June 2, 1992

Mr. Peter DeSantis
BP Oil Company
2868 Prospect Park Drive
Rancho Cordova, CA 95670

Subject: BP Oil Facility No 11109, 4250 Foothill Blvd., Oakland, CA

Dear Mr. DeSantis,

This office has received and reviewed the "Feasibility Study and Remedial Work Plan", dated April 2, 1992, submitted by Alton Geoscience(AG), your consultant of record. Thank you for having the document prepared for evaluation by this office in a prompt manner.

Upon review of the workplan there are several points in need of clarification prior to the final concurrence by the Alameda County Division of Hazardous Materials:

1) This office concurs with the workplan allowing for the installation of monitoring wells in the future if required in a "Vapor Extraction System" as the need is yet to be determined.

2) The zone of influence should be carefully determined and reported to this office as soon as the information becomes available.

3) Submit all copies of the requisite permits to this office as required by other concerned agencies.

4) This office concurs with addressing the "free-floating" product and dissolved phase product at this time. However, in the future it may become necessary to modify the system to remediate to other concern at the site.

5) Provide this office with a workplan that will insure the QA/QC of the removed and treated groundwater.

6) Upon receipt of the addendum to the workplan, you may commence construction of the remediation system. Please provide this office with forty-eight (48) hours notice prior to the construction of the proposed system

BP OIL

BP Oil Company
Aetna Bldg., Suite 360
2868 Prospect Park Drive
Rancho Cordova, California 95670-6020
(916) 631-0733

92 APR -9 PM 1:47

April 3, 1992

6. LOP #102

Mr. Paul Smith
Alameda Health Care Services
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

RE: BP FACILITY #11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA 94601

Dear Mr. Smith,

Attached please find the Feasibility Study and Remedial Work Plan for the above referenced facility.

Please call me at (916) 631-6919 with any questions regarding this submission.

Respectfully,

Peter J. DeSantis

Peter J. DeSantis
Environmental Resources Management

PJD:sml

Attachment

cc: Al Sevilla, ALISTO Engineering
Lester Feldman, RWQCB San Francisco Bay Region
Peter Lange, ALTON Geoscience
David Baker, Mobil Oil
Site file

FEASIBILITY STUDY AND REMEDIAL WORK PLAN

for

BP Oil Company Service Station No. 11109
4280 Foothill Boulevard
Oakland, California

Project No. 30-0248

Prepared for:

BP Oil Company
Aetna Building, Suite 360
Rancho Cordova, California

Prepared by:

Alton Geoscience
5870 Stoneridge Drive, Suite 6
Pleasanton, California

April 2, 1992

TABLE OF CONTENTS

1.0 INTRODUCTION

BP Oil Company retained Alton Geoscience to perform a feasibility study and develop a work plan for remediation of petroleum hydrocarbons in soil and ground water at BP Oil Company Service Station No. 11109, 4280 Foothill Boulevard, Oakland, California. A site vicinity map is shown in Figure 1. A brief description of the site and review of existing data are presented below.

2.0 SITE DESCRIPTION AND SENSITIVE RECEPTORS SURVEY

A sensitive receptors survey was conducted to identify nearby environmental elements and land uses that may be affected by or affect the subsurface environment at the site. The Sensitive Receptors Survey Form is included as Appendix A, and the findings of the survey are as follows:

The site is bounded by single family residents to the north/ northwest and a church to the northeast. The western corner of the intersection is occupied by a Chevron service station, the south corner by a Shell service station, and the east corner by Fremont High School (see Figure 1).

A records search of the Regional Water Control Board, San Francisco Bay Region (RWQCB) fuel release list and files was conducted on December 17, 1991. There are three other confirmed fuel release sites within a 1/4-mile radius on the list.

- Chevron Station No. 9-0076, 4625 Foothill Boulevard, Oakland

  This site is approximately 60 feet southwest of the BP Oil site. Site investigative efforts have detected free product in the ground water with a thickness of up to 2 feet, and the extent of dissolved-phase hydrocarbons in ground water is not assessed. RWQCB files contain a work plan for installation of a ground water recovery system (Weiss 1991), and recent observations show a system being presently installed.

- Stop-N-Go, 4100 Foothill Boulevard, Oakland

  This site is approximately 800 feet northwest of the BP Oil site. Analysis of soil samples collected during tank removal activities in September 1986 detected 21 parts per million (ppm) total petroleum hydrocarbons (TPH). RWQCB files do not indicate any further action.

- Unocal Station No. 2656, 4251 E. 14th Street, Oakland

  This site is approximately 1,300 feet southwest of the BP Oil site. Analysis of soil samples collected from the vicinity of a former waste oil tank detected up to 2,900 ppm total oil and grease (TOG) and 200 ppm total petroleum hydrocarbons as diesel (TPH-D). Quarterly analysis of ground water samples, collected from three monitoring wells constructed onsite, has not detected total petroleum hydrocarbons as gasoline (TPH-G) or TPH-D.

There are no reported public water supply wells in the area. East Bay Municipal Utilities District (EBMUD) is the purveyor of domestic water supply for the City of Oakland. EBMUD obtains water from the Mokulumne River, and treats it prior to distribution (personal communication EBMUD 1991).

3.0 SUMMARY OF FINDINGS

3.1 Ground Water Monitoring and Sampling

A summary of the results of ground water elevation measurements and laboratory analyses is presented in Table 1. A review of the results can be generalized as follows:

- Currently, there are five 4-inch-diameter and one 2-inch-diameter ground water monitoring wells onsite (MW-2 through MW-7) and two 2-inch-diameter ground water monitoring wells (MW-8 and MW-9). As shown in the attached site plan (Figure 2), MW-8 is located to the west of the site, across Foothill Boulevard, and MW-9 is located to the east of the site, in High Street.

- Free product, at a thickness of up to 0.13 foot, has been observed in Monitoring Well MW-5. During each monitoring event, the free product has been manually bailed as an interim remedial measure. To date, approximately 0.5 gallons have been removed.

- 1,2-dichloroethane at a concentration of up to 0.7 parts per billion (ppb) and methylene chloride at a concentration of 51 ppb have been detected in ground water samples collected from MW-2.

- TPH-G have been detected in ground water samples collected from onsite Monitoring Wells MW-2, MW-3, MW-4, and MW-7 at concentrations of up to 1,300 ppb. Benzene, toluene, ethylbenzene, and xylenes (BTEX) have been detected in ground water samples collected from these wells at concentrations of up to 62 ppb. Additionally,

concentrations of up to 1.3 ppb xylenes have been detected in the ground water samples collected from MW-6.

- A Chevron service station across Foothill Boulevard from the BP Oil site is currently implementing ground water investigation and remediation procedures. The extent of hydrocarbon-affected ground water in the direction of the BP Oil site is not defined and free product has been observed in monitoring wells onsite.

- The highest concentration of petroleum hydrocarbons detected in ground water samples analyzed during the most recent sampling event was 1,100 ppb TPH-G and 170 ppb benzene in MW-7. MW-5 was not sampled during this event due to the presence of free product.

- Ground water was generally encountered in MW-3, MW-5 through MW-7, and MW-9 at depths of 9 to 12 feet deeper than the stabilized ground water level.

- The piezometric surface, as calculated from water elevations observed in the monitoring wells, slopes to the west-northwest with an average gradient of 0.075 foot per foot across the site. It should be noted that the actual flow direction of ground water may not follow the piezometric surface. A piezometric surface map is presented as Figure 5.

- A review of the hydrogeologic cross sections (Figures 3 and 4) suggests that stratigraphic units are generally continuous in the east-west direction, and discontinuous in the north-south direction. Continuous layers in the east-west direction may provide preferred fluid migration pathways.

- The extent of petroleum hydrocarbons in the ground water beneath the site has been assessed to the north and west. The extent of dissolved-phase hydrocarbons is not assessed in the southwestern direction towards the Chevron service station or upgradient from MW-7.

3.2 Soil Sampling

A summary of the results of soil sampling is included in Table 2. A review of the analytical data for soil samples collected from this site can be generalized as follows:

- The shallow stratigraphy beneath the site consists predominantly of silty clay and clayey sand with minor clayey to sandy gravel lenses. Generally, silty clay was encountered in the borings from below the surface, at elevations of 35 to 39 feet above mean sea level (msl),

and 17 to 29 feet above msl. Exceptions were encountered in Wells MW-3 (silty to sandy clay throughout the boring) and MW-7 (clayey sand from approximately 26 to 34 feet above msl). Other separate silty clay layers, of thicknesses less than 5 feet, were encountered in some of the borings. Coarser-grained sediment types were encountered at several depth intervals, and are relatively continuous across the study area in the east-west direction.

- Stratigraphic units are relatively discontinuous across the site in the north-south direction. The shallow water-bearing unit that the monitoring wells address is a clayey sand that may be continuous across the study area in an east-west direction. Figure 3 shows the east-west Hydrogeologic Cross Section A-A', which runs in the apparent ground water gradient direction. Figure 4 shows the north-south Hydrogeologic Cross Section B-B', which runs perpendicular to the apparent ground water gradient direction.

- Petroleum hydrocarbons were detected in soil samples collected from Wells MW-5, MW-6, and MW-7. The highest concentrations of TPH-G and benzene detected in soil samples were collected from MW-5 at a depth of 21 feet below grade, with concentrations of up to 6,100 ppm TPH-G and 14 ppm benzene.

- Petroleum hydrocarbons were detected in relatively shallow soil samples collected from Wells MW-5 and MW-7, while petroleum hydrocarbons were detected just above ground water in soil samples collected from other borings at the site. No petroleum hydrocarbons were detected in MW-3, MW-8, or MW-9.

Slug tests, step tests, and a constant rate extended pumping test performed between October 15, 1991, and January 15, 1992, suggest the average transmissivity of the aquifer material beneath the site is approximately 0.2 foot per day (ft/day). Findings from these tests were used in developing the preliminary design of a ground water remediation system. See Appendix B for a discussion of aquifer testing and analysis.

4.0 REMEDIAL ACTION OBJECTIVES

The objective of site mitigation is to ensure that the biological receptors associated with each environmental pathway are not exposed to hazardous chemicals at levels above the Applied Action Levels (AALs) as adopted by the California Department of Health

Services (CDHS). The general methods implemented are those designed to reduce the toxicity, mobility, or volume of contaminants.

Specifically, the mitigation objective for this site is to abate the potential impact on the aquifer from:

1. Free product observed in MW-5
2. Dissolved-phase gasoline-range hydrocarbons detected in all of the onsite wells
3. 1,2-dichloroethane and methylene chloride present in the ground water in the vicinity of MW-2.

The general response actions presented in this remedial plan are measures that can be implemented to manage and/or control a site-specific contamination problem to meet the remedial action objectives. These measures are in accordance with the United States Environmental Protection Agency (USEPA) draft, Guidance for Conduction of Remedial Investigations and Feasibility Studies Under CERCLA (USEPA 1988), and the California Department of Health Services California Site Mitigation Tree Manual (CADOHS 1986).

5.0 FEASIBILITY STUDY

Based on the results of previous activities performed at the site, the extent of adsorbed-phase, dissolved-phase, and free-floating hydrocarbons has not been fully assessed.

This study, therefore, will primarily address an interim system designed to control and remediate the onsite free product and dissolved-phase hydrocarbons. The system will be designed to allow the addition of new pumping wells and, if necessary, a vapor extraction system for adsorbed-phase hydrocarbon remediation.

There are numerous combinations of available remedial technologies for site cleanup. Selection of the appropriate remedial option(s) is site specific and depends on the geology, hydrology, nature, extent, and concentration of hydrocarbons detected in the subsurface, as well as regulatory requirements. Details of the criteria considered during the screening of site-specific remedial alternatives in this study are presented in Appendix C.

Site investigation activities, including pumping test results, suggest that an automatic ground water recovery system (ARS) is the most appropriate method to hydraulically contain and remediate free product and hydrocarbon-affected ground water at

this site. The selected alternates for collection and treatment of the recovered fluid are summarized below.

≈ 720 gpd

5.1 Ground Water Collection

It is recommended that the ARS collect ground water from existing 4-inch-diameter Monitoring Wells MW-4, MW-5, and MW-7 at a flow rate of approximately 0.5 gallons per minute (gpm) each. The results of aquifer analysis and modeling suggest that pumping from these wells may induce hydraulic containment and capture of the onsite free product and hydrocarbon-affected ground water. It should be noted, however, that the ground water flow direction, which partially controls the capture radius, may not precisely correlate with the potentiometric surface presented in Figure 5.

The actual zone of influence generated by the pumping system will be monitored weekly for the first month after startup and every month thereafter. The pumping rates will be adjusted as necessary to achieve the desired drawdown, and the system will be designed to accommodate additional wells, if necessary. System parameters will be tracked to assess system effectiveness and for the calibration of a hydrodynamic flow model.

5.2 Ground Water Treatment

After review of available ground water treatment technologies (Appendix C), carbon treatment has been selected as the most appropriate method for extracted ground water. The advantages of this option include: (1) proven highly efficient and effective technology; (2) minimal community and regulatory impact; and (3) cost effectiveness.

Implementation of this option is contingent upon approval by the appropriate regulatory agencies. Concerns that must be addressed during engineering design include effluent discharge requirements and minimization of the visual and audible impact of the system, considering the current use of the site and adjacent properties.

6.

This remedial work plan addresses recovery, containment, and treatment of onsite free-floating and dissolved-phase hydrocarbons. This work plan does not address a vapor recovery system, but vapor conveyance lines will be included in the trenching system to facilitate the addition of a vapor extraction system at a later date.

6.1 System Description

Installation of an ARS is proposed to control and recover free product and dissolved-phase hydrocarbons at the site. The system will first pump recovered ground water from the three 4-inch-diameter recovery wells using submersible pumps designed to extract ground water at a projected pumping rate of approximately 0.5 gpm per well.

The pumps will transfer ground water to a 375-gallon surge tank which will allow water to flow through the carbon beds at the optimum design flow rate of the units. Water will then be treated using two 1,000-pound carbon adsorption units prior to discharge to the sanitary sewer. The recovery system schematic is shown in Figure 5.

Analysis of influent and effluent samples relative to the activated carbon units will monitor the efficiency of the carbon. The proposed ground water remediation system will consist of the following items:

1. Recovery wells (existing 4-inch-diameter Wells MW-4, MW-5, and MW-7). Well construction details are presented in Appendix D.

2. Three submersible pumps for ground water recovery. Pumping rates will be adjusted to achieve optimum free product and hydrocarbon-affected ground water recovery. The pump will be positioned sufficiently above the bottom of the well to prevent intrusion of solids and effectively capture the hydrocarbons, which generally float near the top of the water layer.

3. Electrical conduit and water-return piping to connect the pumps to the treatment system; vapor-return piping for future VES use; and piping for discharge of effluent to the sanitary sewer connection. Piping will be laid in trenches a minimum of 24 inches below grade.

4. An aboveground treatment system, to include:

    a. A reinforced concrete pad with a berm for spill containment, and a 6-foot fence for security and visual screening of the aboveground equipment.

    b. A high-density polypropylene surge tank with 375-gallon capacity. An oil/water separator and a storage tank will be installed to capture and store free product.

    c. Two 1,000-pound carbon canisters based on an assumed average influent TPH-G concentration of 30 ppm, which

is an estimate of the maximum concentrations from the three wells. Assuming a total pumping rate of 1.5 gpm and a carbon adsorption capacity of 6.5 pounds of hydrocarbons per 100 pounds of carbon, approximately 200 pounds of carbon will be expended per month initially. Therefore, two 1,000-pound carbon canisters will be used to minimize carbon replacement costs.

d. A centrifugal pump for transfer of water from the surge tank through the carbon units to the sanitary sewer.

e. Electronic probes for automatic level control with redundant probes for emergency shutdown including probes to shut down the system if the water level in the surge tank exceeds a preset amount.

f. A totalizing flow meter to track the total quantity of water pumped through the system.

g. A cartridge prefilter to eliminate suspended solids, located between the surge tank and the carbon canisters.

h. A control panel to operate and react to pump sensors, flow rates, etc. Trenching and paving from the recovery wells to the treatment system equipment and to the sanitary sewer.

i. A temporary power pole and power supply panel.

The aboveground equipment compound will be constructed to be as inconspicuous as possible.

Prior to construction of the system, permits and approvals will be obtained from the appropriate agencies, including, but not limited to: the Alameda County Health Agency (ACHA); the local sanitary district; Oakland Fire Department; Oakland Building and Planning Department; and Pacific Gas and Electric (PG&E).

Once the recovery system is operational, Alton Geoscience will perform periodic sampling of the influent and effluent as required by the appropriate agencies. An operation and maintenance program will be prepared and followed to ensure continued safe and reliable operation of the equipment.

The effectiveness of the system will be evaluated based on the individual and total pumping rates achieved, influent/effluent sampling data, and quarterly monitoring and sampling results.

6.2 Proposed Scope of Work

A description of the proposed scope of work for ground water remediation is presented below:

Task 1: Pre-Construction Activities

Pre-construction activities will include: procurement of all necessary permits; detailed engineering design of the ground water recovery and treatment system; development of a site-specific safety plan; liaison with appropriate agencies to review the work plan, if necessary; scheduling of construction and field activities and subcontractors; and location of underground utility lines and piping.

Task 2: Ground Water Extraction/Treatment Installation

Installation of equipment and hardware for the recovery/treatment system will include: trenching and installation of the piping and electrical supply; electrical sensors and wiring; pumps; one tank; two 1,000-pound carbon treatment units; piping; concrete pad; and security fencing.

Task 3: Startup, Operation, and Maintenance

Startup of recovery system equipment will include troubleshooting and adjustments of operating parameters (a letter report will be submitted to the local sanitary [redacted] of completion of the startup phase). Operation and maintenance of the system would include visual inspections and maintenance on a weekly basis, monthly collection and analysis of effluent samples, monthly water level monitoring, and quarterly ground water sampling of all wells.

To estimate a baseline for the treatment system influent and effluent water, initial samples will be collected from the influent and effluent of the carbon treatment system. The samples will be analyzed on a 5-day turnaround time using the appropriate EPA testing methods, according to local sanitary district requirements. The system will be restarted when approval to discharge to the sanitary sewer is obtained from the local sanitary district.

Task 4: System Tracking and Reporting

Reports will be issued quarterly, and will include monthly and cumulative compilations of the remediation

progress, a description of recordkeeping protocol, and an evaluation of system effectiveness with regard to future system modification(s).

7.0 SITE SAFETY

All field procedures and activities related to conduct of the site work will be in accordance with the site-specific safety plan developed for the project. The site safety plan will be developed in compliance with applicable requirements of the California Occupational Safety and Health Association (Cal-OSHA).

8.0 IMPLEMENTATION SCHEDULE

The site activities proposed herein will be completed within approximately 80 work days after work plan approval. The schedule for completion of major tasks is as follows:

Activity	Estimated Work Days After Work Plan Approval
- Pre-Construction Activities	
- Design	30
- Permitting	60
- Equipment Installation	80
- Startup	90

This schedule may be subject to revision. Any changes will be communicated in advance to the appropriate agencies and parties involved.

This report was prepared by:

ALTON GEOSCIENCE

Jeffrey P. Davies, P.E. M 27704
Manager, Northern California Engineering

4/2/92
Date

Peter C. Lange, R.G. 5089
Associate, Northern California Operations

4/2/92
Date

7x9"
4/93

REFERENCES

Alton Geoscience 1992. Supplemental Site Investigation Report. Report in progress prepared for BP Oil Company. Concord, California.

CADOHS 1986. The California Site Mitigation Decision Tree Manual. Report prepared for the State of California. May. Sacramento, California.

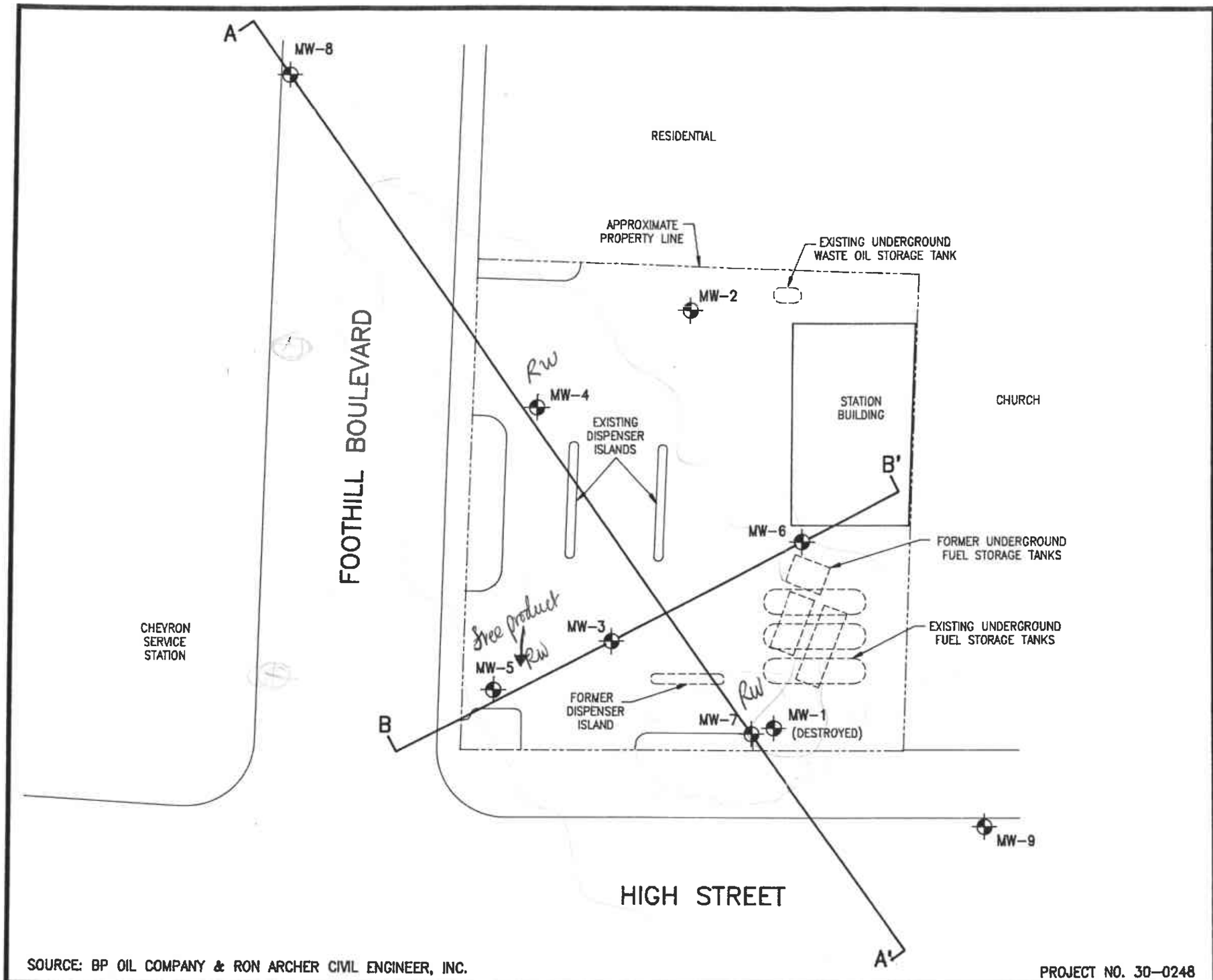
USEPA 1988. Guidance on Feasibility Studies Under CERCLA. Report prepared for Hazardous Waste Engineering Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, and Office of Waste Programs Enforcement. June. McLean, Virginia.

FIGURE 1

SITE VICINITY MAP

BP OIL SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE PROJECT NO. 30-0248



N

0 15 30

APPROXIMATE SCALE IN FEET

LEGEND:

GROUND WATER MONITORING WELL

A A' LINE OF HYDROGEOLOGIC CROSS SECTION

SOURCE: BP OIL COMPANY & RON ARCHER CIVIL ENGINEER, INC.

PROJECT NO. 30-0248

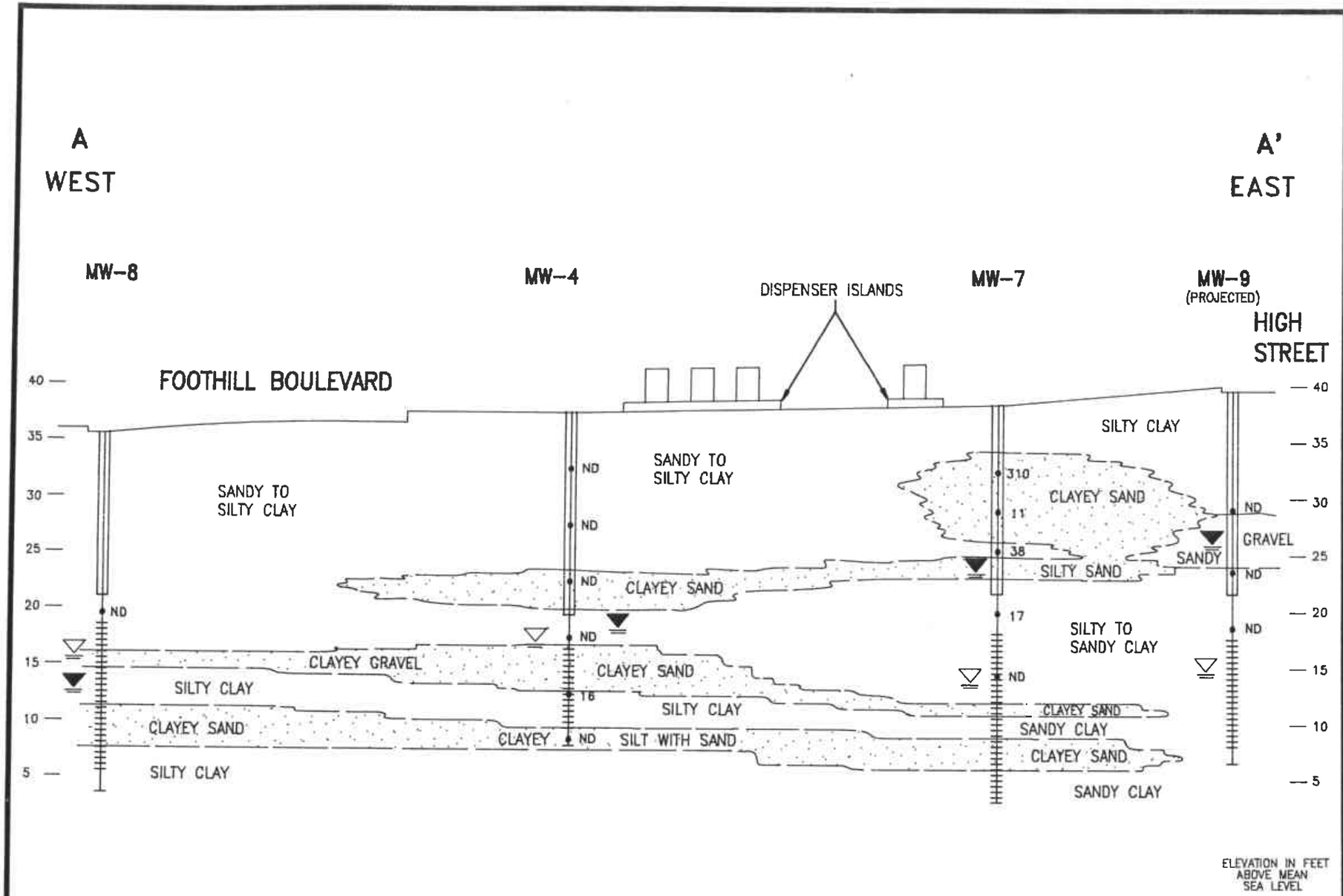
FIGURE 2: SITE PLAN

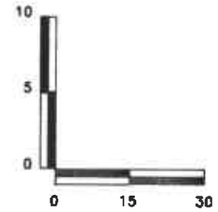
BP OIL COMPANY
SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
Pleasanton, California

248-SP

3/23/92





APPROXIMATE SCALE IN FEET

LEGEND:

- GROUND WATER MONITORING WELL SHOWING SEAL AND SLOTTING
- GEOLOGIC CONTACT
- WATER LEVEL ENCOUNTERED DURING DRILLING
- STABILIZED WATER LEVEL ON OCTOBER 3, 1991
- • 17 SOIL SAMPLE LOCATION AND TOTAL PETROLEUM HYDROCARBONS AS GASOLINE CONCENTRATIONS IN PARTS PER MILLION
- ND NOT DETECTED AT OR ABOVE LABORATORY DETECTION LIMITS

FIGURE 3: HYDROGEOLOGIC CROSS SECTION A–A'

BP OIL COMPANY
SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
1000 Burnett Ave. Ste. 140

PROJECT NO. 30-0248

248-CSA

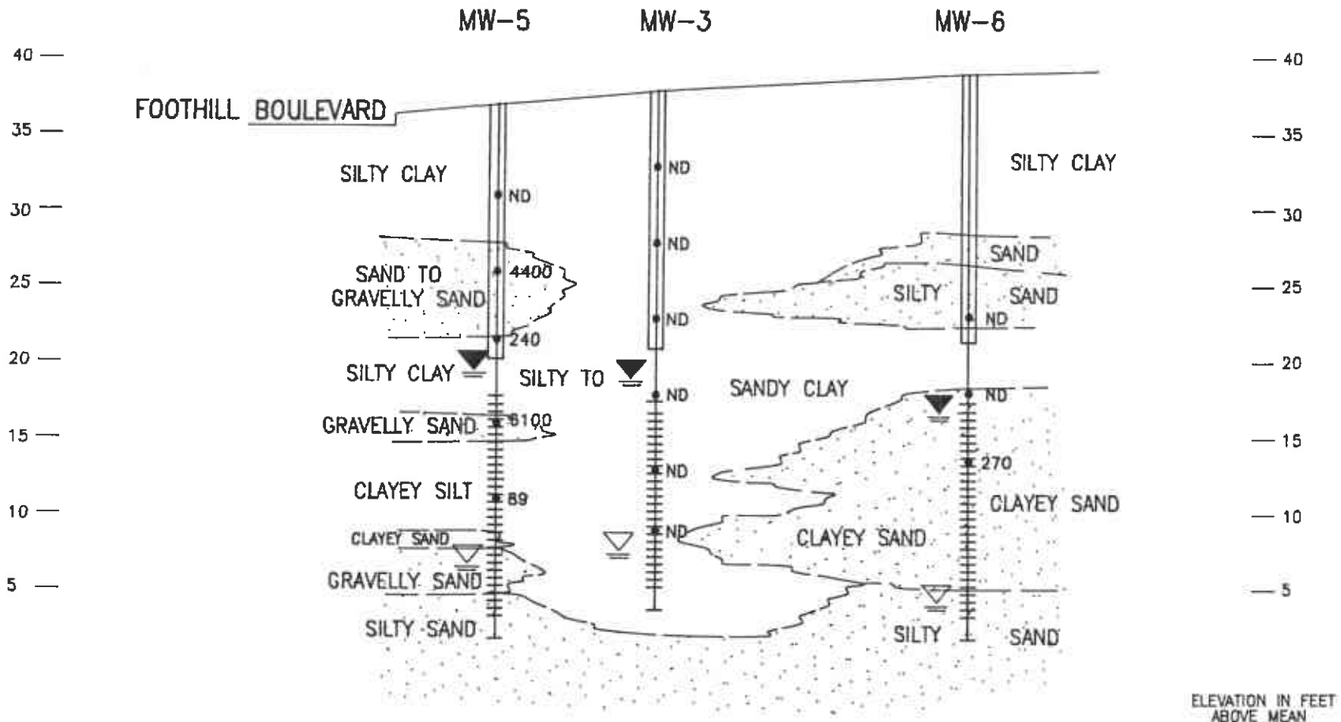
3/23/92

B

SOUTH

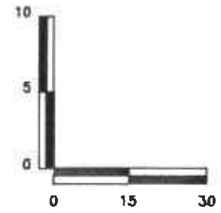
B'

NORTH



ELEVATION IN FEET ABOVE MEAN SEA LEVEL

PROJECT NO. 30-0248



APPROXIMATE SCALE IN FEET

LEGEND:

	GROUND WATER MONITORING WELL SHOWING SEAL AND SLOTTING
	GEOLOGIC CONTACT
	WATER LEVEL ENCOUNTERED DURING DRILLING
	STABILIZED WATER LEVEL ON OCTOBER 3, 1991
• 270	SOIL SAMPLE LOCATION AND TOTAL PETROLEUM HYDROCARBONS AS GASOLINE CONCENTRATIONS IN PARTS PER MILLION
ND	NOT DETECTED AT OR ABOVE LABORATORY DETECTION LIMITS

FIGURE 4: HYDROGEOLOGIC CROSS SECTION B-B'

BP OIL COMPANY
SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
Pleasanton, California

248-CSB

3/23/92

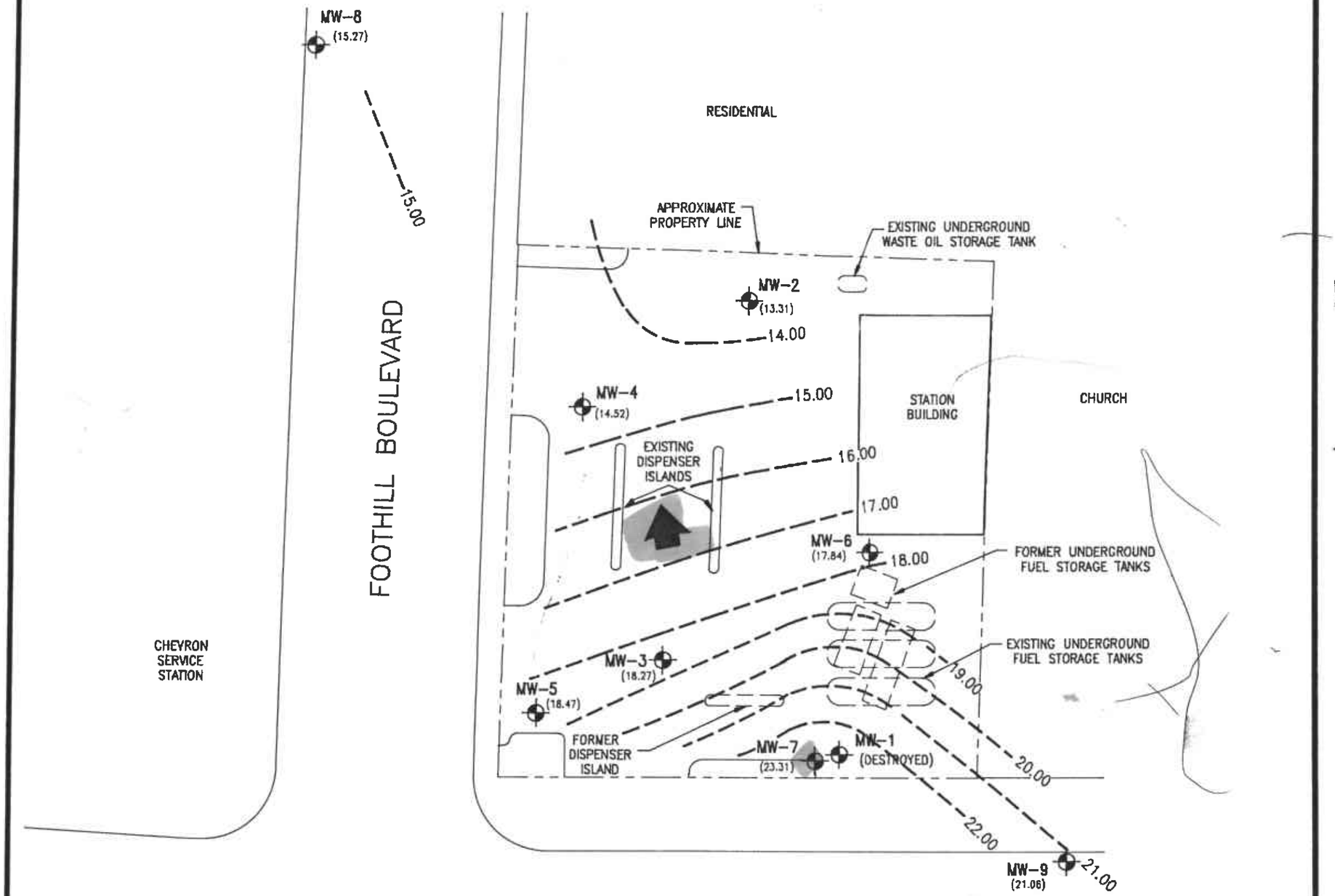


FIGURE 5: GROUND WATER POTENTIOMETRIC SURFACE CONTOUR MAP
(OCTOBER 3, 1991)

BP OIL COMPANY
SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

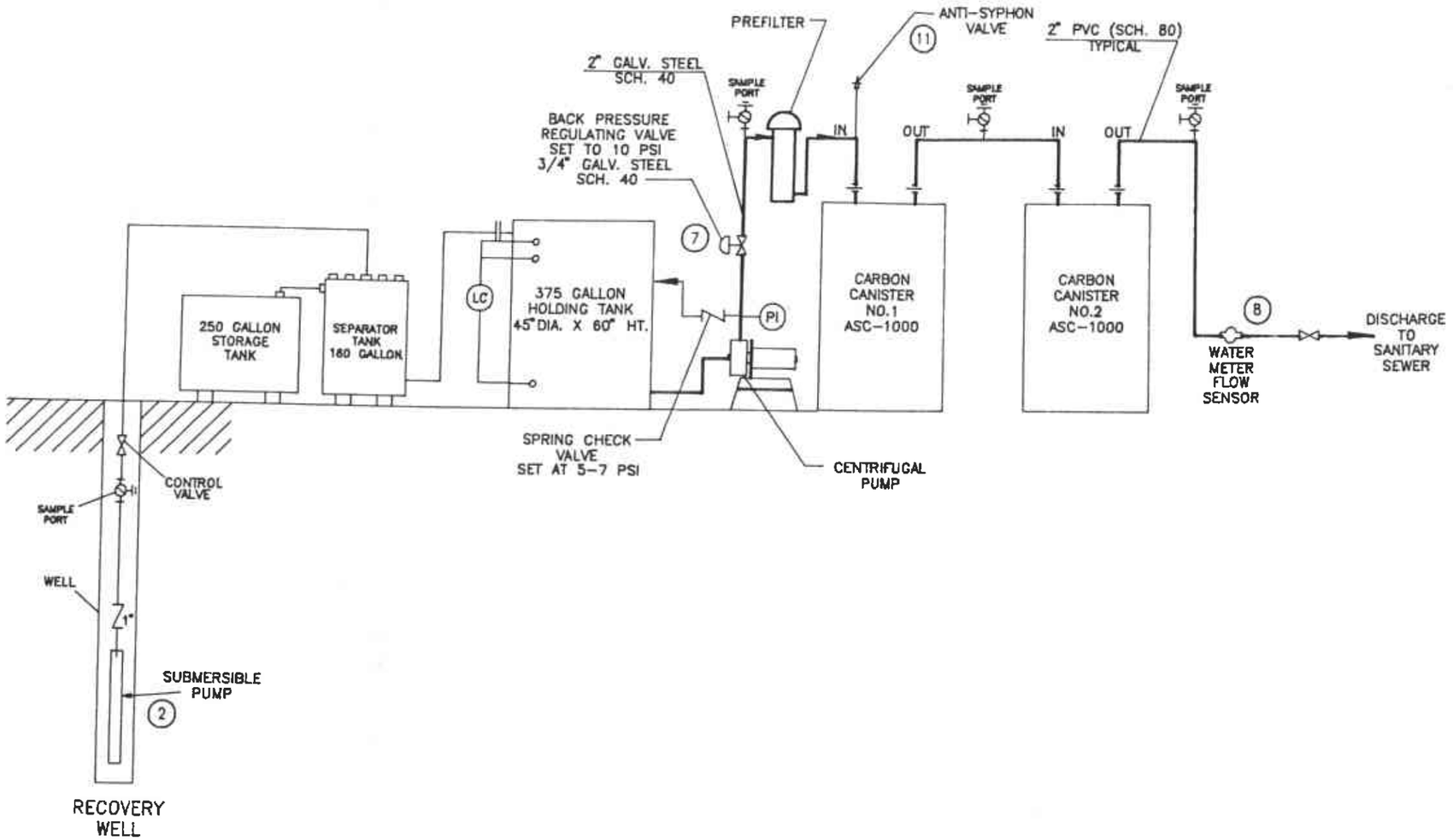
ALTON GEOSCIENCE
Pleasanton, California

SOURCE: BP OIL COMPANY & RON ARCHER CIVIL ENGINEER, INC.

PROJECT NO. 30-0248

248-GW

3/23/92



NOT TO SCALE

LEGEND:

VALVE AND PIPING SYMBOLS

- GATE VALVE
- CHECK VALVE
- BALL VALVE
- UNION
- CAMLOCK
- PI — PRESSURE INDICATOR
- LC — LEVEL CONTROL
- FLANGE

FIGURE 6: RECOVERY SYSTEM SCHEMATIC

BP OIL COMPANY
SERVICE STATION NO. 11109
4280 FOOTHILL BOULEVARD
OAKLAND, CALIFORNIA

ALTON GEOSCIENCE
Pleasanton, California

PROJECT NO. 30-0248

248-SCHM

3/2/92

Table 1
Survey and Water Level Monitoring Data and
Summary of Analytical Results of Ground Water Samples
BP Oil Company Service Station No. 11109
4280 Foothill Boulevard, Oakland, California
Elevation and Depth Measurements in feet above sea level

Concentrations in parts per billion (ppb)

WELL ID	DATE OF SAMPLING/ MONITORING	CASING ELEV.	DEPTH TO WATER	PRODUCT THICK-NESS	GROUND WATER ELEVATION	TPH-G	TPH-D	B	T	E	X	HVOC	TOG	LAB
MW-1	01/31/90	38.19	15.41	---	22.78	---	---	---	---	---	---	---	---	---
MW-1	02/05/90	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-2	02/05/90	38.21	21.91	---	16.3	1300	---	14	ND<1.0	9	13	---	---	SAL
MW-2	02/14/91	38.21	21.16	---	17.05	ND<50	ND<10000	ND<0.3	ND<0.3	ND<0.3	ND<0.3	51*	ND<5000	SAL
MW-2	05/13/91	38.21	21.32	---	16.89	ND<50	ND<50	ND<0.3	ND<0.3	ND<0.3	ND<0.3	0.5**	6000	SAL
MW-2	07/24/91	38.21	22.92	---	15.29	---	---	---	---	---	---	---	---	---
MW-2	10/03/91	38.21	24.90	---	13.31	ND<50	ND<50	ND<0.3	0.8	ND<0.3	ND<0.3	0.7**	ND<5000	SAL
MW-2	10/15/91	38.21	24.10	---	14.11	---	---	---	---	---	---	---	---	---
MW-2	12/04/91	38.21	INACCESSABLE		---	---	---	---	---	---	---	---	---	---
MW-2	12/16/91	38.21	23.95	---	14.26	---	---	---	---	---	---	---	---	---
MW-2	01/06/92	38.21	23.30	---	14.91	---	---	---	---	---	---	---	---	---
MW-2	01/22/92	38.21	23.14	---	15.07	---	---	---	---	---	---	---	---	---
MW-3	02/05/90	37.74	17.45	---	20.29	1400	---	15	ND<2.5	11	8	---	---	SAL
MW-3	02/14/91	37.74	18.52	---	19.22	320	---	8	ND<0.3	8	1	---	---	SAL
MW-3	05/13/91	37.74	19.32	---	18.42	640	---	13	ND<0.3	18	1	---	---	SAL
MW-3	07/24/91	37.74	20.69	---	17.05	---	---	---	---	---	---	---	---	---
MW-3	10/03/91	37.74	19.47	---	18.27	940	---	21	ND<0.3	23	2.1	---	---	SAL
MW-3	10/15/91	37.74	20.46	---	17.28	---	---	---	---	---	---	---	---	---
MW-3	12/04/91	37.74	18.29	---	19.45	---	---	---	---	---	---	---	---	---
MW-3	12/16/91	37.74	18.34	---	19.40	---	---	---	---	---	---	---	---	---
MW-3	01/06/92	37.74	18.50	---	19.24	---	---	---	---	---	---	---	---	---
MW-3	01/22/92	37.74	17.86	---	19.88	---	---	---	---	---	---	---	---	---

Table 1
Survey and Water Level Monitoring Data and
Summary of Analytical Results of Ground Water Samples
BP Oil Company Service Station No. 11109
4280 Foothill Boulevard, Oakland, California
Elevation and Depth Measurements in feet above sea level

Concentrations in parts per billion (ppb)

WELL ID	DATE OF SAMPLING/ MONITORING	CASING ELEV.	DEPTH TO WATER	PRODUCT THICK-NESS	GROUND WATER ELEVATION	TPH-G	TPH-D	B	T	E	X	HVOC	TOG	LAB
MW-4	02/05/90	37.09	20.75	---	16.34	620	---	ND<0.5	9	ND<0.5	10	---	---	SAL
MW-4	02/14/91	37.09	21.73	---	15.36	180	---	ND<0.3	ND<0.3	0.4	2	---	---	SAL
MW-4	05/13/91	37.09	18.55	---	18.54	72	---	0.7	ND<0.3	ND<0.3	ND<0.3	---	---	SAL
MW-4	07/24/91	37.09	21.31	---	15.78	---	---	---	---	---	---	---	---	---
MW-4	10/03/91	37.09	22.57	---	14.52	57	---	ND<0.3	ND<0.3	ND<0.3	ND<0.3	---	---	SAL
MW-4	10/15/91	37.09	22.88	---	14.21	---	---	---	---	---	---	---	---	---
MW-4	12/04/91	37.09	22.54	---	14.55	---	---	---	---	---	---	---	---	---
MW-4	12/16/91	37.09	22.59	---	14.50	---	---	---	---	---	---	---	---	---
MW-4	01/06/92	37.09	22.00	---	15.09	---	---	---	---	---	---	---	---	---
MW-4	01/22/92	37.09	21.58	---	15.51	---	---	---	---	---	---	---	---	---
MW-5	10/03/91	36.55	18.08	---	18.47	79000	---	13000	7400	1400	6200	---	---	SAL
MW-5	10/15/91	36.55	18.55	---	18.00	---	---	---	---	---	---	---	---	---
MW-5	12/04/91	36.55	18.44	---	18.11	---	---	---	---	---	---	---	---	---
MW-5	12/16/91	36.55	18.66	---	17.89	---	---	---	---	---	---	---	---	---
MW-5	01/06/92	36.55	19.12	---	17.43	---	---	---	---	---	---	---	---	---
MW-5	01/22/92	36.55	14.59	---	21.96	---	---	---	---	---	---	---	---	---
MW-6	10/03/91	38.57	20.73	---	17.84	ND<50	---	0.7	0.8	ND<0.3	1.3	---	---	SAL
MW-6	10/15/91	38.57	21.20	---	17.37	---	---	---	---	---	---	---	---	---
MW-6	12/04/91	38.57	21.26	---	17.31	---	---	---	---	---	---	---	---	---
MW-6	12/16/91	38.57	21.12	---	17.45	---	---	---	---	---	---	---	---	---
MW-6	01/06/92	38.57	20.29	---	18.28	---	---	---	---	---	---	---	---	
MW-6	01/22/92	38.57	20.12	---	18.45	---	---	---	---	---	---	---	---	
MW-7	10/03/91	37.64	14.93	---	22.71	360	---	62	13	3.4	20	---	---	SAL
MW-7	10/15/91	37.64	15.16	---	22.48	---	---	---	---	---	---	---	---	---
MW-7	12/04/91	37.64	15.41	---	22.23	---	---	---	---	---	---	---	---	---
MW-7	12/16/91	37.64	15.21	---	22.43	---	---	---	---	---	---	---	---	---
MW-7	01/06/92	37.64	14.56	---	23.08	---	---	---	---	---	---	---	---	---
MW-7	01/22/92	37.64	14.63	---	23.01	---	---	---	---	---	---	---	---	---

Table 1
Survey and Water Level Monitoring Data and
Summary of Analytical Results of Ground Water Samples
BP Oil Company Service Station No. 11109
4280 Foothill Boulevard, Oakland, California
Elevation and Depth Measurements in feet above sea level

Concentrations in parts per billion (ppb)

WELL ID	DATE OF SAMPLING/ MONITORING	CASING ELEV.	DEPTH TO WATER	PRODUCT THICK-NESS	GROUND WATER ELEVATION	TPH-G	TPH-D	B	T	E	X	HVOC	TOG	LAB
MW-8	10/03/91	35.18	22.37	---	12.81	ND<50	---	ND<0.3	0.6	ND<0.3	0.9	---	---	SAL
MW-8	10/15/91	35.18	22.70	---	12.48	---	---	---	---	---	---	---	---	---
MW-8	12/04/91	35.18	22.44	---	12.74	---	---	---	---	---	---	---	---	---
MW-8	12/16/91	35.18	22.47	---	12.71	---	---	---	---	---	---	---	---	---
MW-8	01/06/92	35.18	21.94	---	13.24	---	---	---	---	---	---	---	---	---
MW-8	01/22/92	35.18	21.44	---	13.74	---	---	---	---	---	---	---	---	---
MW-9	10/03/91	38.24	14.12	---	24.12	ND<50	---	ND<0.3	0.4	ND<0.3	ND<0.3	---	---	SAL
MW-9	10/15/91	38.24	14.27	---	23.97	---	---	---	---	---	---	---	---	---
MW-9	12/04/91	38.24	13.84	---	24.40	---	---	---	---	---	---	---	---	---
MW-9	12/16/91	38.24	14.18	---	24.06	---	---	---	---	---	---	---	---	---
MW-9	01/06/92	38.24	13.42	---	24.82	---	---	---	---	---	---	---	---	---
MW-9	01/22/92	38.24	13.75	---	24.49	---	---	---	---	---	---	---	---	---

EXPLANATION OF ABBREVIATIONS:

TPH-G :Total Petroleum Hydrocarbons as Gasoline (EPA method 8015 modified)
TPH-D :Total Petroleum Hydrocarbons as Diesel (EPA method 8015 modified)
B :Benzene (EPA method 8020 or 8240)
T :Toluene (EPA method 8020 or 8240)
E :Ethylbenzene (EPA method 8020 or 8240)
X :Xylenes (EPA method 8020 or 8240)

TOG :Total Oil & Grease (EPA method 503D & 503E)
HVOC :Halogenated Volatile Organic Compounds
--- :No analysis conducted. Monitoring Well MW-1 was not analyzed due to the presence of free-floating product
ND :Not detected above reported detection limits
* :Methylene Chloride
** :1,2-Dichloroethane
SAL :Superior Analytical Lab

Note: Top of casing elevations for all wells are surveyed relative to the City of Oakland survey station, with an elevation of 42.19 feet above mean sea level.

Note: Results of analysis from MW-4 on 10/3/91 ground water sampling revealed a non-standard gasoline pattern.

TABLE 2

Summary of Analytical Results of Soil Samples
BP Oil Company Service Station No. 11109
4280 Foothill Boulevard, Oakland, California

Project No.: 30-0248

Concentrations in parts per million (ppm)

SAMPLE ID	DATE OF SAMPLING	SAMPLE DEPTH (feet)	TPH-G	B	T	E	X	TOTAL ORGANIC PB	LAB
MW-3	01/29/90	5	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-3	01/29/90	10	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-3	01/29/90	15	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-3	01/29/90	20	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-3	01/29/90	25	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-3	01/29/90	29	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-4	01/30/90	5	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-4	01/30/90	10	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-4	01/30/90	15	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-4	01/30/90	20	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-4	01/30/90	25	16	ND<.050	ND<.050	ND<.050	.170	---	SAL
MW-4	01/30/90	29	ND<1	ND<.005	ND<.005	ND<.005	ND<.005	---	SAL
MW-5	09/09/91	6	ND<1	.003	ND<.003	ND<.003	.003	ND<2	SAL
MW-5	09/09/91	11	4400	8.5	58	55	260	ND<2	SAL
MW-5	09/09/91	15.5	240	1	1.4	2.5	9.5	ND<2	SAL
MW-5	09/09/91	21	6100	14	47	34	120	---	SAL
MW-5	09/09/91	26	89	.23	.390	.5	1	---	SAL
MW-6	09/09/91	16	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL
MW-6	09/09/91	21	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL
MW-6	09/09/91	25.5	270	ND<.030	.780	.340	.510	---	SAL
MW-7	09/10/91	6	310	ND<.150	.860	.690	1.6	ND<2	SAL
MW-7	09/10/91	9.5	11	ND<.003	.035	.013	.028	ND<2	SAL
MW-7	09/10/91	13	38	.120	.110	.089	.120	ND<2	SAL
MW-7	09/10/91	18.5	17	.053	.035	.160	.098	ND<2	SAL
MW-7	09/10/91	24	ND<1	.003	ND<.003	.003	ND<.003	ND<2	SAL

TABLE 2

Summary of Analytical Results of Soil Samples
BP Oil Company Service Station No. 11109
4280 Foothill Boulevard, Oakland, California

Project No.: 30-0248

Concentrations in parts per million (ppm)

SAMPLE ID	DATE OF SAMPLING	SAMPLE DEPTH (feet)	TPH-G	B	T	E	X	TOTAL ORGANIC PB	LAB
MW-8	09/11/91	16	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL
MW-9	09/11/91	10.5	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL
MW-9	09/11/91	16	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL
MW-9	09/11/91	21	ND<1	ND<.003	ND<.003	ND<.003	ND<.003	---	SAL

EXPLANATION OF ABBREVIATIONS:

TPH-G :Total Petroleum Hydrocarbons as Gasoline
B :Benzene
T :Toluene
E :Ethylbenzene
X :Xylenes
ND :Not detected above given detection limits
SAL :Superior Analytical Lab

APPENDIX A

SENSITIVE RECEPTORS SURVEY FORM

SENSITIVE RECEPTORS SURVEY
SITE SURVEY AND LITERATURE SEARCH

Client: BP Oil Company Project No.: 30-0248

Station No.: 11109

Location: 4280 Foothill Blvd.

City/State: Oakland, CA

I. Provide answers to the following questions:

A. Is there a public water supply well within 2500 feet? Y/N N
If Yes, Distance _____ ft.

B. Is there a private water supply well within 1000 feet? Y/N N
If Yes, Distance _____ ft.

C. Is there a subway within 1000 feet? Y/N N
If Yes, Distance _____ ft.

D. Is there a basement within 1000 feet? Y/N UNK
If Yes, Distance _____ ft.

E. Is there a school within 1000 feet? Y/N Y
If Yes, Distance 100 ft.

F. Is there a surface body of water within 1000 feet? Y/N N
If Yes, Distance _____ ft.
Name _____

II. Describe type of local water supply.

Public: East Bay Municipal Utility District (EBMUD)

- Suppliers Name: EBMUD
- Suppliers Source: Reservoirs in the Sierra Nevada Mtns.
- Distance to Site: Greater than 100 miles

Private: None

SENSITIVE RECEPTORS SURVEY
SITE SURVEY AND LITERATURE SEARCH

III. Distance to Nearest Adjacent Properties:

Residential	0 ft.
Commercial	60 ft.
Industrial	4,000 ft.
Hospital	6,000 ft.
School (Fremont High School)	100 ft.
	Name

IV. Aquifer Classification, if available.

Class I	- Special Ground Waters	
	- Irreplaceable Drinking Water Source	
	- Ecologically Vital	
Class II	- Current and Potential Drinking Water Sources	
Class III	- Not Potential Source of Drinking Water	X

V. Describe observation wells, if any.

Number	8
Free Product?	Y/N Y

VI. Signature of Preparer: [signature]

Date: 1/29/92

VII. Sketch of Site

See Attached

APPENDIX B

SUMMARY OF AQUIFER TESTING RESULTS AND ANALYSIS

SUMMARY OF AQUIFER TESTING RESULTS AND ANALYSIS

Slug tests, step pumping tests, and a constant rate pumping test were performed to determine the aquifer characteristics at the site for use in the design of a ground water remediation system.

Analysis of Aquifer Parameters by Slug Test

On October 15, 1991, slug tests were conducted on Monitoring Wells MW-4, MW-6, and MW-7. Prior to conducting the slug tests, depth to water was measured in each of the wells. The tests were performed using a data logger with pressure sensitive transducers and a solid PVC slug.

The PVC slug was introduced into the well and the water level was allowed to stabilize. The slug was then removed as smoothly and rapidly as possible to produce a nearly instantaneous drop in water level. The transducer and data logger were used to record the rise in water level as the well recovered. The well was monitored until the water level had recovered at least 80 percent of the induced drawdown.

Transmissivity (T) and hydraulic conductivity (K) values were calculated using the aquifer testing program AQTESOLV (Geraghty and Miller 1989) to fit the data curves to a Cooper et al. (1978) theoretical solution for slug tests in a confined aquifer. Using this method it was calculated that:

Well ID	T, ft/min	K, ft/day
MW-4	0.0002	0.07
MW-6	0.0019	0.19
MW-7	0.0020	0.16

Analysis of Aquifer Parameters by Step Test

On October 29, 1991, a step drawdown test was performed on MW-7. Three steps were performed at pumping rates (Q) of 0.25, 0.5, and 1.1 gallons per minute (gpm). The rate of drawdown in the well at these pumping rates was used to estimate an optimum flow rate for the extended test.
On January 15, 1992, a step drawdown test was performed on MW-5. Two steps were performed at pumping rates (Q) of 0.5 and 0.75 gallons per minute (gpm).

The Birsoy and Summers (1980) method was used to calculate an adjusted time for the pumping rates or "steps" for both tests. A plot of corrected drawdown vs. the logarithm of the corrected time is presented in Appendix H. The transmissivity is calculated from the slope of the line of each step:

MW-5	R^2	T, ft^2/min	K, ft/day
Step 1	0.97	0.0012	0.10
Step 2	0.97	0.0028	0.20

MW-7	R^2	T, ft^2/min	K, ft/day
Step 1	0.96	0.0015	0.12
Step 2	0.99	0.0029	0.23
Step 3	0.96	0.0017	0.13

R^2 is a correlation coefficient, and indicates how closely the theoretical slope matches the actual slope of the data. An ideal match will have an R^2 of 1.

Analysis of Aquifer Parameters by Extended Pumping Test

On November 8, 1991, an extended aquifer pumping test was performed. Prior to initiating the pumping test all wells onsite were opened and allowed to stabilize for 2 hours. Transducers were placed in the pumping well (MW-7) and three observation wells, located at 48 feet (MW-3), 58 feet (MW-6), and 75 feet (MW-9) from the pumping well. An Instrumentation Northwest TERRA 8 data logger was programmed to record readings from the transducers every 15 seconds for the first 30 minutes after pumping began, every minute for the next hour, and every 2 minutes for the duration of the test.

Depth to water measurements in MW-2, MW-4, and MW-5 were measured every hour for the duration of the test and for 2 hours after the pump was shut down. These measurements were made using an electronic probe accurate to 0.01 foot.

The test was conducted for 8 hours at a constant flow rate of 0.4 gpm. During the pumping test it was found that the water level in Observation Wells MW-6 and MW-9 decreased, presumably in response to the pumping, but the water level in Observation Well MW-3, located 48 feet from the pumping well, rose approximately 0.5 feet during the first 4 hours of the test, then fell gradually for the remaining 4 hours. The water level in MW-5 rose approximately 0.65 feet during the 8 hours of the pumping test. Water levels in MW-2 and MW-4 remained constant throughout the test.

A rise in water level indicates that some unknown source is affecting the aquifer behavior; offsite pumping or irrigation, utility leakage, expansion, or contraction of the aquifer in response to pressure changes, or infiltration of rain water can all affect an aquifer. It must be assumed that this rise in water level may have seriously affected the pumping test results.

After review of the site geology, it was determined that the aquifer in the southern area of the site is probably confined or semi-confined. Given this assumption AQTESOLV was used to calculate the storativity (S), and transmissivity (T), based on the Hantush (1960) solution for leaky/confined aquifers:

Well ID	S	T, ft^2/min	K, ft/day
MW-6	0.0026	0.0025	0.21
MW-9	0.0006	0.0061	0.57

Discussion of Results

The hydraulic conductivity values calculated from the slug tests, step tests, and extended pumping test are all fairly consistent. Review of the site geology indicates that the soil underlying the site consists primarily of silty to sandy clay with sandy layers. Silty clay generally has a hydraulic conductivity less than 0.1 ft/day, (Fetter, 1980) but the presence of sandy material would be expected to increase the conductivity of the aquifer.

After completion of the pumping test, a numerical model (FLOWPATH, Franz and Guiger, 1990) was used to model the observed drawdown at the observation wells during the pumping test. Calculations were performed assuming an average hydraulic conductivity of 0.2 ft/day (the average of all the tests) and 0.57 ft/day (the maximum value calculated from the extended test).

Assuming K = 0.2 ft/day, the program calculated a steady state drawdown greater than that which was observed during the extended test. However, the unexpected behavior of the wells onsite makes it impossible to accurately assess the true drawdown in the observation wells. It should also be noted that FLOWPATH is a two-dimensional model, and assumes that the system is in a steady state; a condition which was not reached during the 8 hours of the extended pumping test. A calculation performed using a value of K = 0.57 ft/day indicated slightly less drawdown in the observation wells.

The radius of influence of a one-year capture zone calculated from the pumping test results is shown in Appendix A. The following table presents the predicted results using the listed parameters in the FLOWPATH computer model.

RESULTS OF CAPTURE ZONE MODELING

PUMP RATE (gpm)	HYDRAULIC CONDUCT-IVITY (ft/day)	1 YR DOWN-GRADIENT CAPTURE ZONE RADIUS (ft)	1 YR UP-GRADIENT CAPTURE ZONE RADIUS (ft)	1 YR CROSS-GRADIENT CAPTURE ZONE RADIUS (ft)
0.40	0.2	30	60	45
0.40	0.57	15	95	45

These results are highly dependent upon the steep gradient assumed to exist at this site. This calculated gradient may be partially a function of the monitoring well screen interval, and may not be truly defined by the site investigation. If this is the case, the calculated capture zone may be a poor prediction of the actual ground water capture which will be generated at this site.

It is recommended that after system installation, the induced drawdown in all wells at the site be carefully monitored. The observed behavior of the pieziometric surface in the wells will help establish the parameters of the aquifer system, and act as a guide to system efficiency and effectiveness.

REFERENCES

AQTESOLV: Aquifer Test Solver. 1989. G. M. Duffield and J. Rumbaugh, Geraghty and Miller Modeling Group. Reston, VA.

Birsoy, Y.K., and W.K. Summers. 1980. "Determination of Aquifer Parameters from Step Tests and Intermittent Pumping Data" Ground Water, 18, pp. 137-146.

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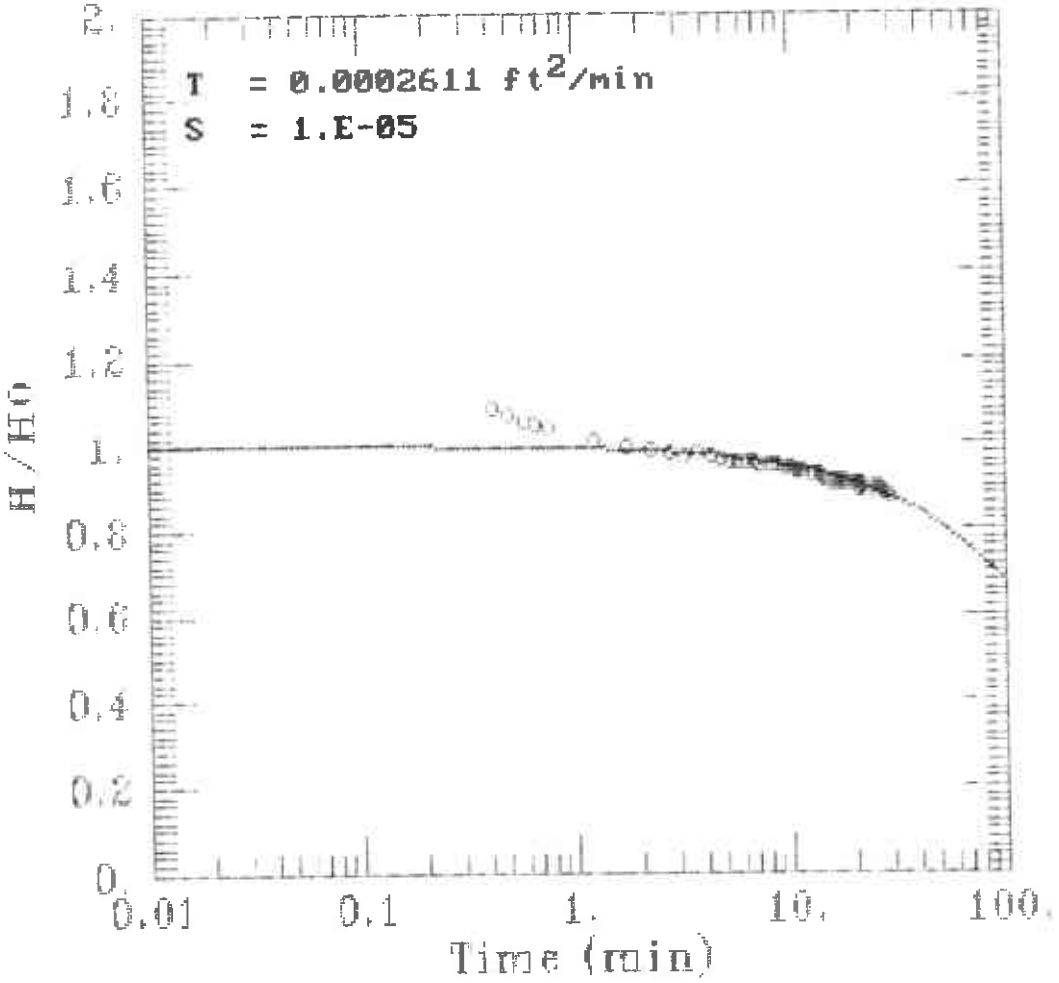
Fetter, C.W. 1980. "Applied Hydrogeology". Charles E. Merrill Publishing Co. Columbus, Ohio.

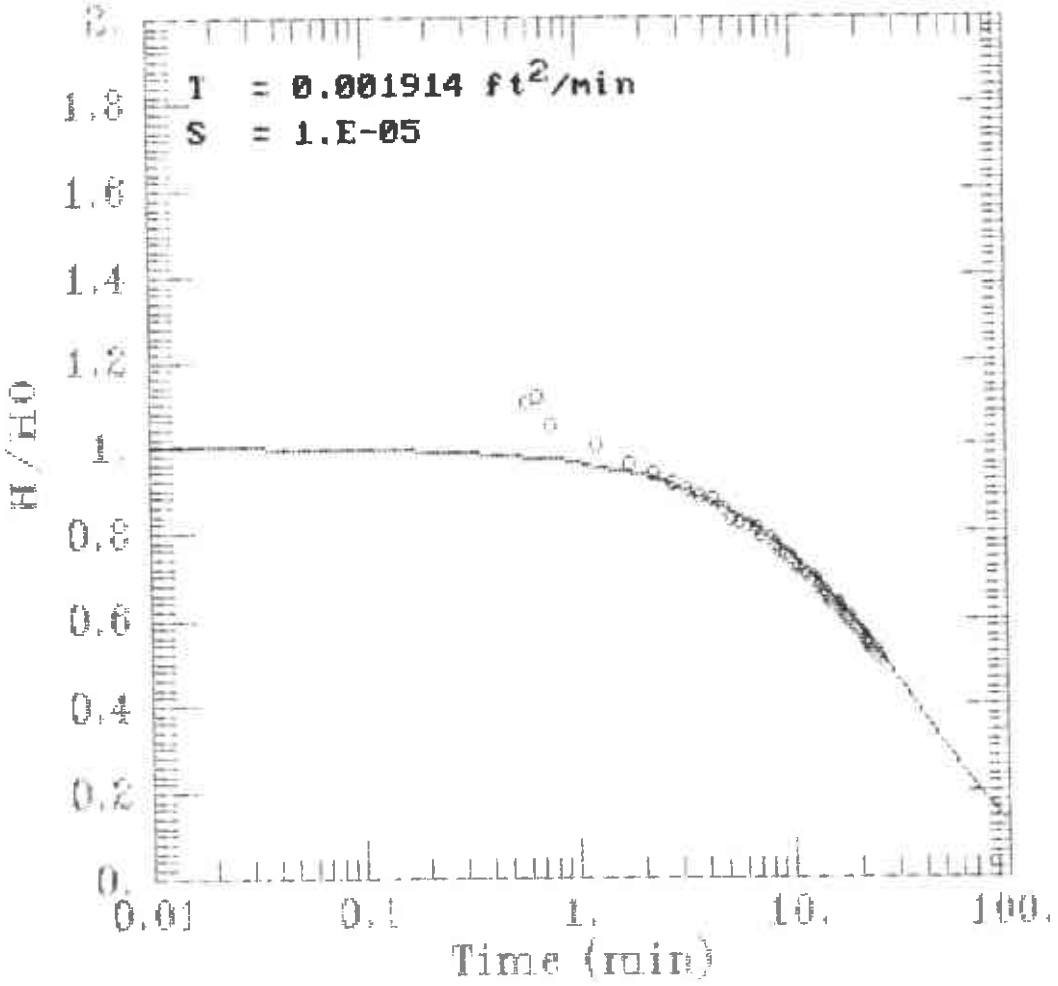
Flowpath: Two Dimensional Horizontal Aquifer Simulation Model. 1990. T. Franz and N. Guiger, Waterloo Hydrogeologic Software, Ontario, Canada.

Hantush, M.S. 1960. "Modification of the Theory of Leaky Aquifers", Journal of Geophys. Res., Vol. 65, No. 11, pp. 3713-3725.

MW-4 SLUG OUT


T = 0.0002611 ft²/min
S = 1.E-05
H / H0
2.
1.8
1.6
1.4
1.2
1.
0.8
0.6
0.4
0.2
0.
0.01
0.1
1.
10.
100.
Time (min)

MW-6 SLUG OUT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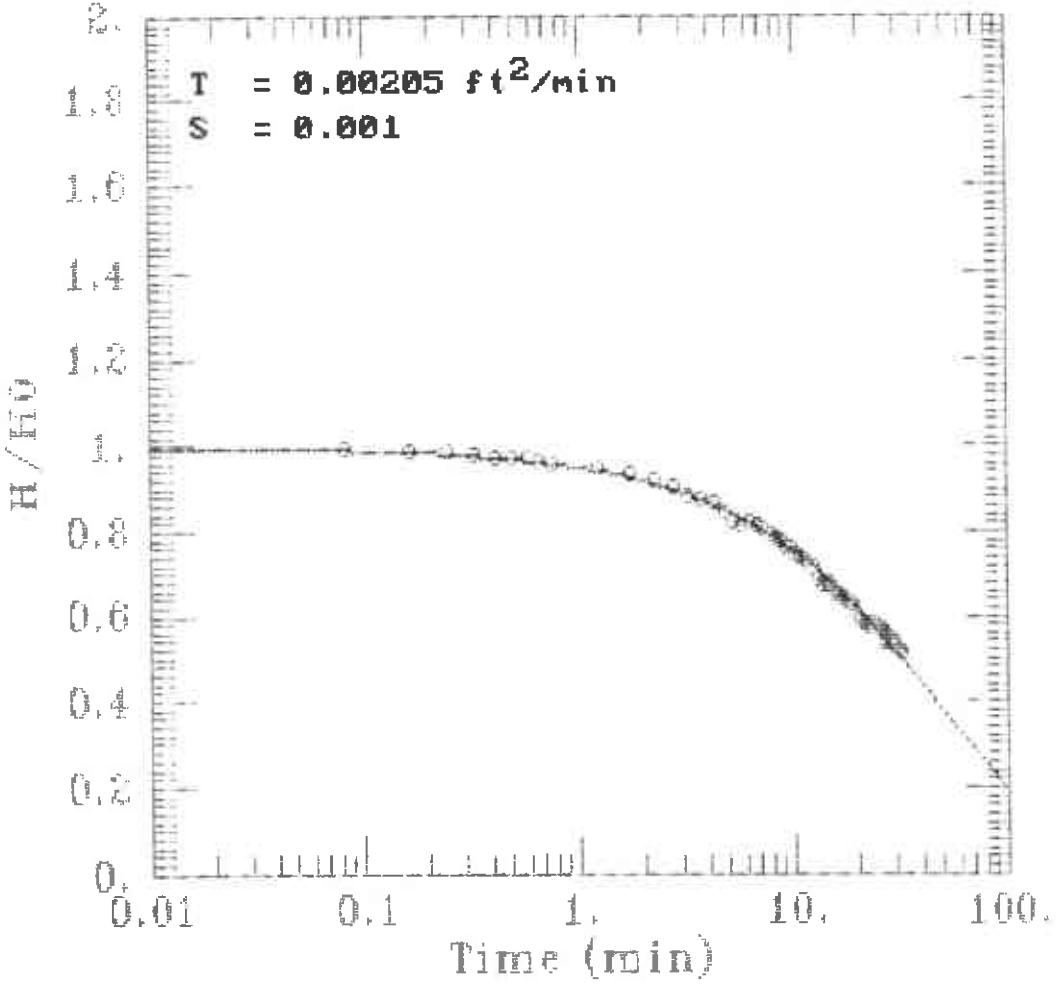
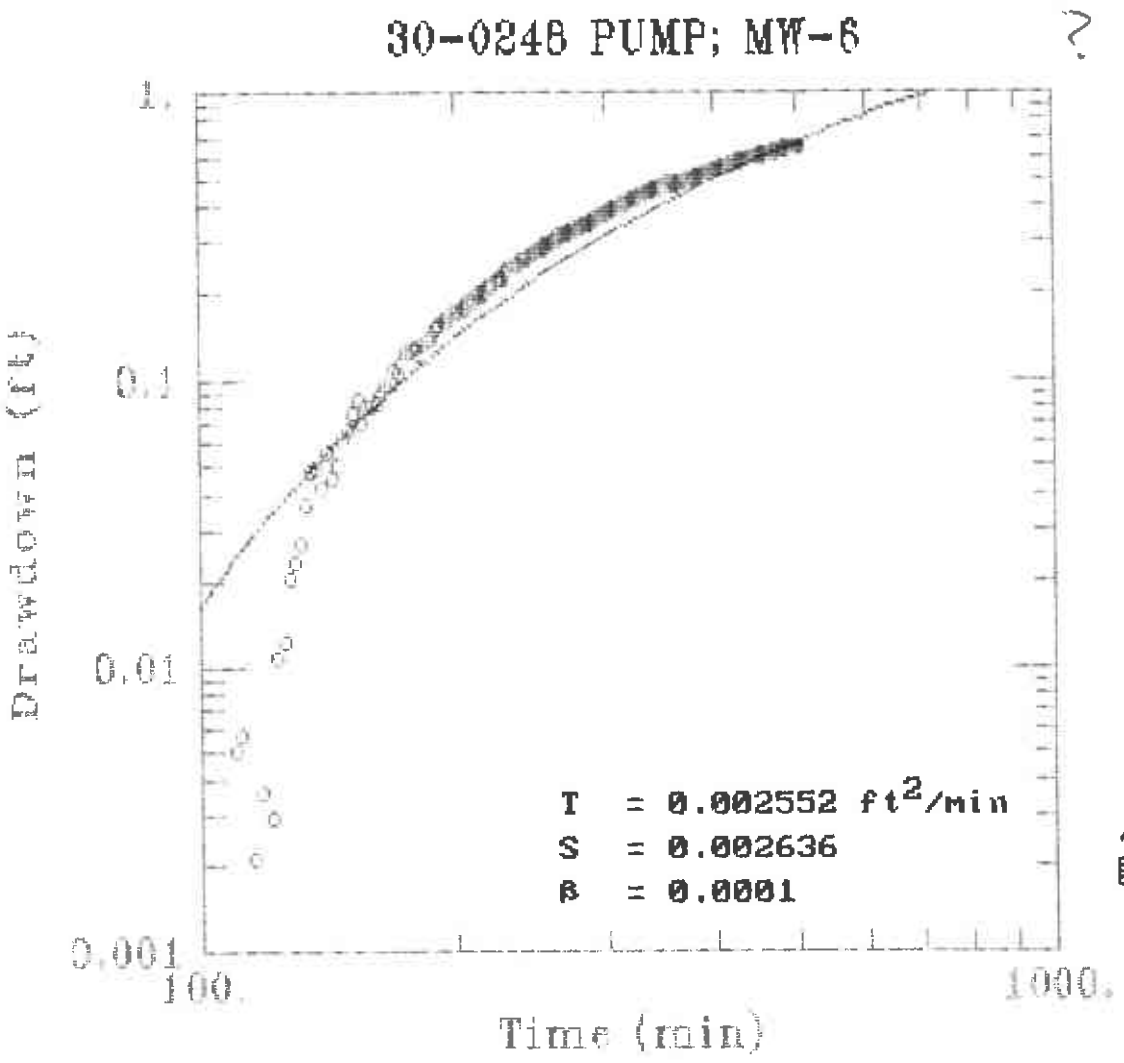
S = 1.E-05
H/H0
2.
1.8
1.6
1.4
1.2
1.
0.8
0.6
0.4
0.2
0.
0.01
0.1
1.
10.
100.
Time (min)

MW-7 SLUG OUT



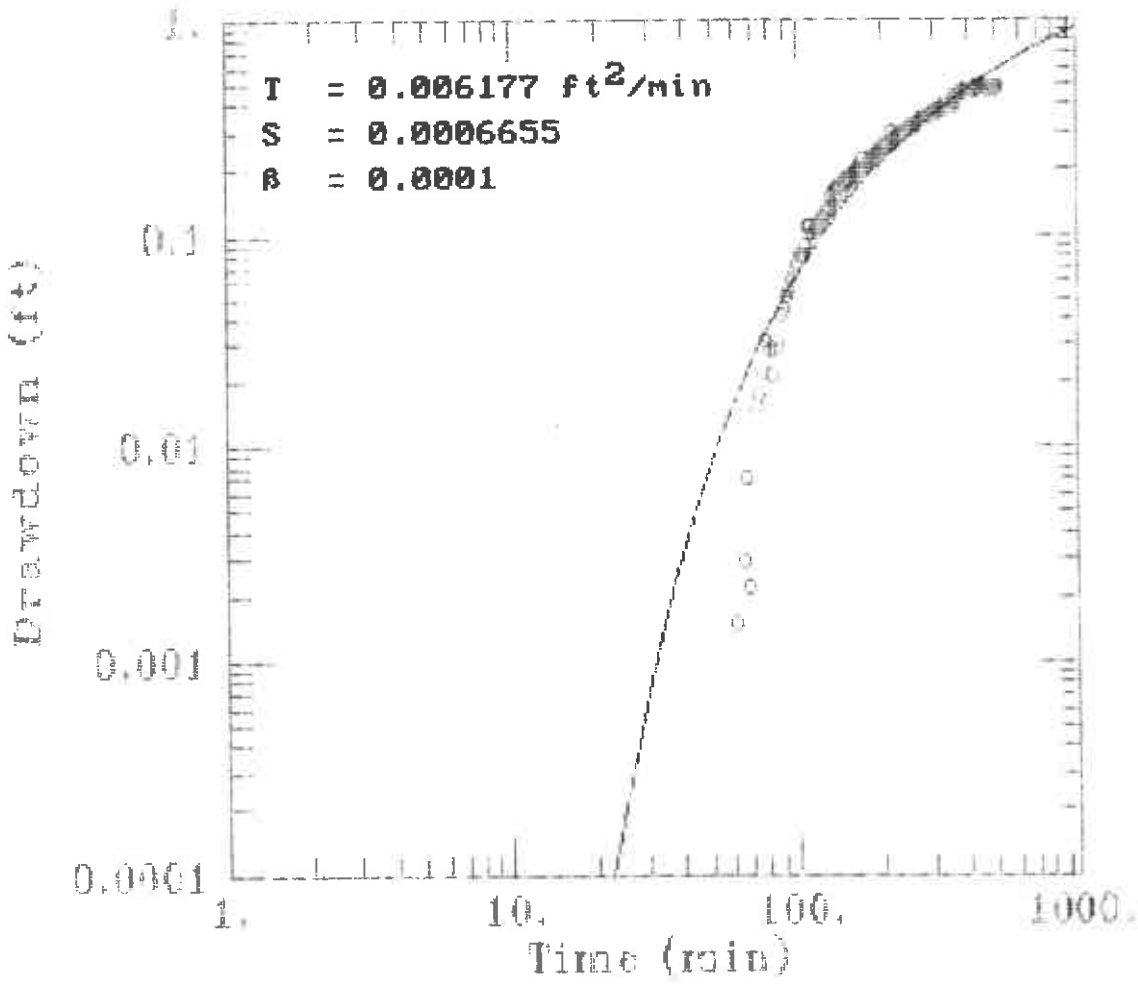


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

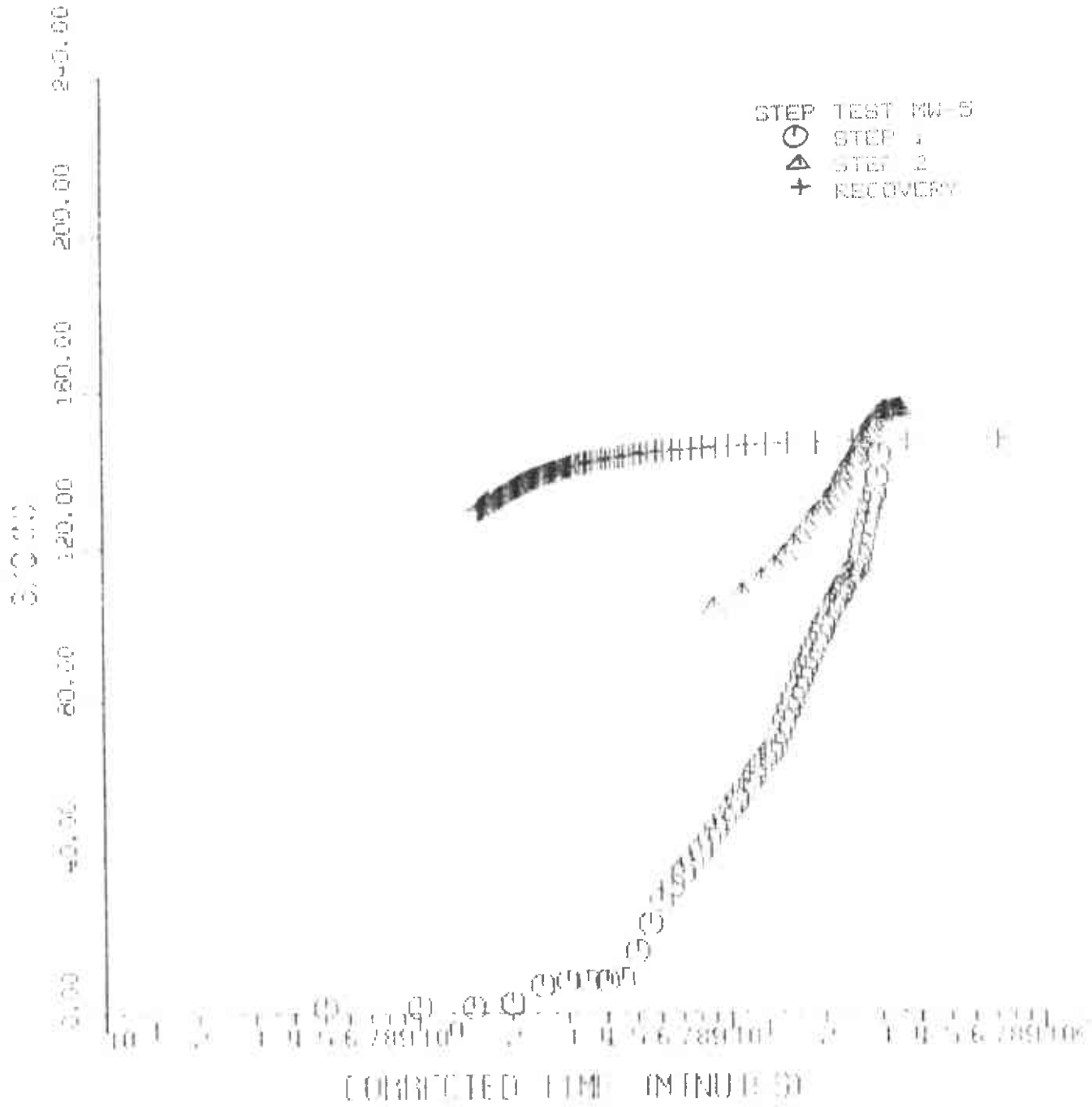
30-0248 PUMP TEST; MW-9

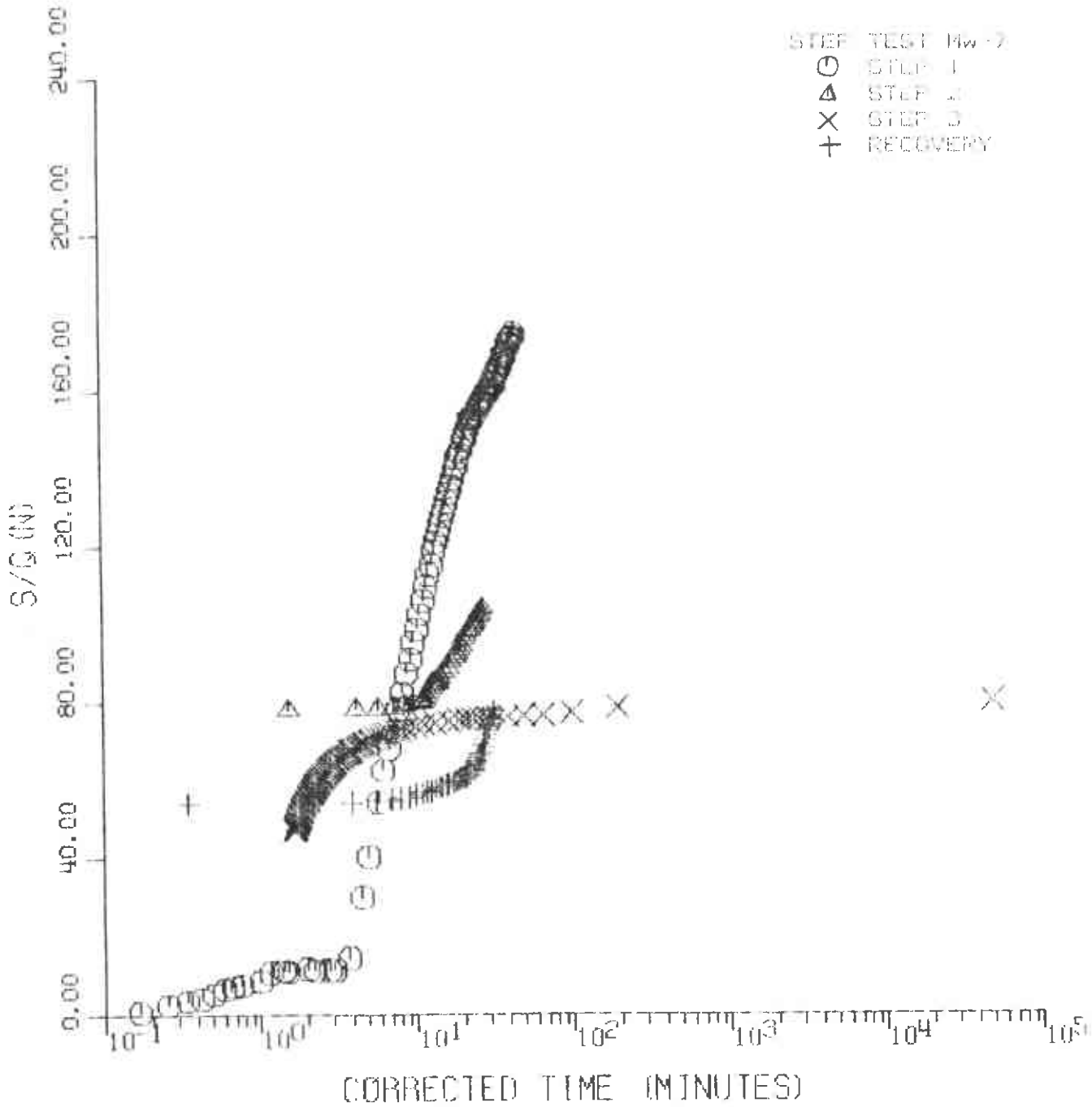


AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group


STEP TEST MW-5
STEP 1
STEP 2
RECOVERY
240.00
200.00
160.00
120.00
80.00
40.00
0.00
CORRECTED TIME (MINUTES)


STEP TEST (Mw = ?)
STEP 1
STEP 2
STEP 3
RECOVERY
S/S (N)
0.00
40.00
80.00
120.00
160.00
200.00
240.00
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
10^{5}
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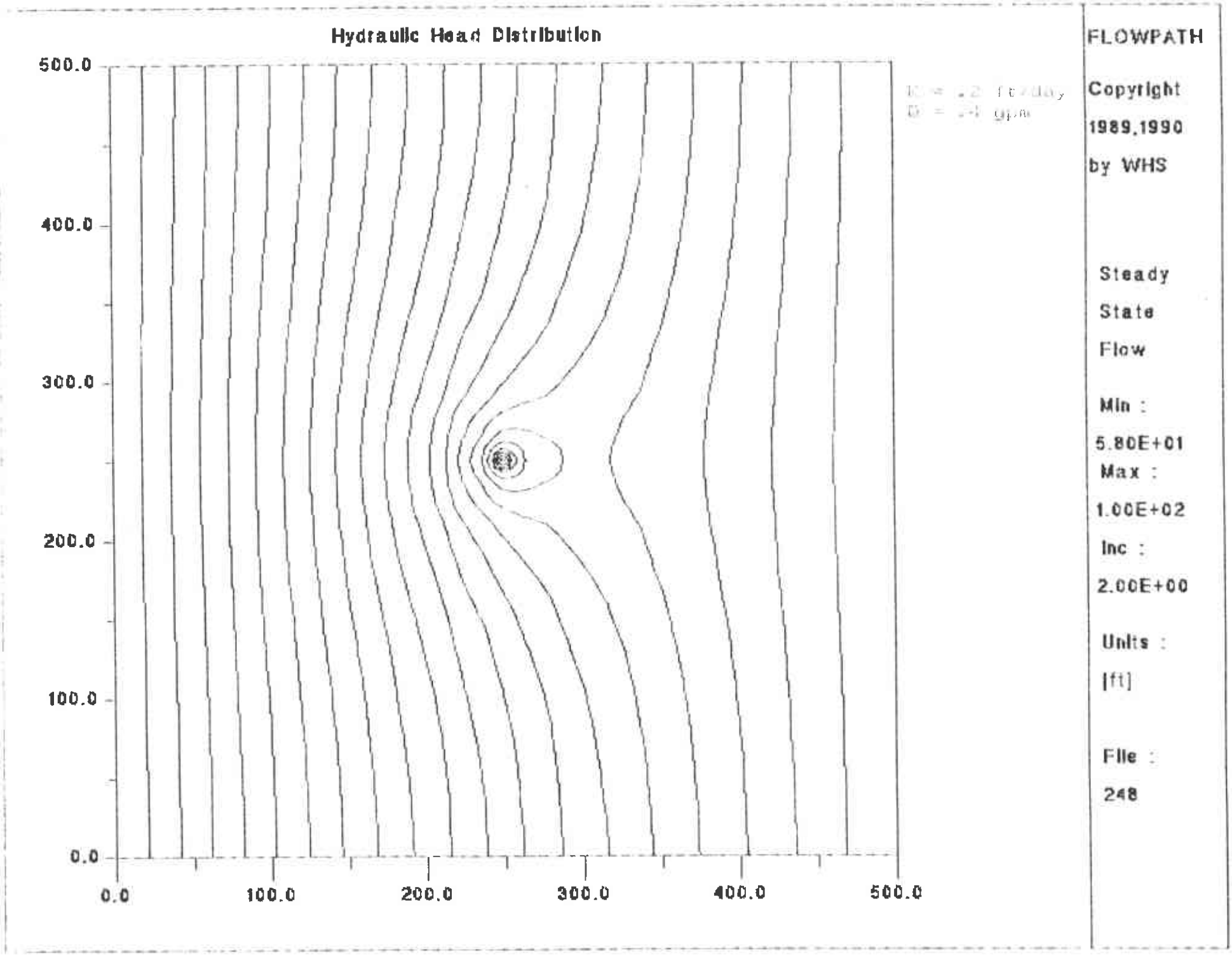
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FLOWPATH
Copyright
1989,1990
by WHS
Steady
State
Flow
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Inc :
2.00E+00
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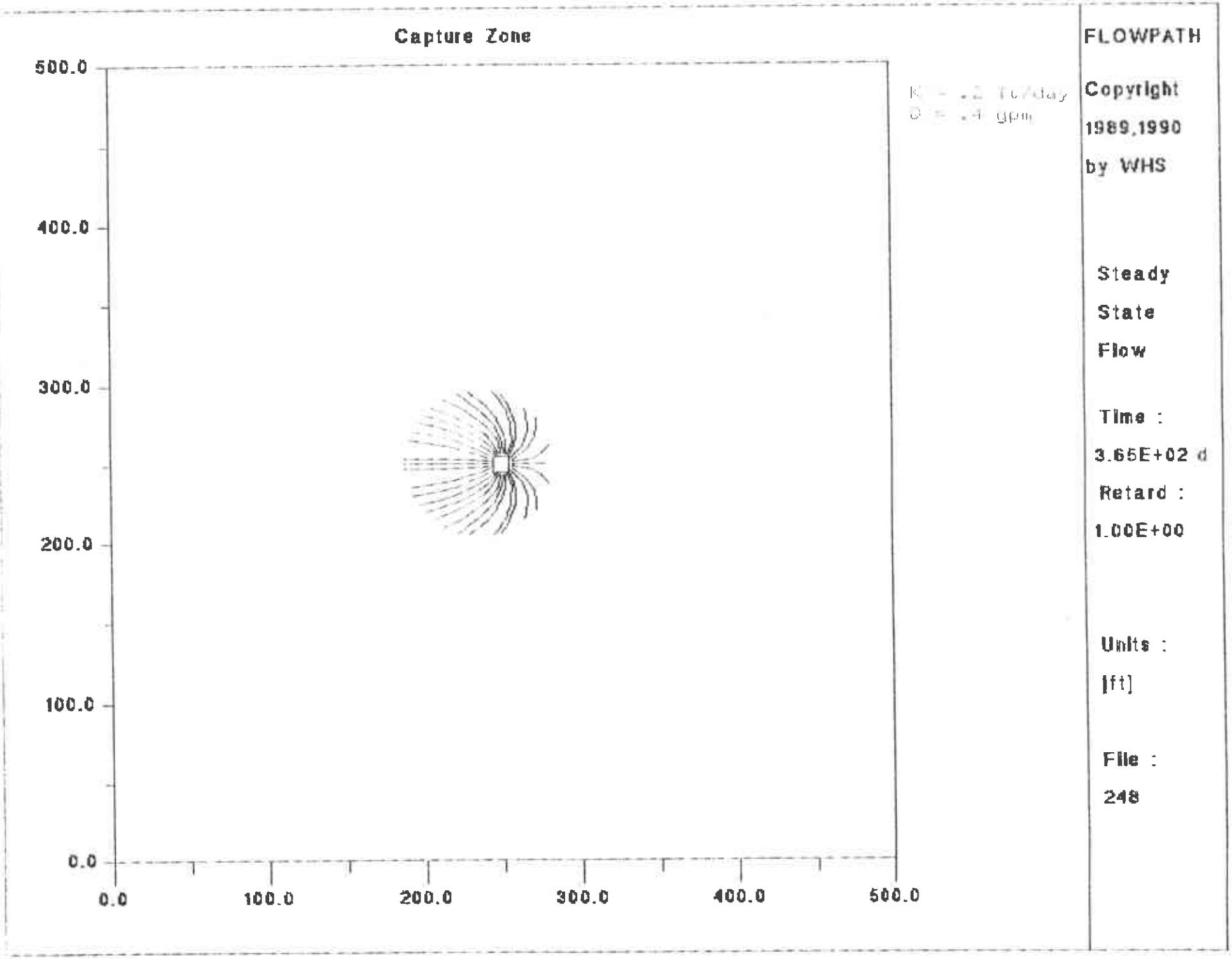
File :
248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by WHS
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Units :
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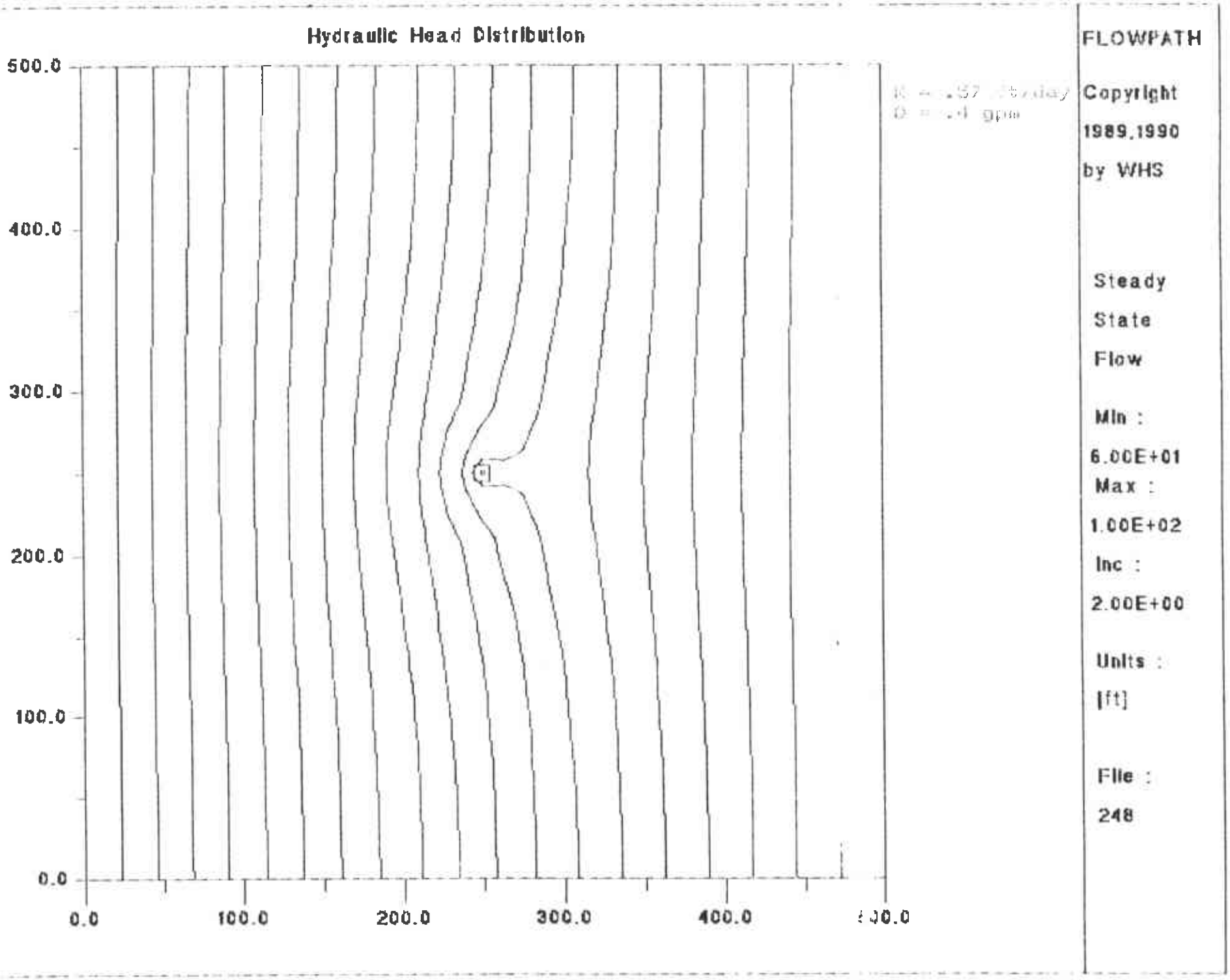
File :
248


Hydraulic Head Distribution
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FLOWPATH
Copyright
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by WHS
Steady
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Max :
1.00E+02
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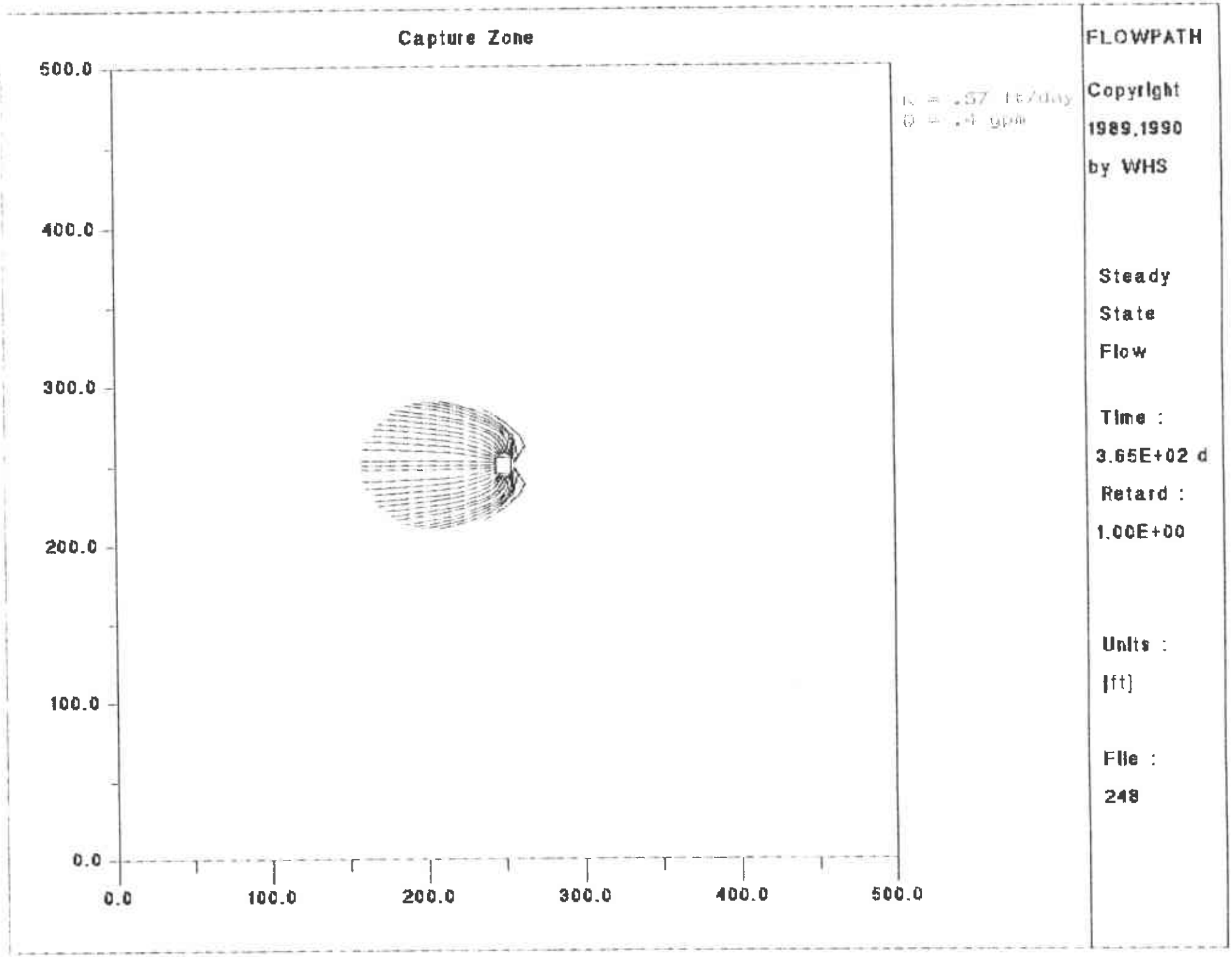
Units :
[ft]
File :
248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FLOWPATH
Copyright
1989,1990
by WHS
Steady
State
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Retard :
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Units :
[ft]
File :
248

APPENDIX C

REMEDIAL ALTERNATIVES, SCREENING CONSIDERATIONS, AND OPTIONS

APPENDIX C

REMEDIAL ALTERNATIVES, SCREENING CONSIDERATIONS, AND OPTIONS

There are numerous combinations of available remedial technologies for site cleanup. Selection of the appropriate remedial option(s) is site specific and depends on the geology, hydrology, type, extent, and concentrations of hydrocarbons in the subsurface, as well as regulatory requirements. According to the California Department of Health Services, California Site Mitigation Decision Tree Manual (CADOHS 1986), the National Oil and Hazardous Substances Contingency Plan (NCP) specifies that remedial alternatives should be classified either as source control or offsite remedial actions (management of migration). Remedial options for this site are classified as source control options because the following conditions are met (CADOHS 1986):

- The known and suspected chemical contamination at the site is restricted to near its original location.
- The remedial technologies considered are onsite control measures, including removal and offsite disposal or treatment at a facility approved under the Resource Conservation and Recovery Act (RCRA).
- It will prevent or minimize offsite releases of contaminants.

The screening of site specific remedial alternatives must take into consideration five criteria that are evaluated based on two factors; these are presented below (CADOHS 1986):

Remedial Alternative Criteria

1. Performance
   - Effectiveness
   - Useful life
2. Reliability
   - Operation and maintenance requirements
   - Demonstrated and expected reliability
3. Implementability
   - Site conditions affecting constructability
   - External factors affecting implementation

4. Time

- Time to implement
- Time to see beneficial results

5. Safety

- Safety and health of workers
- Safety and health of nearby communities

General Response Actions and Associated Remedial Technologies (Waste Oil):

1. Waste and Soil Excavation and Removal

- Excavation/removal: backhoe, excavator
- Grading
- Capping
- Revegetation

2. In Situ Treatment Methods

- Bioreclamation

3. Direct Waste Treatment

- Incineration
- Treatment of aqueous and liquid waste streams: biological treatment techniques, chemical treatment techniques, physical treatment techniques, discharge to POTW
- Solidification/stabilization/fixation

4. Land Disposal Storage

- Landfills
- Surface impoundments

General Response Actions and Associated Remedial Technologies (Dissolved-Phase, Gasoline-Range Petroleum Hydrocarbons):

1. Ground Water Controls

- Capping
- Containment barriers: vertical barriers
- Ground water pumping
- Subsurface collection drains

2. In Situ Treatment Methods

- Bioreclamation

3. Direct Waste Treatment

- Biological treatment techniques: trickling filters, rotating biological discs, fluidized bed bioreactors
- Chemical treatment techniques: UV/peroxidation
- Physical treatment techniques: activated carbon, air stripping
- Discharge to POTW

According to the NCP, Section 300.68, the remedial option selected should be "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, or the environment."

APPENDIX D

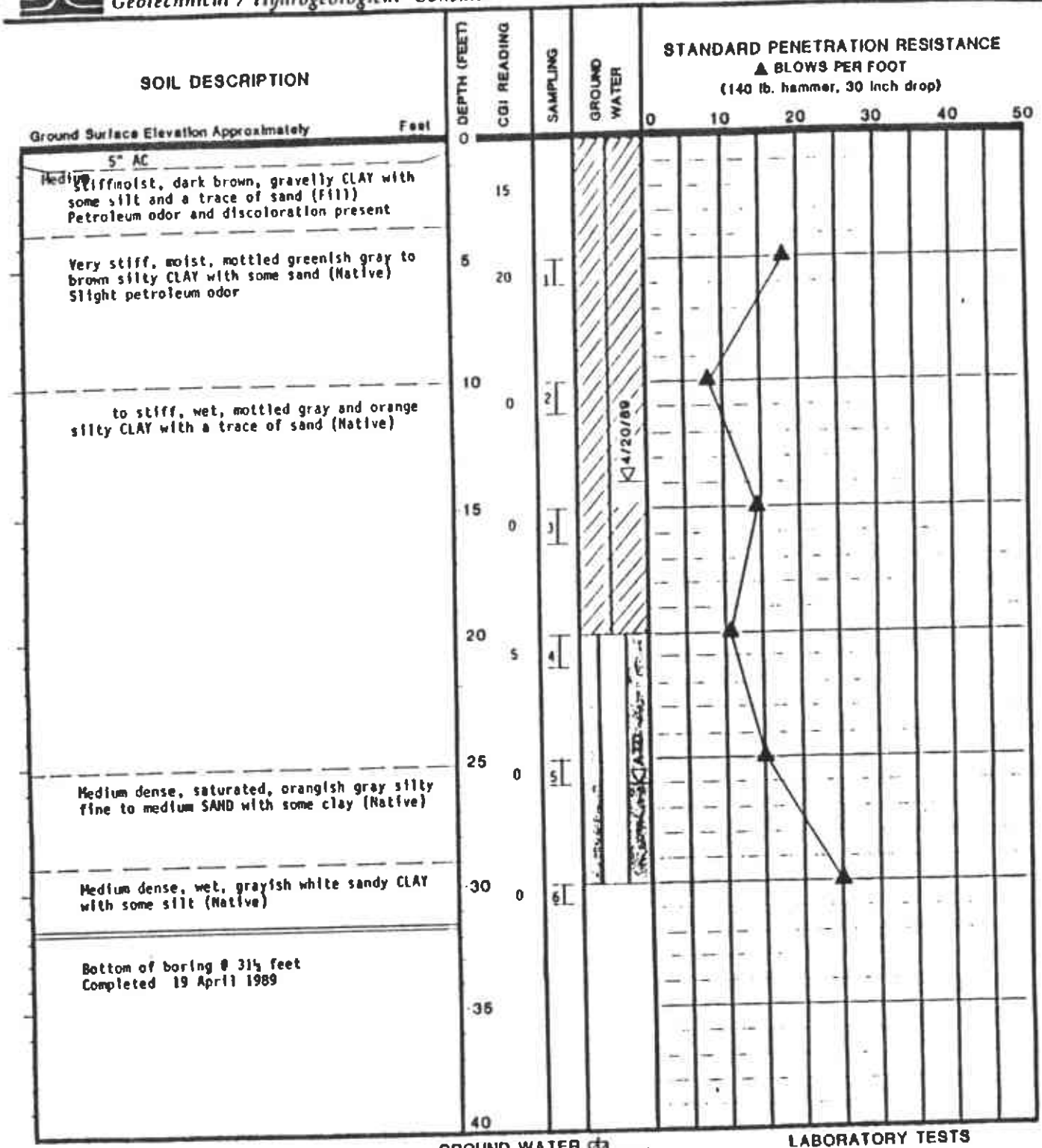
BORING LOGS AND WELL CONSTRUCTION DETAILS OF PROPOSED EXTRACTION WELLS

-6065

RZA

RITTENHOUSE-ZEMAN & ASSOC., INC.
Geotechnical / Hydrogeological Consultants

BORING NUMBER B-1 W O W-6095
PROJECT NAME Oakland, CA Mobil



SAMPLING
I 2" OD SPLIT SPOON SAMPLE
I 3" OD SHELBY SAMPLE
⊠ 2.5" ID RING SAMPLE
B BULK SAMPLE
★ SAMPLE NOT RECOVERED

GROUND WATER
SEAL
DATE
WATER LEVEL AT TIME OF DRILLING ATD
OBSERVATION WELL TIP
SILICA SAND

LABORATORY TESTS
● % WATER CONTENT
NP NON PLASTIC
LIQUID LIMIT
NATURAL WATER CONTENT
PLASTIC LIMIT

FIGURE 2

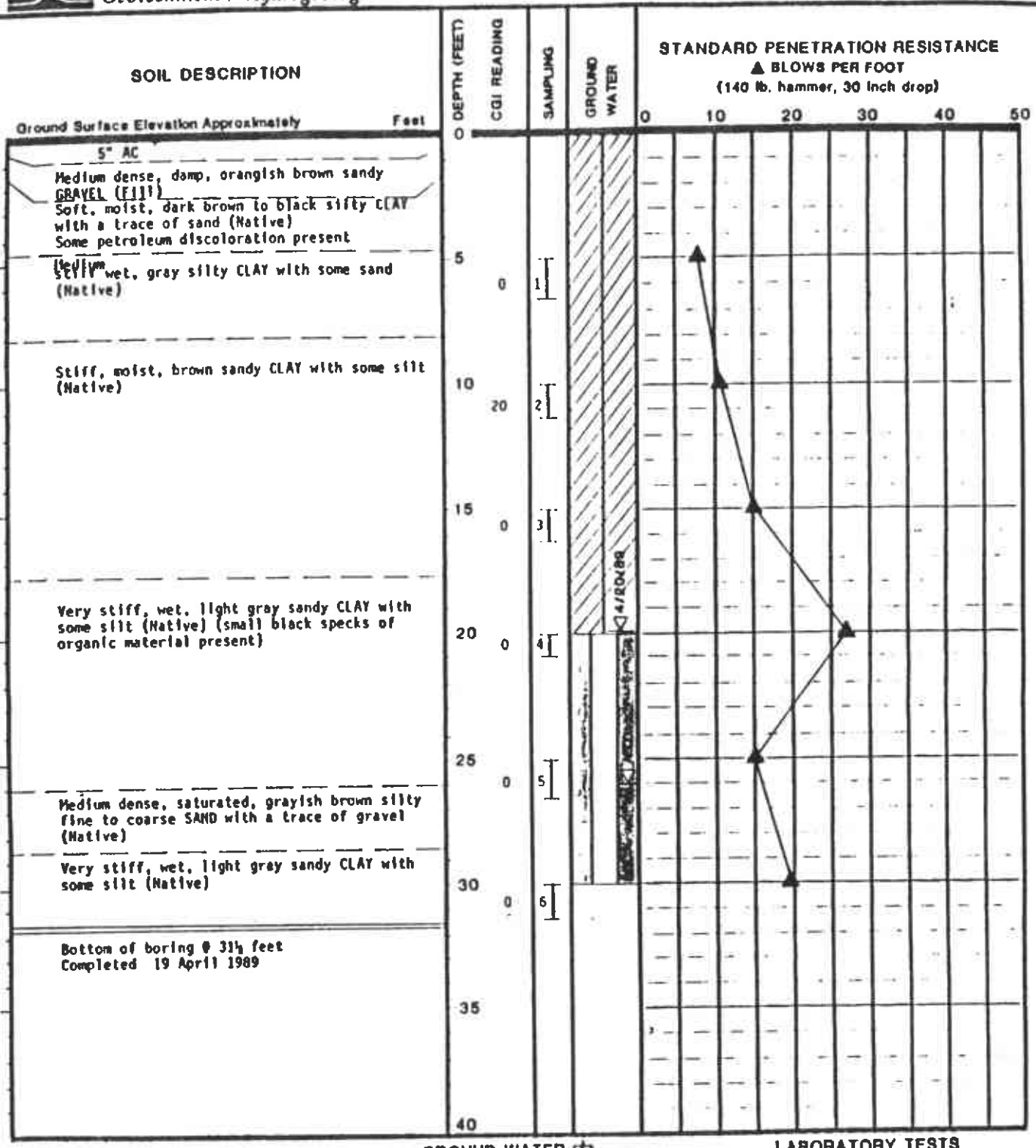
RZA

RITTENHOUSE-ZEMAN & ASSOC., INC.

Geotechnical / Hydrogeological Consultants

BORING NUMBER B-2 W.O. W-6095

PROJECT NAME Oakland, CA Mobil



SAMPLING

- 2" OD SPLIT SPOON SAMPLE
- 3" OD SHELBY SAMPLE
- 2.5" ID RING SAMPLE
- B BULK SAMPLE
- ▲ SAMPLE NOT RECOVERED

GROUND WATER

SEAL

DATE

WATER LEVEL AT TIME OF DRILLING

OBSERVATION WELL TIP

SILICA SAND

LABORATORY TESTS

- ● % WATER CONTENT
- NP NON PLASTIC
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT

FIGURE 3

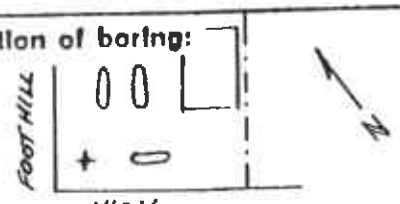
ALTON GEOSCIENCE

LOG OF EXPLORATORY BORING

PROJECT NO. 30-103 DATE 01/29/90
CLIENT Mobil Oil Corporation
LOCATION 4280 Foothill Blvd., Oakland
LOGGED BY B. Nagle DRILLER Bayland

BORING NO B-3
Sheet 1 of 1

Field location of boring:



Ground Elev. Datum

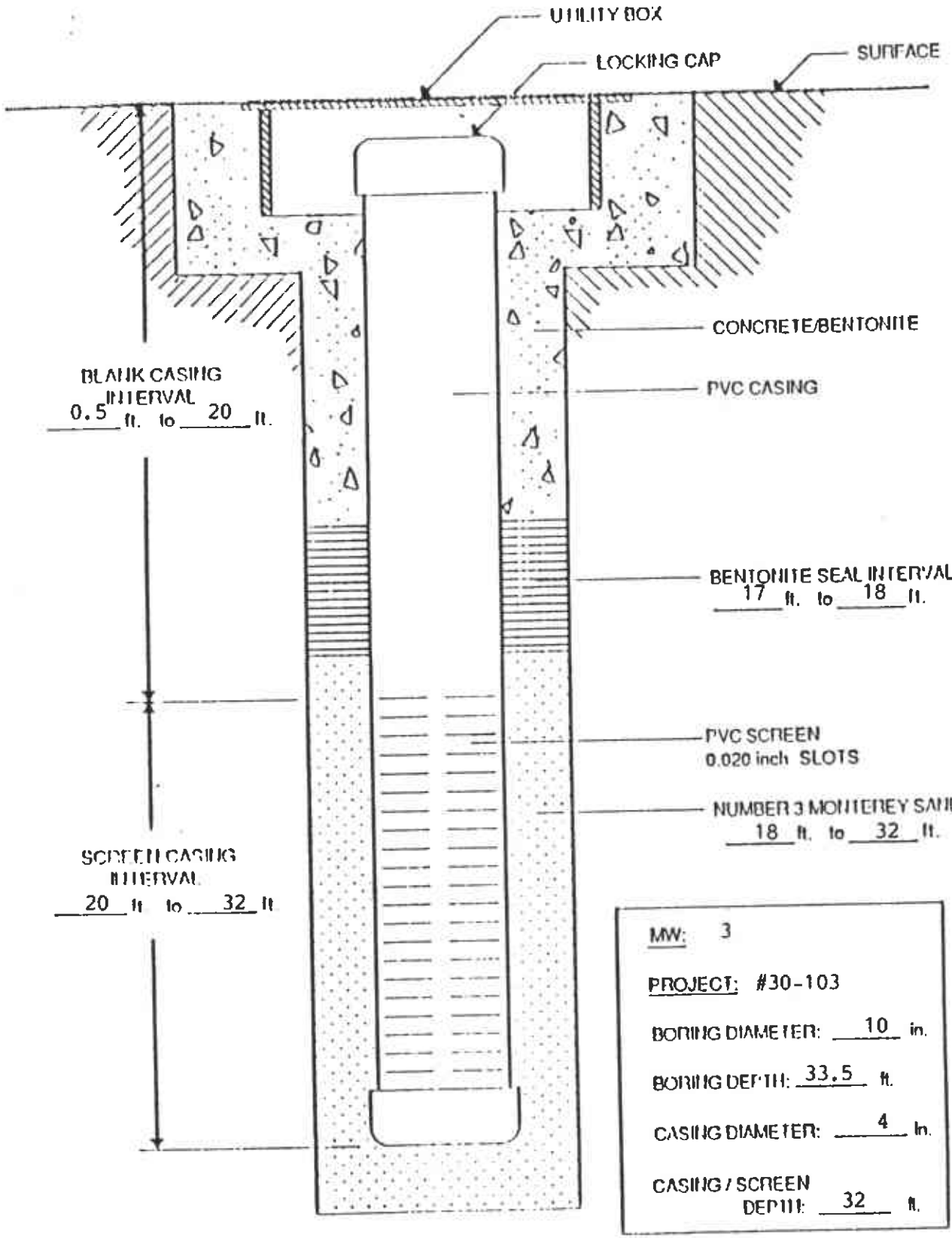
Drilling method Hollow-stem auger
Hole Dia. 10"

Casing Installation Data 4" perforated (0.020") pipe 32-20', #3 lonestar sand 33-18', bentonite pellets 18-17'; cement seal to surface.

Water Level	6.72	20.28					
Time	11:00	13:51					
Date	1/29/90	2/05/90					

Blow Counts	PID/OVA	Depth	Sample	Soil Group Symbol (USCS)	Litho-graphic Symbol	DESCRIPTION
						3" asphalt; 6" baserock
		2		CL		SILTY CLAY: Black, moist, high plasticity.
	25	4				Appearance of fine to coarse grained sand; color change to dark brown.
3,4,8	50	6		CL		
		8				SILTY CLAY: Mottled olive green/brown, moist, moderate plasticity, stiff; gravels up to ¼".
		10				
10,13,17	40	12		CL		SANDY CLAY: Brown, moist, low plasticity, very stiff; gravels up to ½".
		14				Driller felt auger out of gravels at 13'
6,7,9	40	16				SILTY CLAY: Tan, damp to moist, medium plasticity, stiff, blue-gray staining along occasional rootlets.
		18				
		20		CL		Change to very moist, increase in ½" carbon granules.
5,9,10	25	22				
		24				
4,9,15	50	26				SANDY CLAY: Blue-gray to tan, moist, low plasticity, stiff.
	100 In Shoe	28		CL		Color change to light gray.
5,6,9		30				Top of 32'-33½' sample wet with sandy gravel stringers up to 2".
7,10,14		32		CL		SILTY CLAY: Mottled brown and gray, damp, medium plasticity, very stiff.
						Boring terminated at 33½'. Free ground water encountered at approximately 31'.

MONITORING WELL CONSTRUCTION DETAIL



MW: 3

PROJECT: #30-103

BORING DIAMETER: 10 in.

BORING DEPTH: 33.5 ft.

CASING DIAMETER: 4 in.

CASING / SCREEN DEPTH: 32 ft.

ALTON GEOSCIENCE
1170 BURNETT AVE., STE S
CONCORD, CA. 94520

NOTE DRAWING NOT TO SCALE

PROJECT #30-103

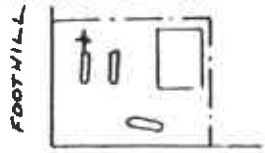
ALTON GEOSCIENCE

LOG OF EXPLORATORY BORING

PROJECT NO. 30-103 DATE 01/30/90
CLIENT Mobil Oil Corporation
LOCATION 4280 Foothill Blvd., Oakland
LOGGED BY B. Nagle DRILLER Bayland

BORING NO B-4
Sheet 1 of 1

Field location of boring:



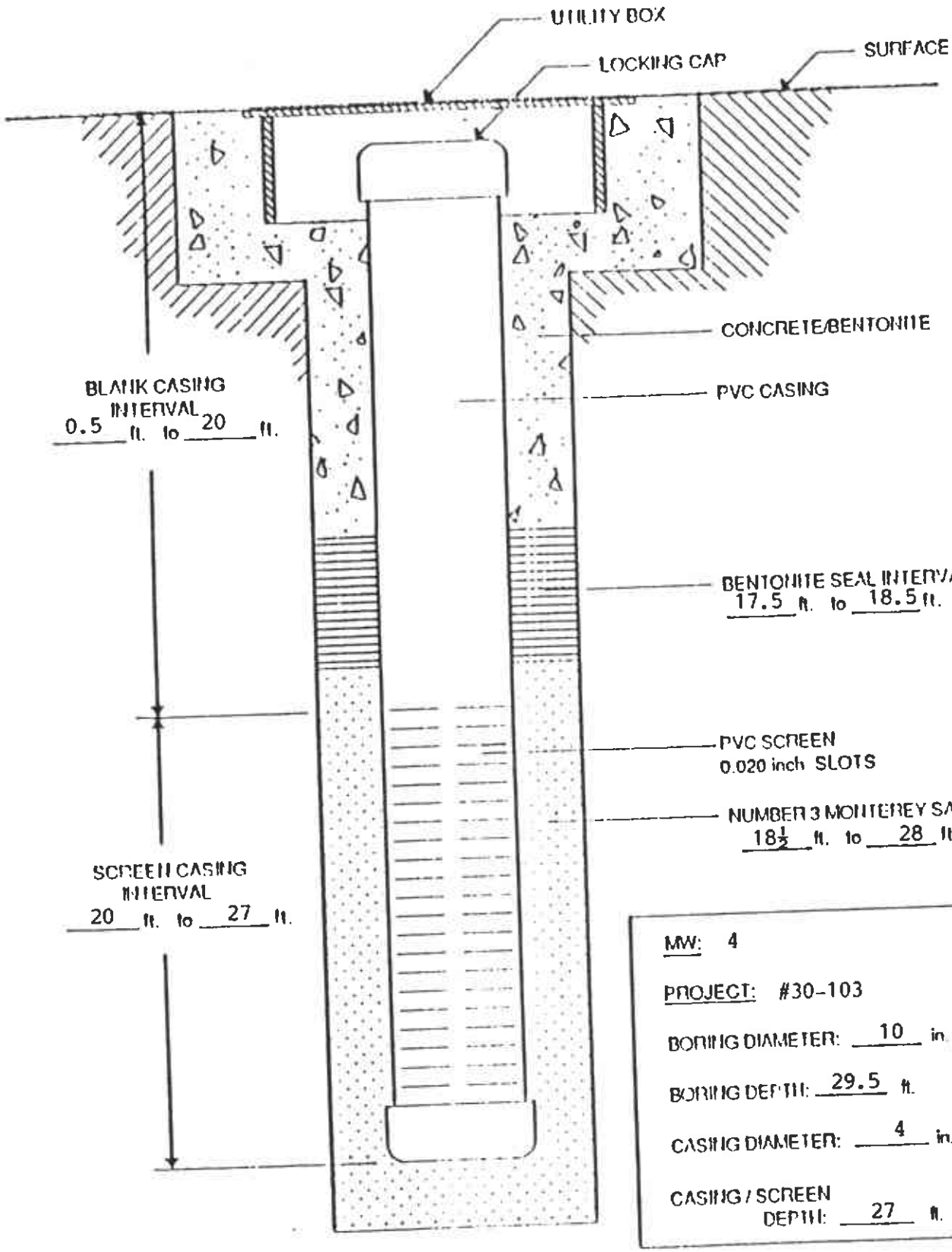
Ground Elev. 416 Datum

Drilling method Hollow-stem auger
Hole Dia. 10"
Casing Installation Data 4" perforated (0.020") pipe 27-20'; #3 lonestar 27-18½, bentonite pellets 18½-17½; neat cement seal 17½ to surface.

Water Level	17.07	16.32					
Time	13:30	13:15					
Date	1/30/90	2/05/90					

Blow Counts	PID/OVA	Depth	Sample	Soil Group Symbol (USCS)	Litho-graphic Symbol	DESCRIPTION
						4" asphalt, 6" baserock
		2				SILTY CLAY: Dark brown, damp to moist, high plasticity,
		4				stiff.
4,7,7	20	6				SILTY CLAY: Mottled orange-brown, damp, low plasticity, stiff; minor fine sand and angular gravels up to ¼".
		8				SANDY CLAY: Light brown, damp, medium plasticity, stiff; occasional carbon granules.
3,5,7	40	10				
		12				Driller felt increase in resistance at 13½ feet.
		14				CLAYEY SAND: Brown, moist, medium dense; occasional fine to coarse grained gravels up to ¼".
6,9,11	25	16				Driller felt smoother drilling at approximately 17'.
		18				
		20				
4,5,13		22				SANDY CLAY: Light brown, moist, low plasticity, stiff
		24				CLAYEY SAND: Light brown, wet, medium dense.
						SILTY CLAY: Mottled blue gray and brown, low plasticity,
5,9,12	75	26				very stiff; minor very fine sand.
		28				Driller needed more pressure to drill at 27'.
3,7,10	70					CLAYEY SILT: Whiteish gray to tan, moist, low plasticity,
						very stiff; some fine sand.
						Boring terminated at 29½ feet.
						Free ground water encountered at approximately 20 feet.

MONITORING WELL CONSTRUCTION DETAIL



MW: 4

PROJECT: #30-103

BORING DIAMETER: 10 in.

BORING DEPTH: 29.5 ft.

CASING DIAMETER: 4 in.

CASING / SCREEN DEPTH: 27 ft.

ALTON GEOSCIENCE
1170 BURNETT AVE., STE S
CONCORD, CA. 94520

NOTE DRAWING S NOT TO SCALE PROJECT #30-103

ALTON GEOSCIENCE LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/09/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY

BORING NO. MW-5
WELL NO. MW-5
Page 1 of 1

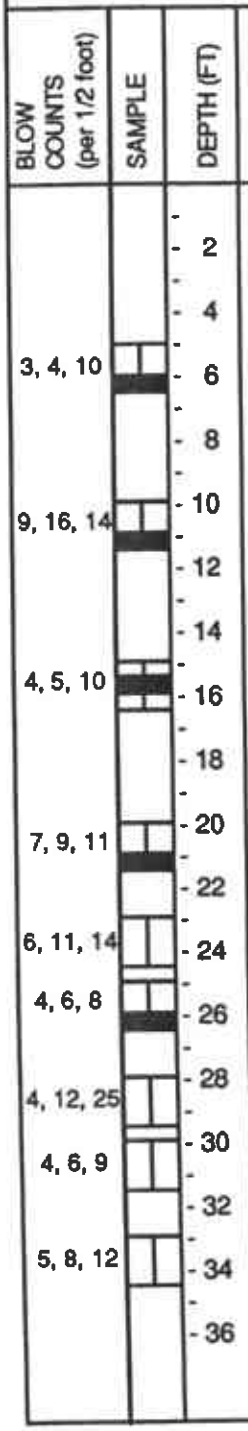
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION 36.55

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 10"
SAMPLER TYPE California Modified Split-Spoon Sampler
CASING DATA 4" diameter, Schedule 40 PVC, 18' blank, 15' slotted
DRILLER Soils Exploration

DEPTH TO WATER	18.08'	18.55'	18.66'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



COMMENTS
4" Asphalt, 2" Road Base
SILTY CLAY: dark brown, damp, moderate plasticity.
SILTY CLAY: dark brown with olive gray mottling, stiff; occasional sand and gravel.
SANDY CLAY: olive green, damp, low plasticity.
GRAVELY SAND: olive green, damp, medium dense.
SAND: olive green, damp, fine grained.
GRAVELY SAND: olive green, damp.
SILTY CLAY: light brown, damp, medium plasticity, stiff; olive green staining along occasional rootlets, minor fine grained sand.
GRAVELY SAND: olive gray to brown to gray, moist, medium dense; hydrocarbon sheen.
CLAYEYSILT: tan, moist, stiff, with minor sands; blue-gray staining along occasional rootlets at 25'.
SAME, firm.
CLAYEY SAND: mottled tan and bluish gray, wet, very stiff.
GRAVELY SAND: gray, wet, loose to medium dense; abundant silty sand lenses.
SILTY SAND: light brown, moist, stiff to very stiff; occasional wet sandy gravel.
BORING TERMINATED AT 34.5 FEET BELOW GRADE.

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/09/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY _____

BORING NO. MW-6
WELL NO. MW-6

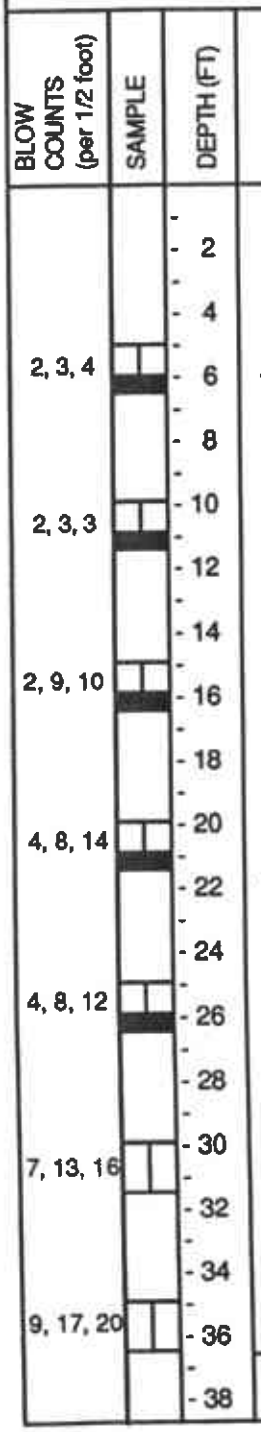
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION _____

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 10"
SAMPLER TYPE California Modified Split-Spoon Sampler
CASING DATA 4" diameter, Schedule 40 PVC, 20' blank, 15' slotted
DRILLER Soils Exploration

DEPTH TO WATER	20.73'	21.20'	21.12'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



COMMENTS

4" Asphalt, 1" Road Base and Pea Gravel

SILTY CLAY: dark brown, damp.

SILTY CLAY: tan, damp, firm, some sand, occasional gravel.

Abundant pea gravel at approximately 7 to 9 feet.

SAND: brown, damp, loose, fine grained, no fines; with thin clay bed.

SILTY SAND: tan, mottled olive green, damp,: occasional gravels to 1/2".

SILTY CLAY: tan, mottled olive green, damp, medium plasticity, stiff.

CLAYEY SAND: tan, damp, medium dense, fine to coarse grained.

SAME: increase in sand content, bluish gray staining at 25.5' to 26'.

SILTY - CLAYEY SAND: light tan, moist, medium dense.

SILTY SAND: tan, wet, medium dense; with occasional gravel lenses.

BORING TERMINATED AT 36.5 FEET BELOW GRADE.

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/09/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY

BORING NO. MW-7
WELL NO. MW-7
Page 1 of 1

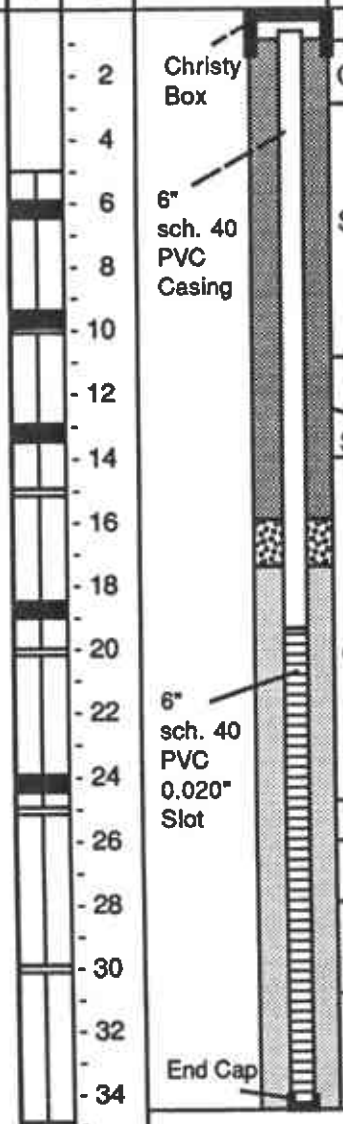
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 12"
SAMPLER TYPE Continuous
CASING DATA 6" diameter, Schedule 40 PVC, 19.5 blank, 15 slotted
DRILLER Soils Exploration

DEPTH TO WATER	14.93'	15.16'	15.21'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



USCS	COMMENTS
	3" Asphalt, 6" Road Base
CL	SILTY CLAY: dark brown, damp, medium plasticity.
SC	CLAYEY SAND: bluish gray, damp; occasional gravel up to 1" diameter. SAME: brown to bluish gray, damp; abundant gravel, occasional silty clay lens.
CL	SILTY CLAY: mottled bluish gray - orange brown, damp, medium plasticity; stained along rootlets.
SM	SILTY SAND: bluish gray to brown, damp.
CL	SILTY CLAY: mottled bluish gray - orange brown, damp, medium plasticity; stiff. SAME: mottled bluish gray - orange brown, damp, medium plasticity; stiff. SANDY CLAY: mottled bluish gray - olive green, damp, medium plasticity, very stiff. SILTY CLAY: brown, damp, medium plasticity, very stiff. SANDY CLAY: olive green, wet, low plasticity.
SC	CLAYEY SAND: brown, wet, medium dense.
CL	SANDY CLAY: tan, moist to wet, low plasticity.
SC	CLAYEY SAND: tan, wet, medium dense; some orange brown mottling.
CL	SANDY CLAY: tan, moist to wet, low plasticity, stiff; increasing sand at 34', clay fractions along horizontal planes.

BORING TERMINATED AT 34.5 FEET BELOW GRADE.

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/11/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY

BORING NO. MW-8
WELL NO. MW-8
Page 1 of 1

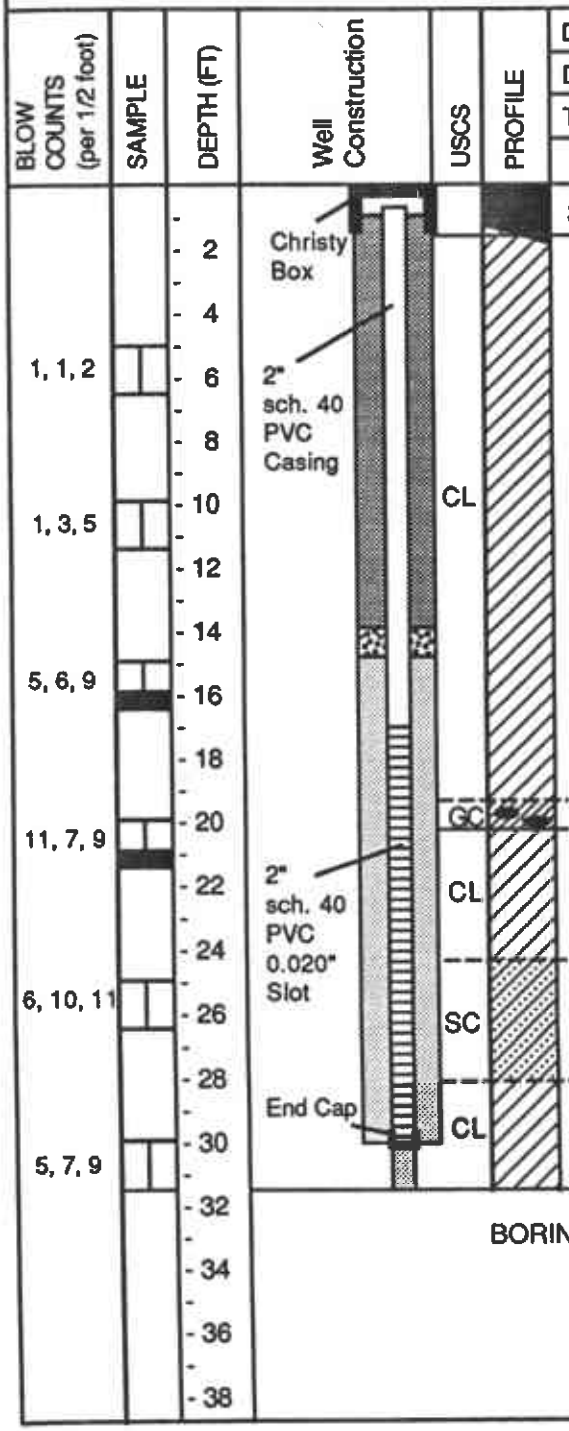
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 8"
SAMPLER TYPE California Modified Split-Spoon Sampler
CASING DATA 2" diameter, Schedule 40 PVC, 19' blank, 13' slotted
DRILLER Soils Exploration

DEPTH TO WATER	22.37'	22.70'	22.47'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



COMMENTS
3" Asphalt, 4" Concrete, 12" Road Base and Pea Gravel
SILTY CLAY: dark brown, damp, moderate plasticity.
SANDY CLAY: mottled light - dark brown, moist, low plasticity, soft; abundant coarse grained sand.
SAME: light brown, moist, firm; fine grained sand.
SILTY CLAY: brown, damp, low plasticity, stiff; abundant coarse grained sand.
CLAYEY GRAVEL: lens.
SILTY CLAY: brown, wet, medium plasticity, stiff; abundant coarse grained sand.
CLAYEY SAND: light brown, wet, medium dense.
SILTY CLAY: light brown, damp, medium plasticity, stiff; occasional coarse grained sand and black rootlets.
BORING TERMINATED AT 31.5 FEET BELOW GRADE.

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/11/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY _____

BORING NO. MW-9
WELL NO. MW-9
Page 1 of 1

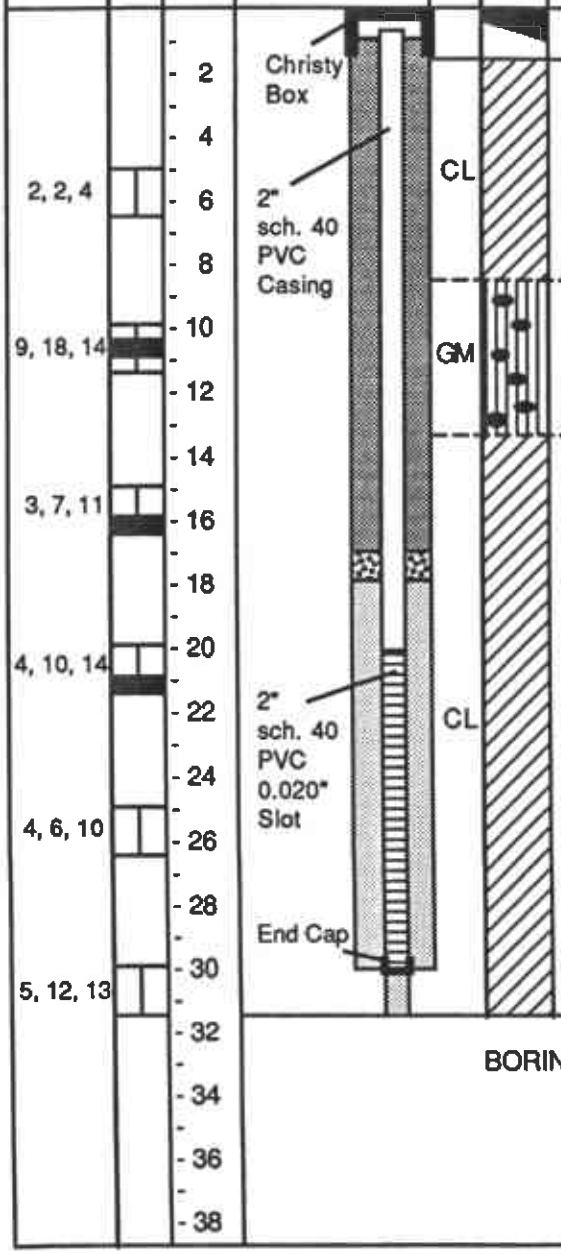
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION _____

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 8"
SAMPLER TYPE California Modified Split-Spoon Sampler
CASING DATA 2" diameter, Schedule 40 PVC, 20' blank, 10' slotted
DRILLER Soils Exploration

DEPTH TO WATER	14.12'	14.27'	14.18'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



COMMENTS

3" Asphalt, 6" Concrete, 12" Road Base and Pea Gravel

SILTY CLAY: dark brown, damp, high plasticity, firm.

SANDY CLAY:dark brown, damp, firm, soft; fine to coarse grained sand.

SANDY GRAVEL: olive green to brown, damp, medium dense; with clay matrix.

SANDY CLAY: brown, damp, stiff; with abundant gravel. No gravels at 16'.

SAME: very stiff,occasional carbonacious gravels.

SAME: stiff, with orangish brown mottling, SATURATED

SILTY CLAY: brown, damp, medium plasticity, very stiff; minor fine to coarse grained sand.

BORING TERMINATED AT 31.5 FEET BELOW GRADE.

LEGEND TO BORING LOGS
BP Service Station, No. 11109
4280 Foothill Road, Oakland, CA

PROJECT NO. 30-0248

GEOLOGIC LEGEND:

COARSE GRAINED SOILS	GRAVELS more than 1/2 of coarse fraction > No. 4 Sieve	Little or no fines	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel-sand mixtures
		Appreciable fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS more than 1/2 of coarse fraction < No. 4 Sieve	Little or no fines	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sands, little or no fines
		Appreciable fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS	SILTS AND CLAYS Liquid limit < 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gavely clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit > 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PE	Peat, humus, swamp soils with high organic contents

SYMBOL LEGEND:

- Portland Cement
- #3 Lonestar Sand
- Bentonite Pellets
- Driven Interval Sample recovery
- Sample saved for possible analysis
- Stabilized water level
- Ground water level encountered during drilling

ALTON GEOSCIENCE
1000 Burnett Ave., Ste. 140
Concord, California

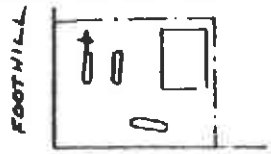
ALTON GEOSCIENCE

LOG OF EXPLORATORY BORING

PROJECT NO. 30-103 DATE 01/30/90
CLIENT Mobil Oil Corporation
LOCATION 4280 Foothill Blvd., Oakland
LOGGED BY B. Nagle DRILLER Bayland

BORING NO B-4
Sheet 1 of 1

Field location of boring:



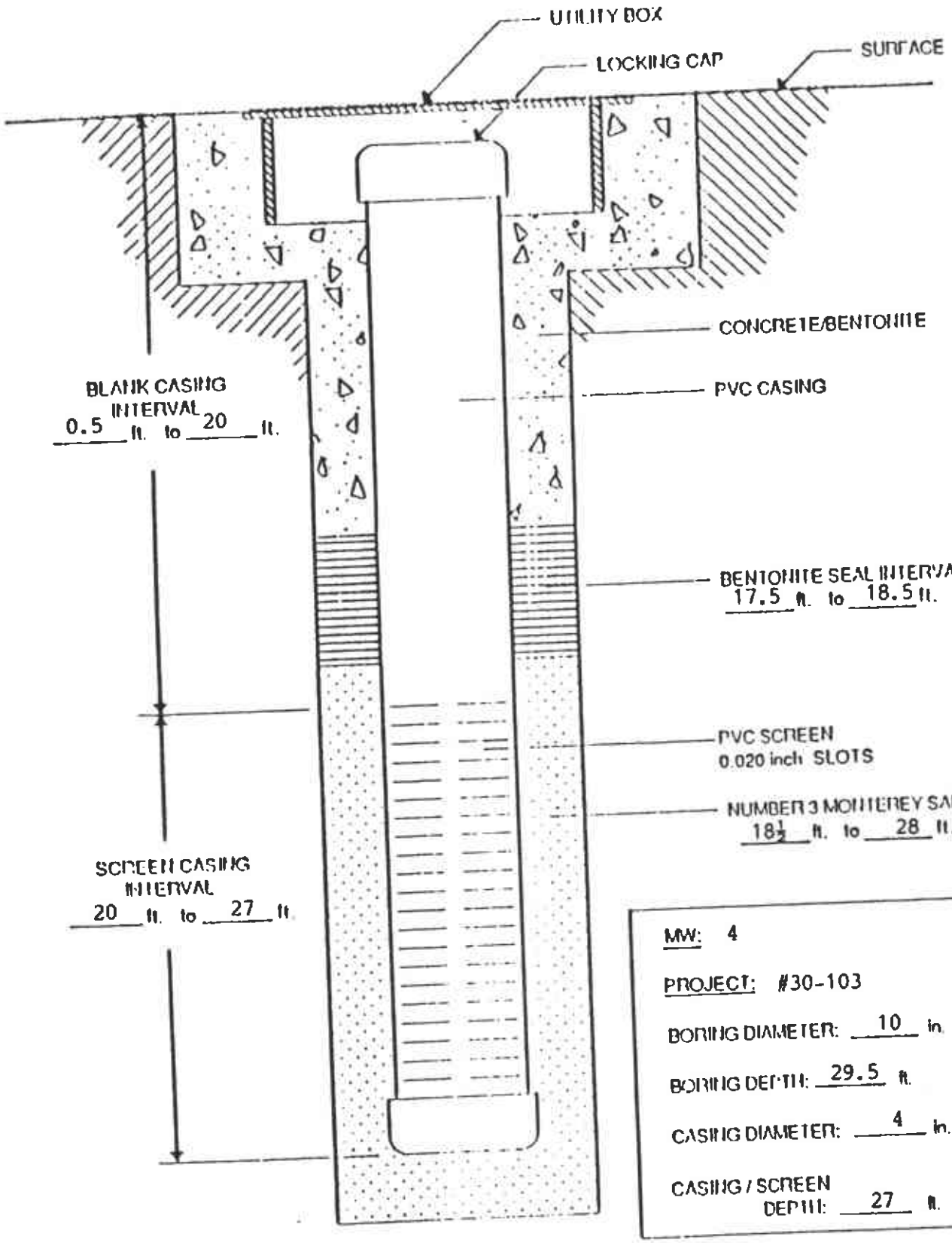
Ground Elev. 416.4 Datum

Drilling method Hollow-stem auger
Hole Dia. 10"
Casing Installation Data 4" perforated (0.020") pipe 27-20'; #3 lonestar 27-18½, bentonite pellets 18½-17½; neat cement seal 17½ to surface.

Water Level	17.07	16.32				
Time	13:30	13:15				
Date	1/30/90	2/05/90				

Blow Counts	PID / OVA	Depth	Sample	Soil Group Symbol (USCS)	Litho-graphic Symbol	DESCRIPTION
						4" asphalt, 6" baserock
		2				SILTY CLAY: Dark brown, damp to moist, high plasticity, stiff.
		4				
4,7,7	20	6				SILTY CLAY: Mottled orange-brown, damp, low plasticity, stiff; minor fine sand and angular gravels up to ¼".
		8				SANDY CLAY: Light brown, damp, medium plasticity, stiff; occasional carbon granules.
3,5,7	40	10				
		12				Driller felt increase in resistance at 13½ feet.
		14				CLAYEY SAND: Brown, moist, medium dense; occasional fine to coarse grained gravels up to ¼".
6,9,11	25	16				Driller felt smoother drilling at approximately 17'.
		18				
4,5,13		20 ▽				SANDY CLAY: Light brown, moist, low plasticity, stiff
		22				CLAYEY SAND: Light brown, wet, medium dense.
		24		?	?	SILTY CLAY: Mottled blue gray and brown, low plasticity, very stiff; minor very fine sand.
5,9,12	75	26				Driller needed more pressure to drill at 27'.
		28				
3,7,10	70					CLAYEY SILT: Whitish gray to tan, moist, low plasticity, very stiff; some fine sand.
						Boring terminated at 29½ feet.
						Free ground water encountered at approximately 20 feet.

MONITORING WELL CONSTRUCTION DETAIL



MW: 4

PROJECT: #30-103

BORING DIAMETER: 10 in.

BORING DEPTH: 29.5 ft.

CASING DIAMETER: 4 in.

CASING / SCREEN DEPTH: 27 ft.

ALTON GEOSCIENCE
1170 BURNETT AVE., STE S
CONCORD, CA. 94520

NOTE DRAWING NOT TO SCALE PROJECT #30-103

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/09/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY

BORING NO. MW-5
WELL NO. MW-5
Page 1 of 1

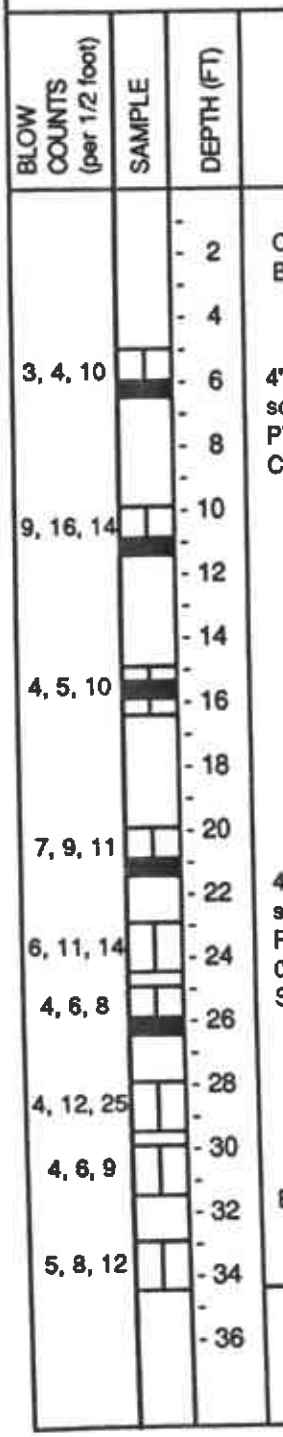
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION 36.55

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 10"
SAMPLER TYPE California Modified Split-Spoon Sampler
CASING DATA 4" diameter, Schedule 40 PVC, 18' blank, 15' slotted
DRILLER Soils Exploration

DEPTH TO WATER	18.08'	18.55'	18.66'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



COMMENTS

4" Asphalt, 2" Road Base

SILTY CLAY: dark brown, damp, moderate plasticity.

SILTY CLAY: dark brown with olive gray mottling, stiff; occasional sand and gravel.

SANDY CLAY: olive green, damp, low plasticity.

GRAVELY SAND: olive green, damp, medium dense.

SAND: olive green, damp, fine grained.

GRAVELY SAND: olive green, damp.

SILTY CLAY: light brown, damp, medium plasticity, stiff; olive green staining along occasional rootlets, minor fine grained sand.

GRAVELY SAND: olive gray to brown to gray, moist, medium dense; hydrocarbon sheen.

CLAYEYSILT: tan, moist, stiff, with minor sands; blue-gray staining along occasional rootlets at 25'.

SAME, firm.

CLAYEY SAND: mottled tan and bluish gray, wet, very stiff.

GRAVELY SAND: gray, wet, loose to medium dense; abundant silty sand lenses.

SILTY SAND: light brown, moist, stiff to very stiff; occasional wet sandy gravel.

BORING TERMINATED AT 34.5 FEET BELOW GRADE.

ALTON GEOSCIENCE
LOG OF EXPLORATORY BORING

PROJECT NO. 30-0248 DATE DRILLED 9/09/91
CLIENT BP Oil Co., Service Station No. 30-0248
LOCATION 4280 Foothill Blvd., Oakland, CA
LOGGED BY B. Nagle APPROVED BY _____

BORING NO. MW-7
WELL NO. MW-7
Page 1 of 1

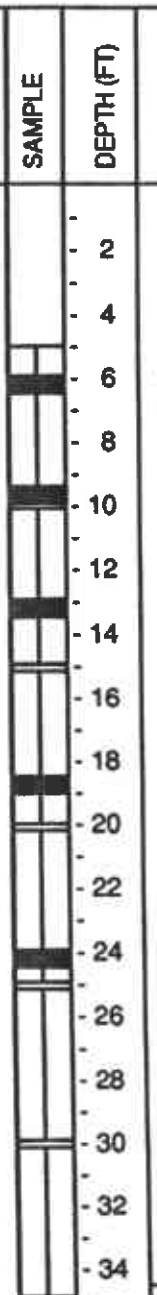
FIELD SKETCH OF BORING LOCATION

(SEE SITE PLAN)

TOP OF CASING ELEVATION _____

DRILLING METHOD C.M.E. 55, HSA HOLE DIAM. 12"
SAMPLER TYPE Continuous
CASING DATA 6" diameter, Schedule 40 PVC, 19.5 blank, 15 slotted
DRILLER Soils Exploration

DEPTH TO WATER	14.93'	15.16'	15.21'
DATE	10/03/91	10/15/91	12/16/91
TIME	--	--	--



USCS	PROFILE	COMMENTS
		3" Asphalt, 6" Road Base
CL		SILTY CLAY: dark brown, damp, medium plasticity.
SC		CLAYEY SAND: bluish gray, damp; occasional gravel up to 1" diameter. SAME: brown to bluish gray, damp; abundant gravel, occasional silty clay lens.
CL		SILTY CLAY: mottled bluish gray - orange brown, damp, medium plasticity; stained along rootlets.
SM		SILTY SAND: bluish gray to brown, damp.
CL		SILTY CLAY: mottled bluish gray - orange brown, damp, medium plasticity; stiff. SAME: mottled bluish gray - orange brown, damp, medium plasticity; stiff. SANDY CLAY: mottled bluish gray - olive green, damp, medium plasticity, very stiff. SILTY CLAY: brown, damp, medium plasticity, very stiff. SANDY CLAY: olive green, wet, low plasticity.
SC		CLAYEY SAND: brown, wet, medium dense.
CL		SANDY CLAY: tan, moist to wet, low plasticity.
SC		CLAYEY SAND: tan, wet, medium dense; some orange brown mottling.
CL		SANDY CLAY: tan, moist to wet, low plasticity, stiff; increasing sand at 34', clay fractions along horizontal planes.

BORING TERMINATED AT 34.5 FEET BELOW GRADE.