RESNA
Working To Restore Nature

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03/01/93

WORK PLAN
for
ADDITIONAL SUBSURFACE INVESTIGATION AND EVALUATION OF INTERIM REMEDIATION ALTERNATIVES
at
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

61035.08

Prepared by
RESNA Industries Inc.

Prepared for
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

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Project Geologist

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Project Manager

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CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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March 1, 1993
0301MWHE
61035.08

Mr. Michael Whelan
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

Subject: Transmittal of Work Plan for Additional Subsurface Investigation and Evaluation of Interim Remediation Alternatives at ARCO Station 6148, 5131 Shattuck Avenue in Oakland, California.

Mr. Whelan:

As requested by ARCO Products Company (ARCO), RESNA Industries Inc. (RESNA) has prepared the attached Work Plan for review and approval by the Alameda County Health Care Services Agency (ACHCSA). This Work Plan was initiated to further evaluate the lateral extent of gasoline hydrocarbons beneath the site and to evaluate viable soil and groundwater remedial alternatives for the subject site. This work plan was prepared at the request of Ms. Susan Hugo of ACHCSA during the meeting held in the offices of the ACHCSA on September 30, 1992.

This work plan summarizes RESNA's approach, field methods, and project steps recommended to perform an additional subsurface investigation and to evaluate interim remedial alternatives for soil and groundwater at the above referenced site. The proposed work includes gaining offsite access from adjacent property owners for installation of an offsite monitoring well and obtaining well construction permits from the Alameda County Flood Control and Water Conservation District, Zone 7 (ACFCWCD). Proposed work also includes advancing ten shallow onsite soil borings and collecting soil samples in the unsaturated and capillary fringe zones and from the silty clay beneath the shallow water-bearing zone in two of the borings for possible laboratory analyses to determine efficient placement of future vapor-extraction and air-sparging wells in areas impacted by gasoline hydrocarbons. Upon gaining offsite access, one offsite groundwater monitoring well will be installed. Once the analytical results from the ten onsite test borings are received and evaluated, an additional work plan will be prepared outlining proposed locations for onsite borings to be drilled for installation of vapor extraction and/or air sparging wells in the borings. The wells will be surveyed and the offsite groundwater monitoring well will be sampled for analysis. Proposed work in the additional work plan will also include performing a one-day vapor extraction test (VET) and a one day combination air sparging/vapor extraction test and preparing a report summarizing RESNA's findings, interpretations, and conclusions. Recommendations will be included under a separate cover as requested by ARCO.

The combination vapor extraction and air sparging tests will be performed in lieu of the aquifer testing which appears on the Remediation Schedule for this site (submitted to the ACHCSA and the RWQCB on January 18, 1993). RESNA recommends performing these project steps to evaluate the lateral extent of gasoline hydrocarbons in the soil and groundwater and the feasibility of using vapor extraction and air sparging as an interim soil and groundwater remedial alternative at the site. The project steps are described in detail in this work plan. RESNA will await approval of the work plan by the ACHCSA prior to performing this proposed additional subsurface work.

It is recommended that copies of this addendum to work plan be sent to the following:

Ms. Susan Hugo
Alameda County Health Care Services Agency
80 Swan Way, Room 200
Oakland, California 94621

Mr. Richard Hiett
Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster, Suite 500
Oakland, California 94612

If you have any questions or comments about this Work Plan, please call us at (408) 264-7723.

Sincerely,
RESNA Industries Inc.

Joel Coffman
Project Manager

Enclosure: Work Plan

cc: Valli Voruganti, RESNA
Barbara Sieminski, RESNA

RESNA
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ADDITIONAL SUBSURFACE INVESTIGATION AND EVALUATION OF INTERIM REMEDIATION ALTERNATIVES
at
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

for
ARCO Products Company

INTRODUCTION

ARCO Products Company (ARCO) has requested that RESNA Industries Inc. prepare this Work Plan for Additional Subsurface Investigation and Evaluation of Interim Remediation Alternatives at ARCO Station 6148, located at 5131 Shattuck Avenue in Oakland, California. This work plan is being submitted for review and approval by the Alameda County Health Care Services Agency (ACHCSA), and was initiated at the request of Ms. Susan Hugo of the ACHCSA during a meeting with ARCO, ACHCSA, and RESNA on September 30, 1992. The objectives of this additional investigation are to further evaluate the lateral extent of gasoline hydrocarbons in the soil and groundwater, and to evaluate viable soil and groundwater remediation alternatives.

The proposed scope of work for this additional investigation includes: obtaining a well permit from the Alameda County Flood Control and Water Conservation District, Zone 7 (ACFCWCD) to install onsite and offsite wells and gain offsite access from private property owners; advance ten shallow onsite test borings (TB-1 through TB-10) and collecting soil samples in the unsaturated zone and capillary fringe zone for possible laboratory analyses so that proposed vapor extraction and air-sparging wells may be optimally located in areas impacted by gasoline hydrocarbons, drilling one offsite soil boring (B-10) and collecting soil samples for description and possible laboratory analysis; installing one 2-inch diameter offsite groundwater monitoring well (MW-8) in offsite boring B-10; surveying and developing the well; submitting selected soil samples from boring B-10 for laboratory analysis; and preparing a second work plan summarizing the methods, results, and conclusions of this phase of the investigation. Work to be proposed in the second work plan will include drilling additional onsite soil borings, installing vapor extraction and/or air sparging wells in the borings, performing a one-day vapor extraction test (VET) and a one-day combination air sparging/vapor extraction test, and preparing a report summarizing our findings and conclusions.

SITE DESCRIPTION AND BACKGROUND

General

The site is an operating gasoline station located on the southwestern corner of the intersection of 52nd Street and Shattuck Avenue in Oakland, California. The site location is shown on the Site Vicinity Map (Plate 1). The site is situated on a relatively flat lot at an elevation of approximately 110 feet above mean sea level.

Presently, according to information provided by ARCO, there are three 12,000 gallon underground gasoline-storage tanks (USTs) located in the western portion of the site. The locations of the USTs and pertinent site features are shown on the Generalized Site Plan (Plate 2).

Regional and Local Hydrogeology

ARCO Station 6148 is located west of the East Bay Hills. This area lies within the Berkeley Alluvial Plain, which is a subarea of the East Bay Alluvial Plain. Soils in this area are mapped as older alluvium which consist of a heterogeneous mixture of poorly consolidated to unconsolidated clay, silt, sand, and gravel units (Helley and others, 1979). These sediments were derived mainly from bedrock underlying the hills and represent successive coalescing alluvial fans deposited during the Pleistocene epoch.

Sediments beneath the East Bay Alluvial Plain are believed to be about 200 feet thick in the Berkeley area. Water-yielding capabilities of the sediments are highly variable. Generally, high yields come only from wells that are screened through several water-bearing sand and gravel beds. Groundwater in the East Bay Alluvial Plain occurs predominantly under confined conditions and tends to flow toward the San Francisco Bay to the west and southwest (Hickenbottom and Muir, 1988).

PREVIOUS ENVIRONMENTAL WORK

Previous environmental work performed at and near the site is summarized in a recently submitted report titled "Additional Subsurface Investigation" (RESNA, January 27, 1993).

PROPOSED WORK

RESNA proposes project Steps 1 through Step 9 listed below to evaluate (1) the lateral and vertical extent of gasoline hydrocarbons in soil and groundwater in the vicinity of the former waste-oil tank and existing USTs, and (2) the feasibility of various remediation methods at the subject site including vapor extraction for soil remediation and air sparging in combination with vapor extraction for groundwater remediation. **The combination vapor extraction and air sparging tests will be performed in lieu of the aquifer testing which appears on the Remediation Schedule for this site (submitted to the ACHCSA and the RWQCB on January 18, 1993).** Field work involved with the following steps will be performed in accordance with the attached RESNA Field Methods in Appendix A, and a site specific Site Safety Plan.

Step 1 Attempt to gain offsite access to drill boring B-10 and install groundwater monitoring well MW-8. Onsite work will proceed without gaining offsite access. Submit well permit application for onsite and offsite wells to the ACFCWCD for approval.

Step 2 Advance eight shallow and two deep onsite test borings (TB-1 through TB-10) using a loader-mounted, hydraulically driven sampling rig at the general locations shown on Plate 3, Proposed Boring/Well Locations, and collect selected soil samples from these holes for description and possible laboratory analyses. The eight test borings (TB-1 through TB-8) will be advanced to a depth of about 18 feet for lateral delineation of gasoline hydrocarbons in the vadose zone and to help site proposed vapor-extraction and air-sparging wells. The two deep test borings (TB-9 and TB-10) will be advanced to an apparent confining silty to sandy clay unit at depths between 26 and 30 feet in attempt to obtain vertical delineation. Upon gaining offsite access, drill one offsite soil boring, B-10, and install one 2-inch diameter groundwater monitoring well (MW-8).

Step 3 Submit selected soil samples from hydraulically advanced test borings TB-1 through TB-10 and offsite boring B-10 to a State-certified laboratory and analyzed for total petroleum hydrocarbons as gasoline (TPHg), and benzene, toluene, ethylbenzene, and total xylenes (BTEX) using EPA Methods 5030/8015/8020.

Step 4 Prepare a letter report/work plan outlining results of steps 1 through 3 above and proposing the installation of vapor-extraction wells and air-sparging wells. The vapor-extraction and air sparging wells will be located near those areas indicated by the analytical results of soil samples from test borings TB-1 through TB-10 as being impacted by gasoline hydrocarbons.

Step 5 Submit selected soil samples from the well borings with Chain of Custody Records to a State certified laboratory and analyzed for TPHg, and BTEX using EPA Methods 5030/8015/8020.

Step 6 Survey all the wells to a U.S. Coast and Geodetic Survey Datum relative to mean sea level. This work will be performed by a licensed land surveyor. The offsite groundwater monitoring well MW-8 and the air-sparging wells will also be developed prior to measurement of depth-to-water and sampling of the wells.

Step 7 Conduct a one-day vapor extraction test (VET) to evaluate the feasibility of vapor extraction as a viable soil remedial alternative. Data from the VET will be used to evaluate applied vacuums necessary on the vapor extraction wells to maximize soil-gas yield from the wells; soil-gas air flow rates from the extraction wells; radius of influence of each well and initial extracted hydrocarbon concentrations in soil-gas. Air samples collected during the test will be submitted with Chain of Custody Records to a State certified laboratory and analyzed for TPHg and BTEX using EPA Methods 5030/8020/8015.

Step 8 Conduct a one-day combination air-sparging and vapor-extraction test to evaluate whether vapor extraction is capable of capturing the air-sparge off-gas that is transmitted to the vadose zone. Air and groundwater samples collected during the test will be submitted with Chain of Custody Records to a State certified with Chain of Custody Records to a State certified laboratory and analyzed for TPHg and BTEX using EPA Methods 5030/8020/8015.

Step 9 Prepare a report summarizing field and laboratory procedures, findings, and conclusions.

SCHEDULE OF OPERATIONS

A preliminary time schedule to perform the steps described above is shown on Plate 4, Preliminary Time Schedule. This time schedule is an estimate and is subject to change should groundwater elevations increase, limiting the ability to perform vapor extraction, or other circumstances dictate. Gaining offsite access and associated encroachment permits may delay this project beyond the projected time. If this occurs, ARCO and the appropriate regulatory agencies will be informed. Time is estimated in weeks after gaining regulatory approval of the Work Plan and any changes which must be incorporated into this Work Plan due to regulatory request. RESNA can initiate work at the site within 1 week after receiving authorization to proceed, access and subsurface conditions permitting. Gaining offsite access to install offsite monitoring well will not affect onsite work at the site.

PROJECT STAFF

Ms. Diane Barclay or Mr. James L. Nelson, Certified Engineering Geologists in the State of California, will be in overall charge of hydrogeologic facets, and Dr. Joan E. Tiernan, a Registered Civil Engineer in the state of California, will be in overall charge of engineering facets of this project. Mr. Greg Barclay, General Manager, will provide supervision of field and office operations of the project. Mr. Joel Coffman, Project Manager, will be responsible for the day-to-day field and office operations of the project. RESNA employs a staff of geologists, engineers, and technicians who will assist with the project.

DISTRIBUTION

At ARCO's request, RESNA has forwarded copies of this Work Plan to:

Ms. Susan Hugo
Alameda County Health Care Services Agency
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

Mr. Richard Hiett
Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster, Suite 500
Oakland, California 94612

REFERENCES

Helley, E.S., K.R. Lajoie, W.E. Spangle, and M.L. Blair. 1979. Flatland deposits of the San Francisco Bay Region, California. U.S. Geological Survey Professional Paper 943.

Hickenbottom, K. and Muir, K. 1988. Geohydrology And Groundwater-Quality Overview, East Bay Plain Area, Alameda County, California 205(J) Report.

RESNA. September 29, 1992. Initial Subsurface Investigation Related to Former Waste-Oil Tank at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. RESNA Report 61035.02.

RESNA. November 30, 1992. Letter Report Quarterly Groundwater Monitoring Third Quarter 1992 at ARCO Station 6148, 5131 Shattuck Avenue in Oakland, California. RESNA Report 61035.03.

RESNA. January 18, 1993. Estimated Soil and Groundwater Remediation Implementation Schedule ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. RESNA 61078.02.

RESNA. January 27, 1993. Additional Subsurface Investigation at ARCO Station 6148, 5131 Shattuck Avenue in Oakland, California. RESNA Report 61035.05.

Base: U.S. Geological Survey
7.5-Minute Quadrangles
Oakland East/West, California
Photorevised 1980

N

LEGEND

(•) = Site Location

Approximate Scale

2000 1000 0 2000 4000

feet

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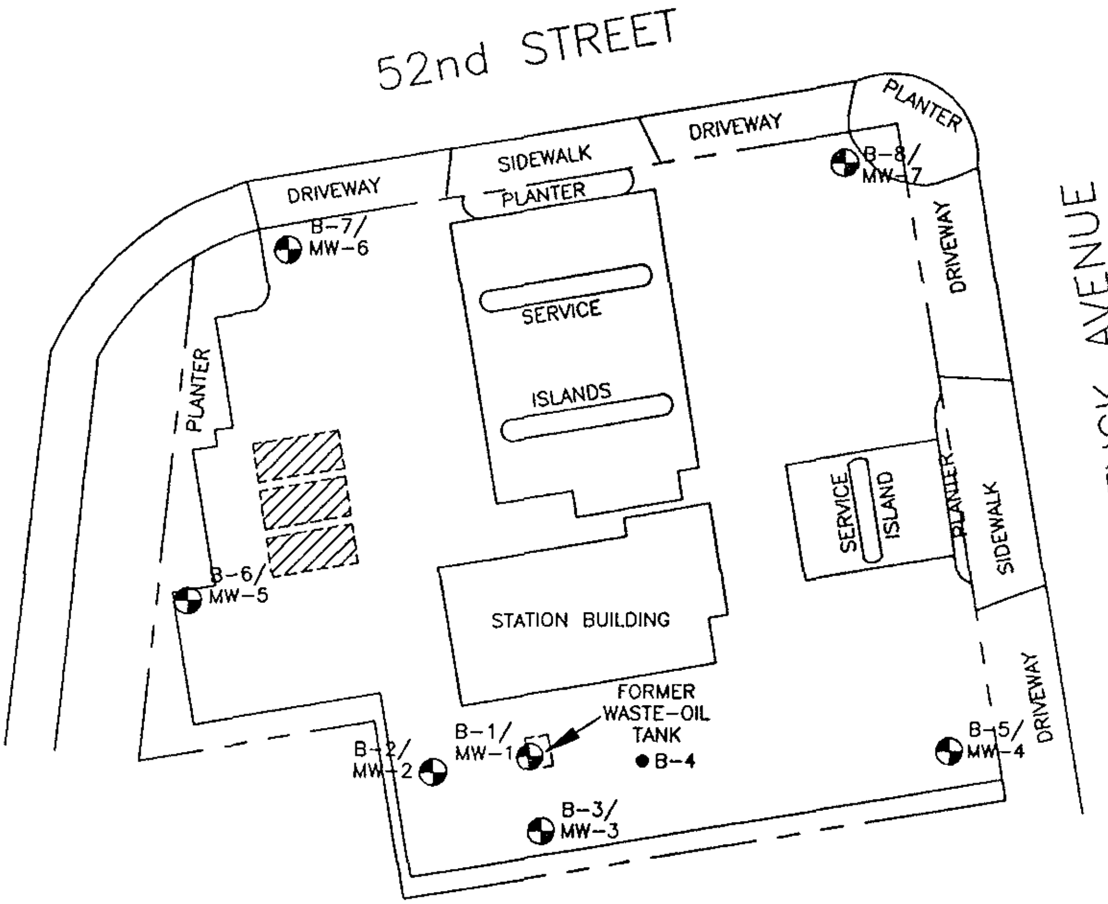
PROJECT 61035.08

SITE VICINITY MAP
ACRO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE

1



EXPLANATION

= Existing underground storage tanks

B-4 = Soil boring (RESNA, December 1991)

B-8/MW-7 = Monitoring well (RESNA, December 1991 and October 1992)

Approximate Scale

40 20 0 40 80

feet

Source: Based on data supplied by John Koch, Surveyor, 11/92.

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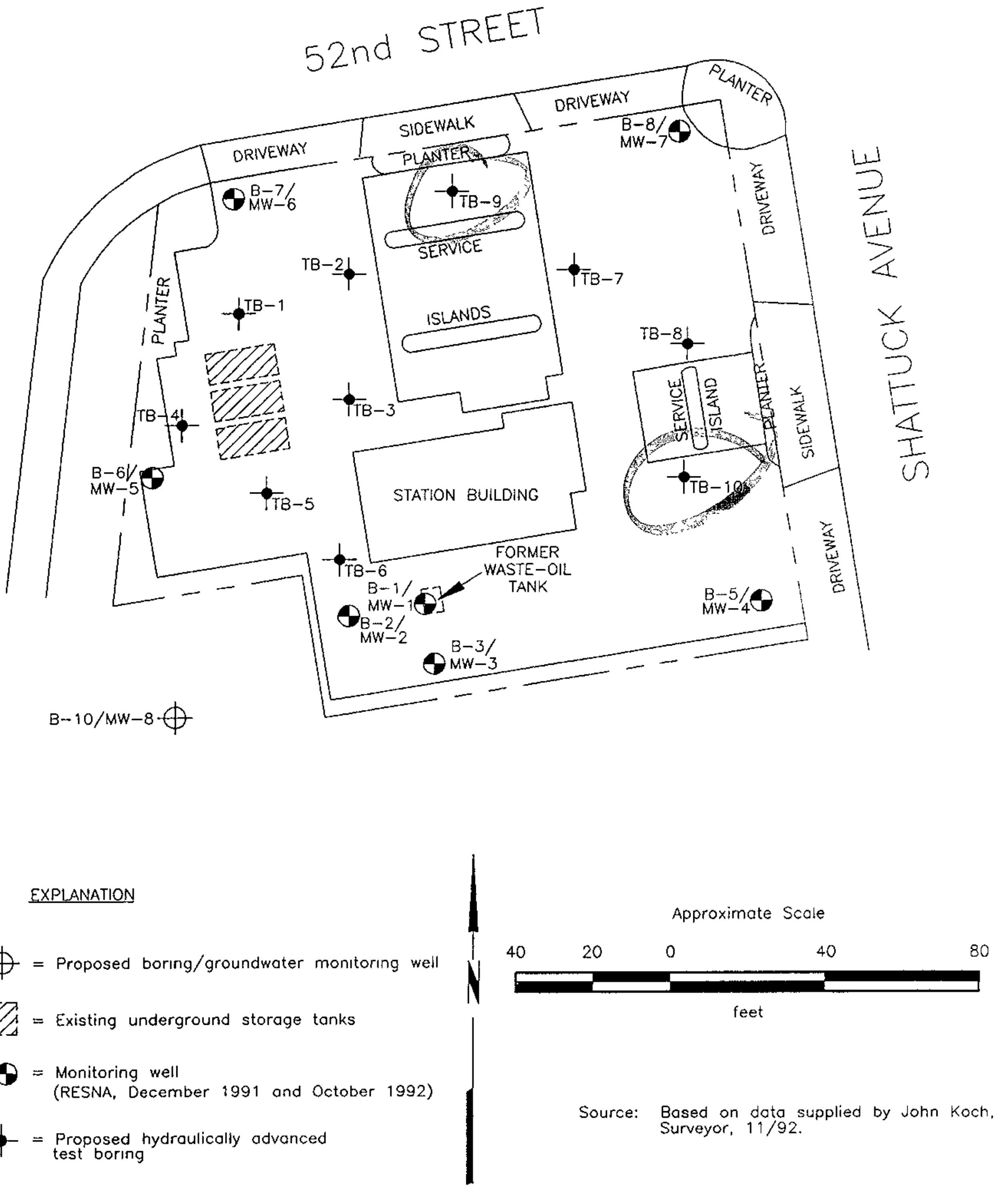
GENERALIZED SITE PLAN
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE 2



EXPLANATION

B-10/MW-8 = Proposed boring/groundwater monitoring well

= Existing underground storage tanks

B-8/MW-7 = Monitoring well (RESNA, December 1991 and October 1992)

TB-10 = Proposed hydraulically advanced test boring

Source: Based on data supplied by John Koch, Surveyor, 11/92.

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PROPOSED BORING/WELL LOCATIONS
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE
3

*STEP 1:
Gain offsite access. Submit well permit application to ACFCWCD.

STEP 2:
Advance ten onsite test borings (TB-1 through TB-10) and one offsite soil boring (B-10) and install one offsite groundwater monitoring well.

STEP 3:
Submit selected soil samples from step 2 to laboratory and analyze for TPHg and BTEX.

STEP 4:
Based on step 3 results, prepare a letter report/work plan to drill and install vapor extraction wells and air-sparging wells.

STEP 5:
Submit selected soil samples from step 4 to laboratory and analyze for TPHg and BTEX.

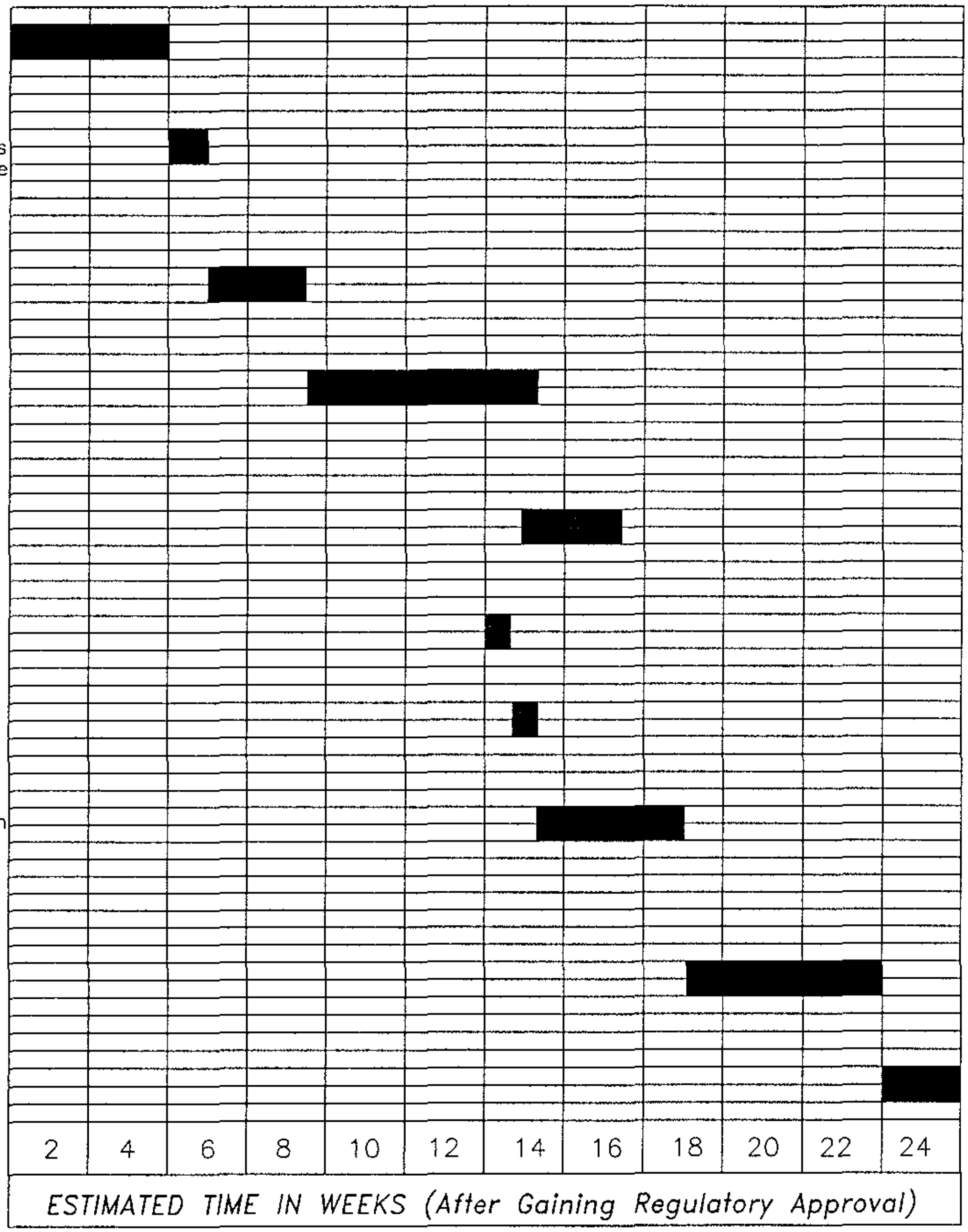
STEP 6:
Survey the wells to a local U.S. coast and geodetic datum

STEP 7:
Conduct a one day VET test.

STEP 8:
Conduct a one day combination air-sparging/VET. Submit air and water samples from steps 7, and 8 to laboratory and analyze for TPHg and BTEX.

STEP 9A:
Prepare a draft report.

STEP 9B:
Finalize report.



* Gaining offsite access will not affect schedule of onsite work.

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PRELIMINARY TIME SCHEDULE
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE 4

APPENDIX A

FIELD METHODS

FIELD PROTOCOL

The following presents RESNA Industries' field protocol for a typical site investigation involving gasoline hydrocarbon-impacted soil and/or groundwater.

Site Safety Plan

The Site Safety Plan describes the safety requirements for the evaluation of gasoline hydrocarbons in soil, groundwater, and the vadose-zone at the site. The site Safety Plan is applicable to personnel of RESNA Industries and its subcontractors. RESNA Industries personnel and subcontractors of RESNA Industries scheduled to perform the work at the site are briefed on the contents of the Site Safety Plan before work begins. A copy of the Site Safety Plan is available for reference by appropriate parties during the work. A site Safety Officer is assigned to the project.

Soil Excavation

Permits are acquired prior to the commencement of work. Excavated soil is evaluated using a field calibrated (using isobutylene) Thermo-Environmental Instruments Model 580 Organic Vapor Meter (OVM). This evaluation is done upon arrival of the soil at the ground surface in the excavator bucket by removing the top portion of soil from the bucket, and then placing the intake probe of the OVM against the surface of the soil in the bucket. Field instruments such as the OVM are useful for measuring relative concentrations of vapor content, but cannot be used to measure levels of gasoline hydrocarbons with the accuracy of laboratory analysis. Samples are taken from the soil in the bucket by driving laboratory-cleaned brass sleeves into the soil. The samples are sealed in the sleeves using aluminum foil, plastic caps, and aluminized duct tape; labeled; and promptly placed in iced storage. If field subjective analyses suggest the presence of gasoline hydrocarbons in the soil, additional excavation and soil sampling is performed, using similar methods. If groundwater is encountered in the excavation, groundwater samples are collected from the excavation using a clean Teflon® bailer. The groundwater samples are collected as described below under "Groundwater Sampling". The excavation is backfilled or fenced prior to departure from the site.

Sampling of Stockpiled Soil

One composite soil sample is collected for each 50 cubic yards of stockpiled soil, and for each individual stockpile composed of less than 50 cubic yards. Composite soil samples are obtained by first evaluating relatively high, average, and low areas of hydrocarbon concentration by digging approximately one to two feet into the stockpile and placing the intake probe of a field calibrated OVM against the surface of the soil; and then collecting one sample from the "high" reading area, and three samples from the "average" areas. Samples are collected by removing the top one to two feet of soil, then driving laboratory-cleaned brass sleeves into the soil. The samples are sealed in the sleeves using aluminum foil, plastic caps, and aluminized duct tape; labeled; and promptly placed in iced storage for transport to the laboratory, where compositing is performed.

Soil Borings

Prior to the drilling of borings and construction of monitoring wells, permits are acquired from the appropriate regulatory agency. In addition to the above-mentioned permits, encroachment permits from the City or State are acquired if drilling of borings offsite on City or State property is necessary. Copies of the permits are included in the appendix of the project report. Prior to drilling, Underground Services Alert (USA) is notified of our intent to drill, and known underground utility lines and structures are approximately marked.

The borings are drilled by a truck-mounted drill rig equipped with 8- or 10-inch-diameter, hollow-stem augers. The augers are steam-cleaned prior to drilling each boring to minimize the possibility of cross-contamination. After drilling the borings, monitoring wells are constructed in the borings, or neat-cement grout with bentonite is used to backfill the borings to the ground surface.

Borings for groundwater monitoring wells are drilled to a depth of no more than 20 feet below the depth at which a saturated zone is first encountered, or a short distance into a stratum beneath the saturated zone which is of sufficient moisture and consistency to be judged as a perching layer by the field geologist, whichever is shallower. Drilling into a deeper aquifer below the shallowest aquifer is begun only after a conductor casing is properly installed and allowed to set, to seal the shallow aquifer.

Drill Cuttings

Drill cuttings subjectively evaluated as containing gasoline hydrocarbons at levels greater than 100 parts per million (ppm) are separated from those subjectively evaluated as containing gasoline hydrocarbons at levels less than 100 ppm. Evaluation is based either on subjective evidence of soil discoloration, or on measurements made using a field calibrated OVM. Readings are taken by placing a soil sample into a ziplock-type plastic bag and allowing volatilization to occur. The intake probe of the OVM is then inserted into the headspace created in the plastic bag immediately after opening it. The drill cuttings from the borings are placed in labeled 55-gallon drums approved by the Department of Transportation, or on plastic at the site, and covered with plastic. The cuttings remain the responsibility of the client.

Soil Sampling in Borings

Soil samples are collected at no greater than 5-foot intervals from the ground surface to the total depth of the borings. The soil samples are collected by advancing the boring to a point immediately above the sampling depth, and then driving a California-modified, split-spoon sampler containing brass sleeves through the hollow center of the auger into the soil. The sampler and brass sleeves are laboratory-cleaned, steam-cleaned, or washed thoroughly with Alconox® and water, prior to each use. The sampler is driven with a standard 140-pound hammer repeatedly dropped 30 inches. The number of blows to drive the sampler each successive six inches are counted and recorded to evaluate the relative consistency of the soil.

The samples selected for laboratory analysis are removed from the sampler and quickly sealed in their brass sleeves with aluminum foil, plastic caps, and plastic zip-lock bags or aluminized duct tape. The samples are then labeled, promptly placed in iced storage, and delivered to a laboratory certified by the State of California to perform the analyses requested.

One of the samples in brass sleeves not selected for laboratory analysis at each sampling interval is tested in the field using an OVM that is field calibrated at the beginning of each day it is used. This testing is performed by inserting the intake probe of the OVM into the headspace in the plastic bag containing the soil sample as described in the Drill Cuttings section above. The OVM readings are presented in Logs of Borings included in the project report.

Logging of Borings

A geologist is present to log the soil cuttings and samples using the Unified Soil Classification System. Samples not selected for chemical analysis, and the soil in the sampler shoe, are extruded in the field for inspection. Logs include texture, color, moisture, plasticity, consistency, blow counts, and any other characteristics noted. Logs also include subjective evidence for the presence of gasoline hydrocarbons, such as soil staining, noticeable or obvious product odor, and OVM readings.

Groundwater Monitoring and Vapor Extraction Well Construction

Groundwater monitoring wells are constructed in selected borings using clean 2-inch-diameter, and vapor extraction wells are constructed in selected borings using clean 4-inch-diameter thread-jointed, Schedule 40 PVC casing. No chemical cements, glues, or solvents are used in well construction. Each casing bottom was sealed with a threaded end-plug, and each casing top with a locking plug. The screened portions of the groundwater monitoring wells are constructed of machine-slotted PVC casing with 0.020-inch-wide slots and the screened portions of the vapor extraction wells are constructed of machine-slotted PVC casing with 0.100-inch-wide slots. Slot size for the subsequent groundwater monitoring and vapor extraction wells are based on previous drilling and well installation data. The screened sections in groundwater monitoring wells are placed to allow monitoring during seasonal fluctuations of groundwater levels. The screened sections in vapor extraction wells are placed immediately above the water table or just below the water table to remediate vadose zone soils and capillary fringe soils exposed as a result of groundwater fluctuations.

The annular space of each groundwater monitoring well is backfilled with No. 3 or No. 2 sand, and each vapor extraction well is backfilled with washed ⅜-inch-diameter pea gravel to approximately two feet above the top of the screened casing for monitoring and vapor wells. The sand pack grain size for subsequent wells is based on previous groundwater monitoring and vapor extraction well installation data. A 1- to 2-foot-thick bentonite plug was placed above the sand pack as a seal against cement entering the filter pack. The remaining annulus was then backfilled with a slurry of water, neat cement, and bentonite to approximately one foot below the ground surface.

An Emmco-Wheaton Christy box with a PVC apron is placed over each groundwater monitoring and vapor extraction wellhead and set in concrete placed flush with the surrounding ground surface.

Groundwater Monitoring Well Development

The monitoring wells are developed by bailing or over-pumping and surge-block techniques. The wells are either bailed or pumped, allowed to recharge, and bailed or pumped again until the water removed from the wells appears to be relatively clear. Turbidity measurements (in NTU's) are recorded during well development and are used in evaluating well development. The development method used, initial turbidity measurement, volume of water removed, final turbidity measurement, and other pertinent field data and observations are recorded. The wells are allowed to equilibrate for at least 48 hours after development prior to sampling. Water generated by well development is stored in 17E Department of Transportation (DOT) 55-gallon drums on site, and remains the responsibility of the client.

Groundwater Sampling

The static water level in each well is measured to the nearest 0.01-foot using a Solinst® electric water-level sounder or oil/water interface probe (if the wells contain floating product) cleaned with Alconox® and water before use in each well. The depth of each well is also measured. The liquid in the wells is examined for visual evidence of gasoline hydrocarbons by gently lowering approximately half the length of a Teflon® bailer (cleaned with Alconox® and water) past the air/water interface. The sample is then retrieved and inspected for floating product, sheen, emulsion, color, sediment, and clarity. Obvious product odor is recorded if noted. If floating product is present in the well, the thickness of floating product is measured using an oil/water interface probe and is recorded to the nearest 0.01 foot. Floating product is removed from wells on site visits.

Groundwater samples from the wells are collected in approximate order of increasing product concentration, as best known or estimated. Wells which do not contain floating product are purged using a submersible pump. Equipment which comes in contact with the interior of the well or the groundwater is cleaned with Alconox® and deionized or distilled water prior to use in each well. The wells are purged until withdrawal is of sufficient duration to result in stabilized Ph, temperature, and electrical conductivity of the water. These parameters are measured to the nearest 0.1 Ph unit, 0.1 degree F, and 10 umhos/cm, respectively, using portable meters calibrated daily to a buffer and conductivity standard, according to the manufacturer's specifications. A minimum of four well volumes is purged from each well. If the well becomes dewatered, the water level is allowed to recover to at least 80 percent of the initial water level. When recovery of the water level has not reached at least 80 percent of the static water level after two hours, a groundwater sample will be collected when sufficient volume is available to fill the sample container. Prior to the collection of each groundwater sample, the Teflon® bailer is cleaned with Alconox® and rinsed with tap water and deionized water, and the latex gloves worn by the sampler changed. Hydrochloric acid is added to the sample vials as a preservative (when applicable). Sample containers remain sealed until usage at the site. A sample method blank is collected by pouring distilled water into the bailer and then into sample vials. Method blanks are analyzed periodically to verify effective cleaning procedures. A sample of the formation water is then collected from the surface of the water in each of the wells using the Teflon® bailer. The water samples are then gently poured into laboratory-cleaned, 40-milliliter (ml) glass vials, 500 ml plastic bottles or 1-liter glass bottles (as required for specific laboratory analysis), sealed with Teflon®-lined caps, and inspected for air bubbles to check for headspace, which would allow volatilization to occur. If a bubble is evident, the cap is removed, more sample is added, and the bottle resealed. The samples are then labeled and promptly placed in iced storage, and the wellhead is secured. A field log of well evacuation procedures and parameter monitoring is maintained. Water generated by the purging of wells is stored in 17E DOT 55-gallon drums, and floating product bailed from the wells is stored in double containment onsite; this water and product remains the responsibility of the client.

Vadose-Zone Sampling

Vapor readings are made with a field calibrated OVM, which has a lower detection limit of 0.1 ppm. Prior to purging each vadose-zone monitoring well, an initial reading is taken inside the well by connecting the tubing of the OVM to a tight fitting at the top of the well. Each vadose-zone monitoring well is then purged for approximately 60 seconds using an electric vacuum pump connected to the tight fitting. Ambient readings of the air at the site are taken with the OVM after each well is purged. The OVM is then connected to the well fitting, and the reading recorded. The well is then again purged for approximately 30 seconds, and again measured using the OVM. These purging and measuring procedures are repeated until two consecutive OVM readings are within ten percent of each other.

Air Sampling

Air samples are collected in opaque Mylar air sample bags using a sample pump with ¼-inch Tygon-type tubing connected to a brass wellhead fitting. Tygon-type tubing is used to minimize sample loss through adsorption and the possibility of distorted results from a sample line contaminated by a previous test run. The samples are sealed in the bags and labeled with the sample number, date, time, and sampler's name. The samples are immediately stored in a cool place for transport to a State-certified laboratory under Chain of Custody documentation.

Sample Labeling and Handling

Sample containers are labeled in the field with the job number, unique sample location, depth, and date, and promptly placed in iced storage for transport to the laboratory. A Chain of Custody Record is initiated by the field geologist and updated throughout handling of the samples, and accompanies the samples to a laboratory certified by the State of California for the analyses requested. Samples are transported to the laboratory promptly to help ensure that recommended sample holding times are not exceeded. Samples are properly disposed of after their useful life has expired.

Vapor-Extraction Test

Short-Term Test

RESNA uses a 300 cubic-inch standard displacement internal combustion (I.C.) engine to perform a vapor-extraction test at a subject site. Prior to the start of the short term test, depth to water measurements are recorded in all onsite monitoring wells to obtain baseline data. A vacuum is applied to each vapor extraction well for a minimum of 30 minutes using the I.C. engine to collect radius of influence data by measurement of induced vacuum at other vapor extraction wells and groundwater monitoring wells, and representative influent vapor samples from each well. At the end of each short-term test, each vapor extraction well is subjected to different applied vacuums and the resulting extracted air flow rates are measured to evaluate well characteristics.

Long-Term Test

The long-term VET is conducted for a minimum of 2.5 hours on the vapor extraction well that is reported to have relatively elevated hydrocarbon concentrations in extracted vapor as measured by a combustible gas meter, or if the well is located at different distances from the observation wells to yield useful radius of influence data. During the long-term test, the well is subjected to the maximum applied vacuum and air flow rates it can yield. Induced vacuum readings are monitored every half an hour at all observation wells to evaluate changes in radius of influence over an extended period of time. Air samples are collected 30 minutes after the start of the test and at the end of the test to evaluate changes in extracted hydrocarbon vapor concentrations with time. An air sample of the treated soil-gas effluent to the I.C engine is collected and analyzed to demonstrate the I.C. engine's destruction efficiency to the local air board. Air samples are also collected for lead and volatile organic hydrocarbon (VOC) analysis. At the end of the one-day VET, depth to water in all monitoring wells is measured to evaluate any upswelling of the water table as a result of vapor-extraction.

The data collected from the short term and long term VETs are used to evaluate the vapor flow rates that can be exacted from the vapor extraction wells, the initial hydrocarbon concentrations of extracted vapors useful in selection of a vapor abatement system, and the effective radius of influence of each vapor extraction well useful in determining the number of additional wells necessary to affect all areas of concern.

Air Sparge Testing

Air sparging involves the injection of air below the water surface so that dissolved hydrocarbons are stripped from the groundwater and moved upward into the vadose zone. Vapors transmitted to the vadose zone are captured using vapor extraction wells. The capture zone of an sparging well and the number of air sparging wells necessary to provide site coverage is highly influenced by the permeability of the sediments below and above the water surface. A field sparge test is therefore necessary in order to evaluate a site specific capture zone for air sparging, the number of sparging wells required to provide site coverage, optimal sparge flow rates and hydrocarbon removal rates.

Prior to performing the sparge test, static water levels, ambient soil-gas pressure, soil-gas concentrations in the wells and water samples are monitored and collected from the air sparge well and monitoring points to obtain baseline data. Using an air-compressor, air sparging (introduction of air into the aquifer) is initiated at air flow rates of 5 to 10 cubic feet per minute (cfm) into the aquifer for a period of about two hours. Soil-gas pressure at the sparge well and the monitoring points is recorded periodically throughout the test. Air and water samples are collected from the sparge well and the monitoring points after the test for BTEX and TPHg analysis. The test procedure is repeated at different air sparge flow rates to determine an optimal sparge rate.

Combined Air Sparge/VET

Prior to performing the combined test, depth-to-water measurements, soil-gas pressure, and soil-gas concentrations at all wells are recorded to obtain baseline data. In order to create a vacuum zone that extends beyond the radius of influence of the sparge point, a vacuum is applied on the vapor extraction well in close proximity to the sparge well to generate a vapor-extraction flow rate of at least two times the optimal air sparge flow rate. The VET is performed using the IC engine while the air sparge test is performed using an air compressor. Sparging at the optimal sparge air flow rate is initiated into the aquifer using the air sparge well. Data collection during the combination test will be similar to the sparge only test and will include the collection of influent soil gas to the I.C engine and induced vacuum readings at all wells to evaluate off-gas capture.

Aquifer Testing

Step-Drawdown Test

The initial water level is measured in the test well, water is pumped from the well using a submersible pump at three different flow rates: low flow, medium flow, and high flow (if possible). The flow rates and drawdowns measured in the pumping well are recorded to evaluate the optimum sustained pumping rate. Pressure transducers are used to measure water levels in the test well during drawdown and partial recovery phases, over a minimum period of approximately one to two hours.

Pumping Test

The initial water levels in wells to be used during the test are measured prior to commencement of pumping. The flow rate of the pump is adjusted to the desired pumping rate, and water levels allowed to recover to initial levels. Pumping then begins, and the starting time of pumping is recorded. Drawdowns in observation wells are recorded at intervals throughout pumping using pressure transducers. Evacuated water is stored in a storage tank at the site and remains the responsibility of the client. After the pump is shut off, recovery measurements are taken in the wells until recovery is at least 80 percent of the initial water level. Barometric pressure and tidal information are collected for the time interval of the pumping test to allow screening of possible effects of atmospheric pressure and tidal fluctuations on the groundwater levels.

Quality Assurance/Quality Control

The sampling and analysis procedures employed by RESNA for groundwater sampling and monitoring follow regulatory guidance for quality assurance/quality control (QA/QC). Quality control is maintained by site-specific field protocols and quality control checks performed by the laboratory. Laboratory and field handling of samples may be monitored by including QC samples for analysis. QC samples may include any combination of the following. The number and types of QC samples are selected and analyzed on a project-specific basis.

Trip blanks - Trip blanks are sent to the project site, and travel with project site samples. They are not opened, and are returned from a project site with the samples for analysis.

Field blank - Prepared in the field using organic-free water. Field blanks accompany project site samples to the laboratory and are analyzed periodically for specific chemical compounds present at the project site where they were prepared.

Duplicates - Duplicate samples are collected from a selected well and project site. They are analyzed at two different laboratories, or at the same laboratory under different labels.

Equipment blank - Periodic QC samples are collected from field equipment rinsate to verify adequate cleaning procedures.

RESNA
Working To Restore Nature

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TRANSMITTAL

TO: Ms. Susan Hugo
Alameda County Health Care Services
80 Swan Way, Room 200
Oakland, California 94621

DATE: March 1, 1993
PROJECT NUMBER: 61035.08
SUBJECT: ARCO STATION 6148, 5131 Shattuck Avenue, Oakland, California.

FROM: Barbara Sieminski
TITLE: Project Geologist

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REMARKS: cc: Mr. Michael Whelan, ARCO Products Company
Mr. Richard Hiett, RWQCB, San Francisco Bay Region
Mr. Joel Coffman, RESNA Industries Inc.

Copies: 1 to RESNA project file no. 61035.08