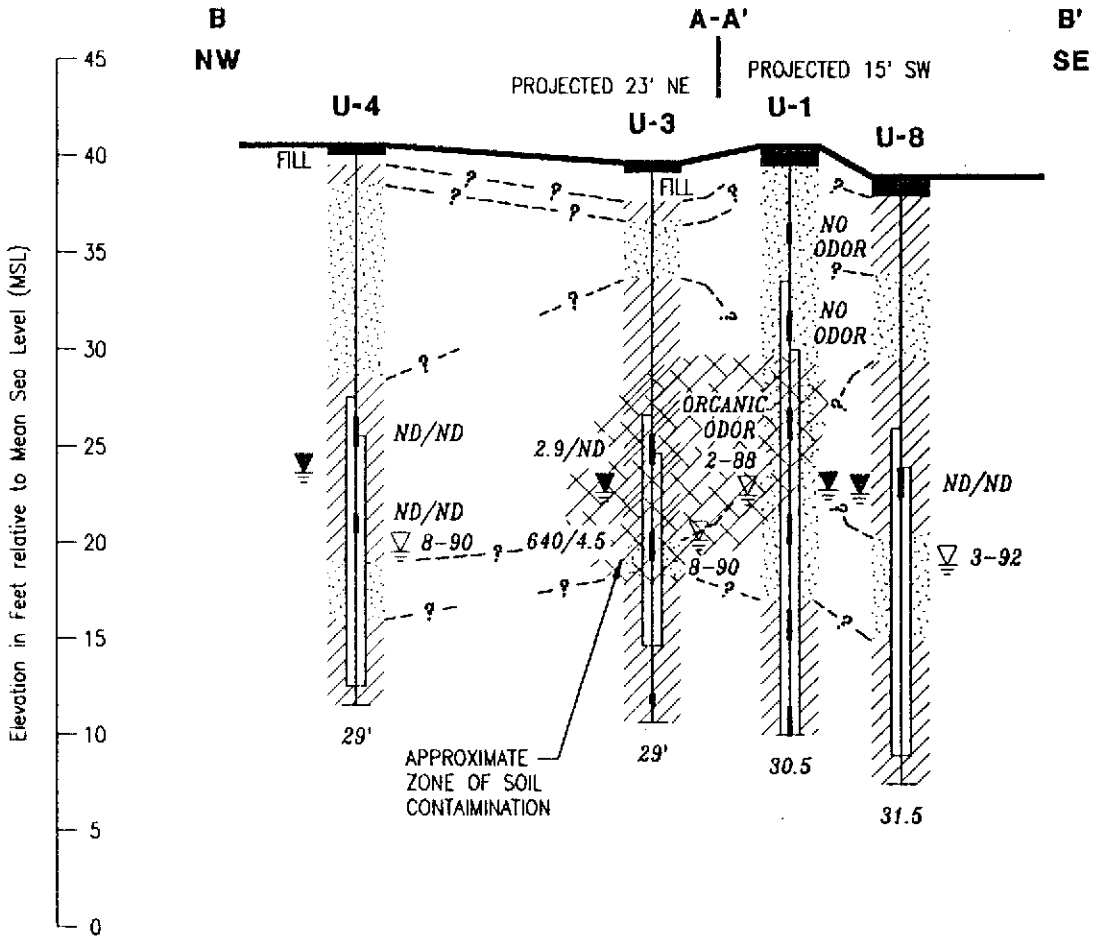


GeoStrategies Inc.

CROSS SECTION A-A'
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE 3

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	



SCALE
HORZ. 1"=40'
VERT. 1"=10'

LEGEND

- Sands and Gravels (SC, SM, SP, SW, GW, GP, GM, GC)
- Silts and Clays (ML, MH, CL, CH)

EXPLANATION

- Pavement section
- TPH-G/Benzene concentrations in ppm — A/B — Soil sample interval
- Not Detected — ND — First encountered water DATE
- Water level measured 9/9/93
- Sandpack interval
- Well screen interval
- 29' — Total Depth of boring

NOTES

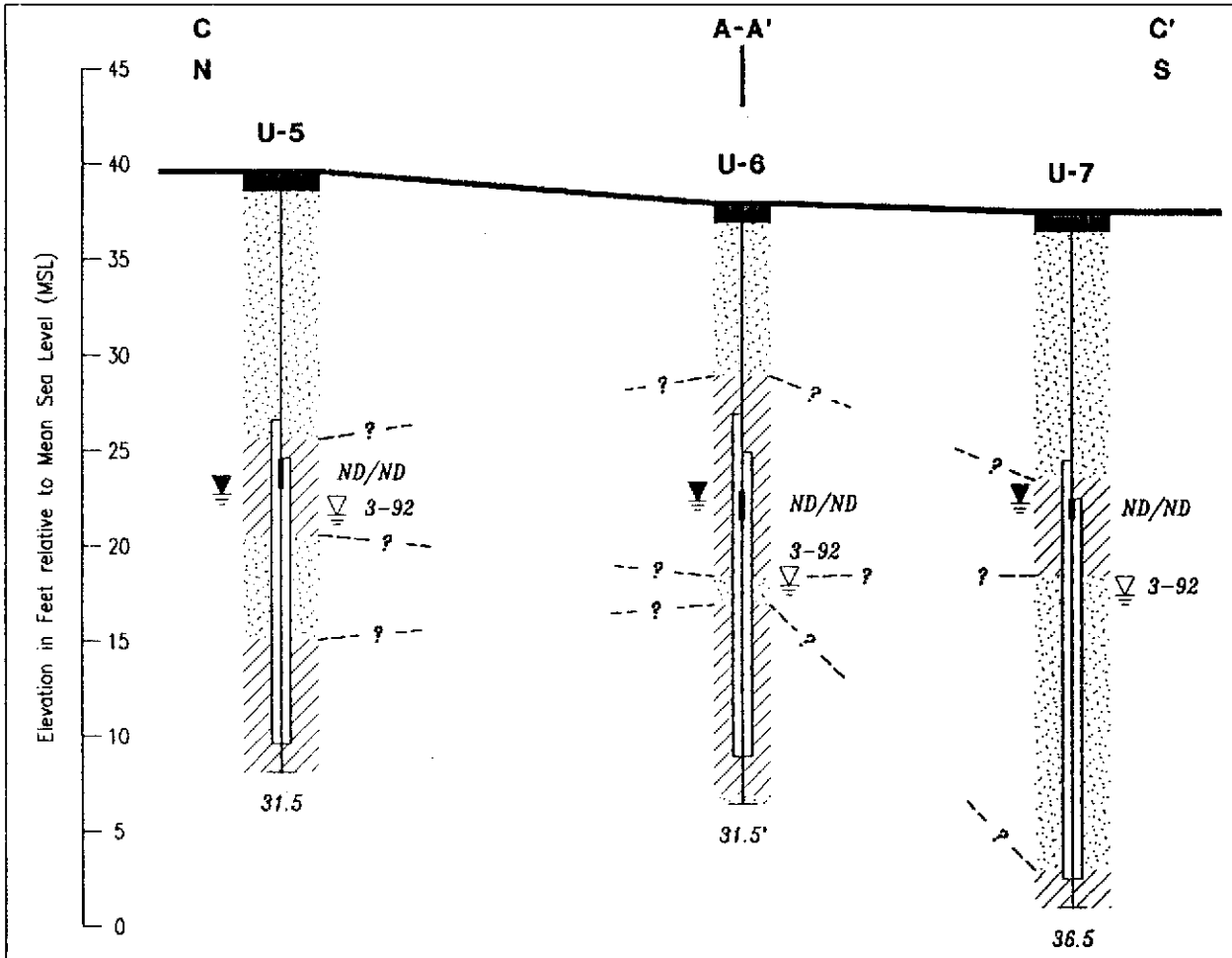
1. General stratigraphic relationships are displayed. Additional horizontal and vertical variations may exist.
2. Indications of hydrocarbons below water level are not included.

GeoStrategies Inc.

CROSS SECTION B-B'
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE 4

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	



SCALE
HORZ. 1"=40'
VERT. 1"=10'

LEGEND

- Sands and Gravels (SC, SM, SP, SW, GW, GP, GM, GC)
- Silts and Clays (ML, MH, CL, CH)

EXPLANATION

- Pavement section
- TPH-G/Benzene concentrations in ppm — A/B — Soil sample interval
- Not Detected — ND — First encountered water *DATE*
- Water level measured *9/9/93*
- Sandpack interval — Well screen interval
- 29' — Total Depth of boring

NOTES

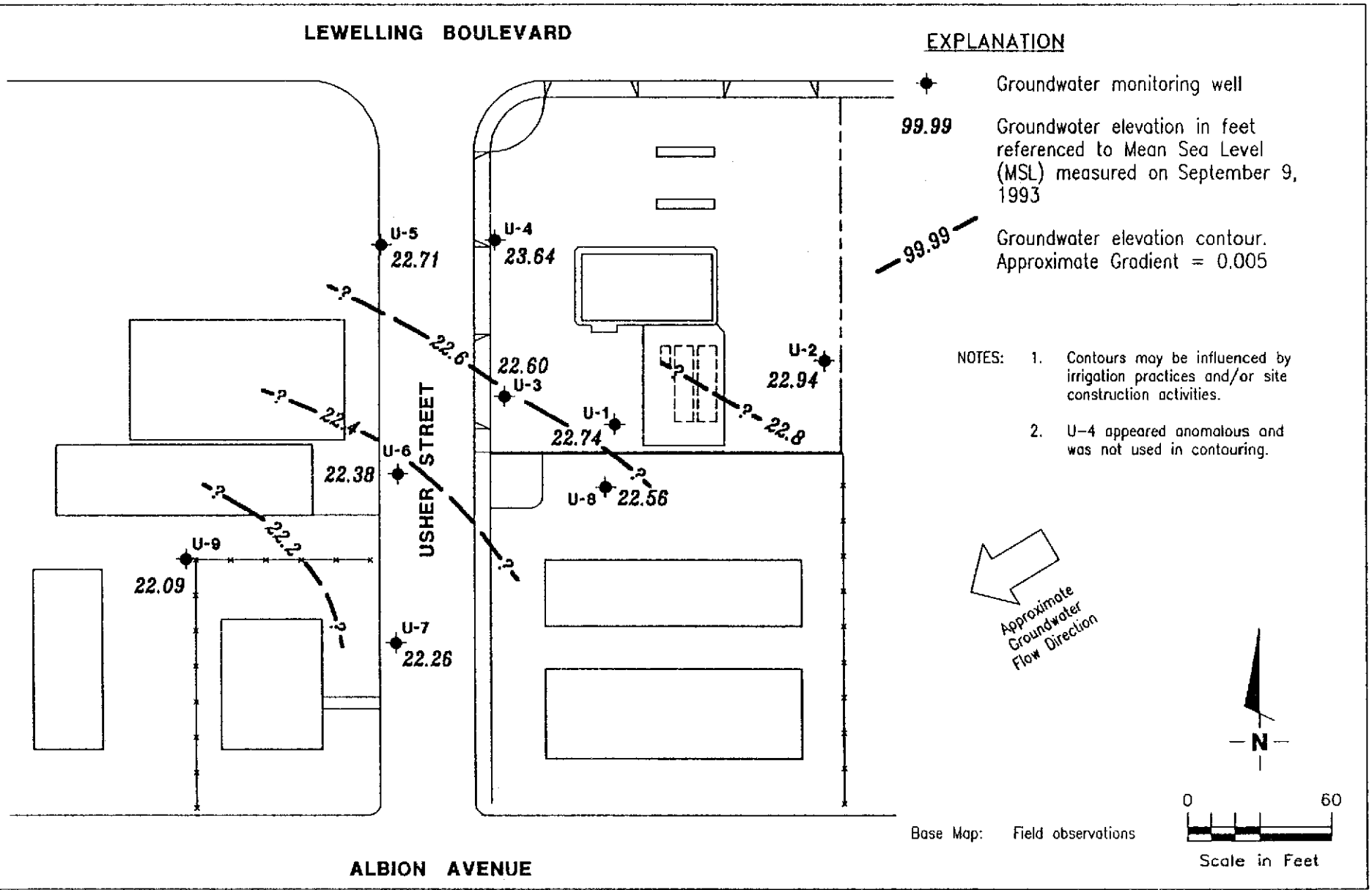
1. General stratigraphic relationships are displayed. Additional horizontal and vertical variations may exist.
2. Indications of hydrocarbons below water level are not included.

GeoStrategies Inc.

CROSS SECTION C-C'
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE 5

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	

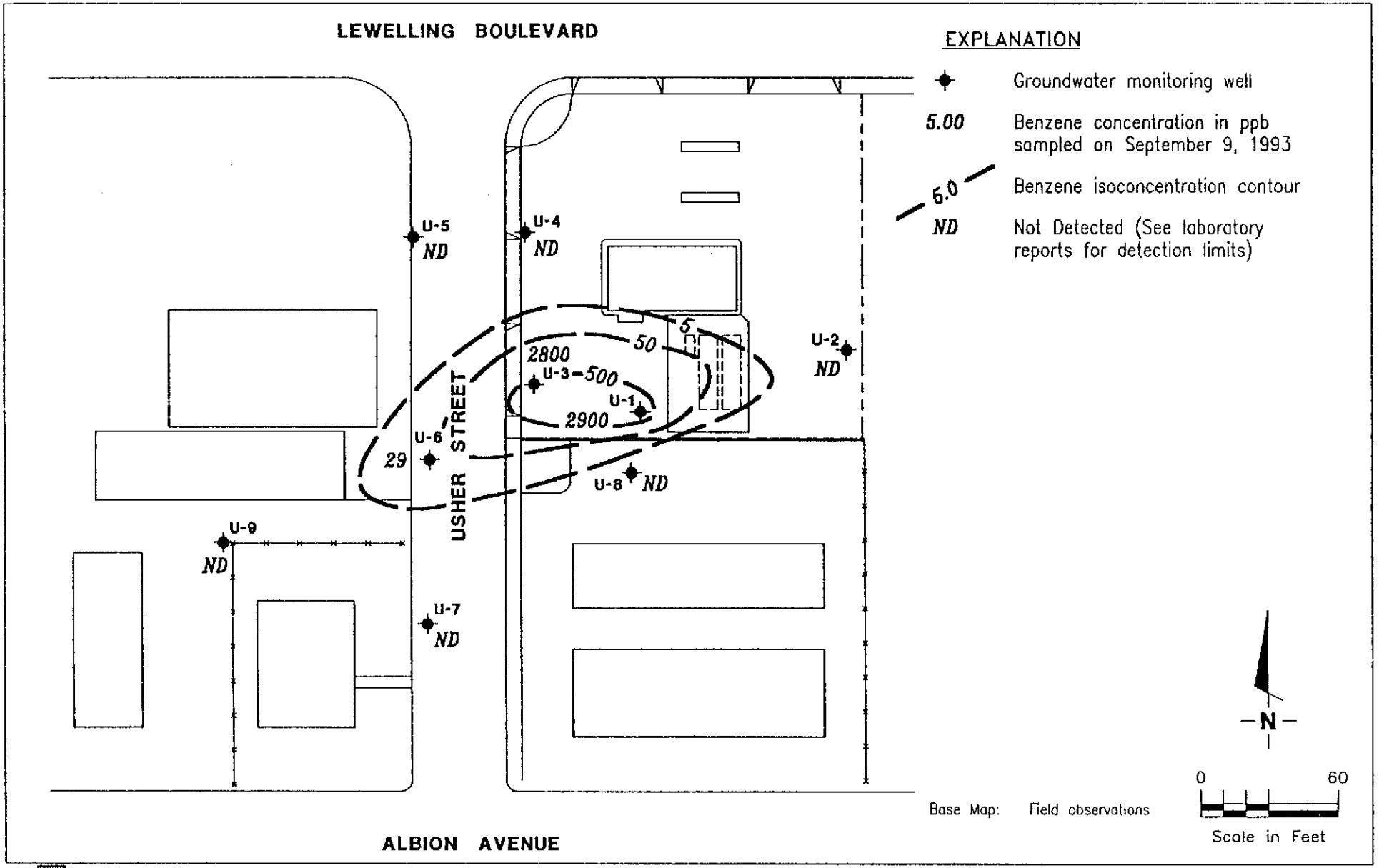


GeoStrategies Inc.

POTENTIOMETRIC MAP
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE
6

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	



GeoStrategies Inc.

BENZENE ISOCONCENTRATION MAP
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE 7

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
780990-16		10/93	