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DATE: March 3, 1993
PROJECT NUMBER: 69036.06
SUBJECT: ARCO Station 2035, 1001 San Pablo Avenue, Albany, California.

FROM: Bruce Maeda
TITLE: Project Engineer

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REMEDIAL ACTION PLAN
for
INTERIM SOIL AND
GROUNDWATER REMEDIATION
at
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

69036.06

3/3/93

Report prepared for

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by
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REMEDIAL ACTION PLAN
for
INTERIM SOIL AND GROUNDWATER REMEDIATION
at
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

For ARCO Products Company

INTRODUCTION

As requested by ARCO Products Company (ARCO), RESNA Industries, Inc. (RESNA) has prepared this Remedial Action Plan (RAP) for the interim remediation of onsite hydrocarbon-impacted soils and groundwater at ARCO Station 2035 located at 1001 San Pablo Avenue in Albany, California. This RAP includes a preliminary design for a combination vapor extraction system (VES) and groundwater recovery system at this site, and has been prepared for review, comment and approval by the California Regional Water Quality Control Board (CRWQCB) and the Alameda County Health Care Services Agency (ACHCSA) prior to installation and operation of the proposed systems. The subject site, ARCO Station 2035 is located at the intersection of San Pablo Avenue and Marin Avenue in Albany, California, as shown on the Site Vicinity Map, Plate 1. The location of the existing monitoring wells, station building, underground storage tanks (USTs) and other pertinent features are shown on Plate 2, the Generalized Site Plan.

The proposed scope of work under this RAP consists of the engineering design, permitting, construction, and start-up of a combination VES and groundwater recovery system at the subject site. The proposed remediation system is intended to serve as an interim remedial measure for onsite hydrocarbon-impacted soils and groundwater beneath the site.

SITE DESCRIPTION AND BACKGROUND

General

ARCO Station 2035 is an operating service station located southeast of the intersection of Marin and San Pablo Avenues at 1001 San Pablo Avenue, Albany, California. The location of the site is shown on Plate 1, Site Vicinity Map. The site is a relatively flat, asphalt-and concrete-covered lot.

Underground Storage Tanks

Four underground gasoline-storage tanks (USTs) were excavated and removed from the site in July and August 1991, including one 6,000-gallon UST (T1), two 4,000-gallon USTs (T2 and T3), and one 10,000-gallon UST (T4). A 550-gallon waste-oil tank was removed from the site in 1977 during ARCO's conversion of the station to a mini-market. The removed gasoline-storage tanks were replaced with four 10,000 gallon USTs. The approximate locations of the former and existing underground storage tanks, former waste-oil tank, and other pertinent features at the site are shown on Plate 2, Generalized Site Plan.

Regional Geology and Hydrogeology

ARCO Station 2035 is located within the East Bay Plain in the north-central portion of the Berkeley Alluvial Plain (Hickenbottom and Muir, 1988). The active Hayward Fault is approximately 2 miles east of the site. Helley et al. (1979) mapped the earth materials underlying the site area as older Quaternary alluvium deposits composed of a heterogeneous mixture of poorly consolidated to unconsolidated clay, silt, sand and gravel. The site is less than 1,200 feet north of the Codornices Creek and approximately 1 mile east of Fleming Point on the eastern shoreline of the San Francisco Bay. The direction of groundwater flow in the vicinity of the site is inferred to be to the west-southwest, based on regional and local topography and drainage patterns (RESNA, November 1992).

Local Subsurface Geology

Based upon previous subsurface investigations, the earth materials encountered at the site consist primarily of silty to gravelly clay and silt interbedded with continuous and discontinuous layers of clayey to sandy gravel and clayey sand (RESNA, November 1992).

PREVIOUS WORK

Limited Site Assessment

On August 9, 1989, Applied GeoSystems (AGS, now owned by RESNA) performed a limited environmental site assessment to evaluate possible gasoline hydrocarbons in the vicinity of the four underground gasoline-storage tanks (AGS, 1990). Five soil borings (B-1 through B-5) were drilled as shown on Plate 2.

Groundwater was encountered in the borings at depths between 17 and 18 feet below ground surface, except in boring B-5 where groundwater was not encountered to a total depth of 20½ feet below ground surface. A hydrocarbon sheen was noted on the surface of water samples obtained from borings B-1 through B-4.

Laboratory analyses of selected soil samples from borings B-1 through B-5 reported concentrations of TPHg ranging from nondetectable to 2,400 parts per million (ppm), as shown on Table 1. AGS concluded that shallow soils (at 10-15 feet depths) near the four underground gasoline storage tanks had been impacted by gasoline hydrocarbons, and shallow groundwater beneath the site appeared to have been impacted by gasoline hydrocarbons.

Underground Storage Tank Removal

A Work Plan (RESNA/AGS, April 29, 1991) and an Addendum One to the Work Plan (RESNA/AGS, April 29, 1992) were prepared by RESNA outlining work to be performed in a limited subsurface investigation at the subject site. Work proposed in Addendum One to the Work Plan, removal and replacement of USTs and product delivery lines, commenced in July 1991 (RESNA/AGS, September 11, 1991).

On June 25, 1991, RESNA personnel supervised the drilling of two soil borings, (B-6 and B-7) to depths of 18 and 19½ feet below ground surface in the area of the proposed new tank pit location as shown on Plate 2.

Groundwater was first encountered at 17½ feet in B-6 and 19½ feet in B-7. Selected soil samples collected from borings B-6 and B-7 were submitted for laboratory analyses for TPHg and BTEX by EPA Methods 8015/8020. TPHg and BTEX concentrations were not detected from any soil sample submitted. The laboratory results of soil samples from borings are summarized in Table 1. Laboratory results of soil samples from new tank pit excavation are summarized in Table 2, Laboratory Analyses of New Tank Pit Soil Samples. Soil sampling locations are presented on Plate 3.

In July and August 1991, four gasoline USTs (T1 through T4) and associated product lines were excavated and removed. Soil samples were collected from the side walls, bottom of the excavation, and beneath the product lines. Selected soil samples were submitted for laboratory analyses for TPHg and BTEX by EPA Method 8015/8020. The analytical results are shown in Table 3, Laboratory Analyses of Former Gasoline Tank Pit Soil Samples, and Table 4, Laboratory Analyses of Product-Line and Product-Dispenser Soil Samples. Based on the tank removal and environmental subsurface investigation RESNA concluded that gasoline hydrocarbons over 100 ppm have not impacted the shallow soils (ground surface to 13 feet below grade) in the vicinity of the former underground steel gasoline-storage tanks; gasoline hydrocarbons over 1,000 ppm have impacted the shallow soils (one foot below grade) in the vicinity of the product dispensers adjacent to the former steel gasoline-storage tanks; and a water "grab" sample collected from the former tank pit and submitted for laboratory analyses showed a concentration of 190 ppb TPHg.

Subsurface Environmental Investigation

An Addendum Two to the Work Plan (RESNA/AGS, September 24, 1991) was prepared by RESNA outlining work to be performed in a subsurface environmental investigation at the subject site. This work included: performing a records research of Alameda County Flood Control and Water Conservation District (ACFCWCD) records for water supply and monitoring wells within a ½-mile radius of the subject site; performing a records research

of the City of Albany Fire Department and ACFCWCD files for nearby and upgradient possible offsite sources of gasoline hydrocarbons; drilling four soil borings (B-8 through B-11); collecting soil samples from the borings; constructing a 6-inch-diameter groundwater recovery well RW-1 in boring B-8, and 4-inch diameter groundwater monitoring wells MW-1 through MW-3 in borings B-9 through B-11, respectively; developing and sampling the wells; submitting soil and groundwater samples for laboratory analyses; surveying wellhead elevations; and performing an aquifer pump test (RESNA, March 6, 1992). Details regarding groundwater recovery and monitoring well construction are presented in Appendix A, Plates A-1 through A-7 (RESNA, March 1991).

The work described above was performed by RESNA in October and November 1991. Based on the results of this investigation RESNA concluded that the majority of gasoline hydrocarbons in the soil at the site was at the depth between approximately 10 to 15 feet below ground surface, within the layer of sandy clays and gravely silts. The lateral extent of gasoline hydrocarbons in the soil had been delineated below 100 parts per million (ppm) only in the northwestern (B-10) and northeastern (B-9) portions of the site, and to nondetectable level (less than 1 ppm) in the southern portion of the site (B-6 and B-7). The vertical extent of gasoline hydrocarbons in the soil at the site had been delineated to nondetectable level (less than 1.0 ppm) at a depth of approximately 16 to 20½ feet below the ground surface with the exception of boring B-8, where 240 ppm of TPHg was detected at a depth of 30 feet below ground surface within the saturated zone. The lateral extent of waste-oil related hydrocarbons in the soil in the area of the former waste-oil tank at the site had not been delineated.

The lateral and vertical extent of gasoline hydrocarbons in the groundwater had not been delineated at the site with the exception of the northwestern part of the site where TPHg concentrations were below laboratory detection limit (<60 parts per billion [ppb]) for TPHg in MW-2. Based on nondetectable concentrations of TOG, TPHd, VOC's, and the metals cadmium, chromium, lead, and nickel in groundwater samples collected from monitoring well MW-3, RESNA concluded that the hydrocarbons associated with the waste-oil tank have not impacted groundwater beneath the site.

Aquifer Pump and Recovery Tests

A step-drawdown test was performed at the site on November 7, 1991 using groundwater recovery well RW-1 to determine an optimum pumping rate at which to perform the aquifer pump test. The well could sustain a pumping rate of 1 gallon per minute (GPM), with a drawdown of 2.7 feet after one hour of pumping. At a pumping rate of 2 GPM, the drawdown in well RW-1 was 8.7 feet after 1 hour. An 18-hour pump test and 6-hour recovery test were conducted at the site on November 14 and 15, 1991. Groundwater recovery well RW-1 was used as the pumping well, and monitoring wells MW-1 through MW-3 were used as the observation wells.

Based on the results of the pump test, RESNA estimated a long-term pumping rate of 1.5 to 1.7 GPM from the recovery well RW-1, and concluded that the predicted zone of capture is sufficiently large to capture a portion of the impacted groundwater and floating product at the site. The sustained water level drawdown in well RW-1 was approximately 6 feet at a pumping rate of approximately 1.5 to 1.7 GPM. The first-encountered water bearing zone was determined to be an 8-foot thick confined zone, with relatively high transmissivity (RESNA, March 1992).

Vapor Extraction Well Installation

In August 1992, six vapor extraction wells (VW-1 through VW-6) were constructed in borings B-14 through B-19, respectively (RESNA, November 1992). The wells were completed with 4-inch-diameter, Schedule 40, polyvinyl chloride (PVC) casing. Well casings were set in the vapor extraction wells (VW-1 through VW-6) to depths of approximately 9½ to 17 feet below ground surface. The screened casings for the vapor extraction wells consist of 4-inch-diameter, 0.100 inch-wide machine-slotted PVC set from the total depths of the wells to approximately 4½ to 5 feet below ground surface. Screened intervals for vapor extraction wells were based on the organic vapor monitor (OVM) readings. Blank PVC casing was set from the top of the screened casing to within a few inches below the ground surface. Details regarding vapor extraction well construction are presented in Appendix B, Plates B-1 through B-6.

Vapor Extraction Test

RESNA performed a one-day onsite VET on August 25, 1992, to collect site specific data and evaluate the feasibility of using vapor-extraction as a soil remediation alternative. Based upon the results of the VET, RESNA concluded that vapor extraction appears to be a viable soil remediation alternative for the remediation of gasoline hydrocarbons from onsite soils. An effective radius of influence for vapor wells VW-1 through VW-6 has been estimated to range from approximately 15 to 40 feet, based upon wellhead flow rates of approximately 80 SCFM and applied vacuums of approximately 90 inches WC. The projected radius of influence appears to vary with compass direction, depending on well location and proximity to backfill areas. Radius of influence appears to be limited (< 15 feet) for vapor wells installed near the former tank complex and product-line areas. This reduced radius of influence may be the result of air short-circuiting through more permeable backfill areas. VET field monitoring data and laboratory analysis of air samples are presented in Tables 5 and 6, respectively (RESNA, November 1992).

Monthly Monitoring and Quarterly Sampling

Monthly monitoring and quarterly sampling of groundwater monitoring wells at the subject site began in October 1991. The highest concentrations of dissolved hydrocarbons in groundwater beneath the site were noted in March 1992 (up to 6,500 ppb of TPHg and 2,600 ppb of benzene in MW-1). From March 1992 to October 1992, hydrocarbon concentrations have decreased significantly in MW-1 (to 190 ppb of TPHg and 68 ppb of benzene), MW-3 (to nondetectable TPHg, toluene, ethylbenzene, total xylene, and to 0.6 ppb of benzene) and remained nondetectable (TPHg) or decreased to nondetectable levels (BTEX) in MW-2. Recovery well RW-1 continues to contain floating product. In January 1992, RESNA initiated the removal of floating product from RW-1 by hand bailing. In April 1992, a Horner EZY Floating Skimmer was installed in recovery well RW-1. In third quarter of 1992 RESNA changed floating product removal from monthly to bi-weekly. Quarterly sampling of groundwater monitoring wells and collection of monthly monitoring data is currently performed by ARCO's subcontractor, EMCON Associates (EMCON) of San Jose, California. The results of previous groundwater monitoring and laboratory analyses of groundwater samples are presented in Tables 7 through 9.

SUMMARY OF SOIL AND GROUNDWATER CONTAMINATION

Extent of Hydrocarbon Impacted Soil

The presently interpreted extent of hydrocarbon impacted soil beneath the site is depicted on Geologic Cross Sections, Plates 5 through 8. The locations of the cross sections are shown in Plate 2. The majority of gasoline impacted soil at concentrations above 100 ppm of TPHg appear to be located in the northern and eastern portions of the site (northern and southern vicinity of the northern service islands, northeastern vicinity of former gasoline tank T4, and immediate vicinity of the former waste-oil tank) at depths between 5 to 15 feet below the ground surface, within silty to gravelly clay interbedded with discontinuous layers of clayey to sandy gravel and clayey sand. The presence of water in this relatively permeable zone appears to have facilitated the movement of gasoline hydrocarbons laterally. Soil sampling locations from the UST removal are presented in Plate 3 (RESNA, 1991). TPHg concentrations in soil between the 4.5 to 6 foot, 9 to 11 foot, and 13 to 16 foot depths are depicted graphically in Soil Contour Maps, Plates 9 through 11, respectively (RESNA, November 1992).

The lateral extent of gasoline hydrocarbons in the soil at the subject site has been delineated below 100 ppm TPHg, with the exception of the northern and eastern vicinity of the site. The vertical extent of gasoline hydrocarbons in the soil at the site has been delineated based on soil samples collected from unsaturated aquitard materials beneath the site (RESNA, November 1992). Results of laboratory analyses of soil samples collected from previous investigations are summarized in Tables 1 through 4, Laboratory Analyses of Soil Samples.

The soil in the immediate vicinity of the former waste-oil tank pit appears to be impacted by waste-oil related hydrocarbons as up to 1,800 ppm of TOG and up to 250 ppm of a non-diesel mixture of hydrocarbons (C9 - C14, and >C17) calculated as TPHd. This TPHd was detected in the soil samples collected from borings B-12 and B-13 located in the immediate vicinity of the former waste-oil tank pit. Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) were not detected in the

soil samples from borings B-12 and B-13, and concentrations of metals (Cd, Cr, Pb, Zn and Ni) were within the range of natural background levels (RESNA, November 1992).

Extent of Hydrocarbon Impacted Groundwater

Groundwater in the first encountered water bearing zone at the site is impacted by gasoline hydrocarbons as evidenced by the presence of floating product in recovery well RW-1, and dissolved hydrocarbons in monitoring well MW-1 (RESNA, November 1992). Graphic interpretations of the extent of TPHg and benzene in the groundwater are shown on Plate 15, TPHg/Benzene Concentrations in Groundwater, based upon sampling conducted in October 1992. The results of previous groundwater monitoring and laboratory analyses of groundwater samples are presented in Tables 7 through 9.

Floating product continues to be observed in groundwater recovery well RW-1. In October and December 1992, floating product thickness was observed by EMCON at 0.04 and 0.51 feet, respectively. The presence of floating product sheen was observed by EMCON from this well in November 1992. The thickness and amount of floating product recovered from well RW-1 by RESNA during 1992 are summarized in Table 10.

The highest dissolved TPHg concentrations have been observed in monitoring well MW-1 in the northeast corner of the site, near the north and east property lines and northeast of the former locations of the four USTs (October 1992). Benzene has recently been detected at concentrations of 68 ppb and 0.6 ppb in groundwater monitoring wells MW-1 and MW-3, respectively (October 1992). Benzene concentrations in well MW-1 exceed the State of California Maximum Contaminant Level (MCL) of 1 ppb for benzene.

The lateral extent of gasoline hydrocarbons in the groundwater has not been delineated at the site with the exception of the northwestern portion of the site (MW-2), and the vicinity of the former waste-oil tank pit (MW-3) where TPHg concentrations were less than 50 ppb. The groundwater at the site does not appear to be impacted by waste-oil related hydrocarbons based on the nondetectable concentrations of TOG, VOCs, Cd, Cr, Pb, Ni, and minor (0.045 ppm) concentration of Zn in monitoring well MW-3 located next to the former waste-oil tank pit (RESNA, November 1992).

GROUNDWATER GRADIENT

The groundwater gradient evaluated for the first-encountered groundwater at this site, based on groundwater elevations obtained by EMCON from wells MW-1 through MW-3 and RW-1 during fourth quarter 1992 is approximately 0.02 ft/ft toward the southwest. This gradient is generally consistent with regional gradient direction. Plates 12 through 14, Groundwater Gradient Maps, are graphic interpretations of the groundwater elevations measured on October 26, November 23, and December 16, 1992. Depth to water measurements, top of casing elevations, and calculated groundwater elevations are presented in Table 7.

DESCRIPTION OF PROPOSED INTERIM INTERIM SOIL AND GROUNDWATER REMEDIATION SYSTEM

The proposed VES and groundwater recovery system will function as an interim soil and groundwater remediation system for onsite hydrocarbon-impacted soils and groundwater beneath the site. Upon installation and operation of the combination system, the adequacy of the systems to remediate hydrocarbon-impacted soils and groundwater beneath the subject site to acceptable regulatory levels for closure will be reassessed. The installation of additional vapor extraction wells or groundwater recovery wells may be necessary in the future, depending on site-specific conditions. In addition, the use of alternative remediation techniques such as air-sparging may be evaluated in the future to enhance the removal of hydrocarbons from both the adsorbed-phase (saturated soils) and dissolved-phase (groundwater), as needed.

Interim VES System

The proposed interim VES will utilize six existing vapor extraction wells (VW-1 through VW-6), groundwater recovery well RW-1, two proposed vapor extraction wells (VW-7 and VW-8), a vacuum blower, and off-gas abatement system to address the majority of gasoline-impacted soils in the northern and eastern portions of the site, which generally exist between the 5 to 15 foot depths (Plates 10 and 11). Two additional vapor extraction wells are proposed to address hydrocarbon-impacted soil in the area between wells VW-4 and VW-5, and in the area of former boring B-4, near the eastern property line. The proposed wells,

VW-7 and VW-8, will be 4-inch diameter wells installed in borings B-20 and B-21. The wells will be screened from approximately 5 to 15 feet, depending on site-specific geologic conditions and the extent of hydrocarbon-impacted soil encountered during drilling. Groundwater recovery well RW-1 will be used to remove free product from the recovery well and enhance the removal of gasoline hydrocarbons from nearby capillary fringe soils. The proposed locations of wells VW-7 and VW-8 are shown in Plate 16. Details regarding vapor extraction well construction are presented in Appendix B, Plates B-1 through B-6.

Based upon VET data, an effective radius of influence for vapor wells VW-1 through VW-6 has been estimated to range from less than 15 feet to 40 feet, depending on compass direction and proximity to tank and product-line backfill areas (RESNA, 1992). These estimates were based upon interpreted VET data for wellhead air flow rates of 40 to 80 standard cubic feet per minute (SCFM) and applied wellhead vacuums of 30 to 90 inches water column (WC). As a result, the interim VES should be operated under similar conditions in order to achieve the estimated radius of influence for each well. Due to the relatively large air flow rates observed from the vapor wells during the VET, operation of the vapor wells may occur individually in sequence, rather than concurrently, to maximize the cost-effectiveness of the off-gas abatement equipment. This design approach is consistent with the relatively low vapor-phase TPHg concentrations observed during the VET. Air samples from only two wells, VW-2 and VW-6, contained relatively high TPHg concentrations at 6,800 and 27,000 mg/m^3 respectively.

The location of existing and proposed vapor extraction wells, and their projected radius of influence is presented on Plate 16. The actual radius of influence will vary depending on subsurface geologic conditions, the extent and distribution of hydrocarbon-impacted soil, and site-specific operating conditions of the VES. The effective radius of influence should be evaluated following long-term operation of the VES.

VES Treatment Processes

Subsurface piping will direct extracted vapor from the wells to an off-gas abatement unit located at the remediation compound. The proposed locations of the remediation compound, future pipe trench locations, and vapor extraction wells are depicted on Plate

17. Components of the VES located in the remediation compound will include: a vapor extraction blower that will extract vapor from the wells through the subgrade piping; a flow indicator that measures extracted flow; a condensate separator to remove entrained droplets of moisture; a 250-cfm catalytic or combination thermal/catalytic oxidizer; two future 1,200-pound vapor phase activated carbon canisters in series; a set of associated piping, control valves, instrumentation and controls; a remote monitoring system to transmit the status of process variables and any alarm or upset conditions; and a fenced remediation compound to preclude public access. Plate 18 depicts a process flow schematic of the proposed VES.

Wellhead piping will be equipped with a vacuum gauge, a sample port, and a shut-off valve so that flow through each well can be adjusted to maximize the total pounds of petroleum hydrocarbons being extracted from the soil. Well vaults with traffic rated covers will be installed at each vapor well and junction boxes for protection. To allow for future expansion of the VES, a limited number of additional vapor extraction pipe stub-out connections may be installed to facilitate the connection of future vapor extraction wells or air-sparging points, if needed (Plate 17).

Based upon ARCO guidelines, a 250 SCFM catalytic or combination thermal/catalytic oxidizer will likely be used to treat the extracted vapors from both the aeration tank and the VES. The use of a catalytic oxidizer will require that influent TPHg concentrations typically be maintained below 3,500 ppmv, equivalent to 25% the lower explosive limit (LEL) for gasoline. The maximum TPHg concentration observed in air samples collected during the VET was 27,000 mg/m^3 from vapor well VW-5. Using an average molecular weight of 95 grams per mole for weathered gasoline, this concentration corresponds to a volumetric concentration of approximately 7,000 ppmv, or 58% of the LEL for gasoline. Consequently, fresh-air dilution may be necessary during the initial start-up phases. The need for dilution air should decrease with time, depending on oxygen content and hydrocarbon vapor concentrations from the vapor wells and aeration tank. The type of vacuum extraction blower and off-gas abatement device will be determined during the design phase of the project. Based upon case studies conducted by others (Johnson, et al), the initially high TPHg concentrations from the vapor wells will typically decrease rapidly with time, depending on site-specific conditions. The off-gas treatment system will be modified to an activated carbon adsorption system when the hydrocarbon concentrations of the vapor

approach 50 ppmv, or when it becomes cost-effective and safe. Manufacturer's specifications for vapor-phase activated carbon are enclosed in Appendix C.

Interim Groundwater Recovery System

The proposed interim groundwater remediation system will utilize the existing 6-inch diameter recovery well RW-1 and a groundwater depression pump to extract groundwater containing dissolved gasoline hydrocarbons from the site. Based upon the results of previous pumping tests, a long-term pumping rate of 1.5 to 1.7 GPM has been projected for the site. The groundwater depression pump will likely consist of a submersible pneumatic pump, with automatic fill and discharge cycles based upon water level. Based upon preliminary designs, the bottom-fill pump inlet will be installed approximately 1 foot from the bottom of the 26-foot well. Considering that the pump actuates approximately 3 feet above the pump inlet, the groundwater surface may be depressed roughly 22 feet from grade surface, corresponding to approximately 12 feet of drawdown, based upon December 1992 groundwater elevations. Manufacturer's specifications for the proposed groundwater depression pump are enclosed in Appendix D.

Following long-term pumping and depression of the potentiometric water surface in recovery well RW-1, free product may be hydraulically drawn into the well. RESNA proposes to remove this free product using vapor extraction from recovery well RW-1. To expedite free product removal, an air bubbler may be installed below the water surface to enhance volatilization of floating product in the well. The combined air/gasoline vapors will be removed by the vapor extraction system.

In addition to enhancing free product removal, vapor extraction from recovery well RW-1 may initiate air flow through newly exposed soils as the groundwater surface becomes depressed through groundwater pumping. Thus, vapor extraction may also enhance removal of gasoline hydrocarbons from the capillary fringe soils in the immediate vicinity of the well. Using vapor extraction should also eliminate the need for free product storage tanks in the remediation compound which may complicate equipment selection and permitting of the interim remediation equipment.

Interim Groundwater Remediation System Treatment Processes

Subsurface piping will direct extracted groundwater from the well to the remediation compound for above-ground treatment to reduce dissolved hydrocarbon constituents, prior to discharge to the sanitary sewer. At the remediation compound, extracted groundwater will be filtered through a bag filter unit to remove particulates. The water will then enter an enclosed aeration tank, where a diffused air stream will pass through the hydrocarbon-containing groundwater to volatilize contaminants. The aerated water will then be pumped through two 200-pound liquid-phase carbon canisters in series to meet discharge requirements of the East Bay Municipal Utility District (EBMUD). The treated groundwater will be discharged under an EBMUD permit to an on-site sewer lateral which discharges to the City of Albany sanitary sewer. The exact location of the sewer lateral will be determined in the design phase of the project. Off-gas vapors from the aeration tank will be directed to the off-gas abatement unit for the VES for treatment. Plate 18 depicts a process flow schematic of the proposed groundwater treatment system. Manufacturer's specifications for the aeration tank and liquid-phase activated carbon are enclosed in Appendix E.

An additional benefit of the aeration tank is that free product which is inadvertently removed by the groundwater depression pump should collect in the aeration tank chamber and later be volatilized. The top inlet, bottom outlet design of the baffled aeration tank should prevent free product from entering the liquid-phase carbon canisters.

Spill Prevention and Safety Plan

As a part of spill prevention and containment (safety measures), the catalytic or thermal/catalytic oxidizer will be equipped with a low and a high temperature shutdown; continuous temperature measurement instrumentation consisting of at least two thermocouple probes at the inlet in event one shall fail; a strip chart recorder for continuous temperature recording; a flash back flame arrestor; high and low pressure switches for supplemental fuel, if applicable; and a low pressure switch at the blower inlet to shut the VES off in event of blower failure. These safety features will ensure that the catalytic or thermal/catalytic oxidizer will never operate under conditions of low temperatures which

lowers system destruction efficiency, under high temperature runaway conditions resulting in damage to the catalyst or create an explosive atmosphere; and when low air flow exists. A remote monitoring system will be installed to continuously monitor and periodically report the status of process variables which can influence the systems' performance and cause an alarm or shut-down condition. When any of these conditions are triggered the remote monitoring system will notify RESNA's San Jose office personnel by facsimile so that the condition can be rectified prior to system restart. Any system failure causing a violation of the Bay Area Air Quality Management District (BAAQMD) permit will be reported immediately to the BAAQMD and a written report will be filed with BAAQMD within five working days of any such release.

Spill prevention measures when the vapor phase carbon system is brought on-line will include: a pressure indicator installed on the first carbon canister to prevent over-pressurizing the carbon canisters; a low pressure switch and indicator influent to the blower to shut the VES off in event of blower failure; two high temperature switches for prevention of explosive conditions; and a remote monitoring system to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm or shut-down condition.

Spill prevention measures for the groundwater treatment system will include high-high level switches in the aeration tank to prevent overflow; pressure switches or pressure relief valves on the carbon canisters to prevent overpressurizing; a low pressure switch on the aeration tank blower to shut-off the groundwater treatment system in the event of blower failure; and a remote monitoring system to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm or shut-down condition. When any alarm conditions are triggered the remote monitoring system will notify RESNA's San Jose office personnel by facsimile so the condition can be rectified prior to system restart.

Additional spill prevention measures will include double containment for the aeration tank, liquid-phase carbon vessels, and the condensate storage tank. A fire extinguisher and no smoking signs will also be installed in the remediation compound.

PROPOSED SCOPE OF WORK

Based on the results of previous subsurface investigations, RESNA proposes the following project Tasks 1 through 8 listed below, as a method of approach to design and permit the interim VES and groundwater remediation system described above. These tasks outlined below are described in detail in ensuing sections:

- o Task 1. Interim Remedial Action Plan
- o Task 2. Design of Plans and Specifications
- o Task 3. Building and Discharge Permits
- o Task 4. Bid Package and Evaluation
- o Task 5. Equipment Procurement
- o Task 6. Construction and Construction Inspection
- o Task 7. System Startup and Operation
- o Task 8. System Performance Evaluation

Task 1. Interim Remedial Action Plan

As requested by ARCO, RESNA will submit this Interim Remedial Action Plan (RAP) for the preliminary design of a VES and groundwater recovery system at this site for review and approval to the CRWQCB and ACHCSA prior to installation of the proposed remediation system. This RAP describes interim remedial measures to be implemented for onsite hydrocarbon-impacted soil and groundwater at the site, including the design, construction, and proposed operation, maintenance and monitoring of the interim VES (discussed under Task 8) to be installed at this site. A preliminary schedule of work, including a construction schedule, is presented at the end of this report. A brief description of previous work is also included.

Task 2. Design of Plans and Specifications

This phase of the proposed work will include: engineering calculations; list of equipment, materials and instrumentation; preparation of Plans and Specifications including site and remediation compound layouts, trench and section details, and a process and

instrumentation diagram (P&ID); in-house plan check and review; one set of minor revisions to the Plans and Specifications by ARCO; and one by the City of Albany Building Department. Also under this task, RESNA personnel will meet with Pacific Gas & Electric Company (PG & E) and City of Albany personnel to discuss electrical service requirements, natural gas hookup, other City requirements and take site measurements. Under this phase of the work, after determining electrical and natural gas service availability, the vapor extraction blower and the off-gas abatement unit will be selected.

Task 3. Building and Discharge Permits

An Authority to Construct and Permit to Operate application will be completed and submitted to the BAAQMD to allow for construction and installation of the proposed interim VES. The application will include a site history, VES specifications, and analytical results for known and suspected pollutants.

The complete set of Plans and Specifications will also be submitted to the City of Hayward Building, Planning and Fire Departments for review, comment and approval prior to construction and installation of the interim VES and groundwater recovery system, and city sewer connections. A sewer discharge permit application was prepared and submitted to EBMUD in January 1992. Revisions to the sewer discharge permit application may be necessary, pending completion of system design. A Hazardous Waste Storage Permit for onsite storage of the condensate collected in the condensate separator may also be required by the Fire Department. One set of minor revisions to the permits to incorporate regulatory agency comments is planned.

Task 4. Bid Package and Bid Evaluation

After the design is completed, a bid package will be prepared for submittal to construction contractors for installation of the proposed interim VES. A minimum of three pre-qualified contractors will receive the bid package. One meeting with each contractor is included in the scope of work, as well as time to answer contractor questions and assist them in preparation of their bids. This will not be a publicly advertised Bid Period with sealed bids. Contractor bids will be evaluated and recommendations made for Award of Contract.

Task 5. Equipment Procurement

After engineering design is completed, permits have been obtained, and a contractor selected, RESNA will then provide ARCO with a list of long-lead capital equipment (greater than 4 weeks) to be ordered. Either ARCO or RESNA will directly order the equipment from the vendor. Possible capital equipment to be ordered include the catalytic or thermal/catalytic oxidizer, vapor extraction blower, and vapor phase carbon. Other equipment (valves, pipes, etc), and instrumentation will be purchased by the contractor.

Task 6. Construction and Construction Inspection

Upon approval of the interim RAP, after having secured the City Building, Fire and Planning Department Permits, BAAQMD air discharge permit, EBMUD sewer discharge permit, after selection of a general contractor, and after equipment procurement, system installation in accordance with the approved Plans and Specifications will be initiated. Construction will include: construction of utility trenches to contain all necessary gas and electrical lines; connection to the sanitary sewer; installation of necessary underground pipes and electrical conduits to and from the proposed treatment compound; pressure testing of lines; construction of the remediation compound; electrical service and natural gas hookup; and installation and plumbing of all soil and groundwater remediation equipment. Construction of the remediation system will begin after design of the VES and groundwater remediation system is complete, proposed onsite vapor extraction wells have been installed, and discharge and city building permits have been obtained.

Task 7. System Startup and Operation

This section and the ensuing sections detail a monitoring plan to verify the effectiveness of the proposed interim VES at this site.

System Monitoring

After completion of system installation, operation of the proposed interim VES and groundwater remediation system will be initiated in compliance with all applicable

regulatory agencies. Startup procedures will include system monitoring, maintenance and sampling within the first five days of operation. Operation and maintenance of the VES as described above typically include: daily site inspections for the first five days of operation, and site visits once every week for the first month. After the first month of operation, site visits will be typically performed once every two weeks, or as needed over the operating life of the remediation systems. Modifications to this typical schedule will be made if additional requirements are specified by the guidelines set forth by the BAAQMD in the Authority to Construct/Permit to Operate for this site, as necessary.

Site inspections will typically include: monitoring and adjustment of system parameters to optimize VES and groundwater treatment system efficiency; periodic sampling and field monitoring of influent and effluent as required by the BAAQMD; and other periodic maintenance to promote continued operation of the remediation equipment. Parameters monitored and adjusted in the field will include: field measurement of vapor extraction flowrates, induced vacuum responses at onsite wells if applicable, and hydrocarbon vapor concentrations with an organic vapor monitor approved by the BAAQMD.

A remote monitoring system will be installed to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm condition. The monitoring system will also notify RESNA's San Jose office when an alarm condition exists so that the condition can be rectified prior to restart of the system.

System Sampling

Typical BAAQMD guidelines require that during the startup phase of the catalytic or thermal/catalytic oxidizer, influent and effluent air samples to the VES be collected to evaluate destruction efficiency of the unit. To demonstrate compliance with BAAQMD regulations, the VES will likely be sampled at least once during the first week of operation, and once per month for the life of the remediation system. With the exception of influent and effluent air samples collected and analyzed as detailed above, during the first two days of operation and later on a biweekly and monthly basis, all other sampling of the VES will be conducted using a field organic vapor monitoring instrument approved by the BAAQMD. If at any time the results of laboratory analyses or field monitoring readings show emission

limits to be exceeded, a confirmation air sample will be taken immediately and analyzed on a 24 hour turnaround basis. If emission limits are still exceeded, the system will be shut down and any necessary corrective action will be performed before repeating the startup sequence. BAAQMD will be notified that emission limits were exceeded within 24 hours of such indication.

The off-gas treatment system will be modified to an activated carbon adsorption system (two, in-series 1,200-pound vapor-phase activated carbon canisters) when the hydrocarbon concentrations of the vapor approach 50 ppmv, or when it becomes cost-effective. Typical BAAQMD guidelines require that, extracted vapor influent to and effluent from the carbon system will be monitored with a field instrument approved by the BAAQMD on a daily basis until the frequency of carbon changeout can be determined. System monitoring frequency will likely be changed to once every two weeks with a field instrument and monthly verification with bag samples upon receiving BAAQMD approval.

Influent and effluent water samples will be collected for laboratory analysis during the first week of startup. All water compliance sampling will be conducted in accordance with the EBMUD sewer discharge permit requirements.

Task 8. System Performance Evaluation

Following continued operation of the interim VES and groundwater recovery system, a system performance evaluation will be conducted to monitor the effectiveness of the interim soil and groundwater remediation systems. This evaluation will be performed in conjunction with continued groundwater monitoring and sampling at the subject site, and will be submitted together with the regularly scheduled quarterly monitoring and sampling reports. This report may include the following: hours of operation; system influent and effluent field monitoring readings collected; laboratory results of influent and effluent air and water samples collected and analyzed; total and individual vapor extraction well and groundwater extraction well flow rates; induced vacuum responses recorded in observation wells; all other relevant field data collected; and results obtained such as observed radius of influence, system destruction efficiency, groundwater treatment system efficiency, etc.

Recommendations will then be made to further optimize system performance and to further enhance remediation of subsurface impacted soils and groundwater. Recommendations may include tie-in of additional vapor extraction wells or groundwater extraction wells to the remediation system, upgrading of the off-gas abatement unit, etc.

SCHEDULE OF OPERATIONS

Plate 19 depicts the preliminary time schedules agreed upon during a September 30, 1992 meeting with ARCO, the ACHCSA, and RESNA to complete the above referenced tasks. The time frames for the appropriate regulatory agencies to review and approve the RAP, permits, and construction Plans and Specifications are also estimated in the schedule. The permitting time frame is expected to take about as long as the engineering time frame. The hatched lines represent estimates of times which may be required to complete tasks should unforeseen delays occur. These unforeseen delays may include permitting issues, offsite access issues, estimated times of operation of the respective remediation systems, or items discussed below.

This preliminary time schedule will be delayed if regulatory review of the interim RAP is delayed or, if after review of the RAP, the regulatory agencies involved have comments and require a submittal of a revised addendum, if delays are encountered in the installation of onsite vapor wells, if delays associated with the BAAQMD air discharge permit, EBMUD sewer discharge permit, or City of Albany building or planning departments are encountered, if long-lead equipment cannot be delivered within the estimated timeframe, if system installation gets delayed due to inclement weather, negotiations with lessee, and delays in utility installation. The estimated schedule also assumes that results of the planned offsite investigation will not impact onsite soil and groundwater remediation.

The schedule assumes that soil remediation can be completed in one year, if no additional wells are needed to complete remediation; and no significant equipment breakdown occurs. The progress and expected duration of the soil cleanup is dependent on physical factors such as: fluctuating groundwater levels both naturally and/or artificially induced (pumping of other wells near the site), and the correlation of data from specific points (wells and borings) with the actual conditions across the site. Fluctuating groundwater levels in onsite

wells may decrease the effective screen available to vent from and hence reduce the effectiveness of the VES. Duration of cleanup can be more accurately predicated after a performance evaluation of the VES system has been completed.

The schedule assumes that the performance evaluation will show that the remediation system is effectively removing hydrocarbons from areas of impacted soil and groundwater onsite. It also assumes that additional on or offsite vapor extraction wells are not required to effectively remediate impacted areas, once the treatment system is operational. Installation of additional wells will require submittal of a work plan to regulatory agencies, well permits to install wells, and installation and tie in of wells to the existing VES.

To verify cleanup of previously impacted soil, verification borings will be drilled and samples collected and analyzed to show that the soil has been remediated below currently established State cleanup levels. Site closure for soils will be initiated in conjunction with closure for onsite groundwater; i.e., after completion of the installation and operation of the groundwater remediation system.

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental geological and engineering practice in California at the time this investigation was performed. This assessment was conducted solely for the purpose of evaluating environmental conditions of the soil and groundwater with respect to gasoline and waste-oil related hydrocarbons at the site. No soil engineering or geotechnical references are implied or should be inferred. Groundwater field procedures and acquisition of groundwater field data were performed under the direction of EMCON; evaluation and warrant of their field data and field protocols is beyond RESNA's scope of work. Evaluation of the geologic conditions at the site for the purpose of this assessment is made from a limited number of observation points. Subsurface conditions may vary away from the data points available. Additional work, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of assessment. Also, this is to inform all interested parties that The Upjohn Company of Kalamazoo, Michigan is the Assignee for at least two U.S. Patents (1984 and 1986) regarding soil vapor extraction systems and combined

groundwater and vapor extraction wells. The legal implications of these patents to the conventional engineering practice of design and construction of these systems has not been determined.

DISTRIBUTION

It is recommended that copies of this report be sent to the following regulatory agencies:

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

Mr. Barney Chan
Alameda County Health Care Services Agency
80 Swan Way, Room 200
Oakland, California 94621

REFERENCES

AGS January 24, 1990. Limited Environmental Site Assessment at ARCO Station 2035. AGS 96036-1.

Johnson, Stanley, Kemblowski, Byer, Colthart, 1990. A Practical Approach to the Design, Operation, and Maintenance of In-Situ Soil Venting Systems. Shell Oil Company.

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 K. Muir. 1988. Geohydrology and Groundwater-Quality Overview, East Bay Plain Area, Alameda County, California. Alameda County Flood Control and Water Conservation District 205(J) Report.

RESNA/AGS April 29, 1991. Work Plan for Subsurface Investigations and Remediation at ARCO Station 2035, 1001 San Pablo Avenue, Albany, California. AGS 69036.02.

RESNA/AGS April 29, 1991. Addendum One to Work Plan at ARCO Station 2035, 1001 San Pablo Avenue, Albany, California. AGS 69036.02

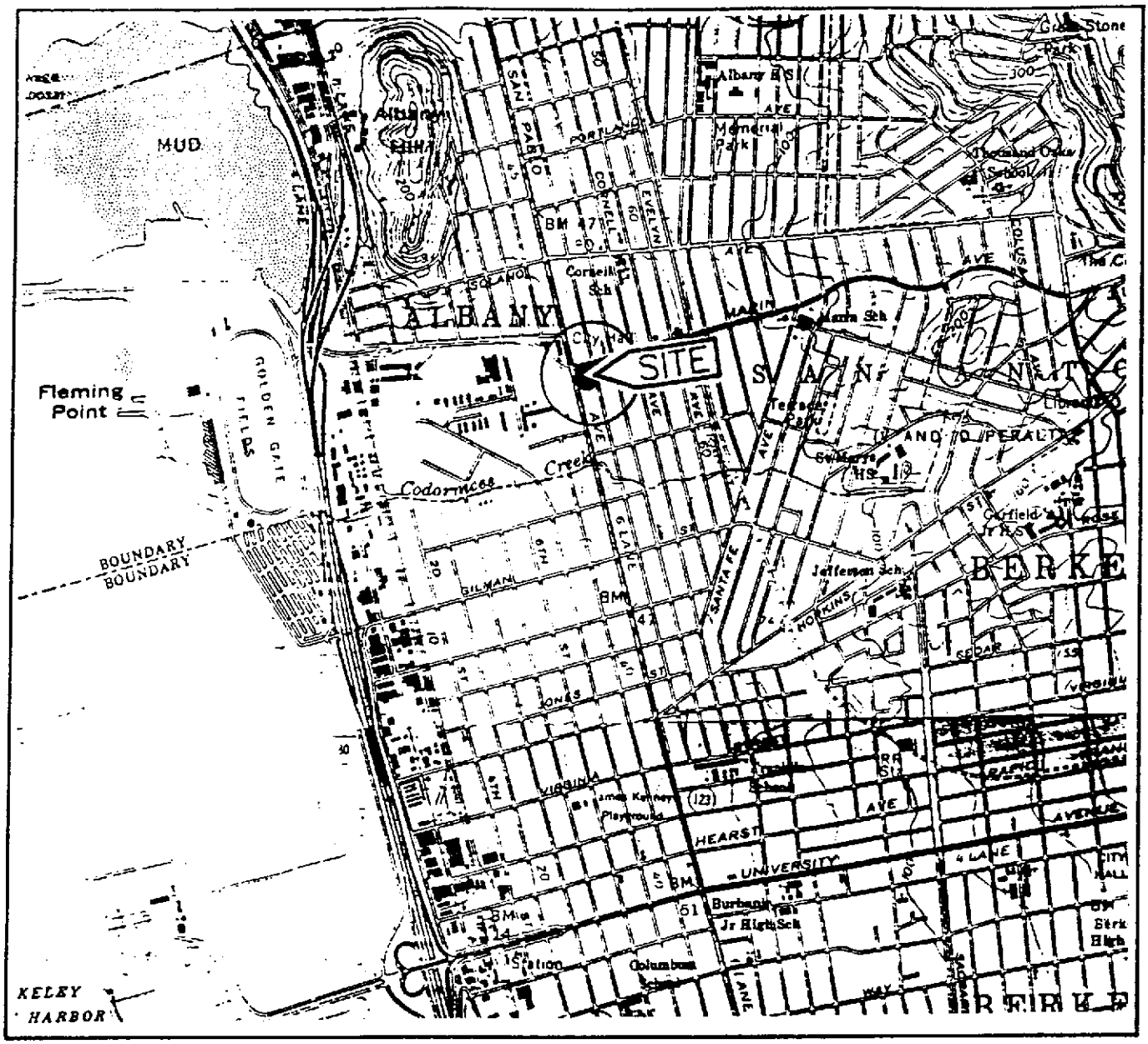
RESNA/AGS September 11, 1991. Underground Gasoline-Storage Tank Removal and Replacement. AGS 69036.03.

RESNA/AGS September 24, 1991. Addendum Two to Work Plan at ARCO Station 2035, 1001 San Pablo Avenue, Albany, California. AGS 69036.02

RESNA March 6, 1992. Subsurface Environmental Investigations and Pump Test at ARCO Station 2035, 1001 San Pablo Avenue, Albany, California. 69036.02.

RESNA November 30, 1992. Additional Environmental Subsurface Investigation and Vapor Extraction Test at ARCO Station 2035, 1001 San Pablo Avenue, Albany, California. 69036.02.

RESNA January 28, 1993. Draft Letter Report, Quarterly Groundwater Monitoring, Fourth Quarter 1992 at ARCO Station 2035, 1001, San Pablo Avenue, Albany, California. 69036.02.



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

N

LEGEND

⊙ = Site Location

Approximate Scale

2000 1000 0 2000 4000

feet

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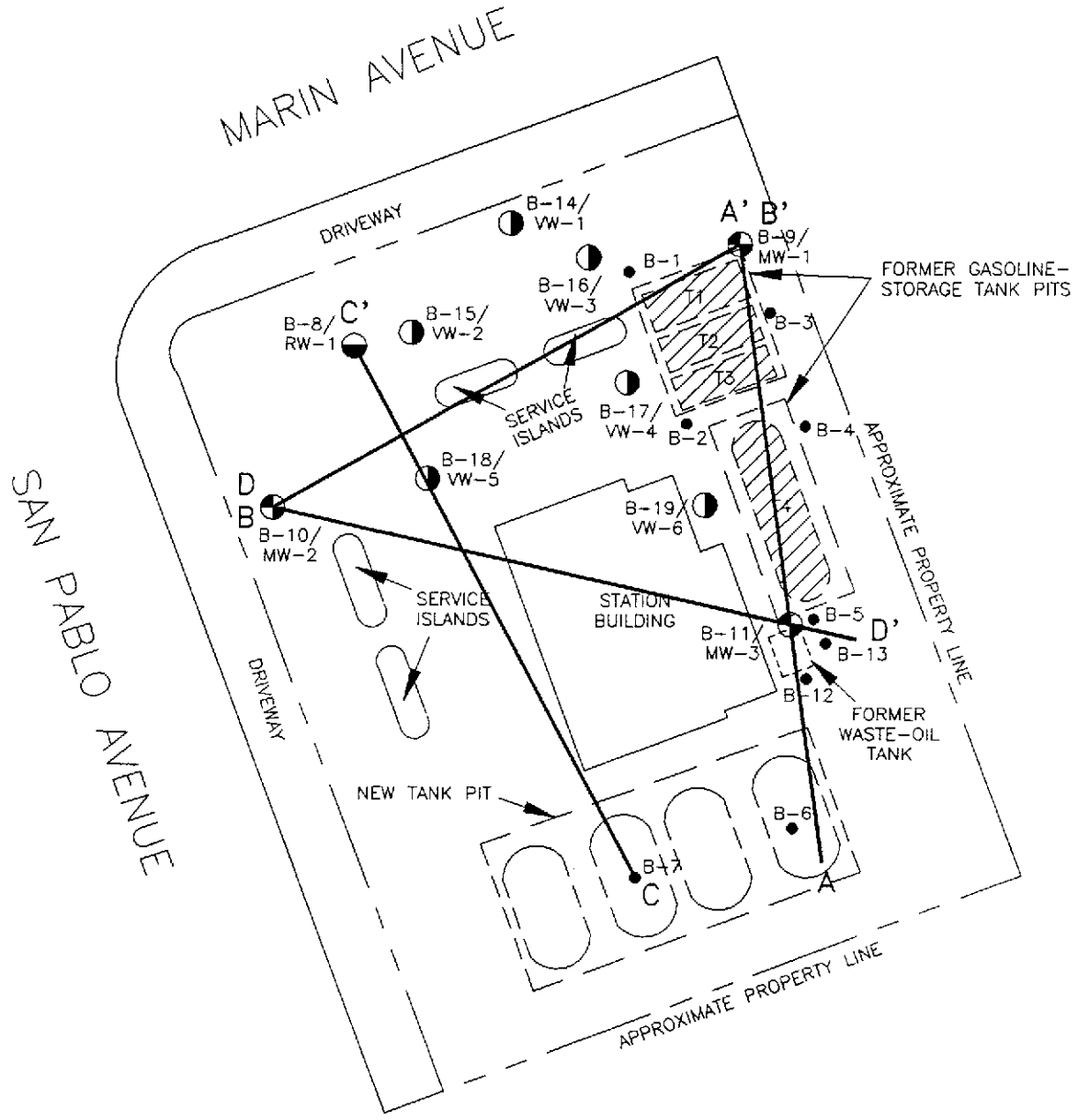
SITE VICINITY MAP
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
1



EXPLANATION

B-19/ VW-6 = Boring/vapor extraction well (RESNA, August 1992)

B-8/ RW-1 = Boring/recovery well (Exceltech, October 1991)

B-11/ MW-3 = Boring/monitoring well (Exceltech, October 1991)

B-13 = Soil boring (RESNA, August 1989 and June 1991)

D — D' = Geologic cross section

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor.

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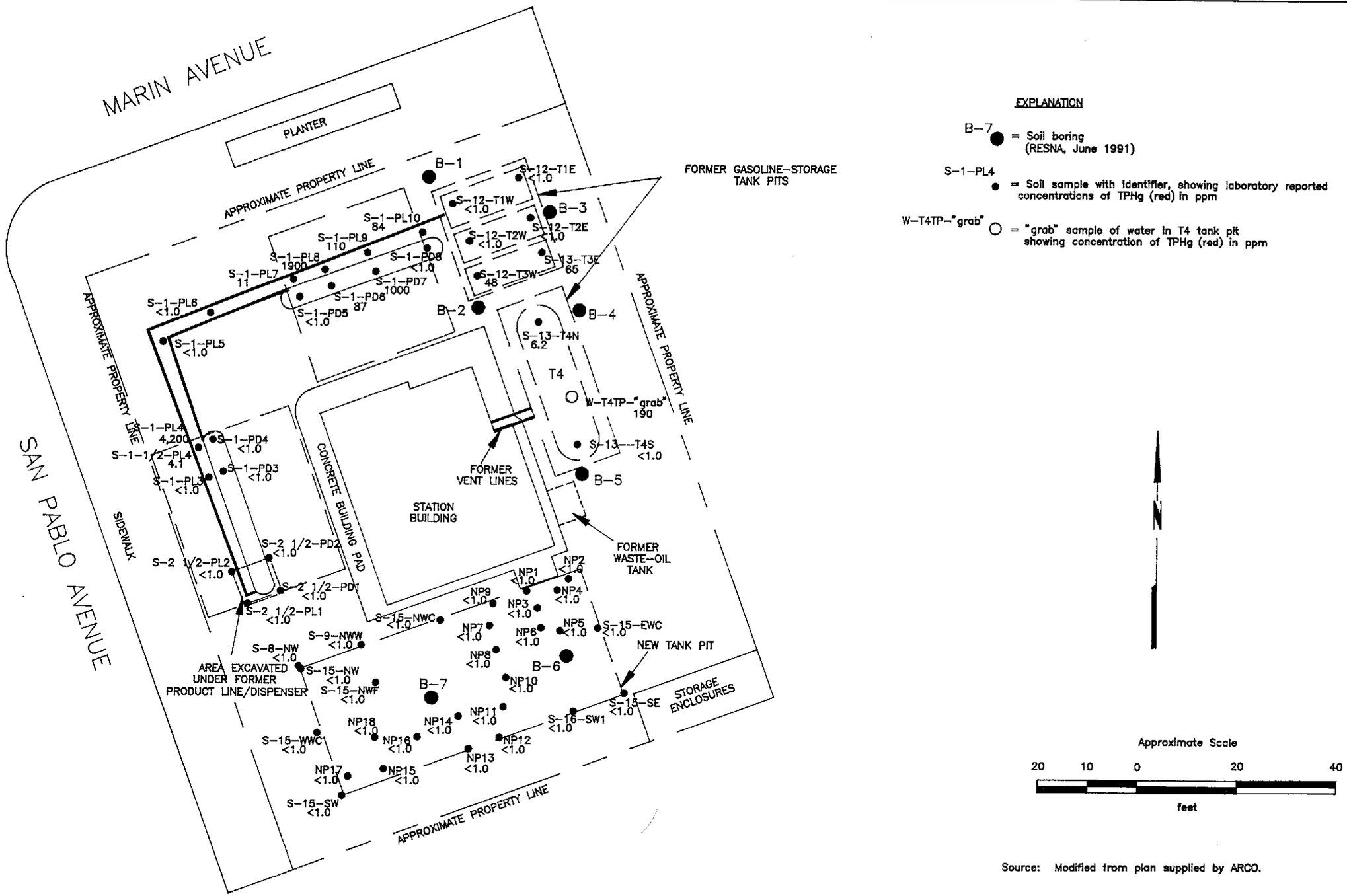
GENERALIZED SITE PLAN
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
2



Source: Modified from plan supplied by ARCO.

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SOIL SAMPLING
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
3

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	DESCRIPTION
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded Gravels or Gravel-Sand mixtures, little or no fines.
		GP	Poorly-graded Gravels or Gravel-Sand mixtures, little or no fines.
		GM	Silty Gravels, Gravel-Sand-Silt mixtures.
		GC	Clayey Gravel, Gravel-Sand-Clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded Sand or Gravelly Sands, little or no fines.
		SP	Poorly-graded Sands or Gravelly Sands, little or no fines.
		SM	Silty Sands, Sand-Silt mixtures.
		SC	Clayey Sands, Sand-Clay mixtures.

MAJOR DIVISION		LTR	DESCRIPTION
FINE-GRAINED SOILS	SILTS AND CLAYS LL<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, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
		OL	Organic Silts and Organic Silt-Clays of low plasticity.
	SILTS AND CLAYS LL>50	MH	Inorganic Silts, micaceous or diatomaceous fine Sandy or Silty Soils, Elastic Silts.
		CH	Inorganic Clays of high plasticity, fat Clays.
		OH	Organic Clays of medium to high plasticity, organic Silts.
HIGHLY ORGANIC SOILS		PT	Peat and other highly Organic Soils.


Depth through which sampler is driven


Relatively undisturbed sample


No sample recovered


Static water level observed in well/boring


Initial water level observed in boring

S-10 Sample number


Sand pack


Bentonite


Neat cement


Caved native soil


Blank PVC


Machine-slotted PVC

P.I.D. Photoionization detector

N.T. Not tested using photoionization detector

BLOWS REPRESENT THE NUMBER OF BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES TO DRIVE THE SAMPLER THROUGH EACH 6 INCHES OF AN 18-INCH PENETRATION.

DASHED LINES SEPARATING UNITS ON THE LOG REPRESENT APPROXIMATE BOUNDARIES ONLY. ACTUAL BOUNDARIES MAY BE GRADUAL LOGS REPRESENT SUBSURFACE CONDITIONS AT THE BORING LOCATION AT THE TIME OF DRILLING ONLY.

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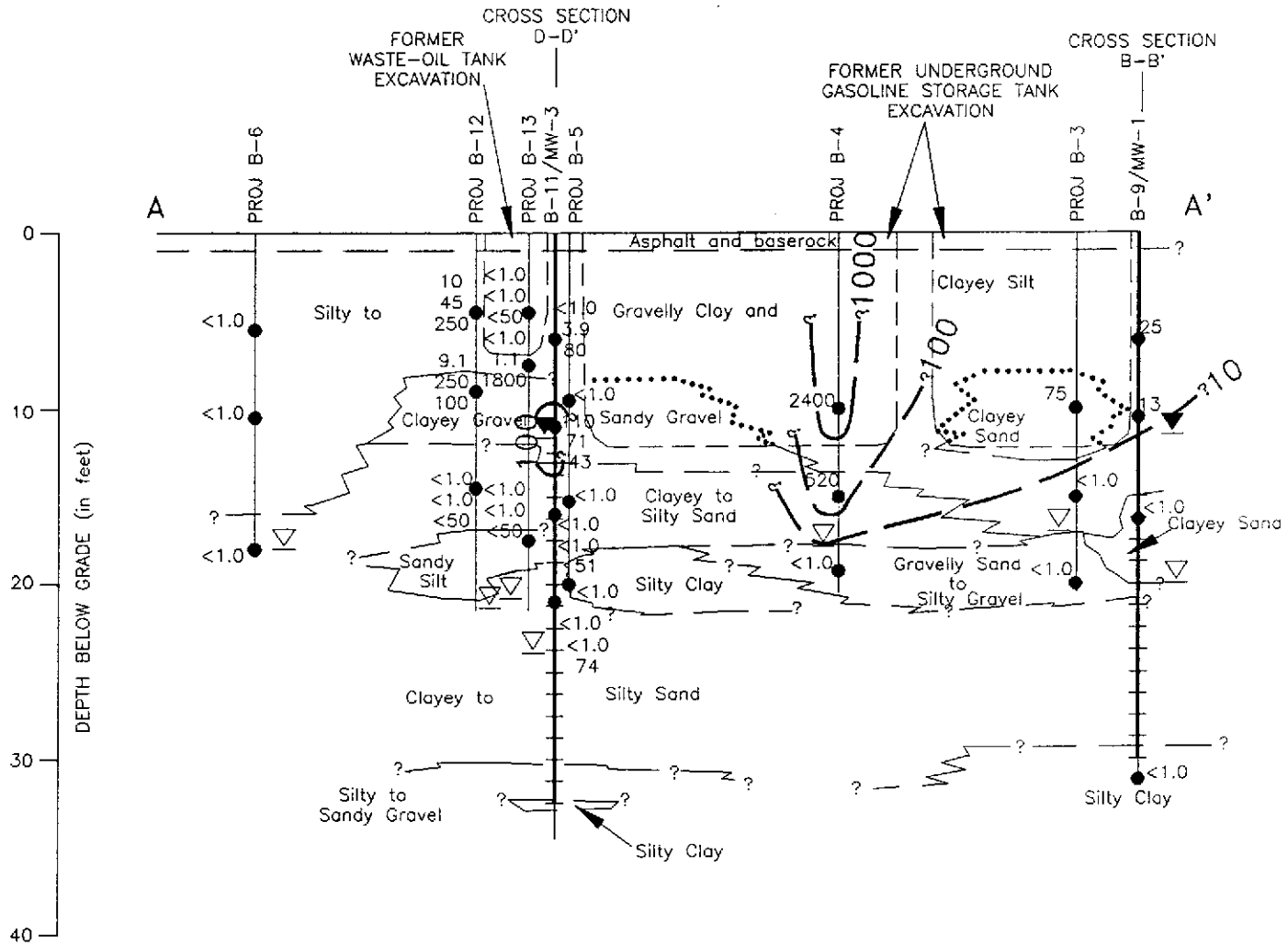
UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL KEY
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
4



EXPLANATION

1000 = Line of equal concentration of TPHg in soil in parts per million (ppm)

2400 / 250 / 1800 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), and TOG (blue) in ppm

= Well casing

= Well screen

= Boring

= Initial water level in boring

= Static water level in well (09/08/92)

Approximate Horizontal Scale

20 10 0 20 40

feet

Approximate Vertical Scale

10 5 0 10 20

feet

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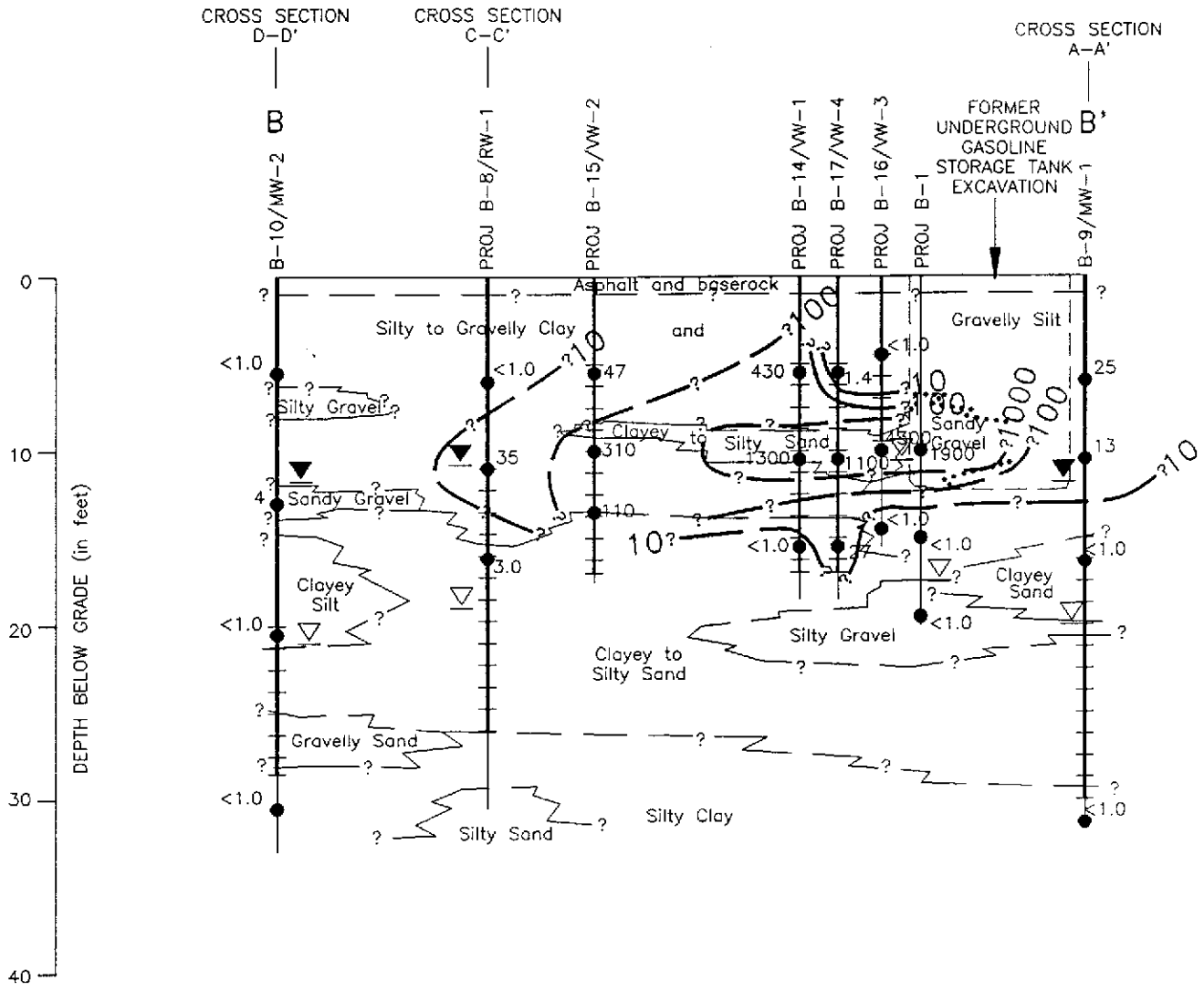
GEOLOGIC CROSS SECTION A-A'
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
5



EXPLANATION

1000 = Line of equal concentration of TPHg in soil in parts per million (ppm)

4300 = Laboratory analyzed soil sample showing concentration of TPHg in ppm

= Well casing

= Well screen

= Boring

▽ = Initial water level in boring

▼ = Static water level in well (09/08/92)

Approximate Horizontal Scale

20 10 0 20 40

feet

Approximate Vertical Scale

10 5 0 10 20

feet

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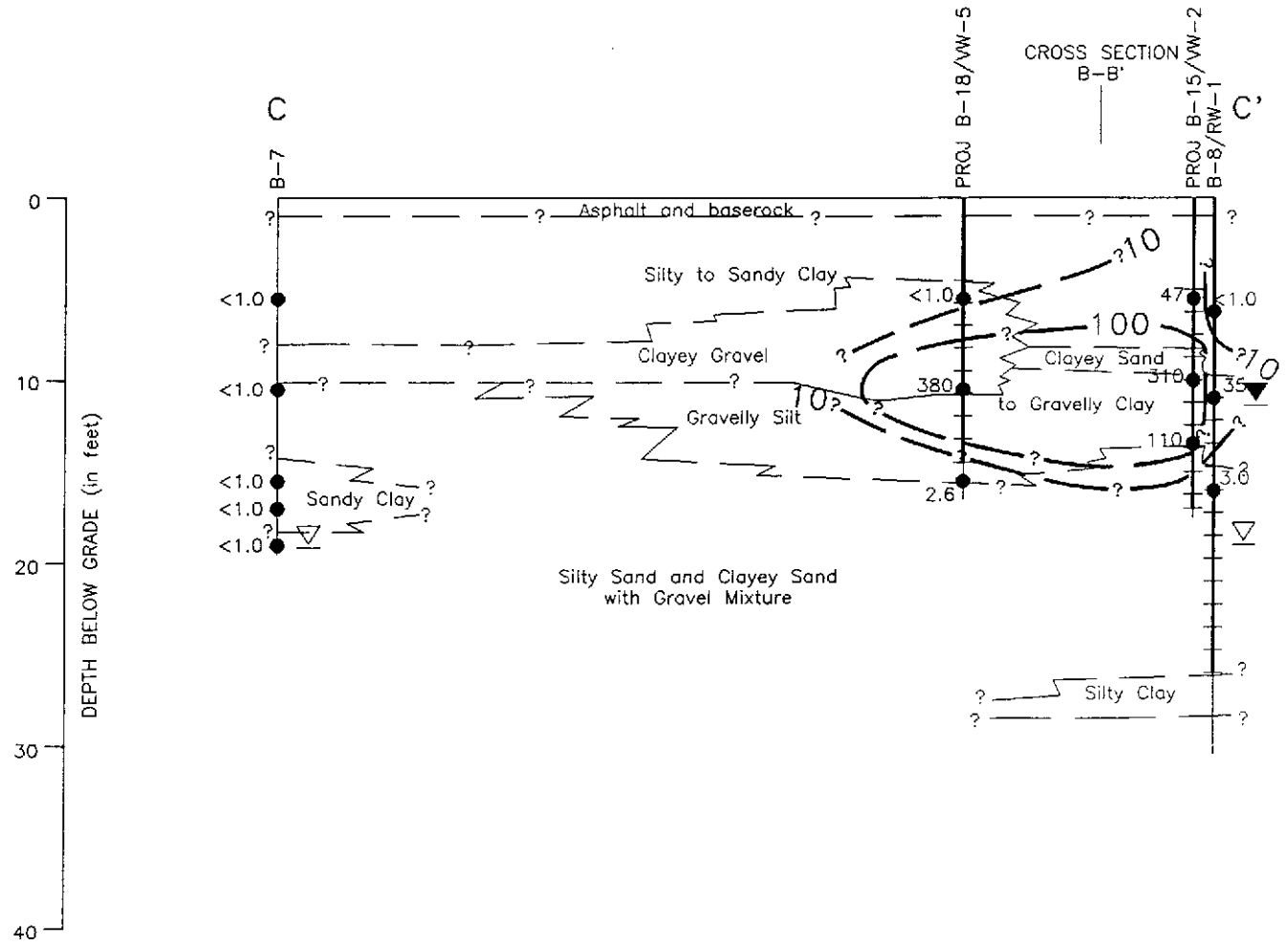
GEOLOGIC CROSS SECTION B-B'
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 6



EXPLANATION

100 = Line of equal concentration of TPHg in soil in parts per million (ppm)

380 = Laboratory analyzed soil sample showing concentration of TPHg in ppm

= Well casing

= Well screen

= Boring

▽ = Initial water level in boring

▼ = Static water level in well (09/08/92)

Approximate Horizontal Scale

20 10 0 20 40

feet

Approximate Vertical Scale

10 5 0 10 20

feet

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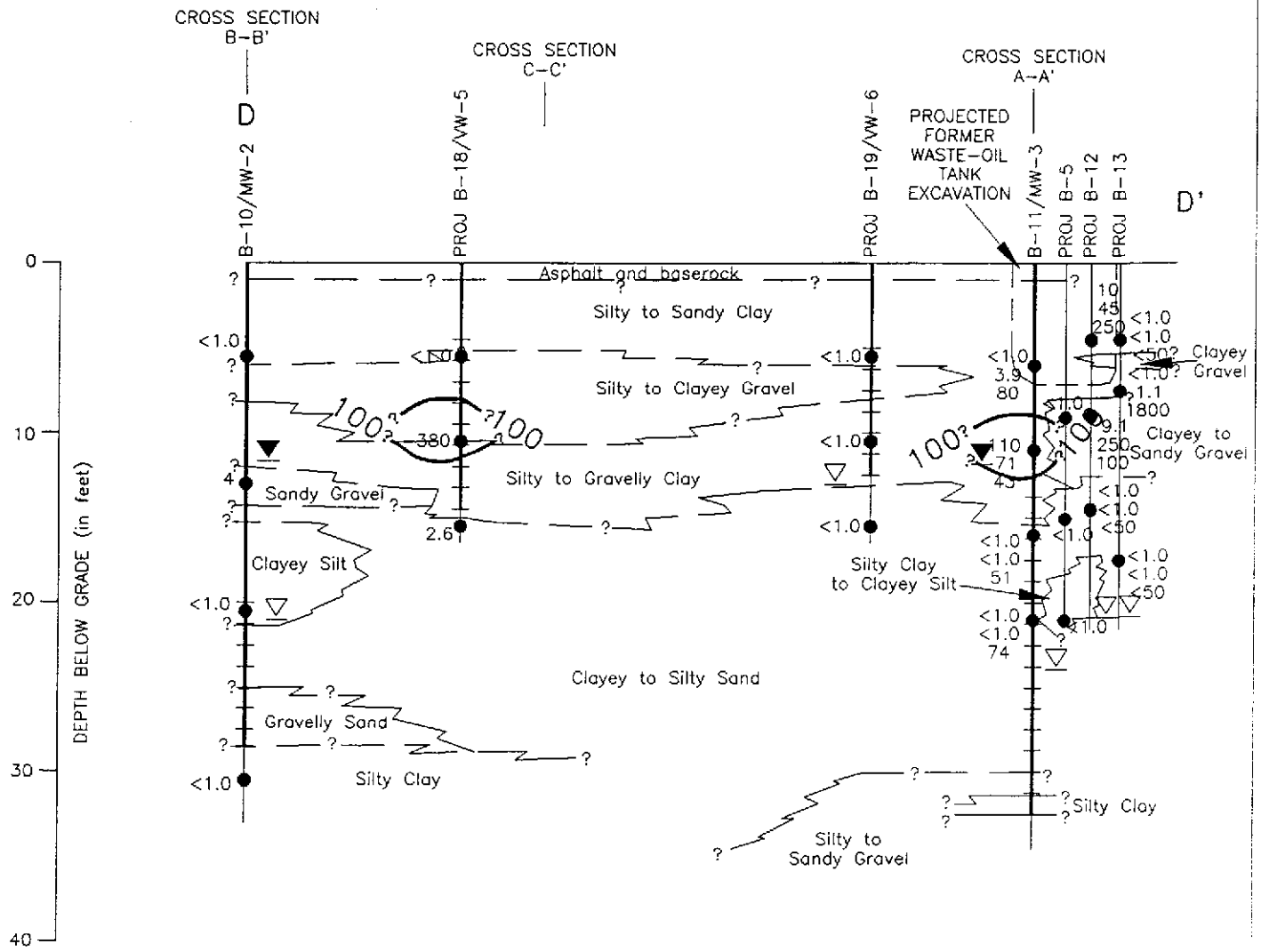
GEOLOGIC CROSS SECTION C-C'
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
7



EXPLANATION

100 = Line of equal concentration of TPHg in soil in parts per million (ppm)

380 / 250 / 1800 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), and TOG (blue) in ppm

= Well casing

= Well screen

= Boring

= Initial water level in boring

= Static water level in well (09/08/92)

Approximate Horizontal Scale

20 10 0 20 40

feet

Approximate Vertical Scale

10 5 0 10 20

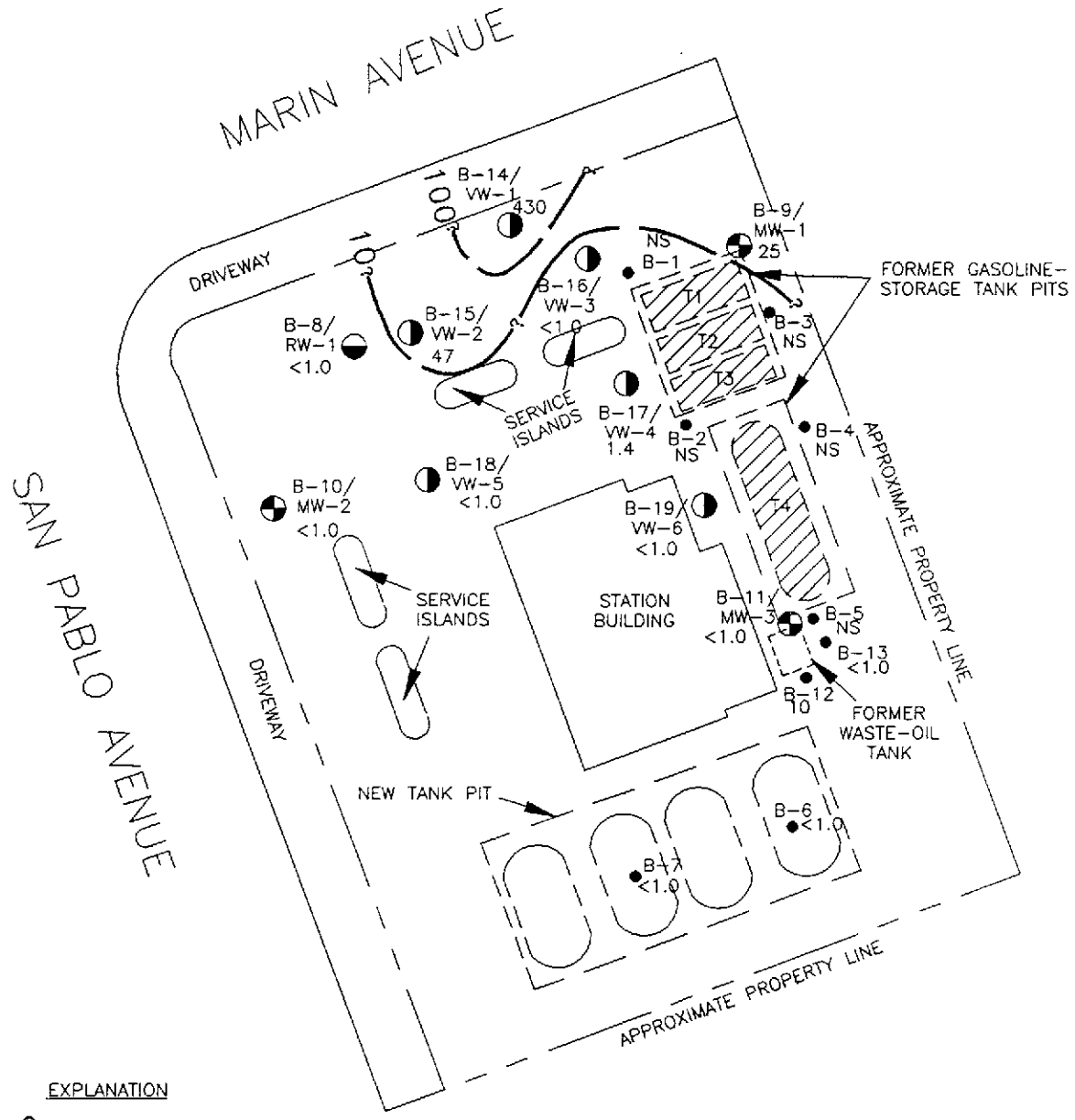
feet

RESNA
Working to Restore Nature

PROJECT 69036.06

GEOLOGIC CROSS SECTION D-D'
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
8



EXPLANATION

100 = Line of equal concentration of TPHg in soil in parts per million (ppm)

430 = Concentration of TPHg in soil at depths between 4-1/2 and 6 feet, in ppm

NS = Not sampled

B-19/ VW-6 = Boring/vapor extraction well (RESNA, August 1992)

B-8/ RW-1 = Boring/recovery well (Exceltech, October 1991)

B-11/ MW-3 = Boring/monitoring well (Exceltech, October 1991)

B-13 = Soil boring (RESNA, August 1989, June 1991, and August 1992)

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor.

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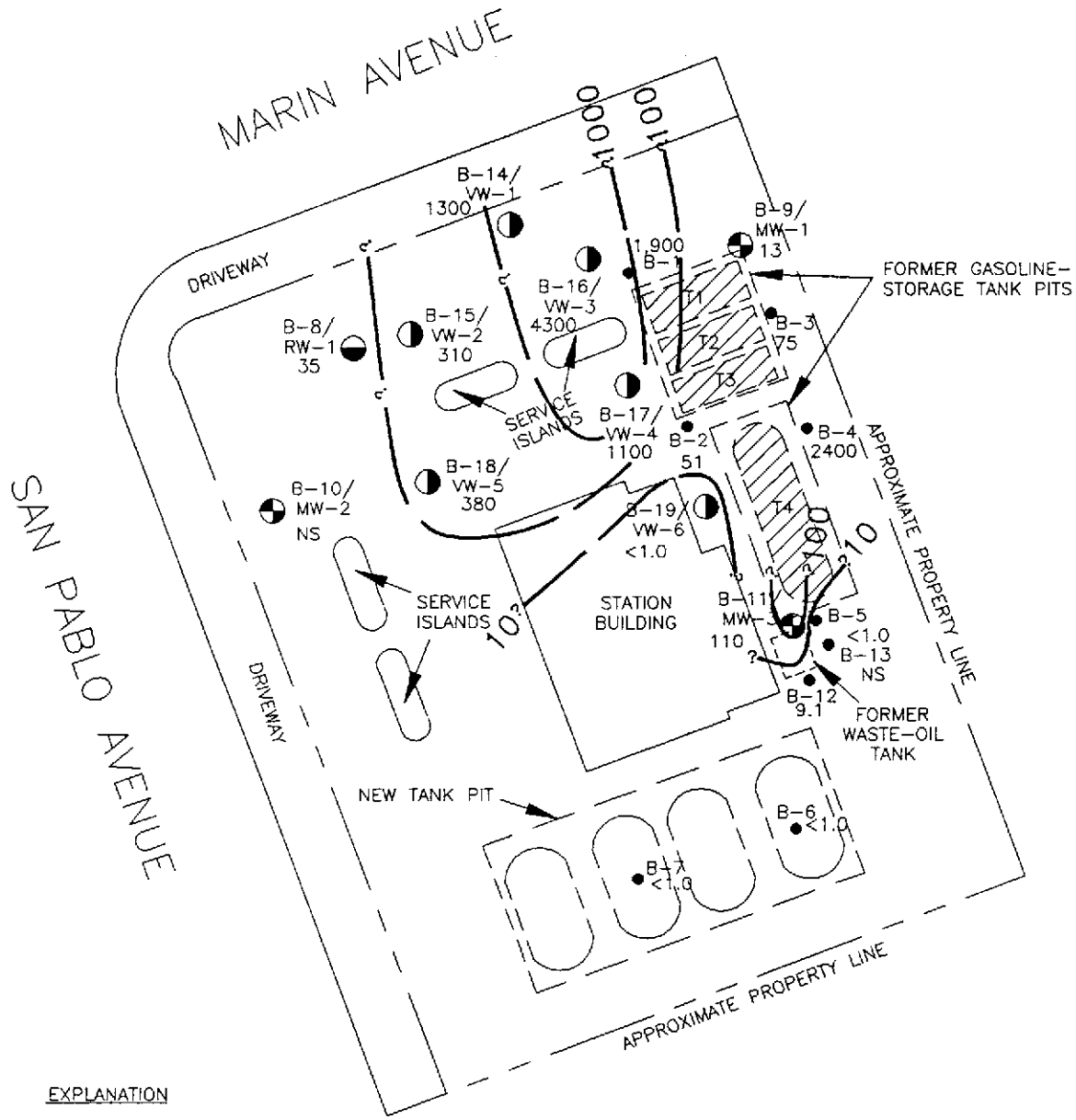
PROJECT 69036.06

CONCENTRATION OF TPHg IN SOIL AT DEPTHS OF 4-1/2 TO 6 FEET
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 9



EXPLANATION

1000 = Line of equal concentration of TPHg in soil in parts per million (ppm)

4300 = Concentration of TPHg in soil at depths between 9 and 11 feet, in ppm

NS = Not sampled

B-19/ VW-6 = Boring/vapor extraction well (RESNA, August 1992)

B-8/ RW-1 = Boring/recovery well (Exceltech, October 1991)

B-11/ MW-3 = Boring/monitoring well (Exceltech, October 1991)

B-13 = Soil boring (RESNA, August 1989, June 1991, and August 1992)

Approximate Scale

30 15 0 30 60

feet

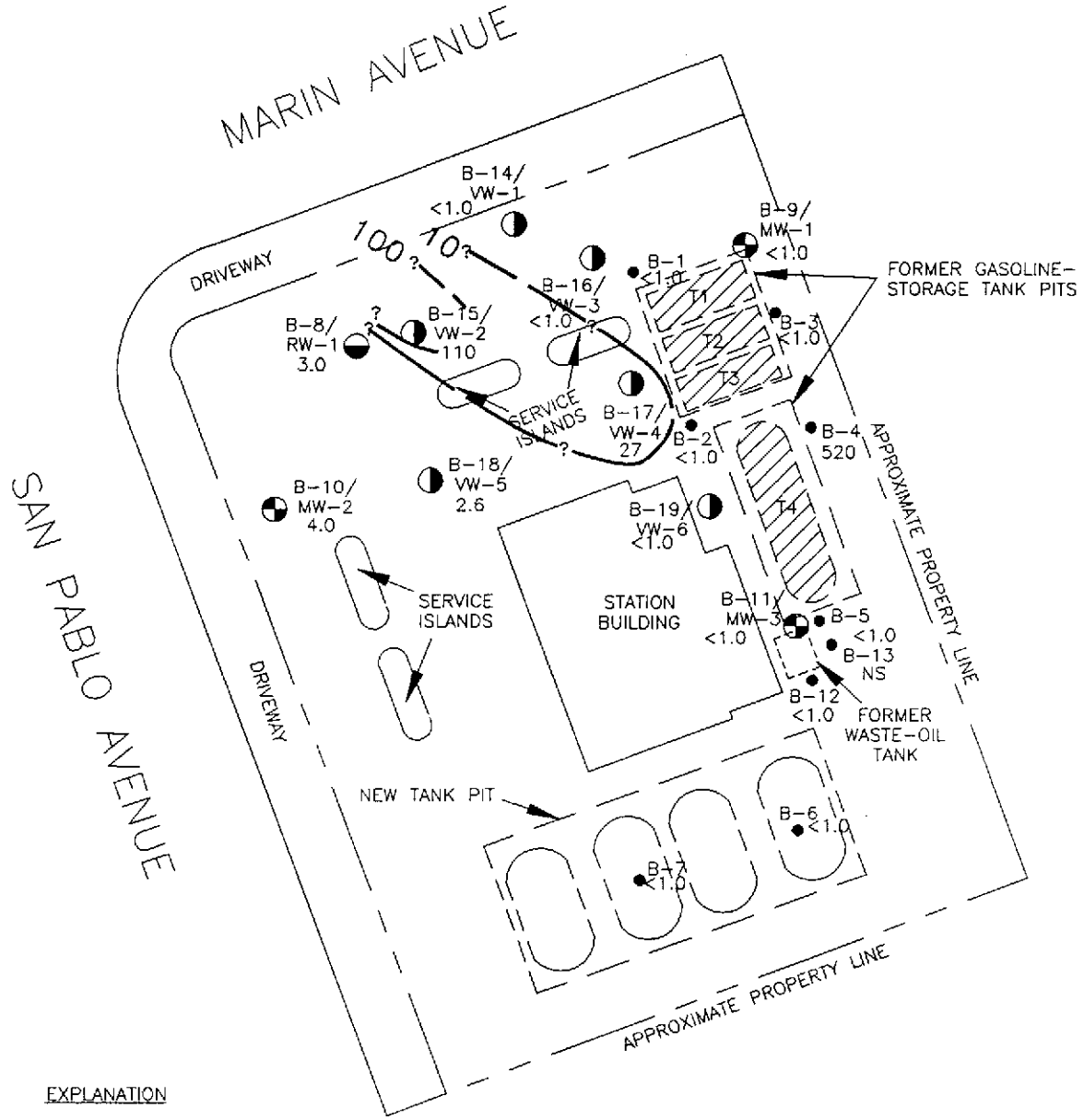
Source: Surveyed by John E. Koch, Land Surveyor.

RESNA
Working to Restore Nature

PROJECT 69036.06

CONCENTRATION OF TPHg IN SOIL AT DEPTHS OF 9 TO 11 FEET
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 10



EXPLANATION

100 = Line of equal concentration of TPHg in soil in parts per million (ppm)

520 = Concentration of TPHg in soil at depths between 13 and 16 feet, in ppm

NS = Not sampled

B-19/ VW-6 = Boring/vapor extraction well (RESNA, August 1992)

B-8/ RW-1 = Boring/recovery well (Exceltech, October 1991)

B-11/ MW-3 = Boring/monitoring well (Exceltech, October 1991)

B-13 = Soil boring (RESNA, August 1989, June 1991, and August 1992)

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor.

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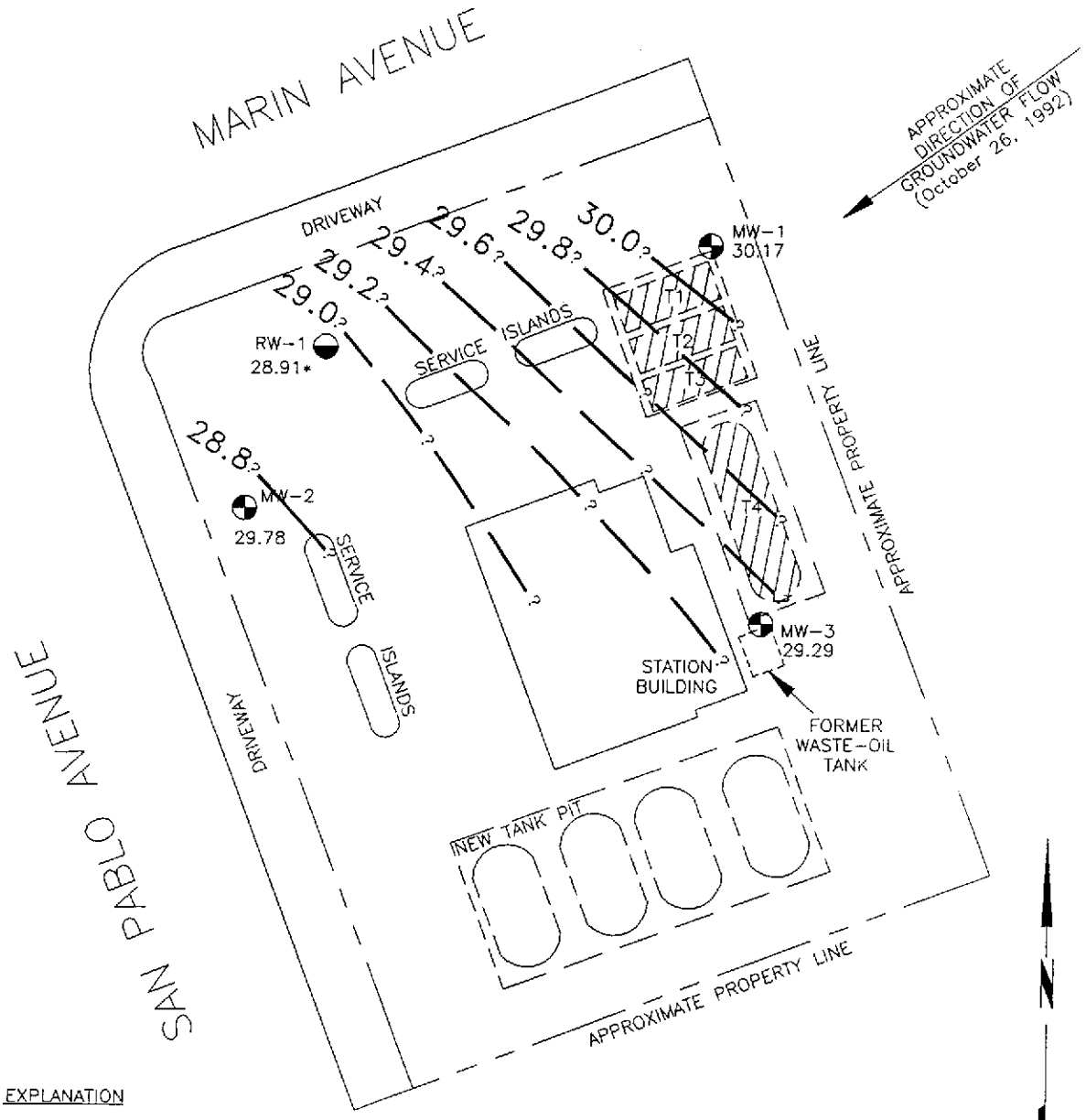
CONCENTRATION OF TPHg IN SOIL AT DEPTHS OF 13 TO 16 FEET
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 11



EXPLANATION

RW-1 = Recovery well (Exceltech, October 1991)

MW-3 = Monitoring well (Exceltech, October 1991)

= Former underground gasoline tank pits

30.0 = Line of equal elevation of groundwater in feet above mean sea level (MSL)

30.17 = Elevation of groundwater in feet above MSL, October 26, 1992

* = Floating product

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor. Dated October 29, 1991.

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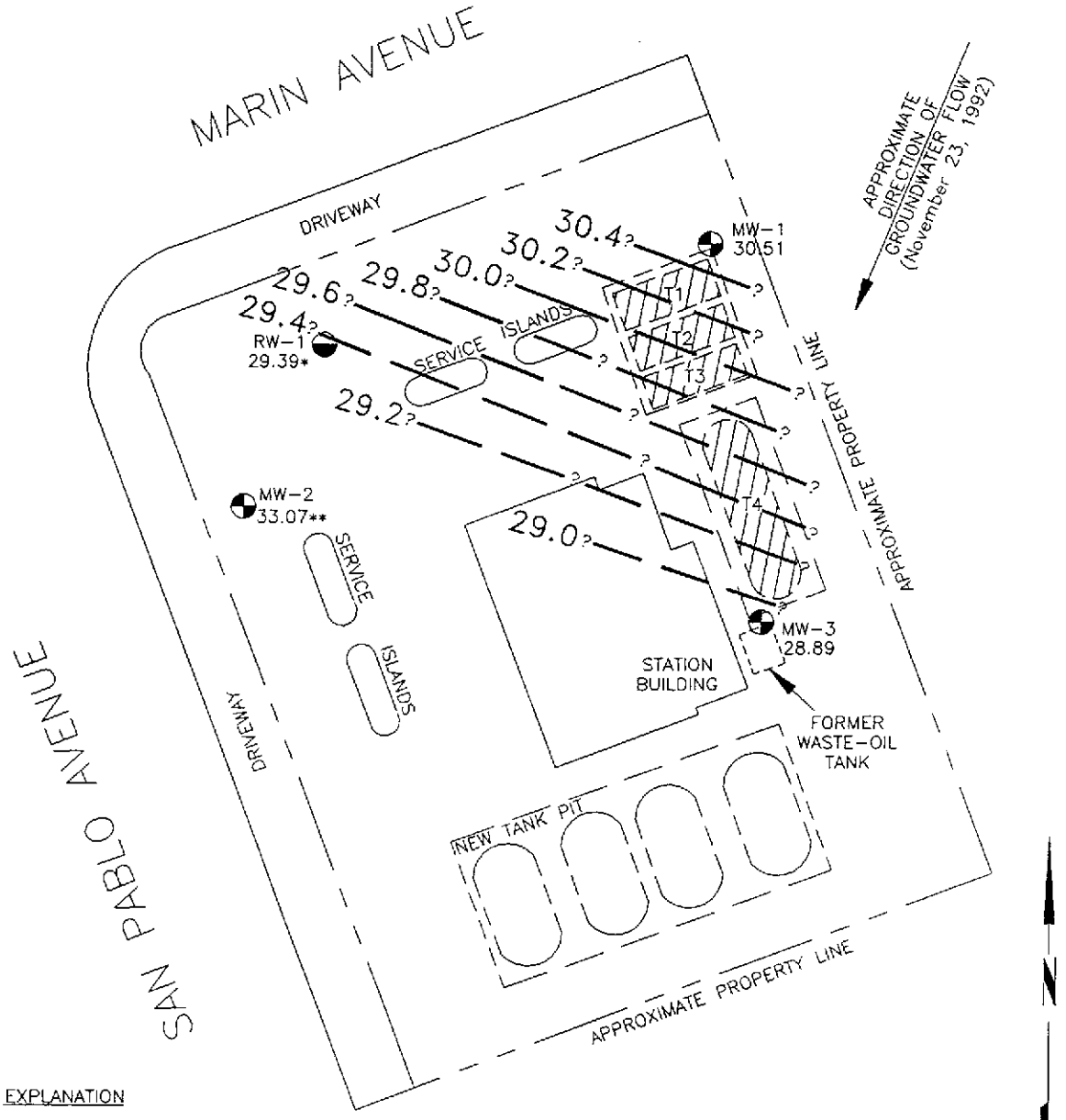
GROUNDWATER GRADIENT MAP
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
12



EXPLANATION

RW-1 = Recovery well (Exceltech, October 1991)

MW-3 = Monitoring well (Exceltech, October 1991)

= Former underground gasoline tank pits

30.4 = Line of equal elevation of groundwater in feet above mean sea level (MSL)

30.51 = Elevation of groundwater in feet above MSL, November 23, 1992

* = Floating product

** = Not used for gradient evaluation due to anomalous DTW level

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor. Dated October 29, 1991.

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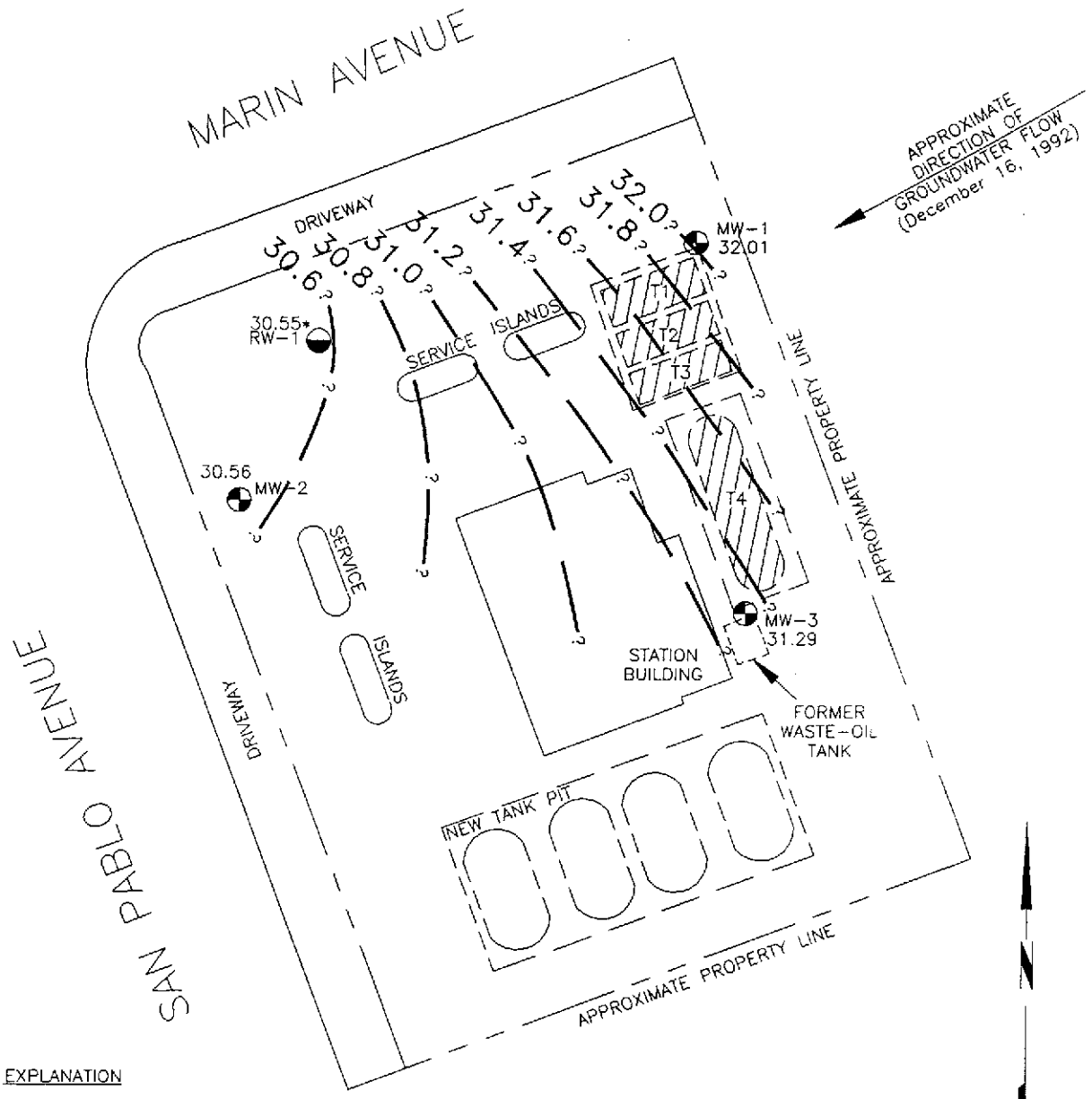
PROJECT 69036.06

GROUNDWATER GRADIENT MAP
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
13



EXPLANATION

RW-1 = Recovery well (Exceltech, October 1991)

MW-3 = Monitoring well (Exceltech, October 1991)

= Former underground gasoline tank pits

32.0 = Line of equal elevation of groundwater in feet above mean sea level (MSL)

32.01 = Elevation of groundwater in feet above MSL, December 16, 1992

* = Floating product

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor. Dated October 29, 1991.

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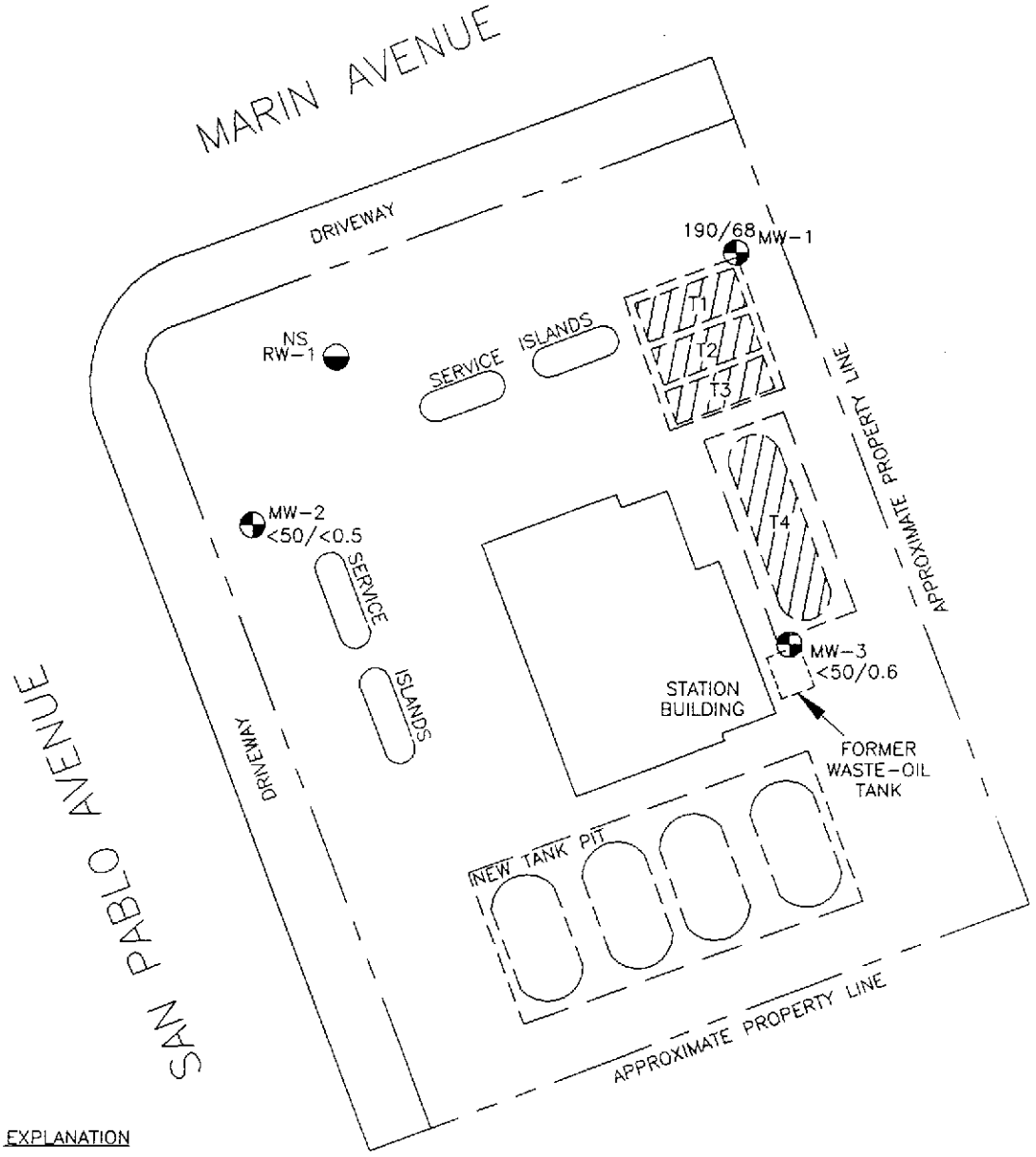
GROUNDWATER GRADIENT MAP
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
14



EXPLANATION

RW-1 = Recovery well (Exceltech, October 1991)

MW-3 = Monitoring well (Exceltech, October 1991)

T1 T2 T3 = Former underground gasoline tank pits

190/68 = Concentration of TPHg/Benzene in groundwater, in parts per billion (ppb), October 26, 1992

NS = Not sampled due to floating product

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor. Dated October 29, 1991.

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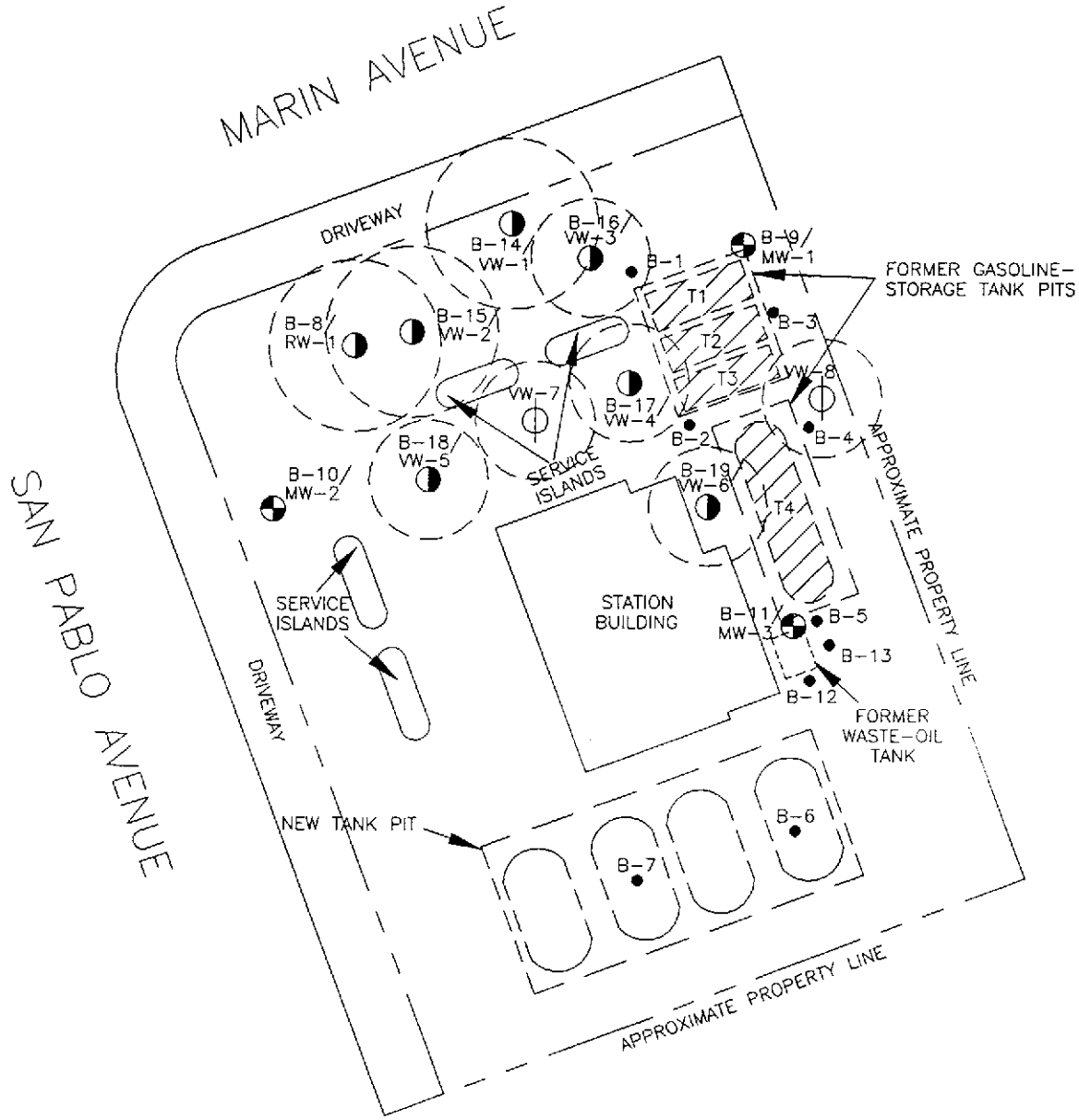
PROJECT 69036.06

TPHg/BENZENE CONCENTRATIONS IN GROUNDWATER
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 15



EXPLANATION

B-19/ VW-6 = Vapor extraction well (RESNA, August 1992)

B-8/ RW-1 = Recovery well (Exceltech, October 1991)

B-11/ MW-3 = Monitoring well (Exceltech, October 1991)

VW-8 = Proposed boring/vapor extraction well

B-13 = Soil boring (RESNA, August 1989, June 1991, and August 1992)

= Estimated radius of influence for vapor extraction wells

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor Dated October 29, 1991.

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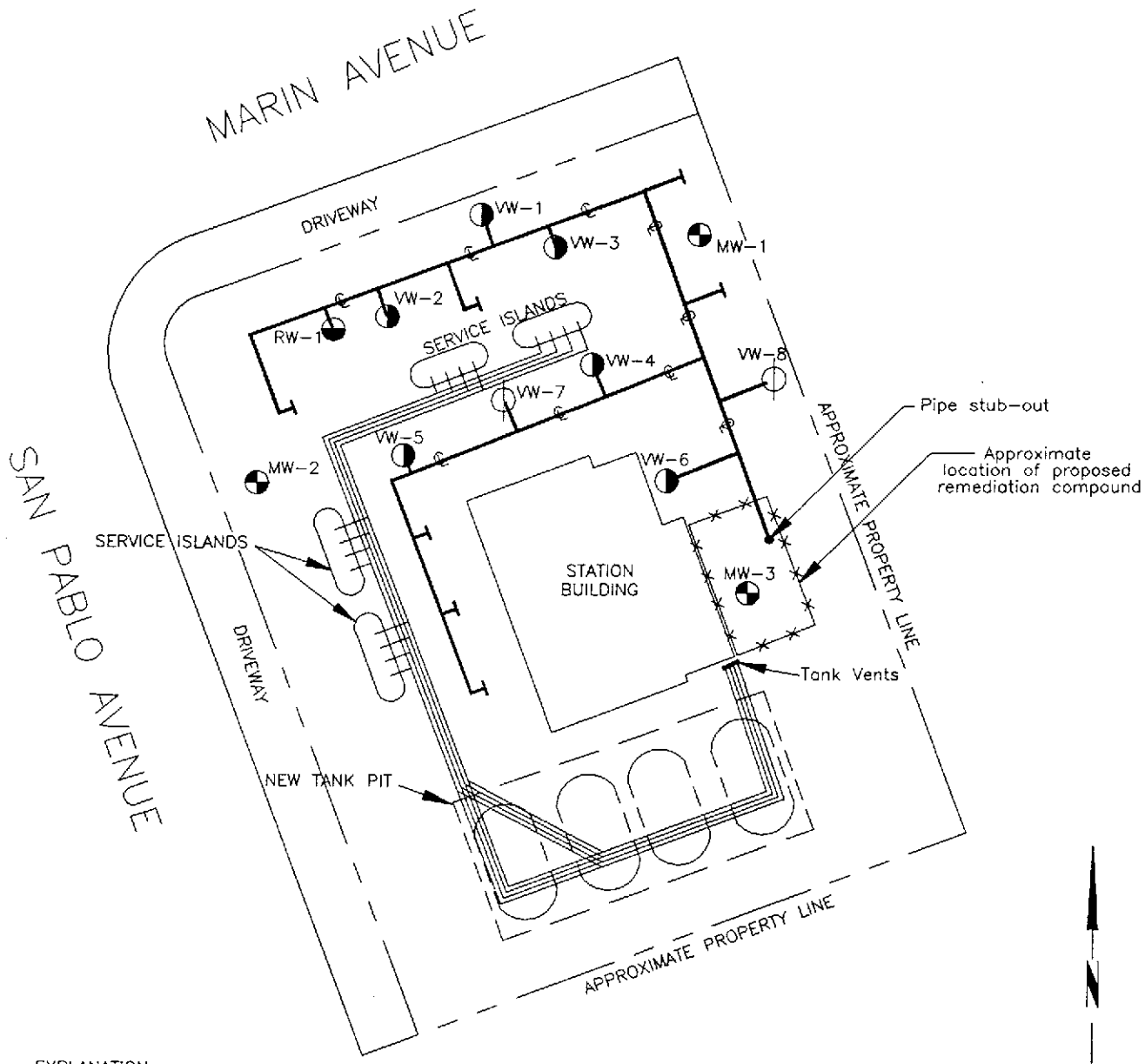
PROJECT 69036.06

VAPOR EXTRACTION WELL LOCATIONS
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 16



EXPLANATION

VW-6 ◑ = Vapor extraction well (RESNA, August 1992)

RW-1 ◒ = Recovery well (Exceltech, October 1991)

MW-3 ◔ = Monitoring well (Exceltech, October 1991)

VW-8 ⊕ = Proposed boring/vapor extraction well

℄ = Center-line of proposed pipe trenches

= Proposed pipe stub-out locations for potential future air-sparging points, groundwater recovery wells, or vapor extraction well connections (if needed)

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by John E. Koch, Land Surveyor. Dated October 29, 1991.

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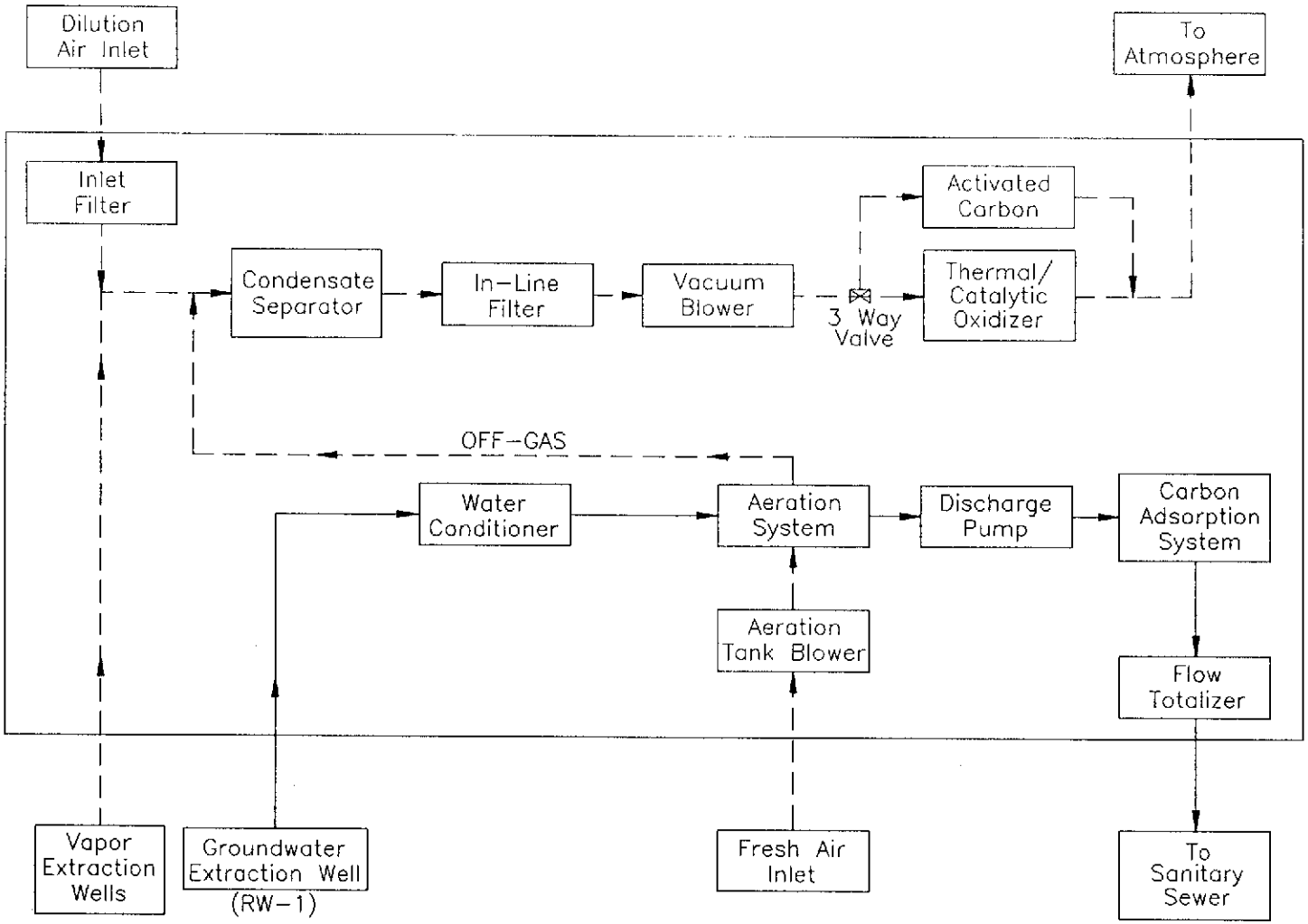
PROJECT 69036.06

PROPOSED REMEDIATION SITE PLAN
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE 17



EXPLANATION

VW-1,2,3,4,5,6,7,8, and RW-1

= Water flow

= Vapor flow

PLATE 18

PROCESS FLOW SCHEMATIC
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

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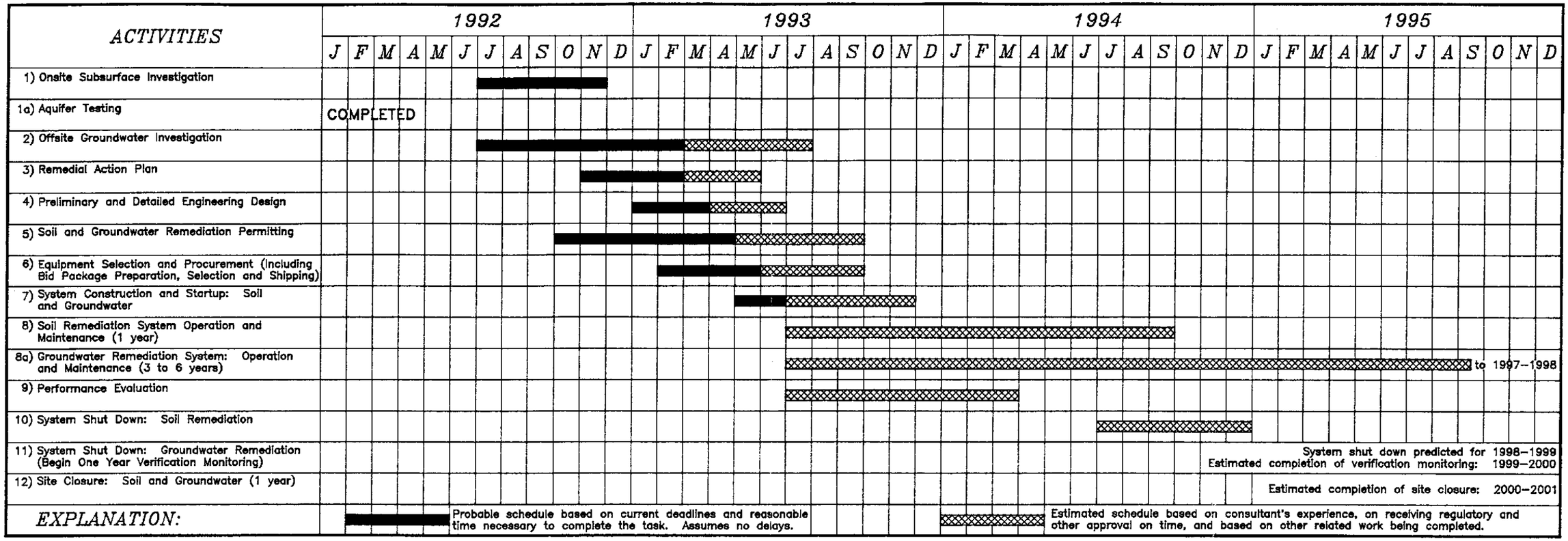
PROJECT 69036.06



1 and 1a) Onsite Subsurface Investigation:
- Initial Onsite Assessment completed prior to 1992.
- Additional Onsite Subsurface Investigation and Vapor Extraction Test Report submitted by December 1, 1992.
- Aquifer testing completed prior to 1992.

2) Offsite Groundwater Investigation:
- Delayed by 4 months due to encroachment permitting from CalTrans and City of Albany.
- Offsite Investigation Report to be submitted by March 1, 1993. Report to be combined with results of installation of additional onsite monitoring wells.

3) Remedial Action Plan:
- Completion of offsite investigation will not affect remediation schedule.
- RAP due to ACHCSA by March 1, 1993.

4) Preliminary and Detailed Engineering Design:
- Assumes no RAP revisions are necessary.
- Assumes no changes to design after regulatory comments.
- Only onsite remediation needed.
- Design to be completed by April 1, 1993.

5) Permitting (Soil and Groundwater):
- Assumes no design changes will make additional permitting necessary, including modification of treatment system.
- Permitting to be completed by May 1, 1993.
- Also assumes no special regulatory agency, city committee, or other entity places special permitting requirements on this project.

6) Equipment Selection and Procurement:
- Assumes all equipment is available from stock and can be obtained within 4 to 6 weeks.
- Selected equipment approved by ACHCSA.
- Bids will be evaluated and contract will be awarded by April 1, 1993.
- Equipment will be received by June 1, 1993.

7) System Construction and Startup (Soil and Groundwater):
- Assumes no delays due to weather.
- Assumes no delays due to special permitting requirements.
- Assumes no delays due to negotiation with property owners.
- Assumes no delays due to other contractors performing work onsite.
- Assumes no delays due to utility installation.
- Construction to begin by June 1, 1993.
- System startup to begin by July 1, 1993.

8 and 8a) System Operation and Maintenance:
- It is anticipated that groundwater remediation can be completed within 3 to 6 years.
- Assumes that it is technically feasible to achieve cleanup levels.
- Assumes no delays due to special permitting requirements.
- Assumes no offsite remediation will be necessary.
- Assumes no significant equipment breakdowns.
- System start-up in July 1993.

9) Performance Evaluation:
- Evaluation shows that system will effectively remove hydrocarbons from soil and groundwater impacted areas and will reduce concentrations significantly over time.
- Evaluation shows that additional vapor and groundwater extraction wells are not required to effectively remediate impacted areas once the treatment system is operational.
- Performance evaluation to be completed by January to March 1994.

10) Shut Down of Soil Remediation System:
- Cleanup will be completed in approximately 1 year after startup.
- Soil remediation system expected to be shut down by October to December 1994.

11) Shut Down of Groundwater Remediation System:
- Cleanup will be completed approximately 3 to 6 years after startup.
- Only one year of verification groundwater monitoring will be required before site closure can be initiated.
- Groundwater remediation system expected to be shut down sometime in 1998 or 1999.

12) Site Closure:
- Requirements for soil closure involve only drilling of confirmation borings and performance evaluation at time of system shutoff.
- Requirements for groundwater closure involve only groundwater monitoring and performance evaluation at system shutoff.
- Closure dependent on agency concurrence within 1 year following completion of verification monitoring.
- Assumes no risk assessment will be necessary.

RESNA
Working to Restore Nature

PROJECT 69036.06

REVISION: 2
DATE: 12/10/92

ESTIMATED SOIL AND GROUNDWATER REMEDIATION IMPLEMENTATION SCHEDULE
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
19

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES FROM BORINGS
ARCO Station 2035
Albany, California
(Page 1 of 3)

Date Sample ID	TPHg	B	T	E	X	TPHd	TOG	VOC,PCB, and SVOC	Cd	Cr	Pb	Ni	Zn
August 1989													
S-10-B1	1,900	<4	15	8	53	NA	NA	NA	NA	NA	NA	NA	NA
S-15-B1	<1.0	<0.005	0.006	0.006	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-19½-B1	<1.0	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-10-B2	51	1.9	0.35	0.81	4.0	NA	NA	NA	NA	NA	NA	NA	NA
S-14½-B2	<1.0	0.063	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-20-B2	<1.0	0.039	0.044	0.007	0.041	NA	NA	NA	NA	NA	NA	NA	NA
S-10-B3	75	3.1	8.2	1.8	11.0	NA	NA	NA	NA	NA	NA	NA	NA
S-14½-B3	<1.0	0.21	<0.025	<0.025	0.039	NA	NA	NA	NA	NA	NA	NA	NA
S-20-B3	<1.0	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-10-B4	2,400	33	140	40	220	NA	NA	NA	NA	NA	NA	NA	NA
S-15-B4	520	<1.0	6.9	6.2	6.3	NA	NA	NA	NA	NA	NA	NA	NA
S-19-B4	<1.0	<0.005	0.007	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-9½-B5	<1.0	0.007	0.006	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-15-B5	<1.0	<0.005	0.006	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
S-20-B5	<1.0	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA
June 1991													
S-5½-B6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-17-B6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-5½-B7	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B7	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B7	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-17-B7	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-18½-B7	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
October 1991													
S-6-B8	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-11-B8	35	1.2	1.7	0.42	2.0	NA	NA	NA	NA	NA	NA	NA	NA
S-16-B8	3.0	0.45	0.13	0.11	0.47	NA	NA	NA	NA	NA	NA	NA	NA
*S-30-B8	240	3.6	5.0	4.1	16	NA	NA	NA	NA	NA	NA	NA	NA
S-6-B9	25	0.60	0.58	0.44	1.8	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B9	13	0.74	0.72	0.18	0.95	NA	NA	NA	NA	NA	NA	NA	NA
S-16-B9	<1.0	0.015	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-31-B9	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA

See notes on Page 3 of 3

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES FROM BORINGS
ARCO Station 2035
Albany, California
(Page 2 of 3)

Date Sample ID	TPHg	B	T	E	X	TPHd	TOG	VOC,PCB, and SVOC	Cd	Cr	Pb	Ni	Zn
October 1991cont.													
S-5½-B10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-13-B10	4.0	0.13	0.15	0.041	0.16	NA	NA	NA	NA	NA	NA	NA	NA
S-20½-B10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-30½-B10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-6-B11	<1.0	0.010	<0.0050	<0.0050	<0.0050	3.9	80	ND[b]	<0.50	49	7.7	97	41
S-11-B11	110	<0.0050	<0.0050	<0.0050	0.27	71	43	ND[b]	<0.50	80	5.8	77	69
S-16-B11	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	57	ND[b]	<0.50	33	7.5	25	45
S-21-B11	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	74	ND[b]	<0.50	39	7.2	32	56
August 1992													
S-4½-B12	10	<0.0050	<0.0050	0.0070	0.050	45[e]	250	ND	<0.50	59	<5.0	58	40
S-9-B12	9.1	<0.0050	<0.0050	0.0060	0.082	250[e]	100	ND	<0.50	42	<5.0	46	37
S-14½-B12	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<50	ND	<0.50	49	7.4	49	69
S-4½-B13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<50	ND	<0.50	68	<5.0	65	43
S-7½-B13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	1.1[e]	1,800	ND[d]	<0.50	51	<5.0	81	46
S-17½-B13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<50	ND	<0.50	43	5.6	51	69
S-5½-B14	430	4.0	16	7.3	42	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B14	1,300	20	82	31	170	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B14	<1.0	0.012	0.034	0.011	0.055	NA	NA	NA	NA	NA	NA	NA	NA
S-5½-B15	47	0.22	0.56	0.76	4.3	NA	NA	NA	NA	NA	NA	NA	NA
S-10-B15	310	3.8	15	7.1	37	NA	NA	NA	NA	NA	NA	NA	NA
S-13½-B15	110	1.5	4.3	2.1	12	NA	NA	NA	NA	NA	NA	NA	NA
S-4½-B16	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-10-B16	4,300	21	110	51	580	NA	NA	NA	NA	NA	NA	NA	NA
S-14½-B16	<1.0	0.010	0.032	0.018	0.18	NA	NA	NA	NA	NA	NA	NA	NA
S-5½-B17	1.4	0.045	0.0080	<0.0050	0.028	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B17	1,100	16	71	27	140	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B17	27	2.1	0.40	0.75	1.3	NA	NA	NA	NA	NA	NA	NA	NA
S-5½-B18	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B18	380	4.8	21	8.7	46	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B18	2.6	0.78	0.48	0.059	0.29	NA	NA	NA	NA	NA	NA	NA	NA
S-5½-B19	<1.0	0.017	0.0090	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-10½-B19	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	NA	NA	NA	NA
S-15½-B19	<1.0	0.15	0.012	0.029	0.032	NA	NA	NA	NA	NA	NA	NA	NA

See notes on Page 3 of 3

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES FROM BORINGS
ARCO Station 2035
Albany, California
(Page 3 of 3)

Date Sample ID	TPHg	B	T	E	X	TPHd	VOC,PCB, TOG and SVOC		Cd	Cr	Pb	Ni	Zn
August 1992cont.													
S-0821-SPAD	550	2.6	9.5	5.4	47	NA	NA	NA	NA	NA	NA	NA	NA

Results for TPHg, BTEX, TPHd, TOG and metals in parts per million (ppm).
Results for VOC, PCB and SVOC in parts per billion (ppb).
TPHg: Total petroleum hydrocarbons as gasoline by EPA method 5030/8015/8020.
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes isomers
BTEX: Analyzed by EPA method 5030/8015/8020.
TPHd: Total Petroleum Hydrocarbons as diesel by EPA method 3550/8015.
TOG: Total oil and grease by Standard method 5520 E&F.
VOC: Volatile organic compounds by EPA method 8240.
PCB: Polychlorinated biphenyls by EPA method 8080.
SVOC: Semi-volatile organic compounds by EPA method 8270.
Cd: Cadmium by EPA method 6010.
Cr: Chromium by EPA method 6010.
Ni: Nickel by EPA method 6010.
Zn: Zinc by EPA method 6010.
Pb: Lead by EPA method 6010.
NA: Not analyzed.
<: Results reported below the laboratory detection limit.
ND: All compounds tested were nondetectable. Detection limits varied for different compounds.
[a]: Sample collected from the saturated zone, analyzed for site characterization purposes only.
[b]: Only VOCs tested.
[c]: Identified as a non-diesel mixture. The mixture in B-12 contained C9 - C14 plus >C16 and >C17. The mixture in B-13 was >C17.
[d]: All compounds tested were nondetectable except ethylbenzene.

Sample Identification:

S-15½-B19
- Boring number
- Depth in feet
- Soil Sample

S-0821-SPAD
- Composite sample
- Soil pile
- Date sampled
- Soil Sample

TABLE 2
LABORATORY ANALYSES OF NEW TANK PIT SOIL SAMPLES
ARCO Station 2035
Albany, California
(Page 1 of 2)

Sample ID	B	T	E	X	TPHg
July 8, 1991					
S-15-EWC	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-SE	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-16-SW1	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-SW	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-NWC	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-WWC	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-NWF	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-9-NWW	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-8-NW	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-15-NW	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
July 9, 1991					
S-0709-NP1(10')	0.025	0.027	0.0060	0.024	<1.0
S-0709-NP2(14')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP3(10')	<0.0050	0.0050	<0.0050	0.018	<1.0
S-0709-NP4(15)	0.0050	0.0050	<0.0050	<0.0050	<1.0
S-0709-NP5(5')	0.012	0.013	<0.0050	0.0080	<1.0
S-0709-NP6(15')	0.017	0.021	0.014	0.056	<1.0
S-0709-NP7(3')	0.0060	0.0060	<0.0050	<0.0050	<1.0
S-0709-NP8(14')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP9(9')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP10(10')	0.0090	0.0060	<0.0050	<0.0050	<1.0
S-0709-NP11(8')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP12(14')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP13(2')	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
S-0709-NP14(6')	<0.0050	<0.0050	0.0050	0.0080	<1.0
S-0709-NP15(5')	<0.0060	<0.0050	<0.0050	0.0060	<1.0
S-0709-NP16(16')	<0.0050	<0.0050	0.0050	0.0080	<1.0
S-0709-NP17(10')	<0.0050	<0.0050	0.0050	0.0080	<1.0
S-0709-NP18(11')	<0.0050	<0.0050	0.0050	0.0080	<1.0

See notes on Page 2 of 2

TABLE 2
LABORATORY ANALYSES OF NEW TANK PIT SOIL SAMPLES
ARCO Station 2035
Albany, California
(Page 2 of 2)

Sample ID	B	T	E	X	TPHg

Notes:
Results in parts per million (ppm).
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes
TPHg: Total petroleum hydrocarbons as gasoline (TPHg with BTEX distinction measured by EPA Methods 5030/8015/8020)
<: Less than the indicated laboratory detection limit.
Sample Identification:

Excavation Samples: S-0709-NP1(10')

- New tank pit consecutive number (sample depth)
- Date of sample
- Soil sample

Sidewall and Floor Samples: S-15-EWC

- Location identifier
- Depth of sample
- Soil sample

TABLE 3
LABORATORY ANALYSES OF FORMER GASOLINE TANK PIT SOIL SAMPLES
ARCO Station 2035
Albany, California
(Page 1 of 1)

Sample ID	B	T	E	X	TPHg	TOG	VOC	Pb
July 3, 1991								
S-12-T1W	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	NA	NA	NA
S-12-T1E	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	NA	NA	NA
S-12-T2W	0.031	<0.0050	0.0080	<0.0050	<1.0	NA	NA	NA
S-12-T2E	0.019	<0.0050	<0.0050	<0.0050	<1.0	NA	NA	NA
S-12-T3W	1.2	2.4	1.0	3.8	48	NA	NA	<0.05
S-12-T3E	0.2	0.51	0.97	3.9	65	NA	NA	<0.05
S-13-T4N	0.45	0.039	0.18	0.33	6.2	NA	NA	NA
S-13-T4S	0.061	0.034	0.0080	0.15	<1.0	<30	ND	NA
	(0.160)			(0.430)				

Results in parts per million (ppm).
NA: Not analyzed.
<: Less than the indicated laboratory detection limit
ND: Less than laboratory limit for each compound, except benzene and total xylenes
( ): Indicates results measured by EPA Method 8240
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes
TPHg: Total petroleum hydrocarbons as gasoline
(TPHg with BTEX distinction measured by EPA Methods 5030/8015/8020)
TOG: Total oil and grease (measured by Standard Method 5520 E and F)
VOC: Volatile organic compounds (measured by EPA Method 8240)
Pb: Organic lead (measured by California LUFT Manual Method, 12/87)

Sample Identification: S-12-T1W

- Tank number and locator
- Depth of sample
- Soil sample

TABLE 4
LABORATORY ANALYSES OF PRODUCT-LINE
AND PRODUCT-DISPENSER SOIL SAMPLES
ARCO Station 2035
Albany, California
(Page 1 of 1)

Sample ID	B	T	E	X	TPHg
July 19, 1991					
S-2½-PL1	<0.005	<0.005	<0.005	<0.005	<1.0
S-2½-PL2	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PL3	0.005	0.02	0.016	0.12	1.7
S-1-PL4	36	320	100	640	4,200
S-1-PL5	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PL6	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PL7	0.10	0.37	0.16	1.2	11
S-1-PL8	3.6	28	29	200	1,900
S-1-PL9	0.2	0.78	0.36	3.1	110
S-1-PL10	0.09	0.43	0.72	2.8	84
S-2½-PD1	<0.005	<0.005	<0.005	<0.005	<1.0
S-2½-PD2	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PD3	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PD4	<0.005	<0.005	<0.005	12	330
S-1-PD5	<0.005	<0.005	<0.005	<0.005	<1.0
S-1-PD6	0.13	0.28	0.48	3.8	87
S-1-PD7	0.35	2.1	1.1	47	1,000
S-1-PD8	<0.005	<0.005	<0.005	<0.005	<1.0
August 9, 1991					
S-1½-PL4	0.21	0.040	0.15	0.12	4.1

Results in parts per million (ppm).
<: Less than the laboratory detection limit.
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes
BTEX: Measured by EPA Method.
TPHg: Total petroleum hydrocarbons as gasoline (measured by EPA Method).

Sample Identification: S-1½-PL1

- Product-line number
- Depth of sample
- Soil sample

TABLE 5
VAPOR EXTRACTION TEST FIELD MONITORING DATA
ARCO Station 2035
Albany, California
(Page 1 of 3)

Influent Air Stream from VW-5					Observation Wells			
					MW-2	RW-1	VW-2	VW-1
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
30.0	1,500	20	--	0	0.0	0.0	0.015	0.0
78.0	0	>100	--	8	0.0	0.0	0.06	0.0
83.0	NM	>100	--	15	0.05	0.01	0.11	0.0
83.0	300	>100	--	20	0.0	0.0	0.11	0.0
68.0	NM	80	--	--	NM	NM	NM	NM
57.0	NM	60	--	--	NM	NM	NM	NM
44.0	NM	40	--	--	NM	NM	NM	NM
0	NM	20	--	--	NM	NM	NM	NM
DTW_i : 11.7 DTW_f : 13.2 (top of casing)								
Distance from extraction well VW-5 (feet):					25.0	25.0	24.0	40.0
Well Screen Interval (FT BGS): 4.5'-14.5'					20-29	11-26	5-17	5-17
Approximate exposed well screen: = 4.5'-13.2' (Δ≈8.7')					none	none	5-13.2	5-9.3

Influent Air Stream from VW-4					Observation Wells					
					VW-6	VW-5	VW-3	VW-2	VW-1	MW-1
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
44.0	300	41	--	0	0.0	0.065	--	0.01	0.0	0.0
83.0	400	100	--	10	0.0	0.05	0.05	0.05	0.005	0.0
83.0	300	100	--	35	0.0	0.05	0.05	0.07	0.1	0.05
DTW_i : 10.7 DTW_f : 14.3 (top of casing)										
Distance from extraction well VW-4 (feet):					24.0	39.0	19.0	40.0	27.0	30.0
Well Screen Interval (FT BGS): 5-17'					5-12	4.5-14.5	4.5-9.5	5-17	5-17	15-30
Approximate exposed well screen: 5-14.3' (Δ≈6.3')					5-7.2	4.5-13.2	4.5-8.7	5-13.2	5-9.3	none

TABLE 5
VAPOR EXTRACTION TEST FIELD MONITORING DATA
ARCO Station 2035
Albany, California
(Page 2 of 3)

Influent Air Stream from VW-6					Observation Wells				
					VW-4	VW-3	VW-1	MW-1	MW-3
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
65.0	NM	60	–	0	0.03	0.0	0.0	0.0	0.11
87.0	NM	100	–	5	0.005	0.0	0.0	0.0	0.10
87.0	NM	100	–	20	0.0	0.0	0.0	0.0	0.06
87.0	600	100	–	35	0.0	0.0	0.0	0.0	0.0
DTW_i : 11.2' DTW_f : 12.1' (Top of Casing)									
Distance from extraction well VW-6 (feet):					24.5	44.5	54.0	42.7	22.5
Well Screen Interval (FT BGS): 5-12.5'					5-17	4.5-9.5	5-17	15-30	12.5-25
Approximate Exposed Well Screen: 5-12.1' ($\Delta \approx 7.1'$)					5-14	4.5-8.7	5-9.3	none	none

Influent Air Stream from VW-3					Observation Wells					
					VW-6	VW-4	MW-1	VW-2	VW-1	VW-5
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
79.0	700	84	–	5	0.17	0.40	0.0	0.76	0.20	0.12
74.0	700	80	–	30	0.14	0.48	0.0	0.90	0.21	0.19
DTW_i : 8.9 DTW_f : 8.7' (Top of Casing)										
Distance from extraction well VW-3 (feet):					46.0	19.0	21.0	38.0	16.0	49.0
Well Screen Interval (FT BGS): 4.5-9.5'					5-12.5	5-17	15-30	5-17	5-17	4.5-14.5
Approximate exposed well screen: 4.5-8.7' ($\Delta \approx 4.2'$)					5-12.1'	5-14.3	none	5-13.2	5-9.3	4.5-13.2'

Influent Air Stream from VW-2					Observation Wells				
					VW-1	VW-3	VW-4	MW-2	VW-5
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
35.0	NM	26	–	0	0.0	0.5	0.0	0.0	0.0
39.0	3,000	30	–	15	0.17	0.27	0.0	0.05	0.085
39.0	3,500	30	–	30	0.16	0.26	0.01	0.0	0.09
DTW_i : 11.1' DTW_f : 13.2' (Top of Casing)									
Distance from extraction well VW-2 (feet):					24.0	40.0	40.0	36.0	24.0
Well Screen Interval (FT BGS): 5-17'					5-17	4.5-9.5	5-17	20-29	4.5-14.5
Approximate exposed well screen: 5-13.2' ($\Delta \approx 8.2'$)					5-9.3'	4.5-8.7'	5-14.3	none	4.5-13.2

TABLE 5
VAPOR EXTRACTION TEST FIELD MONITORING DATA
ARCO Station 2035
Albany, California
(Page 3 of 3)

Influent Air Stream from VW-1					Observation Wells				
					VW-4	VW-3	VW-2	VW-5	MW-2
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum	Induced Vacuum
79.0	100	100	--	15	0.0	0.70	0.64	0.08	0.0
79.0	200	99	--	30	0.0	0.78	0.68	0.095	0.0
79.0	NM	98	--	40	0.0	0.80	0.70	0.09	0.0
79.0	NM	98	--	70	0.02	0.90	0.78	0.105	NM
79.0	NM	90	--	90	0.05	0.86	0.72	0.10	NM
74.0	300	90	--	105	0.05	0.86	0.74	0.115	NM
78.0	200	90	--	120	0.05	0.88	0.74	0.105	NM
61.0	NM	60	--	--	NM	NM	NM	NM	NM
39.0	NM	40	--	--	NM	NM	NM	NM	NM
0.0	NM	20	--	--	NM	NM	NM	NM	NM
DTW_i : 11.1' DTW_f : 9.3'									
Distance from extraction well VW-1 (feet):					27.0	16.0	24.0	40.0	59.0
Well Screen Interval (FT BGS): 5-17'					5-17	4.5-9.5	5-17	4.5-14.5	20-29
Approximate Exposed Well Screen: 5-9.3' (▲≈4.3')					5-14.3	4.5-8.7	5-13.2	4.5-13.2	none

Flow measured in cubic feet per minute (CFM).
Concentration measured in parts per million by volume (ppmv) on Combustible Gas Meter.
Vacuum measured in inches of water column.
Temperature measured in degrees Fahrenheit.
DTWi = Initial depth to water prior to VET and pumping or bailing operations (measured from top of well casing).
DTWf = Final depth to water after VET (measured from top of well casing).
NM = Not Measured.
FT BGS = Feet Below Grade Surface

Note: Exposed Well Screen refers to well screened intervals above the potentiometric water surface. Values are only approximate since depth to water is measured from top of casing and screened intervals are referenced from grade surface.

TABLE 6
LABORATORY ANALYSIS OF AIR SAMPLES
ARCO Station 2035
Albany, California
(Page 1 of 1)

Sample ID	Sample Location	Elapsed Time of Sample	TPHg	B	T	E	X	Pb
A-VW1-30	VW-1	30	57	<5	<5	<5	<5	NA
A-VW1-EFF	EFFLUENT*	30	110	<5	<5	<5	<5	NA
A-VW1-120	VW-1	120	14	<5	<5	<5	<5	0.004
A-VW2-30	VW-2	30	6,800	83	16	<5	<5	NA
A-VW3-30	VW-3	30	<10	<5	<5	<5	<5	NA
A-VW4-30	VW-4	30	14	<5	<5	<5	<5	NA
A-VW5-30	VW-5	30	27,000	330	220	<25**	36	NA
A-VW6-30	VW-6	30	20	<5	5.2	<5	5.7	NA

Concentrations reported in milligrams per cubic meter (mg/m^3), which is equivalent to ($\mu g/\ell$).
< : Below the minimum laboratory detection limit for air.
NA: Not analyzed.
TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Method 8015).
B: benzene, T: toluene, E: ethylbenzene, X: total xylene isomers
BTEX: Analyzed by EPA Method 8240
*: Effluent vapors sampled after abatement by the internal combustion engine.
**: Laboratory Reported that sample was diluted due to matrix interference.

TABLE 7
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 2035
Albany, California
(Page 1 of 2)

Well / Date	Elevation of Wellhead	Depth to Water	Elevation of Groundwater	Evidence of Product
MW-1				
10/29/91	41.41	11.86	29.55	None
11/07/91		10.94	30.47	None
11/14/91		10.97	30.44	None
01/19/92		10.06	31.35	None
02/19/92		8.65	32.76	None
03/19/92		8.33	33.08	None
04/21/92		9.32	32.09	None
05/12/92		9.82	31.59	None
06/12/92		10.50	30.91	None
07/15/92		10.69	30.72	None
08/07/92		10.53	30.88	None
09/08/92		11.04	30.37	None
10/26/92		11.24	30.17	None
11/23/92		10.90	30.51	None
12/16/92		9.40	32.01	None
MW-2				
10/29/91	40.38	11.10	29.28	None
11/07/91		11.20	29.18	None
11/14/91		11.21	29.17	None
01/19/92		10.44	29.94	None
02/19/92		8.70	31.68	None
03/19/92		8.84	31.54	None
04/21/92		9.80	30.58	None
05/12/92		10.29	30.09	None
06/12/92		10.95	29.43	None
07/15/92		11.15	29.23	None
08/07/92		11.01	29.37	None
09/08/92		11.41	28.97	None
10/26/92		11.60	28.78	None
11/23/92		7.31	33.07	None
12/16/92		9.82	30.56	None
MW-3				
10/29/91	41.44	11.62	29.82	None
11/07/91		11.52	29.92	None
11/14/91		11.50	29.94	None
01/19/92		10.56	30.88	None
02/19/92		9.52	31.92	None
03/19/92		9.01	32.43	None
04/21/92		9.70	31.74	None
05/12/92		10.29	31.15	None

See notes on Page 2 of 2.

TABLE 7
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 2035
Albany, California
(Page 2 of 2)

Well / Date	Elevation of Wellhead	Depth to Water	Elevation of Groundwater	Evidence of Product
MW-3cont.				
06/12/92		11.26	30.18	None
07/15/92		11.28	30.16	None
08/07/92		11.15	30.29	None
09/08/92		11.70	29.74	None
10/26/92		12.15	29.29	None
11/23/92		12.55	28.89	None
12/16/92		10.15	31.29	None
RW-1				
10/29/91	40.33	10.85	29.48	Sheen
11/07/91		11.97	28.36	0.01
11/14/91		11.03	29.30	0.01
01/19/92		10.22*	30.11*	3.26
02/19/92		8.49*	31.84*	2.14
03/19/92		8.50*	31.83*	0.50
04/21/92		9.68*	30.65	0.03
05/12/92		10.47	29.86	Product not measured
06/12/92		11.41	28.92	Product not measured
07/15/92		11.35	28.98	None
08/07/92		10.80*	29.53*	0.02
09/08/92		10.80*	29.53*	0.62
10/26/92		11.42*	28.91*	0.04
11/23/92		10.94	29.39	Sheen
12/16/92		9.78*	30.55*	0.51

Wellhead Elevation based on benchmark (B1198): A standard Bronze Disk in the sidewalk 0.8' behind the face of curb on the northerly side of Marin Avenue 6' +/- westerly of the curb return at the northeast corner of Marin Avenue and San Pablo Avenue at an elevation of 40.426 feet above mean sea level, City of Albany, California.

Depth-to-water measurements in feet below the top of the well casing.

*Adjusted water level due to product. The recorded thickness of the floating product was multiplied by 0.80 to obtain an approximate value for the displacement of water by the floating product. This approximate displacement value was then subtracted from the measured depth to water to obtain a calculated depth to water. These calculated groundwater depths were subtracted from surveyed wellhead elevations to calculate the differences in groundwater elevations.

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES - TPHg and BTEX
ARCO Station 2035
Albany, California
(Page 1 of 2)

WELL DATE	TPHg	B	T	E	X
MW-1					
10/29/91	620	76	69	15	60
03/19/92	6,500	2,600	89	42	290
06/12/92	2,900	1,100	2.5	21	15
09/08/92	820	350	<5*	<5*	<5*
10/26/92	190	68	<0.5	0.6	<0.5
1/13/93	430	130	5.3	5.0	9.0
MW-2					
10/29/91	<60	2.4	4.6	0.48	2.3
03/19/92	<50	6.8	0.9	<0.5	1.1
06/12/92	<50	<0.5	<0.5	<0.5	<0.5
09/08/92	<50	<0.5	<0.5	<0.5	<0.5
10/26/92	<50	<0.5	<0.5	<0.5	<0.5
1/13/93	<50	<0.5	<0.5	<0.5	<0.5
MW-3					
10/29/91	32	2.1	2.8	0.35	1.8
03/19/92	2,100	780	8.8	16	58
06/12/92	720	210	<2.5*	23	4.0
09/08/92	<50	5.3	<0.5	<0.5	<0.5
10/26/92	<50	0.6	<0.5	<0.5	<0.5
1/13/93	<50	1.1	<0.5	<0.5	
RW-1					
10/29/91	Not sampled--sheen				
03/19/92	Not sampled--floating product				
06/12/92	Not sampled--floating product				
09/08/92	Not sampled--floating product				
10/23/92	Not sampled--floating product				
1/13/93	Not sampled--floating product				
MCL:	—	1	—	680	1,750
DWAL:	—	—	100	—	—

Results in parts per billion (ppb).

TPHg: Total petroleum hydrocarbons as gasoline by EPA Method 5030/8015/8020.
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes isomers
BTEX: Analyzed by EPA Method 5030/8015/8020.
<: Results reported below the laboratory detection limit.
*: Laboratory Raised Methods Reporting Limit (MRL) due to high analyte concentration requiring sample dilution.
MCL: State Maximum Contaminant Level (October 1990).
DWAL: State Drinking Water Action Level (October 1990).

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES - TPHg and BTEX
ARCO Station 2035
Albany, California
(Page 2 of 2)

WELL DATE	TPHg	B	T	E	X
MW-4 1/13/93	<50	<0.5	1.3	<0.5	1.6
MW-5 1/13/93	<50	<0.5	<0.5	<0.5	<0.5
MW-6 1/13/93	<50	<0.5	<0.5	<0.5	<0.5
MCL:	—	1	—	680	1,750
DWAL:	—	—	100	—	—

Results in parts per billion (ppb).

TPHg: Total petroleum hydrocarbons as gasoline by EPA Method 5030/8015/8020.
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes isomers
BTEX: Analyzed by EPA Method 5030/8015/8020.
<: Results reported below the laboratory detection limit.
*: Laboratory Raised Methods Reporting Limit (MRL) due to high analyte concentration requiring sample dilution.
MCL: State Maximum Contaminant Level (October 1990).
DWAL: State Drinking Water Action Level (October 1990).

TABLE 9
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
- TPHd, TOG, VOC, SVOC, PCB and Metals
ARCO Station 2035
Albany, California
(Page 1 of 1)

WELL DATE	TPHd	TOG	VOC	SVOC	PCB	Cd	Cr	Pb	Ni	Zn
MW-3										
10/29/91	NA	<5,000	ND[a]	NA	NA	<10	<10	<5	<50	45
03/19/92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
06/12/92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
09/08/92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10/26/92	<50	600	ND[b]	NA	NA	NA	NA	NA	NA	NA
12/01/92	NA	NA	NA	ND[c]	ND[d]	NA	NA	NA	NA	NA
1/13/93	<50	1.1[e]/0.78[f]	<0.5	NA	NA	NA	NA	NA	NA	NA
MCL:	—	—	—	—	—	10	50	50	—	—

Results in parts per billion (ppb).

TPHd: Total petroleum hydrocarbons as diesel by EPA Method 3510/California DHS LUFT Method.
TOG: Total oil and grease by Standard Method 5520 B&F or 5520 C&F.
VOC: Volatile organic compounds by EPA Method 624.
SVOC: Semivolatile organic compounds by EPA Method 3510/8270.
PCB: Polychlorinated biphenyls by EPA Method 3510/8080.
Cd: Cadmium by EPA Method 200.7.
Cr: Chromium by EPA Method 200.7.
Ni: Nickel by EPA Method 200.7.
Zn: Zinc by EPA Method 200.7.
Pb: Lead by EPA Method 3010.
NA: Not analyzed.
<: Results reported below the laboratory detection limit.
ND: Not detected; detection limit varied according to analyte.
[a]: All 37 compounds were nondetectable except for toluene (3.0 ppb).
[b]: All 41 compounds analyzed were nondetectable.
[c]: All 34 compounds analyzed were nondetectable.
[d]: All 7 compounds analyzed were nondetectable.
e: Total oil and grease by Standard Method 5520F.
f: Total oil and grease by Standard Method 5520C.
MCL: State Maximum Contaminant Level (October 1990).

TABLE 10
APPROXIMATE CUMULATIVE PRODUCT RECOVERED
ARCO Station 2035
Albany, California
(Page 1 of 1)

Well / Date	Product Thickness (feet)	Product Recovered (gallons)
YEAR: 1992		
RW-1		
01/29/92	3.35	5.0
02/28/92	2.58	3.8
03/12/92	1.28	2.0
03/25/92	0.91	0.5
05/29/92	0.23	0.3
06/08/92	0.60	0.5
06/30/92	0.15	0.25
07/23/92	0.27	0.5
08/05/92	0.45	0.25
08/17/92	0.50	0.5
09/10/92	0.75	0.5
09/22/92	0.80	1.2
10/06/92	0.65	1.0
10/21/92	0.50	1.0
11/04/92	0.48	1.5
11/17/92	0.40	0.75
12/02/92	0.41	0.75
12/17/92	0.39	1.0
12/29/92	0.53	1.0
	1992 TOTAL:	22.30

Product measured and bailed by RESNA personnel.

APPENDIX A
GROUNDWATER MONITORING WELL BORING LOGS: MW-1, MW-2, MW-3
RECOVERY WELL RW-1 BORING LOGS
[PLATES A-1 TO A-8]

Depth of boring: 31-1/2 feet Diameter of boring: 13 inches Date drilled: 10/14/91

Well depth: 30 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 15 to 30 feet Slot size: 0.020-inch

Drilling Company: Exceltech Drilling Driller: Don and Kenny

Method Used: Hollow-Stem Auger Field Geologist: Rob Campbell

Signature of Registered Professional: [signature]

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved.	
0					Asphalt (3 inches) and baserock (9 inches).	
2			0.5	CH	Silty clay with gravel, black, moist, high plasticity, very stiff to hard.	
4				CL	Sandy clay, brown, moist, low to medium plasticity, hard; obvious product odor.	
6	S-6	11 15 30	3232			
8					Iron oxide mottling.	
10	S-10.5	8 13 19	725			
12					(10/29/91). Color change to light gray mottled with brown, lower plasticity.	
14						
16	S-16	19 35 50	NR	SC	Clayey sand, orange-brown, damp, very dense.	
18						
20	S-20.5	14 19 22	NR		Encountered water 10/14/91.	
				GM	Silty gravel, brown-orange, wet, dense; layer ~3 inches thick.	
				SC	Clayey sand, light gray mottled with orange-brown, moist to wet, dense.	

NR = No reading.

(Section continues downward)

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LOG OF BORING B-9/MW-1

ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE

A-1

Depth	Sample No.	BLOWS	P.I.D.	USCS Code	Description	Well Const.
22				SC	Clayey sand, light gray mottled with orange–brown, moist to wet, dense.	
24						
26	S–26	19 35 40	NR		Alternating seams of wet and moist.	
28						
					Smoother drilling at 29 feet.	
30	S–31	9 12 19	NR	CL	Silty clay, gray, damp, medium plasticity, very stiff.	
32					Total depth = 31–1/2 feet.	
					NR = No reading.	
34						
36						
38						
40						
42						
44						
46						
48						
50						

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LOG OF BORING B–9/MW–1
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A–2

Depth of boring: 33 feet Diameter of boring: 10 inches Date drilled: 10/16/91

Well depth: 29 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 20 to 29 feet Slot size: 0.020-inch

Drilling Company: Exceltech Drilling Driller: Don and Kenny

Method Used: Hollow-Stem Auger Field Geologist: Steve Strausz

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt surface.	
0					Asphalt (2 inches) and baserock (6 inches).	
				CL	Silty clay, dark brown, damp, medium plasticity, stiff.	
2					Color change to lighter gray at 3 feet.	
4					Very stiff.	
	S-5.5	18 23 26	11.8			
6				GM	Silty gravel with minor clay, fine gravel, dark blue-gray, damp, very dense; noticeable product odor.	
8					Smooth drilling at 8 feet.	
				CL	Sandy clay, gray, damp to moist, medium plasticity, hard; minor fine gravel; noticeable product odor.	
10	S-10.5	9 13 19	73.4	▼	(10/29/91).	
12					Rougher drilling at 12 feet.	
	S-13	11 26 30	274	GP	Sandy gravel with clay, brown, moist, dense; obvious product odor.	
14				SC	Clayey sand, gray, moist, very dense.	
	S-15.5	7 11 12	31.9	ML	Clayey silt, light brown, very moist, medium plasticity, very stiff; noticeable product odor.	
16						
18						
20	S-20.5	8 12 17	2.3	▽	Encountered water 10/16/91.	
				SM	Silty sand, fine-grained, light gray, wet, dense.	

(Section continues downward)

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LOG OF BORING B-10/MW-2

ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A-3

Depth	Sample No.	BLOWS	P.I.D.	USCS Code	Description	Well Const.
22				SM	Silty sand, fine-grained, light gray, wet, dense.	
24						
	S-25.5	22 34 35	NR			
26				SW	Gravelly sand with silt, rusty-brown, wet, very dense.	
28					Smoother drilling at 28 feet.	
				CL	Silty clay, light gray-brown, moist, medium plasticity, hard.	
30	S-30.5	9 17 29	NR			
		6			With some gravelly sand interbedded.	
32		11 12				
34					Total depth = 33 feet.	
					NR = No reading.	
36						
38						
40						
42						
44						
46						
48						
50						

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LOG OF BORING B-10/MW-2
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A-4

Depth of boring: 34-1/2 feet Diameter of boring: 10 inches Date drilled: 10/16/91

Well depth: 32-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 12-1/2 to 32-1/2 feet Slot size: 0.020-inch

Drilling Company: Exceltech Drilling Driller: Don and Kenny

Method Used: Hollow-Stem Auger Field Geologist: Rob Campbell

Signature of Registered Professional: [signature]

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt surface.	
0					Asphalt (3 inches) and baserock (9 inches).	
2				CH	Silty clay, black, moist, high plasticity, stiff to very stiff; noticeable product odor.	
4						
6	S-6	5 13 14	NR	CL	Silty clay with some gravel, brown with green mottling, moist, low to medium plasticity, very stiff; noticeable product odor.	
8						
10	S-11	6 8 10	NR	ML	(10/29/92). Clayey silt with medium-grained sand, brown with green mottling, moist, medium plasticity, very stiff, noticeable product odor.	
12						
14						
16	S-16	6 8 10	NR	SC	Clayey sand, gray with orange mottling, damp, medium dense, noticeable product odor.	
18						
20	S-21	8 11 23	NR		(Section continues downward)	

NR = No reading.

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LOG OF BORING B-11/MW-3

ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE

A-5

Depth	Sample No.	BLOWS	P.I.D.	USCS Code	Description	Well Const.
22				SC	Clayey sand, gray with orange mottling, damp, medium dense, noticeable product odor.	
24				▽	Encountered water 10/15/91.	
26	S-26	7 8 12	NR			
28						
30	S-30	21 26	NR	GM	Silty gravel, brown, wet, dense.	
32	S-32.5	17 11 19 28		CL	Minor interbedded silty clay, light brown, very moist, medium plasticity.	
34	S-34	29 50/6"			Sandy gravel with silt, fine sand to fine gravel, brown, wet, very dense.	
36					Total depth = 34-1/2 feet. NR = No reading.	
38						
40						
42						
44						
46						
48						
50						

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LOG OF BORING B-11/MW-3
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A-6

Depth of boring: 30-1/2 feet Diameter of boring: 13 inches Date drilled: 10/15/91

Well depth: 29 feet Material type: Sch 80 PVC Casing diameter: 6 inches

Screen interval: 11 to 26 feet Slot size: 0.020-inch

Drilling Company: Exceltech Drilling Driller: Don and Kenny

Method Used: Hollow-Stem Auger Field Geologist: Rob Campbell

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt (3 inches) and baserock (9 inches).	
2				CH	Silty clay, black, moist, high plasticity; obvious product odor, abundant organics.	
4					PID alarm at 4 feet.	
6	S-6	7 15 20	5681	CL	Silty clay, dark gray mottled with green, moist, medium plasticity, hard; obvious product odor.	
8					Gradational color change from gray to brown.	
10	S-11	11 11 11	*	ML	(10/29/91) Gravelly silt, brown mottled with green, damp, low plasticity, very stiff; obvious product odor. Large caliche clasts.	
12						
14						
16	S-16	15 21 28	*	SC	Clayey sand with some gravel, brown mottled with orange damp, dense; noticeable product odor.	
18					Encountered water at 19 feet (10/15/91).	
20	S-21	19 32 45	0	SM	Increasing sand. Silty sand with gravel, brown, damp, very dense.	
					(Section continues downward)	

*Hydrocarbon vapors overloaded OVM.

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LOG OF BORING B-8/RW-1

ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A-7

Depth	Sample No.	BLOWS	P.I.D.	USCS Code	Description	Well Const.
22				SM	Silty sand with gravel, brown, damp, very dense.	
24						
26	S-26	11 18 25	10			
28				CL	Silty clay, gray with brown streaks, damp to moist, medium, plasticity, hard; noticeable product odor.	
30	S-30	30 50	0	SM	Silty sand with gravel, brown, damp to wet, very dense, no odor.	
32					Total depth = 30-1/2 feet.	
34						
36						
38						
40						
42						
44						
46						
48						
50						

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LOG OF BORING B-8/RW-1
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
A-8

APPENDIX B
VAPOR EXTRACTION WELL BORING LOGS: VW-1 TO VW-6
[PLATES B-1 TO B-6]

Depth of boring: 18-1/2 feet Diameter of boring: 10 inches Date drilled: 08/20/92

Well depth: 17 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 5 to 17 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and John

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Concrete.	
0					Concrete (7 inches).	
				GP	Sandy gravel, gray, damp, dense: baserock.	
2			146	CH	Silty clay, dark brown, damp, high plasticity, soft; product odor.	
4				CL	Sandy clay, trace fine gravel, brown, damp, medium plasticity, very stiff; product odor.	
6	S-5.5	5 8 9	709			
8						
10				SC	Clayey sand with gravel, fine- to coarse-grained sand, dark gray, damp, loose; obvious product odor.	
	S-10.5	5 5 5	576	CL	Gravelly clay with sand, brown mottled gray, moist, low plasticity, stiff; product odor.	
12						
14				SC/ML	Clayey sand, fine-grained, with clayey silt lenses, light gray mottled orange, moist, medium dense; noticeable product odor.	
16	S-15.5	2 4 8	59			
	S-17.5	7 24 26	12		With gravel, less clay, orange-brown.	
18						
					Total Depth = 18-1/2 feet.	
20						

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LOG OF BORING B-14/VW-1
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
B-1

Depth of boring: 17-1/2 feet Diameter of boring: 10 inches Date drilled: 08/19/92

Well depth: 17 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 5 to 17 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and Robert

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional: [signature]

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt-covered surface.	
0					Asphalt (4 inches).	
				GP	Sandy gravel, brown, damp, dense: baserock.	
2				CL/CH	Silty clay, black, damp, medium to high plasticity, stiff; product odor.	
4				CL	Silty clay with sand and fine gravel, brown mottled gray, damp, medium plasticity, very stiff; product odor.	
6	S-5.5	4 8 12	364			
8	S-8.5	8 10 12	522	SC	Clayey sand, fine- to coarse-grained, grayish-brown, moist, medium dense; product odor.	
10	S-10	5 7 11	726	ML	Gravelly silt with sand, brown, moist, low plasticity, very stiff; obvious product odor.	
12	S-12	5 20 14			Color change to brown mottled orange, damp.	
	S-13.5	7 11 20	610	SC/ML	Clayey sand, fine-grained, with sandy silt lenses, greenish brown, moist, dense; product odor.	
14	S-15	7 19 20	65			
16		11 19 24	94		Increasing sand, grayish-brown.	
18					Total depth = 17-1/2 feet.	
20						

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LOG OF BORING B-15/VW-2
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
B-2

Depth of boring: 15-1/2 feet Diameter of boring: 10 inches Date drilled: 08/19/92

Well depth: 9-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 4-1/2 to 9-1/2 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and Robert

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt-covered surface.	
0					Asphalt (4 inches).	
				GP	Sandy gravel, gray, damp, dense: baserock.	
2				CL	Sandy clay, brown, moist, medium plasticity, very soft; product odor.	
4	S-4.5	1 1 1	74			
6						
8				▼		
10	S-10	1 1 2	142	▽SM	Silty sand, fine-grained, dark gray, wet, very loose; product odor.	
12					Some gravel.	
14	S-14.5	2 3 4	7.7	CL	Silty clay with sand, light gray mottled orange, damp to moist, low plasticity, firm.	
16					Total depth = 15-1/2 feet.	
18						
20						

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PROJECT 69036.06

LOG OF BORING B-16/VW-3

ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE

B-3

Depth of boring: 18-1/2 feet Diameter of boring: 10 inches Date drilled: 08/20/92

Well depth: 17 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 5 to 17 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and John

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Concrete.	
0					Concrete (7 inches).	
				GP	Sandy gravel, brown, damp, dense: baserock.	
2				CH	Silty clay, dark brown, damp, high plasticity, firm.	
4				CL	Sandy clay, brown, damp, medium plasticity, very stiff; obvious product odor.	
6	S-5.5	5 10 14	592		Increasing sand, with fine gravel, grayish-brown.	
8						
10	S-10.5	5 6 6	854	SC	Clayey sand, fine-grained, gray, damp to moist, medium dense; product odor.	
12				CL	Gravelly clay with sand, brown mottled gray, moist, low plasticity, stiff; product odor.	
14				SC/ML	Clayey sand, fine-grained, with clayey silt lenses, light gray mottled orange, moist, medium dense; noticeable product odor.	
16	S-15.5	6 8 10	80			
	S-17.5	1 18 30	225		Less clay, with gravel, orange-brown.	
18					Total depth = 18-1/2 feet.	
20						

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PROJECT 69036.06

LOG OF BORING B-17/VW-4
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
B-4

Depth of boring: 16-1/2 feet Diameter of boring: 10 inches Date drilled: 08/21/92

Well depth: 14-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 4-1/2 to 14-1/2 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and John

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt-covered surface.	
0					Asphalt (4 inches).	
				GP	Sandy gravel, gray, damp, dense: baserock.	
2				CL/CH	Silty clay, dark brown, damp, medium to high plasticity, firm.	
4				CL	Sandy clay, brown, damp, medium plasticity, stiff.	
	S-5.5	7 12 12	39	GC	Clayey gravel with sand, grayish-brown, damp, medium dense.	
6						
8						
10					Increasing sand.	
	S-10.5	12 10 8	143			
12				CL	Gravelly clay with sand, grayish-brown, damp to moist, low plasticity, very stiff; product odor.	
14						
	S-15.5	18 12 18	896	SC	Clayey sand with gravel, fine-grained sand, light gray mottled orange, moist, medium dense; product odor.	
16					Total depth = 16-1/2 feet.	
18						
20						

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PROJECT 69036.06

LOG OF BORING B-18/VW-5
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
B-5

Depth of boring: 16-1/2 feet Diameter of boring: 10 inches Date drilled: 08/21/92

Well depth: 12-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 5 to 12-1/2 feet Slot size: 0.100-inch

Drilling Company: Bayland Drilling Driller: Frank and John

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional:

Registration No.: RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Asphalt-covered surface.	
0					Asphalt (4 inches).	
				GP	Sandy gravel, gray, damp, dense: baserock.	
2				CL/CH	Silty clay, black, damp, medium to high plasticity, stiff; product odor.	
4				CL	Silty clay, brownish-gray, moist, medium plasticity, very stiff; noticeable product odor.	
					Color change to brown.	
6	S-5.5	6 12 21	43	GC	Clayey gravel with sand, grayish-brown, moist, dense; noticeable product odor.	
8				CL	Silty clay, trace fine gravel, brown, damp, medium plasticity, stiff.	
10	S-10.5	3 6 9	0		With clayey sand lenses.	
12					▼ ▽	
				SC/CL	Clayey sand, fine-grained, with sandy clay lenses, brown, wet, medium dense.	
14						
16	S-15.5	3 5 8	56			
					Total depth = 16-1/2 feet.	
18						
20						

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PROJECT 69036.06

LOG OF BORING B-19/VW-6
ARCO Station 2035
1001 San Pablo Avenue
Albany, California

PLATE
B-6

APPENDIX C
MANUFACTURER'S SPECIFICATIONS FOR VAPOR-PHASE ACTIVATED CARBON

Quality Certified

VOCarb™

Air Purification Carbon

DESCRIPTION

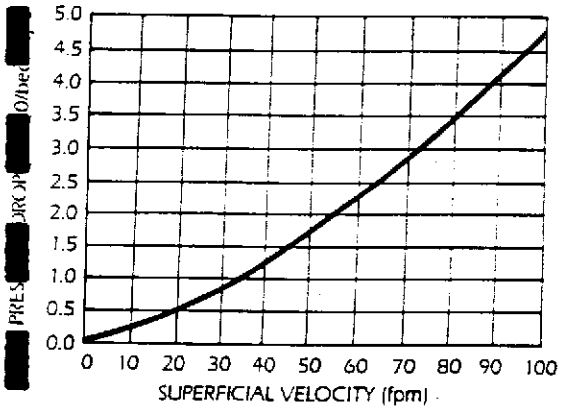
Westates' VOCarb™ activated carbon is the premier activated carbon for air purification applications. VOCarb activated carbon's high retentivity results in VOC adsorption capacities as much as **40% greater than coal** based activated carbons. This high retentivity combined with exceptional hardness makes VOCarb activated carbon the best choice for most vapor phase adsorption applications.

QUALITY CERTIFIED

The manufacturing process for activated carbons is a procedure with many variables that require strict quality control. Westates maintains a modern ASTM quality control laboratory to certify that Westates products meet or exceed the required specifications.

Westates VOCarb at 2.2 Kx mag.

PRESSURE DROP



SAFETY

Under certain conditions, some chemical compounds may oxidize, decompose, or polymerize in the presence of activated carbon. This could result in temperature increases sufficient to cause ignition. As a result, particular care must be taken with compounds having peroxide-forming tendencies.

WESTATES CAPABILITIES

Westates manufactures, regenerates and tests activated carbon in our own facilities, in addition to selecting carbon from other sources. The company has more than 20 years experience in the design of activated carbon adsorption systems. Our technical staff provides expert guidance in selecting the appropriate system for your needs. Our in-house laboratory is fully equipped to provide complete quality control and a continuing analysis of your carbon to maintain maximum adsorption efficiency.

SPECIFICATIONS

Size (U.S. Sieve)	4 x 8
Type	Coconut Shell
CTC - Typical	65%
Retentivity - Typical	39%
Pore Volume - Typical	.55 cc/gm
Surface Area (B.E.T.) Min.	1250 m^2/g
Ash Max.	2%
Hardness Min.	97%
Abrasion Min.	98%
Moisture Max.	2%
Mean Particle Diameter	3.4mm
Apparent Density - Typical	.48 gm/cc 29 lb/ft^3

APPLICATIONS

- VOC Adsorption Tanks
- Industrial Air Cleaners
- HVAC Adsorption Filters
- Odor Control Systems
- Clean Room Air Purifiers
- VOC Vapor Capture Systems

WESTATES carbon ACTIVATED CARBON SYSTEMS

WESTATES CARBON, INC.
2130 Leo Ave., Los Angeles, CA 90040
PHONE: (213) 722-7500
FAX: (213) 722-6207 TLX: 910-321-2355

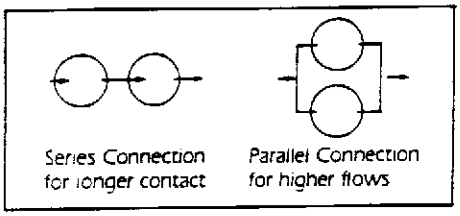
Air Purification System

VENT-SCRUB™

VSC-1200 VSC-2000

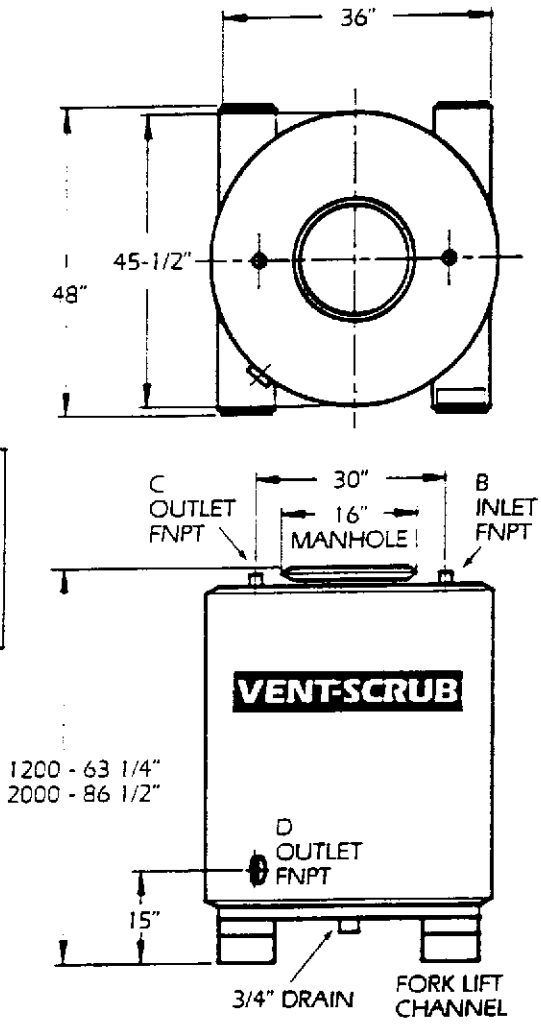
EASY TO INSTALL

VENT-SCRUB™ adsorbers are designed for fast and easy installation on any hard, flat surface. Place the unit as close to the vapor source as possible. The only hardware needed is properly sized pipe or ducting—rigid or flexible—for connection to the inlet/outlet ports. For outdoor use, a rain guard may be needed to protect VENT-SCRUB's™ exhaust.



SAFETY

Under certain conditions, some chemical compounds may oxidize, decompose, or polymerize in the presence of activated carbon. This could result in temperature increases sufficient to cause ignition. As a result, particular care must be taken with compounds having peroxide-forming tendencies.



CORROSION RESISTANCE

The combination of activated carbon and many VOC's can cause severe corrosive or electrolytic damage to metals, even stainless steel. VENT-SCRUB™ adsorbers are designed to prevent these effects in normal service.

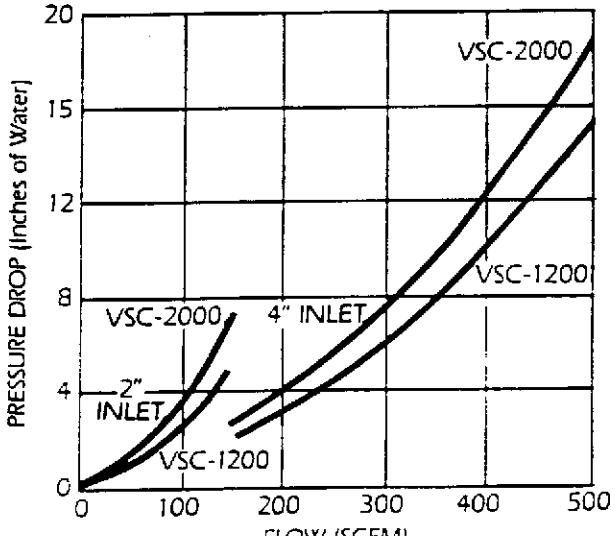
DIMENSIONS

Model No.	A	B	C	D
VSC-1200-2	63-1/4"	2"	2"	N/A
VSC-1200-4	63-1/4"	4"	N/A	4"
VSC-2000-4	86-1/2"	4"	N/A	4"
VSC-2000-4V	86-1/2"	4"	N/A	4"

MATERIALS OF CONSTRUCTION

Vessel:
Coated 12 ga. Carbon Steel
7 ga. Top/Bottom
External Coating:
Powder Coat Enamel
Internal Coating:
Fusion Bonded Epoxy
Piping: PVC

PRESSURE DROP



SPECIFICATIONS

	VSC-1200	VSC-2000
Flow* cfm (max)	500	500
Pressure psig (max)	12	12
Vacuum (in Hg)	15	**
Temperature deg F (max)	120	120
Carbon Fill Volume (cu. ft.)	33	65
Cross Section (sq. ft.)	12.5	12.5
Shipping Weight (lbs.)	1600	2500

*Note: actual design should be based on superficial bed velocity (sbv) as required for specific contaminants.

** VSC-2000-4 8 (in Hg) VSC-2000-4V 15 (in Hg)

WESTATES carbon ACTIVATED CARBON SYSTEMS

WESTATES CARBON, INC.
2130 Leo Ave., Los Angeles, CA 90040
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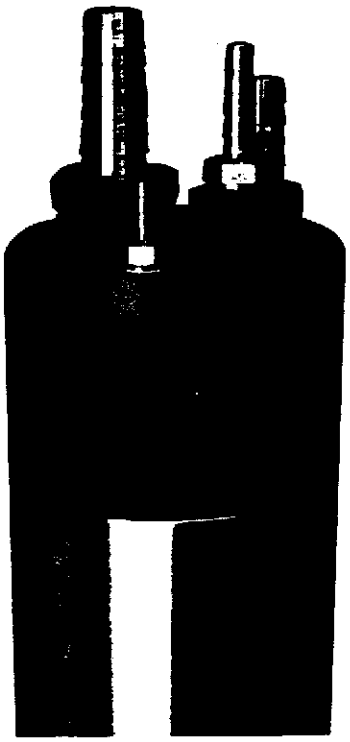
APPENDIX D
MANUFACTURER'S SPECIFICATIONS FOR GROUNDWATER DEPRESSION PUMP

Solo™ Controllerless Remediation Pump

Revolutionary pump eliminates controllers, for the simplest system ever to specify, install, and operate.



OPTIMUM PERFORMANCE—WITH NO CONTROLLERS!

Solo™ is going is going to change the way you think about ground water cleanup. One of the earliest users, a major east coast remediation contractor, says it is "the simplest pump available at this time".

Solo (patent pending) is an intelligent high-rate pneumatic displacement pump for total fluids applications. It runs itself, with an internal float system and a magnetic "brain" cartridge. The brain—about the size of a roll of Life Savers®—senses liquid level in the pump without liquid contact, turning the air supply on when the pump is full, and turning it off as soon as the pump empties.

EASY SET-UP, AUTO-OPTIMIZING

With its built-in brain, Solo doesn't require air cycle or on-off level control at the wellhead, greatly simplifying system design. All you need above the well cap is a compact, inexpensive air filter/pressure control.

Solo is easier to install than other pumps. You don't have to connect controllers or set timing cycles. And system specification is less complex—just run air to each well, drop in Solo and walk away.

Continued operation is truly hands-off. Solo constantly reacts to changes in well recovery rate, so it's always pumping at the highest rate possible. It also shuts down automatically if water in the well drops below the pumping level.

EFFICIENT, TROUBLE-FREE OPERATION

Because cycling is controlled at the pump, Solo is either refilling or discharging 100% of the time. There's no waiting between active phases of the cycle for the entire length of air supply tubing to re-pressurize.

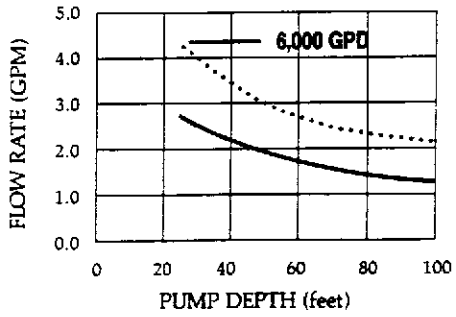
This operating efficiency enables Solo to deliver high pumping rates while reducing air supply requirements.

The pumping mechanism in Solo uses the same high-clearance design that has made Pulse Pump the standard for field performance without clogging or breakdowns. The controller mechanism uses a magnetic link to isolate it from pumped fluids, and is streamlined into a removable cartridge to simplify service. All parts, including the brain cartridge, are rated for at least 5,000,000 cycles and are field-replaceable if necessary.

COST-EFFECTIVE CLEANUP

By eliminating controllers and delivering consistently superior performance, Solo will significantly lower the cost of many cleanup projects. And its simple installation and "hands-off" operation will allow you to handle more jobs in less time.

FLOW PERFORMANCE CURVES:



DEPTH (feet): ····· 10 ft. Submergence/100 psi
——— 2 ft. Submergence/100 psi

On Pump Flow Curves: Flow curves are for a pump at the stated conditions, and will vary under other conditions. Flow rate will also be affected by discharge and air tube sizes and run length. QED's technical service department will check your discharge and air system design and select pump and control equipment to meet your requirements.

CHEMICAL COMPATIBILITY CHART:

	GASOLINE	FUEL OILS	CHLORINATED SOLVENT	NON-CHLORIDE ACIDS	HYDROCHLORIC ACID	BASES
S.S./TEFLON/ NYLON	•	•				•

PULSEPUMP

SPECIFICATIONS:

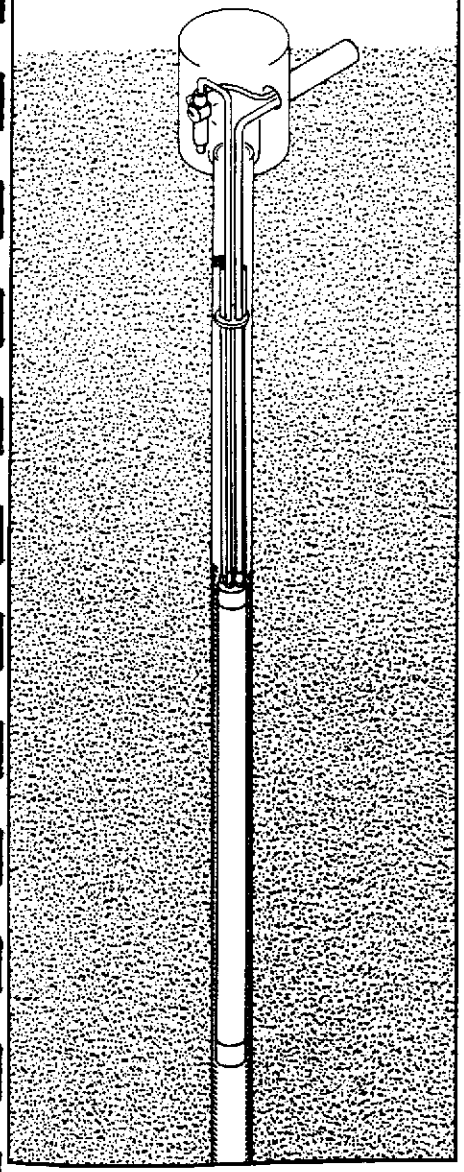
MODEL NO.	PUMP MATERIAL	MIN. WELL I.D. (inches)	PUMP O.D. (inches)	LENGTH (inches)	PUMP VOL. (ml)	WT. (lbs)	FITTING SIZE (inches) & MATERIAL
SP4000	S.S./Teflon/ Nylon	4	3.00	48	2000	14	.25 - .75 (four sizes) S.S. Barb & Clamp

TUBING/HOSE PACKAGES:

MODEL NO.	LENGTH (feet)	TYPE	PUMP* DISCHARGE	PUMP* AIR SUPPLY	PUMP* EXHAUST	BRAIN* EXHAUST
SP25H	25	Hose	.63 Flexible	.25 Flexible	.50 Nylon	.25 Nylon
SP25T	25	Tubing	.75 Nylon	.38 Nylon	.50 Nylon	.25 Nylon
SP50H	50	Hose	.63 Flexible	.25 Flexible	.50 Nylon	.25 Nylon
SP50T	50	Tubing	.75 Nylon	.38 Nylon	.50 Nylon	.25 Nylon
SP100H	100	Hose	.63 Flexible	.25 Flexible	.50 Nylon	.25 Nylon
SP100T	100	Tubing	.75 Nylon	.38 Nylon	.50 Nylon	.25 Nylon

Note: All-nylon tubing is more economical. Flexible hose allows easier coiling for depth adjustment and portability.
* Dimensions in inches

NO PULSE SENDER, NO LEVEL MATE, NO EXHAUST VALVE



SOLO PUMP PACKAGES:

MODEL NO.	WELL DIAM (inches)	CAP ACCEPTS
SP4000A	4	Hose
SP4000B	4	Tubing
SP4000C	6	Hose
SP4000D	6	Tubing
SP4000E	8	Hose
SP4000F	8	Tubing

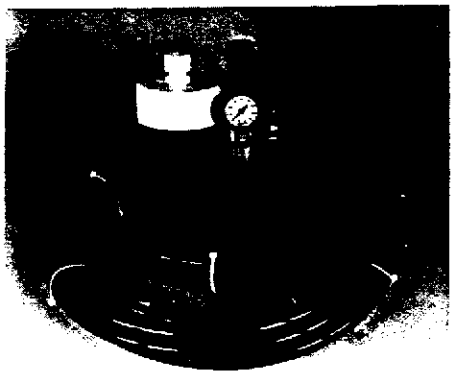
Each package contains: Solo pump, well cap and fittings, filter/regulator with autodrain.

OPERATING REQUIREMENTS:

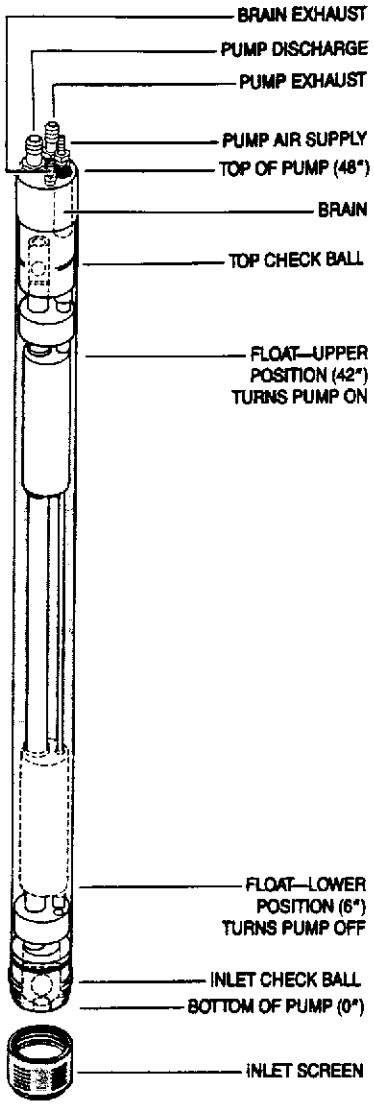
Minimum Depth of Liquid: 48" above pump bottom

Recommended Air Pressure Not To Exceed: 100 psi

Recommended Air Flow Depending On Pump Conditions: 2-4 SCFM



Besides the pump, each basic Solo package include a well cap with attached filter/regulator and a flexible hose (shown) or tubing set.



HOW IT WORKS

Controllerless Remediation Pump

In the intake cycle, the inlet check ball allows liquid to enter the pump, while the top check ball keeps it from coming back into the pump from the discharge tubing. Rising liquid carries the float to the upper position, where it moves the actuator rod up, signalling the brain to allow air to enter the pump, beginning the discharge cycle.

The air pressure seats the inlet check ball and forces the liquid in the pump into the fill tube and up the discharge line, unseating the top check ball with the upward force of the discharging liquid.

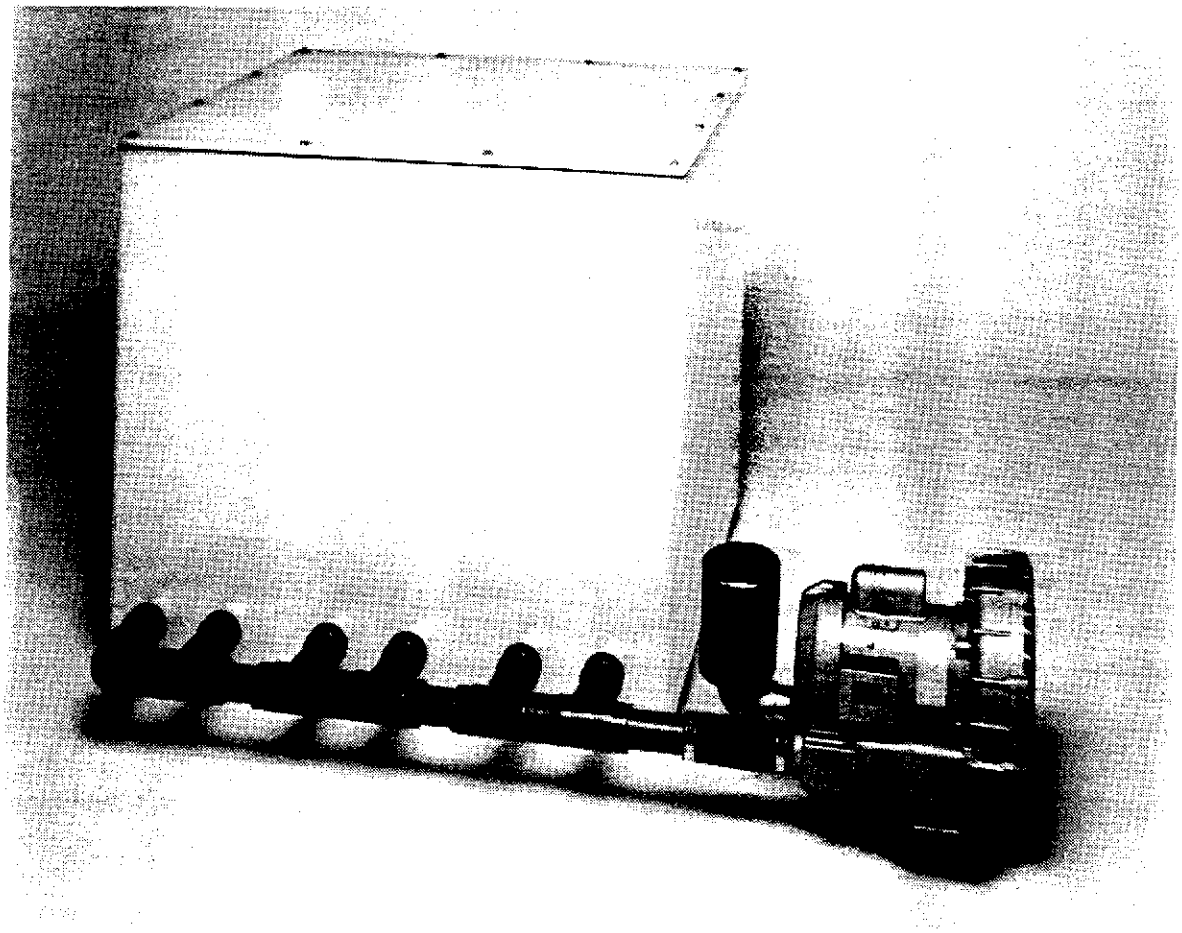
As the liquid level falls in the pump, the float drops down, eventually pulling the actuator rod down, signalling the brain to shut off the air supply. Then the entire cycle repeats.

The Solo requires a minimum depth of 4.0 feet of liquid, and shuts itself off when the well liquid level is pumped down. The pumping action automatically begins again when the well has recharged.

APPENDIX E
MANUFACTURER'S SPECIFICATIONS FOR DIFFUSED AERATION TANK AND LIQUID-PHASE ACTIVATED CARBON

"Specialists in Aeration and Mixing Equipment"

BREEZE™ VOC Stripping Vessel



The Aeromix BREEZE is designed as a compact, self-contained aeration vessel and blower. The specially constructed vessel incorporates baffles and our proven CYCLONE non-fouling stainless steel diffusers. The BREEZE is a revolutionary device for the treatment and clean-up of contaminated groundwater, hazardous wastes, and water supplies. The blower provides air to the diffusers which bubble it into the liquid causing contaminates to be stripped. This contained aeration and mixing action is ideal for the removal and cleanup of volatile organic carbon (VOC) from groundwater and other liquids.

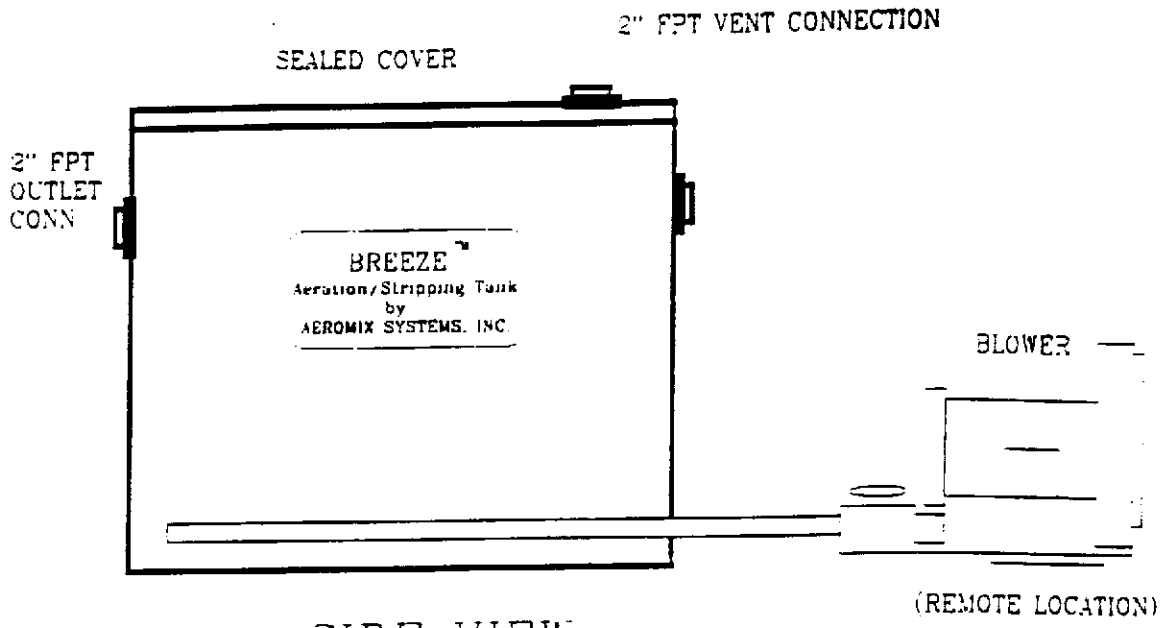
A full line of BREEZE systems are available from AEROMIX and AEROMIX Sales Engineers are ready to help you size a system for your application.

"Specialists in Aeration and Mixing Equipment"

AEROMIX SYSTEMS

BREEZE INFORMATION

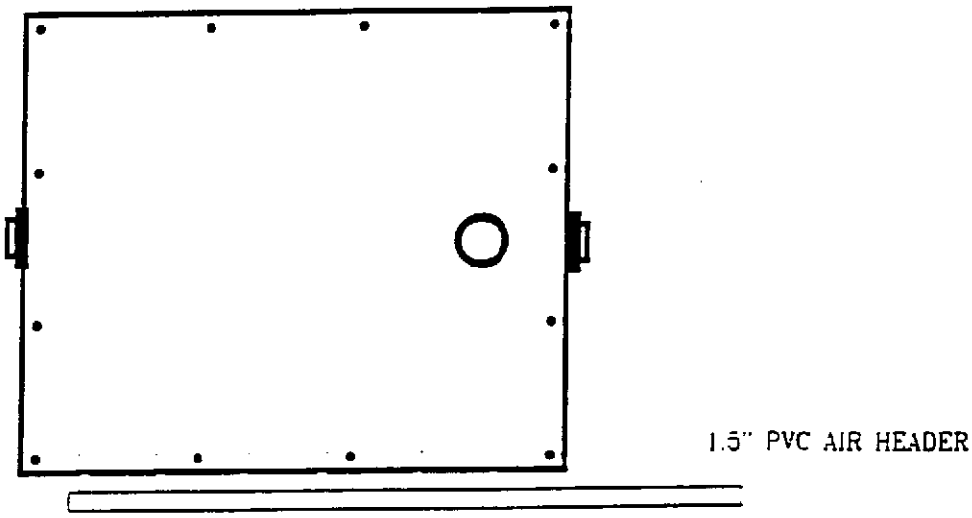
AEROMIX SYSTEMS INC.
2611 North Second Street • Minneapolis, MN 55411-1633 U.S.A. • 1-800-879-3677 • (612) 521-8519 • FAX (612) 521-1455



SIDE VIEW

APPROXIMATE TANK DIMENSIONS 36"L X 32"H X 30"W

aPPROXIMATE OVERALL DIMENSIONS 46"L X 84"H X 36"W (WITHOUT BLOWER)



TOP VIEW

AEROMIX SYSTEMS, INCORPORATED
2611 North Second Street
Minneapolis Minnesota 55411

Notes 1)This drawing is confidential and provided as a purchase decision aid to be made by the addressee. It is not to be copied, loaned or in any way provided to others without the written consent of AEROMIX

2)Final placement and layout of equipment should be supervised by an AEROMIX factory Representative

BREEZE SERIES B

FLOWS UP TO 75 GPM

Date 6/30/91

"Specialists in Aeration and Mixing Equipment"

BREEZE STRIPPING SYSTEM SPECIFICATION

A. General

Provide a total of _____ BREEZE stripping systems as manufactured by AEROMIX SYSTEMS, INCORPORATED of Minneapolis, Minnesota. Each system shall consist of a sealed polypropylene baffled tank with air diffusers and air blower. The tank shall incorporate inlet and outlet fittings to allow contaminated water to be fed in, purified water to be drawn off, and vented gas to be discharged.

B. Tank Construction

1. The tank shall be constructed of high strength, heat resistant polypropylene with a minimum 0.375" wall thickness. All joints shall be welded and completely water tight.

2. An air tight sealed cover shall be provided constructed of high strength, heat resistant polypropylene with a minimum 0.375" wall thickness. Removable stainless steel bolts shall be supplied to lock cover in sealed position. Cover shall be capable of being completely removed for servicing.

3. Inner baffles shall be provided to direct the flow in a tortuous path maximizing air to water contact. A total of ____ baffled sections shall be provided. Baffles shall be welded to the inner tank walls and shall be constructed of high strength, heat resistant polypropylene with a minimum 0.25" wall thickness.

4. The overall tank configuration shall provide a nearly even water level throughout all baffled sections in order to maximize aeration and detention time. Units with different water level sections will not be acceptable.

C. Tank Fittings

The tank shall be provided with at least one ____" PVC bulkhead fitting (FPT) for each of the inlet, outlet, and vent gas.

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D. Air Header

A minimum _____" diameter schedule 40 PVC air header shall be supplied external to the aeration tank so it can be serviced and accessed if necessary. Units with internal headers will not be acceptable. Headers shall incorporate tees to feed air into the diffusers in the aeration tank. A water and air tight seal shall be provided as the header tee passes through the aeration tank wall.

E. Air Diffusers

1. Each baffled section in the aeration tank shall incorporate two CYCLONE stainless steel diffusers as manufactured by AEROMIX SYSTEMS INCORPORATED. Each diffuser shall be designed to provide wide band aeration. Air shall be released trough a series of ports on the diffuser.

2. The diffuser shall be diamond shaped with a series of small air outlet ports on the top of the diamond and a series of large air outlet ports on the lower portion of the diamond. The diamond construction is critical to promote bubble shear and rapid gas transfer into the liquid.

3. The body of the diffuser shall be constructed of 304L stainless steel. A heavy wall end cap shall be provided with an integral 3/4" NPT male pipe connection equivalent to schedule 80 pipe.

4. A balancing orifice shall be provided as required within the 3/4" NPT male pipe connection to assure proper head loss and uniform distribution of air throughout the system.

5. The diffuser shall be easily removable for replacement or servicing by unscrewing it from the air header.

F. Air Blower

A total of _____ regenerative air blower(s) shall be provided. Normal blower location is remote from the aeration tank. Each blower shall be _____ Hp, _____ VAC, _____ Hertz, _____ Phase and produce up to _____ scfm at _____" of water head. Normal motor is TEFC. Explosion proof motors can be supplied if specified.

Quality Certified

AQUA-Carb™

Water Treatment Carbons

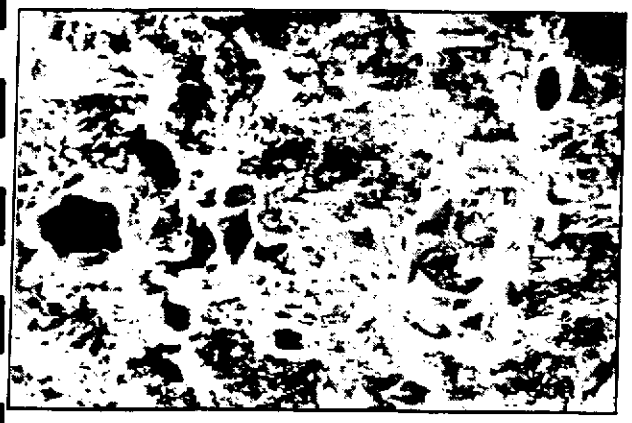
DESCRIPTION

Westates' AQUA-CARB™ activated carbons are high performance adsorbants specifically designed for water treatment. Manufactured from unique high quality substrates, AQUA-CARB activated carbons feature internal pore structures that are ideally suited to remove organic compounds from water. High removal efficiency coupled with their very low water soluble ash content make AQUA-CARB activated carbons the best value for your water treatment needs.

QUALITY CERTIFIED

The process for manufacturing activated carbons involves procedures with many variables that require strict quality control. Westates maintains a modern ASTM quality control laboratory to certify that Westates products meet or exceed all required specifications.

Coconut Shell at 2.2kx mag.



Bituminous Coal at 250x mag.

SAFETY

Wet activated carbon readily adsorbs atmospheric oxygen. Dangerously low oxygen levels may exist in closed vessels or poorly ventilated storage areas. Workers should follow all applicable state and federal safety guidelines for entering oxygen depleted areas.

WESTATES CAPABILITIES

Westates has the facilities for manufacturing, regenerating and characterizing activated carbon. Selected high quality carbons are also available from other sources giving Westates the capability of supplying the best carbon for your treatment needs. We have more than 20 years experience in the design of activated carbon adsorption systems. Our technical staff provides expert guidance in selecting the right system for your needs. Our laboratory is fully equipped to provide complete quality control and a continuing analysis of your carbon to maintain maximum efficiency.

SPECIFICATIONS	CO-401	KP-401	CC-601	CC-401
Size (U.S. Sieve)	8 x 30	–	12 x 40	12 x 30
Iodine No. (Min)	900	850	1100	900
Hardness No. (Min)	97	92	99	99
Abrasion No. (Min)	76	76	99	99
Moisture (Max)	2%	2%	2%	2%
Mean Particle Diam.	1.45mm	1.9mm	1.1mm	1.2mm
Shape	Granule	Pellet	Granule	Granule
Ph Water Extract	7.5	7.5	9.5	9.5
Soluble Phosphate	N.D.*	N.D.	N.D.	N.D.
Ash (Water Soluble)	<.1%	1%	1%	1%
Apparent Density (g/cc)	.49		.49	.52
(lb/ft³)	30.5	30.5	30.5	32

(Refer to selection guide on reverse)

*on-Detectable

WESTATES carbon ACTIVATED CARBON SYSTEMS

WESTATES CARBON, INC.
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AQUA-Carb™
SELECTION GUIDE

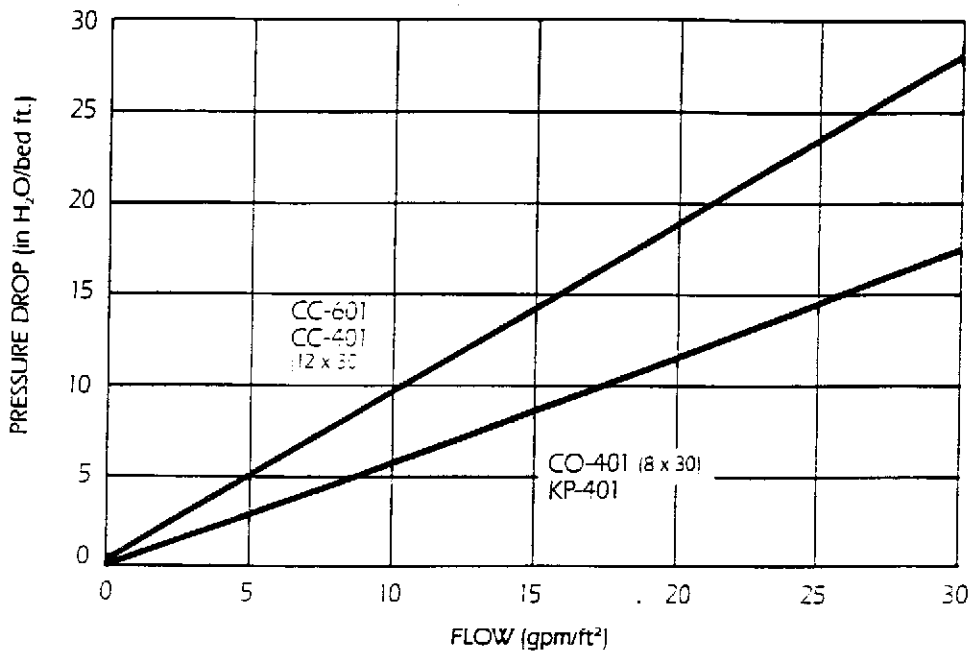
APPLICATIONS

- Potable Water
- Beverage Manufacturing
- Wastewater Treatment
- Process Water Recycling

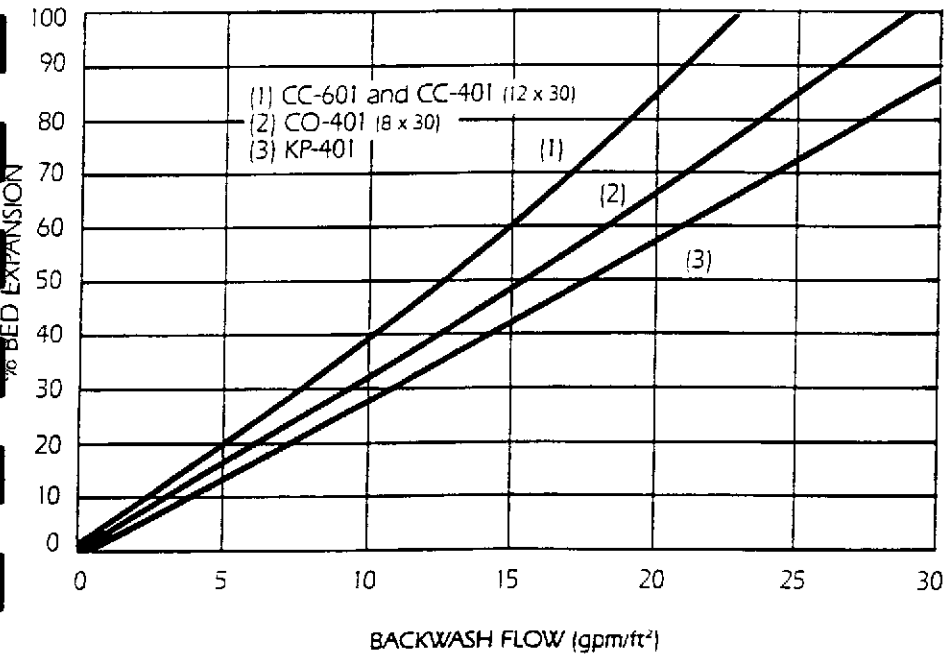
CO-401
Broad spectrum granular adsorbant designed for removal of organics in most water applications. A general all purpose product manufactured from bituminous coal.

KP-401
Broad spectrum adsorbant with uniform particle characteristics designed for use when flow characteristics are important or when very low dust content is required, such as for food processing. A pelletized product manufactured from bituminous coal.

PRESSURE DROP



CARBON BED EXPANSION



APPLICATIONS

- Potable water chlorine and chloramine removal
- TCE, PCE removal
- Plating solution clarification
- Process water organic scavenging

CC-601
A high-capacity adsorbant manufactured from coconut shell and for removal of small molecular size VOCs (TCE, PCE, etc.). The high hardness characteristics also significantly reduce attrition during handling.

CC-401
Similar to CC-601, except that it has slightly lower capacity. Used mainly where particle hardness is important.

WESTATES carbon
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2130 Leo Ave., Los Angeles, CA 90040
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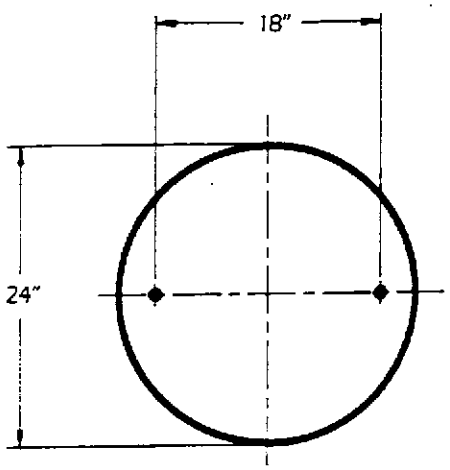
Water Purification System

AQUA-SCRUB™

ASC-200

EASY TO INSTALL

AQUA-SCRUB™ adsorbers are designed for fast and easy installation on any hard, flat surface. The only hardware needed is properly sized pipe or flexible hose for connection to the inlet/outlet ports. It is strongly recommended that a particulate filter be installed upstream from the AQUA-SCRUB™ adsorber.



CORROSION RESISTANCE

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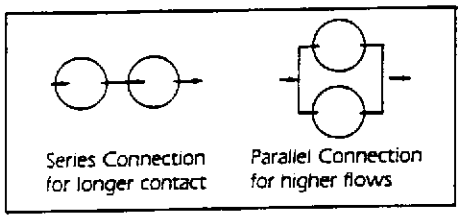
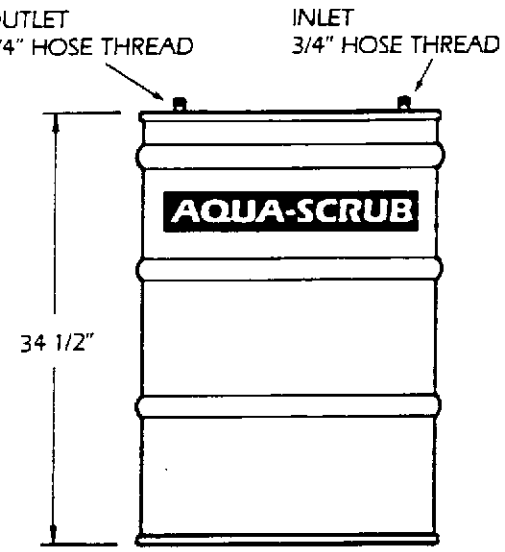




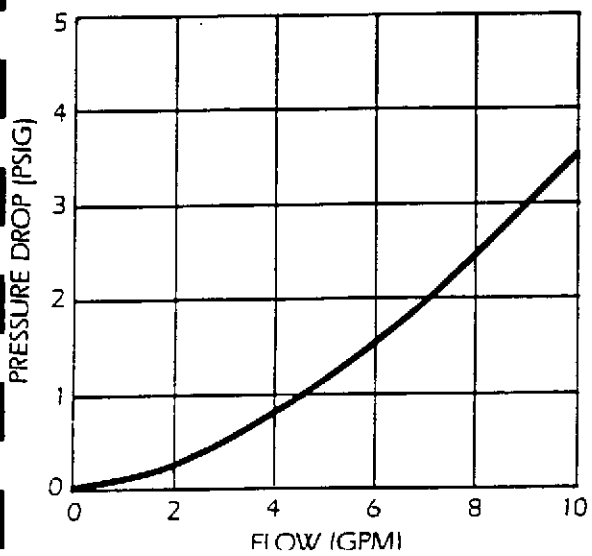
START-UP

Before beginning operation, AQUA-SCRUB™ adsorbers must be backfilled with water or liquid to be treated, and allowed to stand overnight to wet the carbon and eliminate all air (entrapped air is the most common cause of channeling).

MATERIALS OF CONSTRUCTION

Vessel: Coated Carbon Steel
External Coating:
Powder Coat Enamel
Internal Coating: Polyethylene Lined
Piping: PVC

PRESSURE DROP



SPECIFICATIONS

	ASC-200-.75
Flow* gpm (max)	10
Pressure psig (max)	12
Temperature deg F (max)	120
Carbon Fill Volume (cu. ft.)	6.5
Cross Section (sq. ft.)	3.0
Shipping Weight (lbs.)	250

*Note: actual equipment selection should be based on required retention time.

WESTATES carbon ACTIVATED CARBON SYSTEMS

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