groundwater resources inc.

SCOTSMAN CORPORATION
6055 SCARLETT COURT
DUBLIN, CALIFORNIA

SITE INVESTIGATION REPORT

Jan 1989

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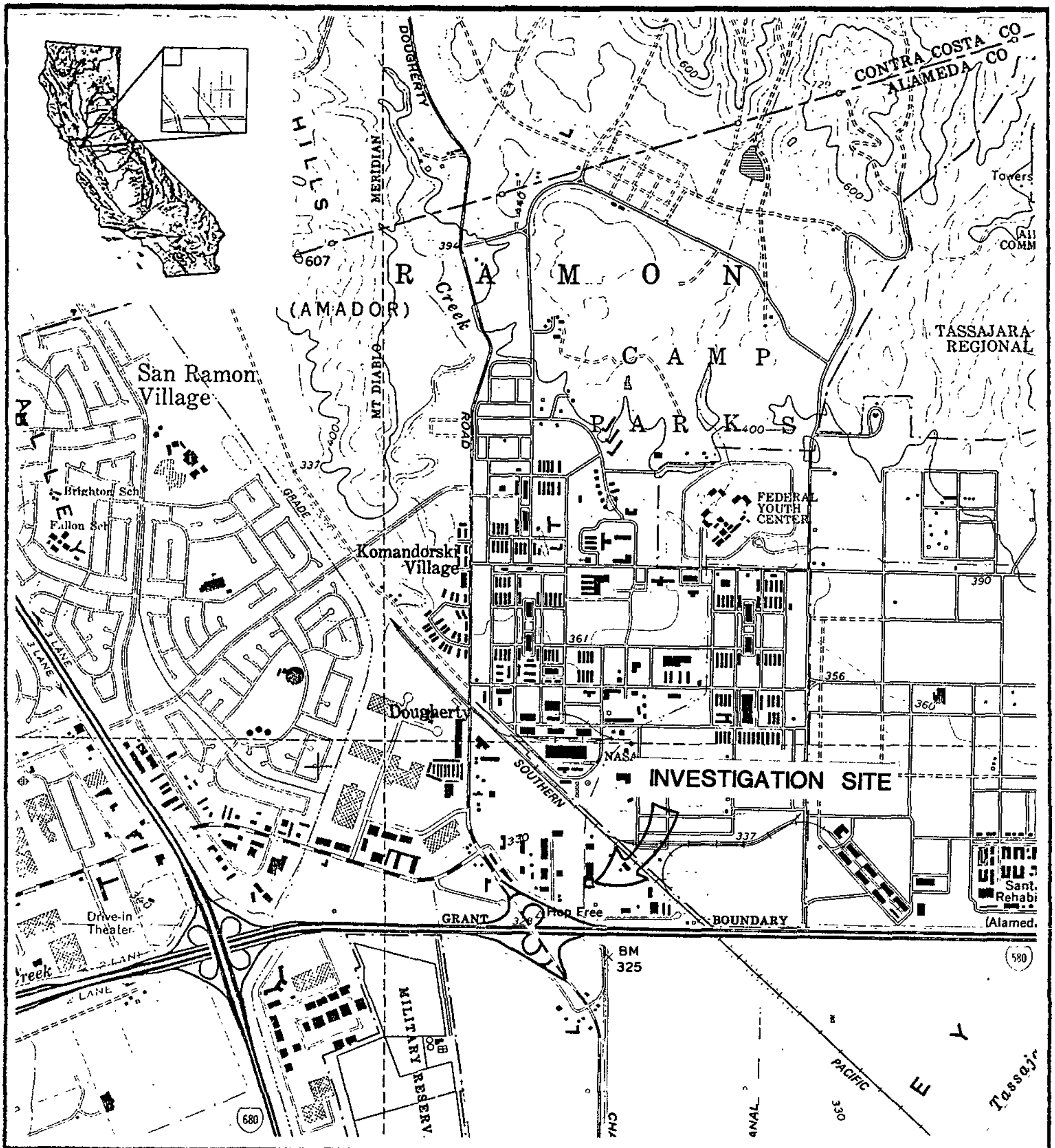
HAZARDOUS MATERIALS/
WASTE PROGRAM

groundwater resources inc.

SITE INVESTIGATION REPORT
SCOTSMAN CORPORATION
6055 Scarlett Court
Dublin, California

ILLUSTRATIONS

APPENDIX



GROUNDWATER RESOURCE INDUSTRIES-(805)835-7700

environmental/geotechnical services

Project Number: 55018

SCOTSMAN CORPORATION
6055 SCARLETT COURT
DUBLIN, CALIFORNIA

LOCATION MAP

PLATE

1

1.0 INTRODUCTION

This report presents the results of an investigation to determine the extent of hydrocarbon contamination at the Scotsman Corporation facility, 6055 Scarlett Court, Dublin, California. Groundwater Resources, Inc. (GRI) performed the investigation. Groundwater remediation is recommended along with additional assessment to determine the extent of groundwater contamination.

2.0 BACKGROUND

Two 500 gallon underground gasoline storage tanks were removed from the Scotsman facility on October 23, 1987. During the removal, corrosion was noted on the tanks and one of the tanks was described as having a hole by the fill point. The water table was observed near tank bottoms at six and one-half feet. A soil sample was collected from below each tank at a depth of eight and one-half feet. Laboratory analyses of the samples reported hydrocarbon contamination in the soil. Based on this Preliminary Assessment, the County Department of Environmental Health ordered a Site Investigation. A plan for investigation was approved by letter dated November 16, 1988 and on December 9, 1988, GRI performed the investigation described in this report.

3.0 AUGERING AND SAMPLING PROCEDURES

Four borings were made in the area of the tank excavation (Plate 2). Three borings made outside of the perimeter of the excavation for determining the lateral extent of contamination were abandoned. Abandonment was performed by pouring granular bentonite into standing water until the top of the bentonite was five feet below grade. Clean fill was added to ground level. Boring B-1 in the center of the excavation was completed as a groundwater monitoring well and redesignated MW-1. Eight-inch, continuous flight, hollow-stem auger equipment was used for boring MW-1. An eight-inch, continuous flight, solid stem auger was used for borings B-2, B-3, and B-4. Core samples were obtained with a two and one-half inch diameter California split-spoon sampler. Drilling was performed by Environmental Services, Inc. of Fremont, CA, under the supervision of a GRI geologist. The cores were described as they were acquired and a log of each boring is presented in Plates 5 through 8. The undisturbed cores selected for laboratory analysis were immediately sealed inside the brass tubes with teflon lined plastic end-caps and integrity tape. All samples were immediately labeled and placed on ice. A Chain of Custody (Appendix B) was maintained for the samples transported to the laboratory for analysis. The solid-stem augers were steamed cleaned and the core-samplers were washed and rinsed after each use to avoid cross-contamination, in accordance with the Sampling Protocol presented in Appendix C.

MW-1 was pumped dry and allowed to recover three times before a water sample was taken. A sample was collected with a bailer and poured directly into two glass VOA bottles with teflon septa in screw-top lids. They were labeled as split (duplicate) samples and chilled immediately for transport to the laboratory with a Chain of Custody.

4.0 FINDINGS

4.1 Field Observations While Augering

The soil at this site is very clayey to the greatest depth augered, 15 feet, in MW-1. It is described as predominately clay, dark gray, plastic and moist. It is occasionally silty and less plastic and is overlain by two or three inches of gravel driveway material at the surface.

The first boring was located in the center of the backfilled excavation. Pea-gravel, used as backfill, comprised the upper two or three feet of the boring. Clay soil used as backfill was sampled at five feet and gasoline odor was observed at seven feet. Gasoline contaminated samples were collected at eight feet and at ten feet, where the clay was wet. The water table was judged to be at approximately 10 feet so the hole was advanced to 15 feet to accommodate a five-foot screen placed between 9 and 14 feet. A rainbow sheen was observed on cuttings as the auger was withdrawn. The boring was completed as monitoring well MW-1 and the water table was measured at 7.5 feet after four hours.

Boring B-2, located 9.5 feet east of MW-1, was started in undisturbed soil outside of the excavation. A faint odor, observed in the five foot sample, grew slightly stronger at seven feet but diminished at nine feet. An 18 inch core sample, started at nine feet, served to advance the boring to below 10 feet total depth. Approximately one hour after the last core was taken, the water table was measured at six feet in the open hole.

Boring B-3 was placed 12 feet south of MW-1, augered and cored nine feet where a final core sample bottomed at 10.5 feet. Samples from three feet and five feet had no odor or PID reading, while the nine foot sample had a slight odor and PID reading. A core sample was taken from the interval between nine feet and 10.5 feet. A short time after the last coring operation, water was observed in the hole at a depth of 6.75 feet below ground level.

Boring B-4 was placed 10 feet west of MW-1, augered and cored to eight and one-half feet where an 18-inch long core was taken. No odor or PID readings were observed at three feet and at five feet. A faint odor and one ppm on the PID was observed at nine feet. The water table was observed while drilling at seven and one-half feet but approximately two hours later the water table was measured at six feet.

4.2 Laboratory Analyses

Soil samples from the borings were analyzed for Benzene, Toluene, Xylene and Ethylbenzene (BTX&E) and Total Petroleum Hydrocarbons (TPH) using California DOHS recommended procedures as described in the LUFT manual, May 1988.

The greatest concentrations of BTX&E and TPH in soil samples were from MW-1 directly beneath the previous tank locations. Samples from the other borings reported slight amounts of contamination in the capillary zone at the top of the water table in B-2, B-3, and B-4. Below Minimum Reporting Levels were reported at three feet in B-3 and B-4. Laboratory findings of Benzene and TPH are depicted in cross-sections through the borings, Plates 3 and 4. The complete results of laboratory analyses are in Appendix A.

4.3 Hydrogeology

The Scotsman Corporation facility is situated in the north side of the Livermore Valley which is, in part, the surface expression of a structural fold which underlies it. Alluvium which fills this portion of the Valley is from the hills northeast of Dublin and locally it is very fine textured, reflecting its source, the relatively soft sedimentary bedrock to the north. Underlying the fine textured suface deposits are Livermore Gravel beds derived from the hills bordering the Valley to the south. The gravels form a groundwater aquifer. 1

Water is standing in a drainage ditch approximately 50 feet west of the borings. The measured depth to water in the borings, six feet, is estimated to be the same as the level of the water in the ditch. Surface drainage is south although the ground is nearly flat at this site.

According to the Alameda County Flood Control and Water Conservation District, the Livermore Valley uses a combination of treated surface water and groundwater. The Water Resources Zone 7 transports water from the Sacramento-San Joaquin Delta through water transmission pipelines to retailers in Livermore Valley. Zone 7 has well fields in Pleasanton currently used as backup for the imported water while the City of Pleasanton, and others, have wells which are currently used for water supply. The deep groundwater basin is recharged from rainfall percolation and from artificial releases of imported water into the valley's stream system.

4.4 Groundwater Table

The water table was measured as high as six feet in borings B-2 and B-4 although it was not observed to be that high in any of the borings during augering. Water in MW-1 did not rise higher than 7.5 feet within six hours after it was completed. In MW-1 a hollow-stem auger was used and no final core was taken after augering to total depth. In the other borings a more efficient solid-stem auger was used and a core-sampler was driven and withdrawn cleanly from total depth.

It is probable that the two different methods used to auger and sample the wells resulted in an apparent difference in hydraulic conductivity of the silt and clay penetrated by in MW-1 compared with the other borings.

5.0 CONCLUSIONS REGARDING CONTAMINATION

5.1 Vadose Plume

No vadose plume was observed while augering; this was confirmed by laboratory analyses. The sample from five feet in boring B-2 reported minor amounts of contamination but, with the water table at six feet in silty clay, the sample was from the capillary fringe rather than the vadose. From the data gathered it is concluded that the vadose plume was excavated during tank removal.

5.2 Groundwater Plume

All of the laboratory analyses reporting any level of contamination, either in soil or water, indicate the presence of a plume of dissolved hydrocarbons in the groundwater. The dissolved Benzene and TPH levels in the water sample agree with the field observation of a film of gasoline on the tools and cuttings from MW-1. Lesser concentrations in the soil samples from five and six feet, in B-2, B-3, and B-4 indicate the backfilled excavation topped off with pea gravel may be a source of recharge to the water table during periods of rainfall.

Because of the strong capillary force and low hydraulic conductivity in the clayey soil, the rainwater spreads laterally at almost the same rate as it does vertically, diluting the fringe and upper levels of the groundwater in the vicinity of the excavation. A small amount of free product trapped among clods of clayey backfill at the bottom of the tank excavation could account for the high hydrocarbon concentrations in the water sample from MW-1.

6.0 RECOMMENDATIONS

6.1 Paving

Pave over the backfilled excavation with concrete or asphalt in order to prevent ponding of water in the pea gravel and to seal and protect the area from the percolation of surface water down through the backfilled excavation. The paving should have a slight crown to shed rainwater and it should extend beyond the margins of the excavation. The joint between the new paving and the existing concrete north of the area should be sealed. In addition, north-south drainage should be established to prevent ponding of runoff water in the vicinity of boring B-4 between the excavation and the access road (Plot Plan, Plate 2). That area is a topographic low.

6.2 Remediation

Equip MW-1 with a low volume pump and begin groundwater remediation by extracting and filtering dissolved product from the water. Include a separator in the initial installation to handle any possible free product with the water.

6.3 Additional Investigation

Commence Phase II assessment of the groundwater contamination by constructing four additional monitoring wells. These wells will be used to determine a local groundwater table gradient and obtain a water sample downgradient from the source of contamination. They can also serve as remediation wells if necessary.

7.0 LITERATURE REFERENCE

1. "Geology and Paleontology of the Pleasanton area, Alameda and Contra Costa Counties, California," by Hall, C.A., Jr., 1958: University of California Pubs. Geol. Sci. Bull. v. 34, no. 1.

8.0 LIMITATIONS

The conclusions and recommendations presented in this report are based on:

The test borings performed at the site.

The observation of field personnel.

The results of laboratory tests performed by SMC Laboratories, Bakersfield, California.

Our understanding of the regulations of Alameda County and the California Regional Water Quality Control Board.

It is possible that variations of the soil or groundwater conditions could exist beyond the points explored in this investigation. Also, changes in the hydrogeologic conditions found could occur at sometime in the future due to variations in rainfall, temperature, regional water usage, or other factors.

The services performed by GRI have been conducted in a manner consistent with the levels of care and skill ordinarily exercised by professionals currently practicing under similar conditions in California. No other warranty, expressed or implied, is made.

Respectfully submitted,

Groundwater Resources, Inc.

Jon P. Fitch

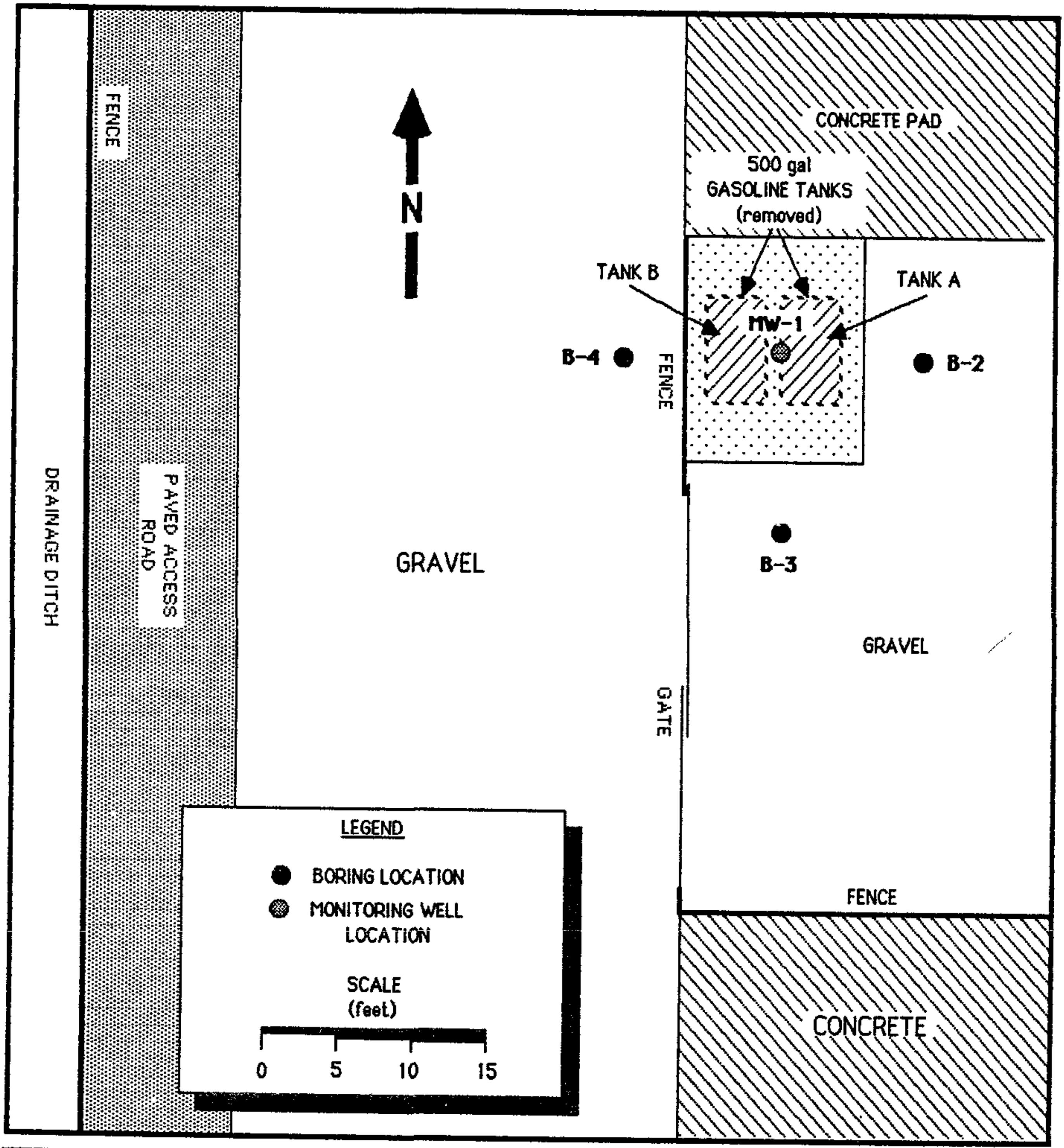
Jon P. Fitch

Date: 1-19-'89

Rex J. Young

Rex J. Young
State Registered
Geologist #720

REX J. YOUNG
No. 720



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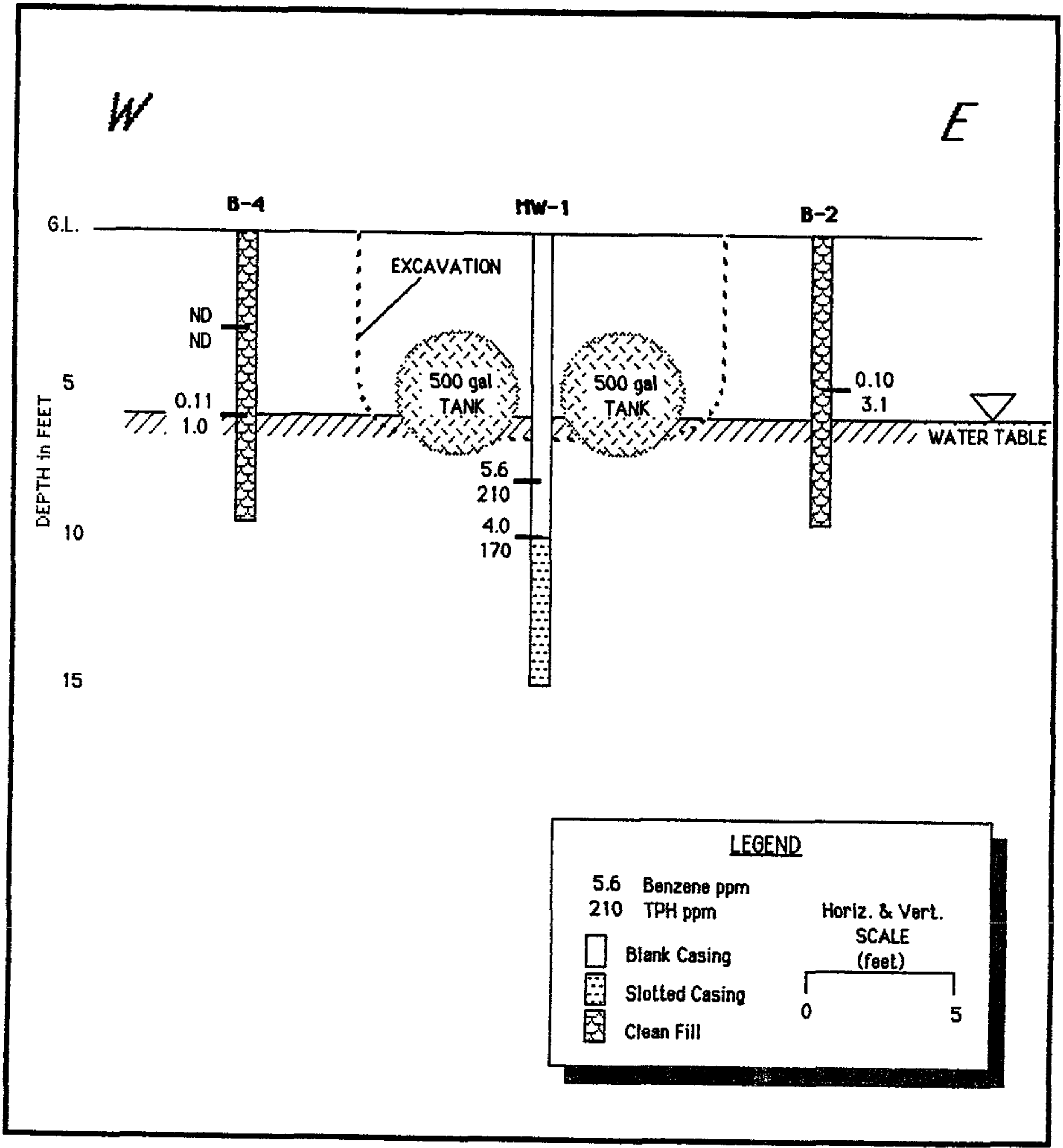
environmental/geotechnical services
Project Number: 55018
d #31

SCOTSMAN CORP.
DUBLIN, CA.

PLOT PLAN

PLATE
2



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d #31

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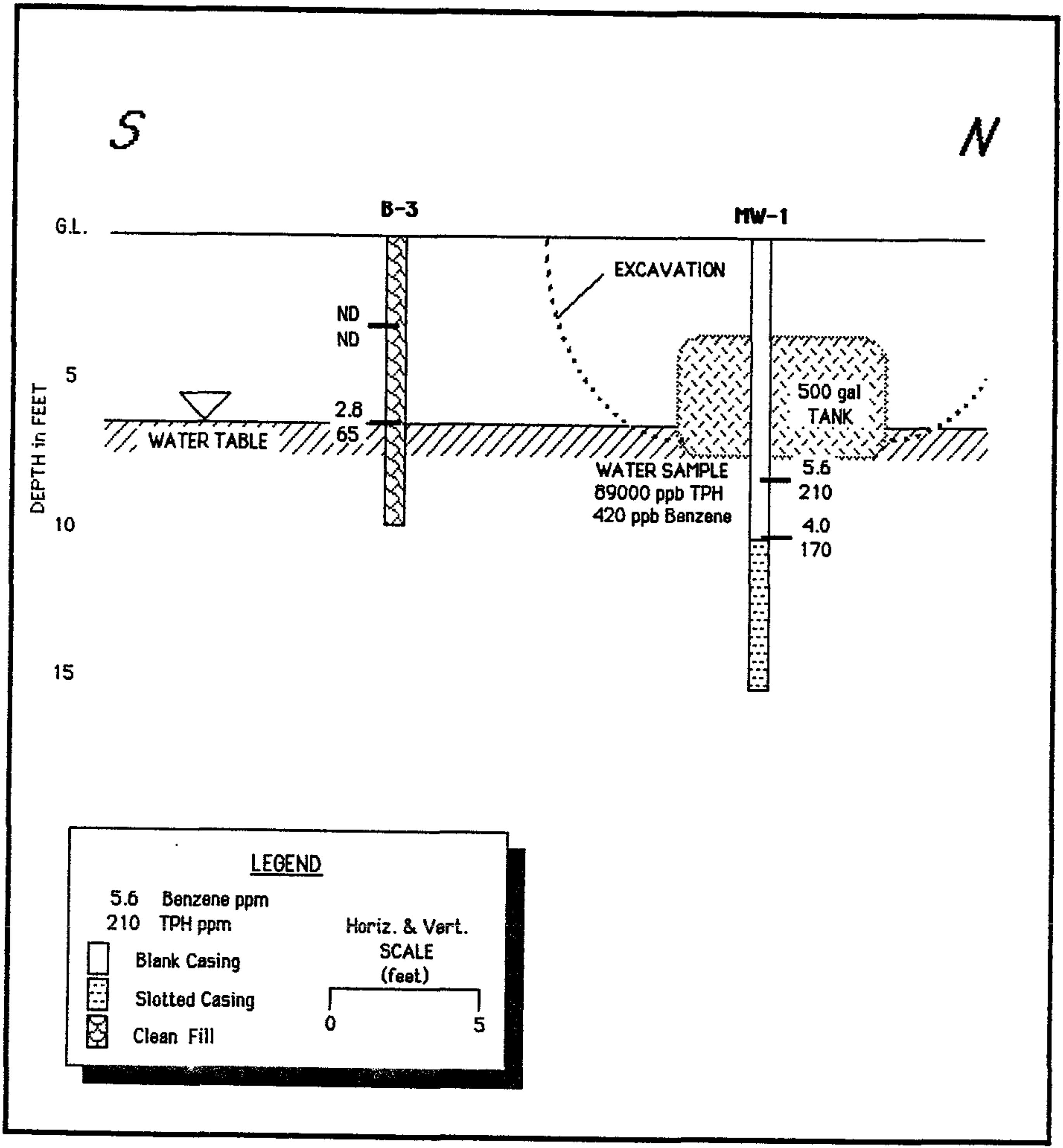
DUBLIN, CA

EAST - WEST CROSS SECTION

PLATE
3



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d #31

SCOTSMAN CORP.
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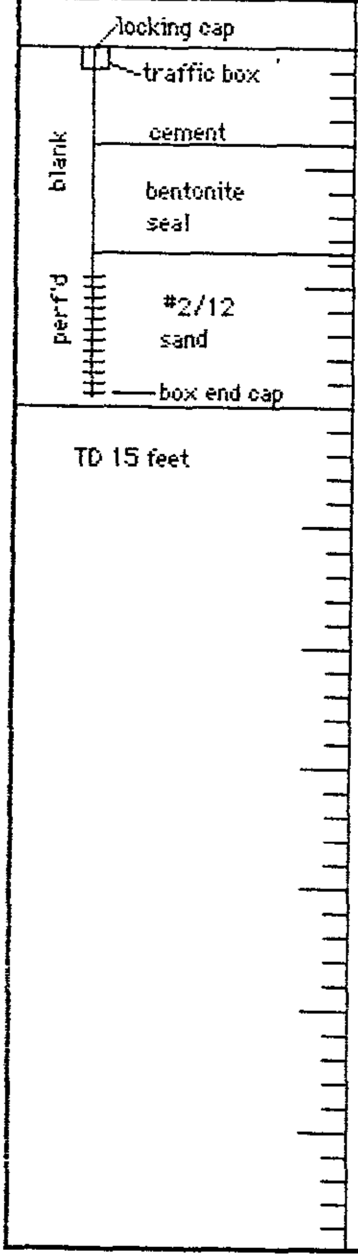
NORTH-SOUTH
CROSS SECTION

PLATE
4

WELL COMPLETION	CHEMICAL ANALYSES Laboratory Benzene TPH ppm	Field Hnu P.I.D. ppm	BLOWCOUNT	DEPTH (feet)	SAMPLE NUMBER	u.s.c.s.-desig.	SOIL DESCRIPTION
				0			Pea-gravel backfill
				5	B-1-5	CL	Clay, gry brn, backfill
	5.6 210	96	6		B-1-8	CL	Clay, dk gry, med plasticity, moist, gasoline odor
	4.0 170	156	7	10	B-1-10	CH	Clay, grnsh gry, med-high plasticity, wet, strng gas odor



*Rainbow noted on auger and cuttings at T.D.

Water encountered at 10.3 ft. while augering.

SURFACE ELEVATION: 325 feet
TOTAL DEPTH: 15 feet
DATE DRILLED: 12-09-88

LOGGED BY: TCR
SUPERVISED BY: RJY
DIAMETER of BORING: 8 inches
WATER TABLE AT: 7.5 feet

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LOCATION: SCOTSMAN CORP.
CENTER OF EXCAVATION

LOG OF BORING MW-1 (B-1)

PLATE
5
page 1 of 1

HOLE ABANDONMENT	CHEMICAL ANALYSES Laboratory Benzene TPH ppm	CHEMICAL ANALYSES Field Hnu P.I.D. ppm	BLOWCOUNT	DEPTH (feet)	SAMPLE INTERVAL	SAMPLE NUMBER	lithology symbol	u.s.c.s.-desig	SOIL DESCRIPTION
				0			▤		
CLEAN FILL							▤		
BENTONITE SEAL	0.10 3.1	20+	4	5	■	B-2-5	▤	CL	Clay, dk gry, med plasticity, moist, fnt odor, no stn
					■	B-2-7	▤	CL	Clay, yelwsh brn, med-low plasticity, moist, mod odor, no stn
TD 10.5 feet		9	4	10	▨	B-2-10	▤	CL	Clay, grysh grn & lt brn mottled, wet, med plasticity, silty, fnt odor
				15					
				20					
				25					
				30					
				35					
				40					
				45					
				50					

SURFACE ELEVATION: 325 feet
TOTAL DEPTH: 10.5 feet
DATE DRILLED: 12-09-88

LOGGED BY: TCR
SUPERVISED BY: RJY
DIAMETER of BORING: 8 inches
WATER TABLE AT: 6 feet

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PROJECT NUMBER: 55018

LOCATION:SCOTSMAN CORP.
9.5' EAST OF MW-1

LOG OF BORING B-2

PLATE
6

page 1 of 1

HOLE ABANDONMENT	CHEMICAL ANALYSES Laboratory Benzene TPH ppm	CHEMICAL ANALYSES Field Hnu P.I.D. ppm	BLOWCOUNT	DEPTH (feet)	SAMPLE INTERVAL	SAMPLE NUMBER	lithology symbol	u.s.c.s.-desig.	SOIL DESCRIPTION
				0					
CLEAN FILL	ND ND	0	9		■	B-3-3	▤	CL	Clay, dk gry, silty, med plasticity, moist, no odor
				5					
BENTONITE SEAL	2.8 65	0	6		■	B-3-6	▦	CH	Clay, dk gry w/wht mott, high plasticity, moist, no odor
TD 10.5 feet		5	6	10	■	B-3-9	▤	CL	Clay, brnsh grn, silty, med plasticity, fnt odor, wet
				15					
				20					
				25					
				30					
				35					
				40					
				45					
				50					

SURFACE ELEVATION: 325 feet
TOTAL DEPTH: 10.5 feet
DATE DRILLED: 12-09-88

LOGGED BY: TCR
SUPERVISED BY: RJY
DIAMETER of BORING: 8 inches
WATER TABLE AT: 6.75 feet

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LOCATION: SCOTSMAN CORP.
12' SOUTH OF MW-1

LOG OF BORING B-3

PLATE
7

HOLE ABANDONMENT	CHEMICAL ANALYSES Laboratory Benzene TPH ppm	Field Hnu P.I.D. ppm	BLOWCOUNT	DEPTH (feet)	SAMPLE NUMBER	u.s.c.s.-desig.	SOIL DESCRIPTION
CLEAN FILL	ND ND	0	4	0	B-4-3	CL	Clay, dk gry, silty, med plasticity, moist, no odor
BENTONITE SEAL	0.11 1.0	0	6	5	B-4-6	CH	Clay, dk gry w/wht mott, high plasticity, moist, no odor
TD 10 feet		0	7	10	B-4-9	CL	Clay, grnsh brn, silty, med plasticity, fnt odor, wet
				15			
				20			Water table first observed at 7.5 ft. while augering.
				25			
				30			
				35			
				40			
				45			
				50			

SURFACE ELEVATION: 325 feet
TOTAL DEPTH: 10 feet
DATE DRILLED: 12-09-88

LOGGED BY: TCR
SUPERVISED BY: RJY
DIAMETER of BORING: 8 inches
WATER TABLE AT: 6 feet

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PROJECT NUMBER: 55018

LOCATION:SCOTSMAN CORP.
10' WEST OF MW-1

LOG OF BORING B-4

PLATE
8
page 1 of 1

APPENDIX A

SMC Laboratory

Analytical Chemistry

Client Name: Groundwater Resources, Inc.
Address : 5610 District Blvd., Suite 106
Bakersfield, CA 93313

Date samples received : 12-12-88
Date analysis completed: 12-20-88
Date of report : 12-20-88

Laboratory No. 2727 through 2735   Project No. 55018

RESULTS OF ANALYSIS

#2727 ID: B-1-8	ugm/gm	MRL,ugm/gm
Benzene	5.6	0.1
Toluene	1.0	0.1
Ethylbenzene	4.2	0.1
p-Xylene	4.1	0.1
m-Xylene	3.1	0.1
o-Xylene	1.6	0.1
Isopropylbenzene	2.1	0.1
TPH (Gasoline)	210	1.0

#2728 ID: B-1-10	ugm/gm	MRL,ugm/gm
Benzene	4.0	0.1
Toluene	1.1	0.1
Ethylbenzene	3.6	0.1
p-Xylene	4.4	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	3.3	0.1
TPH (Gasoline)	170	1.0

Method of Analysis: California DOHS LUFT manual
MRL = Minimum Reporting Level
TPH = Total Petroleum Hydrocarbons
ugm/gm = micrograms per gram
ND = Not detected

Stan Comer
Stan Comer

3155 Pegasus Drive • Bakersfield, CA 93308 • (805) 393-3597
P.O. Box 80835 • Bakersfield, CA 93380 • FAX (805) 393-3623

Laboratory No. 2727 through 2735   Project No. 55018

RESULTS OF ANALYSIS

#2729 ID: B-2-5	ugm/gm	MRL,ugm/gm
Benzene	0.10	0.1
Toluene	ND	0.1
Ethylbenzene	0.10	0.1
p-Xylene	0.10	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	0.10	0.1
TPH (Gasoline)	3.1	1.0

#2730 ID: B-3-3	ugm/gm	MRL,ugm/gm
Benzene	ND	0.1
Toluene	ND	0.1
Ethylbenzene	ND	0.1
p-Xylene	ND	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	ND	0.1
TPH (Gasoline)	ND	1.0

Method of Analysis: California DOHS LUFT manual
MRL = Minimum Reporting Level
TPH = Total Petroleum Hydrocarbons
ugm/gm = micrograms per gram
ND = Not detected

Stan Comer

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Laboratory No. 2727 through 2735   Project No. 55018

RESULTS OF ANALYSIS

#2731 ID: B-3-6	ugm/gm	MRL,ugm/gm
Benzene	2.8	0.1
Toluene	11	0.1
Ethylbenzene	2.1	0.1
p-Xylene	ND	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	0.92	0.1
TPH (Gasoline)	65	1.0

#2732 ID: B-4-3	ugm/gm	MRL,ugm/gm
Benzene	ND	0.1
Toluene	ND	0.1
Ethylbenzene	ND	0.1
p-Xylene	ND	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	ND	0.1
TPH (Gasoline)	ND	1.0

Method of Analysis: California DOHS LUFT manual
MRL = Minimum Reporting Level
TPH = Total Petroleum Hydrocarbons
ugm/gm = micrograms per gram
ND = Not detected

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Laboratory No. 2727 through 2735   Project No. 55018

RESULTS OF ANALYSIS

#2733 ID: B-4-6	ugm/gm	MRL,ugm/gm
Benzene	0.11	0.1
Toluene	ND	0.1
Ethylbenzene	ND	0.1
p-Xylene	ND	0.1
m-Xylene	ND	0.1
o-Xylene	ND	0.1
Isopropylbenzene	ND	0.1
TPH (Gasoline)	1.0	1.0

#2734 ID: MW-1	ugm/L	MRL,ugm/L
Benzene	420	0.5
Toluene	3,000	0.5
Ethylbenzene	3,200	0.5
p-Xylene	2,900	0.5
m-Xylene	2,000	0.5
o-Xylene	3,900	0.5
Isopropylbenzene	60	0.5
TPH (Gasoline)	89,000	50

Method of Analysis for Soil: California DOHS LUFT manual
Method of Analysis for Water: 5030/Gasoline
MRL = Minimum Reporting Level
TPH = Total Petroleum Hydrocarbons
ugm/gm = micrograms per gram
ugm/L = micrograms per liter
ND = Not detected

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Laboratory No. 2727 through 2735   Project No. 55018

RESULTS OF ANALYSIS

#2735 ID: Travel Blank	ugm/L	MRL,ugm/L
Benzene	ND	0.5
Toluene	ND	0.5
Ethylbenzene	ND	0.5
p-Xylene	ND	0.5
m-Xylene	ND	0.5
o-Xylene	ND	0.5
Isopropylbenzene	ND	0.5
TPH (Gasoline)	ND	50

Method of Analysis for Water: 5030/Gasoline
MRL = Minimum Reporting Level
TPH = Total Petroleum Hydrocarbons
ugm/L = micrograms per liter
ND = Not detected

Stan Comer
Stan Comer

APPENDIX B

GROUNDWATER RESOURCE INDUSTRIES

5610 District Blvd., Suite 106
Bakersfield, California 93313
(805) 835-7700 — Bakersfield
(213) 724-3147 — Los Angeles

CHAIN OF CUSTODY RECORD

SHIP TO: SML LAB

SAMPLERS: (Signature) Tim Read

PROJECT NUMBER 55018

ALAMEDA COUNTY

SAMPLE NUMBER	DATE	TIME	COMP. CORE	GRAB WATER	SAMPLE LOCATION	SAMPLE CONDITION UPON RECEIPT	EPA-602 (WATER)	BTX-TVH (GASOLINE)	OIL & GREASE (TOX) LEAD (WASTE OIL)	EPA 418.1 (DIESEL)	TPH (OIL & GREASE), BENZENE (DIESEL)		REMARKS (LAB #'S ETC.)
B-1-8	12/9/88	0925	X		CENTER OF EXCAVATION	Cool		X					2727 #50
B-1-10		0930			"								2728
B-2-5		0955			9½' EAST OF MW-1								2729
B-3-3		1220			12' SOUTH OF MW-1								2730
B-3-6		1225			"								2731
B-4-3		1302			10' WEST OF MW-1								2732
B-4-6		1312			"								2733
MW-1		16:00		X	FROM MW-1								2734 $85
TRAVEL BLANK													

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	CC:
Tim Read	12/12/88 9:34	Karla Henry	12/12/88 9:34		DEB FILE LAB INDEX

APPENDIX C

SAMPLING PROTOCOL

TEST BORING PROCEDURES

I. Soil Sampling Protocol

The following procedures are following during soil sampling operations utilizing the hollow stem auger drilling technique.

A. Hollow Stem Auger

1. Soil borings drilled by the hollow stem auger utilize continuous flight hollow stem augers.

2. Augers, samplers and all downhole equipment are steam cleaned prior to use. In the field steam cleaning is done between borings to minimize the potential for cross-contamination.

3. A G.R.I. geologist observes the work, visually logs the soils, and collects samples at appropriate intervals.

4. The Unified Soils Classification System is utilized to classify soils encountered. Additional geological observations are noted as appropriate.

5. Soil samples destined for laboratory analysis are collected by a modified California Split Spoon. This sampler uses three, six inch long, by two and one-half inch diameter (o.d.) tubes.

Various tubes can be utilized to accommodate the type of analysis necessary:

Brass - All organics and general analyses (not to be used for copper or zinc analysis)

Stainless Steel - All organics and metals analyses for copper and zinc (not to be used for chrome or nickel analyses)

Plastic - All metals analyses (not to be used for organics)

TEST BORING PROCEDURES
(Cont'd)

6. The tubes are cleaned and prepared in the G.R.I. laboratory. Tubes are scrubbed, inside and outside, with a brush and TSP, rinsed, dryed, and packed in clean containers with seals. Tubes are delivered to the drilling site in these closed containers to preserve the state of cleanliness.

7. After the sample(s) have been removed from the sampler, the sampler is completely disassembled and scrubbed in TSP and tap water. It is then rinsed in clean tapwater and reassembled with three clean tubes.

8. Dirty tubes are field washed in TSP solution, rinsed with water, and reused.

9. The sampler is driven by a 140 pound hammer with a 30 inch free fall. Blow counts are recorded as number of blows per inch of drive.

10. The sampler is driven 18 inches at each sampling interval. The first (or lowest) tube is generally retained as the sample for analysis. The other two tubes are retained for back-up or split samples.

11. A sand catcher is used in the sampler where loose soils are anticipated. This will prevent the soil from falling out of the sampler.

12. After retrieval, the sample is visually logged and immediately sealed with aluminum foil lined caps, labeled, and chilled. Clean ice chests and chemical ice ("blue ice") are used to keep the samples cold until delivered to the chemical laboratory. Teflon seals are also available for field samples.

13. Samples are delivered to the laboratory the same day they are taken, if physically possible. If the samples must be held until the next day, they are kept frozen in a secure freezer at the G.R.I. facility.

14. Sample control is maintained by a Chain of Custody form which accompanies the sample. The form documents the time, date, and responsible person during each step in the transportation process.

MONITORING WELL SAMPLING PROTOCOL

II. Groundwater Sampling

A. All equipment that is used in a monitoring well for purging, sampling, or depth measurement is decontaminated by steam cleaning or a TSP wash and rinse procedure prior to use and before re-using when more than one sample is collected.

B. Purge Volume Determination

The following procedure is followed to determine the appropriate purging volume prior to well sampling.

1. The depth-to-water is measured by a clean, electric level indicator. Measurement datum is the top of well protector.

2. Depth to the bottom of the well is measured by a clean tape and plumb bob. If possible, this is compared to the well construction log to determine inconsistencies, i.e. damaged casing, sediment in casing, etc.

3. Water volume is calculated by using the total water depth and the inside diameter of the casing.

C. Well Purging and Sampling

1. Prior to sampling, a minimum of three to five well volumes are purged from each well to ensure that water sampled is representative of the groundwater within the formation.

2. Measurements of H, conductivity and temperature are taken at frequent intervals during the purge. Stabilization of these values indicates that representative formation fluids are being removed from the well.

MONITORING WELL SAMPLING PROTOCOL
(Cont'd)

3. In the event that the well is pumped dry, and alternate procedure will be followed. Once a well is pumped dry, the water that enters the well during recovery is, by definition, representative formation water. The well will, therefore, be pumped dry and allowed to recover to 80% or more of the original water level.

4. Purge water is pumped directly into barrels on site until the proper method of disposal is determined.

5. Samples are pumped or poured from a bailer into sampling bottles prepared by a state certified laboratory contracted for the particular job and placed in refrigerated coolers for transport to the laboratory.

6. Samples are delivered by courier, directly to the lab on the same day of sampling, whenever practical. If next day delivery is necessary, the samples are kept refrigerated at 4 degrees C° overnight and delivered to the laboratory the following morning.

7. Samples are accompanied by a Chain of Custody form which documents the time, date and responsible person during each step of the transportation process.

8. The G.R.I. coded sample numbering system allows identification of sample and client to G.R.I., while not revealing the client to anyone else.