VOLUME I - TECHNICAL REPORT

Site Characterization and Conceptual Remedial Action Plan

Diesel Leak at AC Transit, Emeryville

California Regional
Water Quality Control Board
San Francisco Bay Region

A C T R A N S I T

AC Transit
Alameda-Contra Costa Transit District
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7/28/89

July 24, 1989

State of California
Regional Water Quality Control Board
San Francisco Bay Region
1111 Jackson street, Room 6040
Oakland, California 94607

Attention: Mr. Hossain Kazemi

Dear Mr. Kazemi:

Subject: AC Transit Facilities Improvement Program
Division 2, Emeryville
Site Characterization and Conceptual Action Plan
Diesel Fuel Discharge

In accordance with our commitment to the California State Regional Water Quality Control Board, we are transmitting herewith two copies of our Site Characterization and Remedial Action Plan prepared relative to the accidental release of diesel fuel at our Emeryville facility on or about April 12, 1989. By copy of this letter we are also transmitting a copy of this report to the Alameda County Health Care Services Agency.

On or about April 12, 1989, approximately 16,000 gallons of number 2 diesel fuel escaped through an underground service line in the area of the fuel island tank farm at our Emeryville facility. The majority of this discharge was intercepted and migrated through joint leaks in an adjacent on-site storm drain pipe system. A total of approximately 13,800 gallons has been reclaimed by AC Transit. Approximately 1,000 gallons is believed to have escaped into the San Francisco Bay in spite of AC Transit's efforts to contain the off-site migration of the discharged diesel fuel. The unaccounted for balance of 1,200 gallons is considered within the accuracy limits of the methods employed in measurement.

Following the discharge, AC Transit conducted extensive cleanup and remedial action activities both on- and off-site. Booms and pads were used to soak up free product along Temescal Creek and along the marshland at the point of discharge into the Bay. The off-site storm drain was flushed to remove free product.

Soil along the banks of Temescal Creek that was contaminated as a result of the unauthorized fuel release was removed and appropriately disposed of by AC Transit at all locations, directed by EPA and RWQCB representatives.

Upon discovering that a leak of diesel fuel had occurred and that the discharged fuel was escaping through the storm drain intercept system, AC Transit "plugged" the downstream end of the storm drain, preventing any further discharge of product. Groundwater and free product continuing to flow through the storm drain has been collected and appropriately disposed of off-site or treated and discharged, under permit, through an EBMUD sanitary sewer facility.

The leak in the underground diesel fuel supply system responsible for the unauthorized discharge has been located and fixed. The entire diesel supply system has been pressure tested and found to be satisfactory.

AC Transit conducted a soil and groundwater test program to determine the extent of contamination that may have resulted due to this diesel spill.

A total of 23 soil samples and 20 groundwater samples were taken from borings/wells that were installed on-site for purposes of this investigation. All samples were analyzed for the presence of total diesel petroleum hydrocarbons (TPH-D). In addition, select groundwater samples were also analyzed for the presence of BTEX.

The results of this program, as detailed in the attached report, notes that both free and dissolved diesel fuel product plumes that resulted from the spill appear to have largely been confined to the tank farm area. No further soil remedial treatment is therefore considered warranted. A well monitoring program, to be conducted over the next 12 months, will be undertaken by AC Transit to monitor TPH-D and BTEX levels in the groundwater and to evaluate the movement, if any, of the diesel plume.

AC Transit operations of pumping groundwater and diesel product from the pea gravel backfill area surrounding the tank farm have resulted in a reduction of the depth of thickness of diesel free product in this area from 6", as witnessed immediately after the discovery of the spill, to from 1/4" to 1/2" currently. AC Transit will continue to pump the groundwater/diesel product from the pea gravel backfill area, on an intermittent basis, until the depth has been reduced to a depth of 1/4".

AC Transit has separately prepared and submitted to the RWQCB an NPDES application for permitting a coalescence filter oil separator at the down stream terminus of the on-site storm drain water discharge system. Surface runoff and groundwater migrating through the on-site storm drain system will henceforth be treated before discharge into Temescal Creek.

I believe the attached study is in full compliance with requirements established for the report. I would be pleased to arrange a meeting to discuss any aspect of the report and our conclusions. I can be reached at (415) 577-8803 should a meeting be desired.

Very truly yours,

AC TRANSIT DISTRICT

George Skezas
Director of Maintenance and Construction

Attach.

cc: **Alameda County Health Care Services** w/attach.
Division of Hazardous Materials
Department of Environmental Health
Kaiser Engineers w/attach.

mc

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89-021-R
July 1989

A C TRANSIT

VOLUME I - TECHNICAL REPORT
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1. INTRODUCTION

1.1 GENERAL

This report has been prepared and is submitted at the request of the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). It discusses the following:

- o Diesel leak that occurred at the Alameda-Contra Costa County Transit District (AC Transit) Division 2 Emeryville Maintenance Facility in April 1989.
- o The cleanup and removal actions that have taken place to date in response to the leak.
- o The extent of identified diesel compounds in the soil and groundwater resulting from the diesel leak.
- o Additional remedial actions planned by AC Transit.

AC Transit is submitting this comprehensive document in two volumes (Volume I - Technical Report and Volume II - Appendices) for review and approval by RWQCB, so that the planned remedial actions may proceed.

The cleanup of the diesel leak and early site investigation efforts were reported to RWQCB by AC Transit in a series of reports submitted on April 20, May 11, and May 26, 1989 (AC Transit, 1989, Refs. 4, 5, 6). These reports are summarized briefly in the text of this report.

1.2 LOCATION

Figure 1 shows the site location in relationship to major streets and freeways, Temescal Creek, and San Francisco Bay. Temescal Creek and streets in the immediate site vicinity are shown on Figure 2.

1.3 HISTORY

The AC Transit Division 2, Emeryville Maintenance Facility has been in existence since 1960. The Key System operated a similar bus maintenance facility at the Emeryville site from 1937 to 1960.

AC Transit began reconstruction of the facility in October of 1983, completing it in 1987. The reconstructed facility contains an employee parking structure, an administration and operations building, a new fuel island, a new maintenance building, and a new bus washer. A site plan is shown in Figure 3.

On April 12, 1989, AC Transit personnel determined that one of the two diesel fuel storage/delivery systems at the Emeryville facility had developed a leak. Diesel fuel was observed discharging from a secondary containment system into a pump manhole. From there, diesel fuel had discharged into the backfill media surrounding the underground diesel storage tanks. As a result, off-site release of diesel product occurred through an on-site storm water drain system to the City of Emeryville storm sewer beneath Doyle Street. This storm sewer discharges into Temescal Creek, which empties into San Francisco Bay (see Figure 1).

Upon discovery of this situation early on April 12, 1989, the discharge outlet to the Doyle Street storm sewer was plugged and product flowing within the on-site storm drain was intercepted and pumped to a holding tank. No discharge from the site to the Doyle Street storm sewer has taken place since April 12, 1989.

As a result of the discharge of water and free product into Temescal Creek, portions of the creekbed were contaminated. Areas of contamination were subsequently removed by AC Transit. The extent of the cleanup is addressed herein.

The diesel leak was traced to a probable bonding failure that had occurred at a 45 degree elbow in the fiberglass diesel fuel supply line. The pipeline was repaired and tested before being put back into service. Free product found in the tank farm backfill is being removed through pumping at extraction wells located in the tank farm.

A site investigation study to characterize both the groundwater and soil situation was undertaken. The results of this investigation are presented in this report.

1.4 INVESTIGATION OBJECTIVES AND SCOPE OF WORK

This report is presented to meet the following investigation objectives:

- o Identify the source of the diesel leak and the pathway(s), if any, of off-site migration.
- o Summarize the extent of the diesel leak.
- o Describe the immediate source removal on-site and in Temescal Creek.
- o Assess the extent of the occurrence of diesel compounds in the on-site soil and groundwater.
- o Estimate the volumes of free product recovered.
- o Describe the cleanup and remedial actions completed to date.
- o Define further remedial actions, if indicated.
- o Define a verification monitoring plan, if required.

The scope of work for this investigation included the drilling of 16 exploratory soil borings at locations determined by a registered hydrogeologist and approved by a RWQCB representative. The locations of these borings and wells are shown in Figure 3. From these borings, 23 soil samples were obtained and submitted to a certified analytical laboratory for analysis. Of the 16 soil borings, four were used as temporary sampling wells and then properly plugged and abandoned, ten were converted into groundwater monitoring wells, and two were converted to extraction wells. One additional extraction well was separately installed during the pipeline repair operation.

On-site diesel product has been pumped from the storm drain and from the tank farm area into holding tanks where the product was sampled and off-hauled for disposal.

On May 26, 1989, EBMUD permitted the temporary discharge of groundwater flow from the on-site storm drain system into their sanitary sewer system.

3. INVESTIGATIVE METHODS

The investigation of the diesel release was conducted in two drilling phases, a first phase (April 19-20) and a second phase (April 25-27). In these two phases the presence of diesel compounds in the soil and groundwater was investigated by the drilling of 16 soil borings, collection of 23 soil samples, construction of 10 monitoring wells, and collection of 14 water samples. In addition, three extraction wells were constructed for the purpose of measuring and extracting free diesel product from the tank farm area. A summary of the results of the soil and groundwater sampling taken is presented in Section 5 of this report.

The first phase entailed the drilling of boreholes B1 through B9, to initially establish the extent of migration of free and dissolved product, and the construction of monitoring wells MW1 through MW4, in the immediate vicinity of the fuel island (see Figure 3). The boreholes and wells were generally placed outside the pea gravel area of the tank farm to determine to what extent the native soil was impacted. The locations approximate a semi-circle to the west of the contamination source. Upgradient soil and groundwater samples were taken at B5 to determine background concentrations. Due to the location of the fuel pumps and their utilities, soil and groundwater samples were not taken immediately to the north of the diesel release; B1/MW2 represents the only data from north of the diesel release.

Two extraction wells were installed in the first phase. E1 is located adjacent to the source of the diesel release, which has been determined to be a leak in a diesel fuel supply line. E2 is located immediately south and outside the tank farm; however, it is encased by pea gravel extending from the surface to a depth of approximately 5 feet. E2 was drilled through the pea gravel into the underlying clay zone, thereby creating a sump into which free product flowed. Because of this "sumping" effect, the initial thickness of free product measured in E2 (21 inches) is misleadingly high. Liquid pumped from E2 was predominantly diesel fuel and, once pumped, E2 essentially ran dry. E3 is located in pea gravel on the west edge of the tank farm and adjacent to the north-south storm drain system. The initial thickness of free product in E1 and E3 was approximately 6 inches.

The second phase of the investigation entailed the installation of six downgradient wells, MW5 through MW10 (see Figure 3). These wells were constructed to determine the downgradient migration of dissolved diesel fuel resulting from the diesel leak.

Investigative methods, described in detail in Volume II, Appendix D, address the methodology for:

- o Soil sampling
- o Borehole and groundwater monitoring well construction and development
- o Groundwater sampling

- Certified laboratory and chain of custody procedure
- Groundwater monitoring well survey.

Well construction diagrams are provided in Volume II, Appendix C. Chain of custody forms are provided in Volume II, Appendix F.

4. EVALUATION OF LOCAL HYDROGEOLOGY

The hydrogeologic observations presented below are based on a subsurface investigation that included installation of boreholes, monitoring wells, and extraction wells as shown on Figure 3.

4.1 SUBSURFACE LITHOLOGY

In order to comply with the RWQCB time constraints, the drilling crew was instructed to retrieve soil samples for analysis from designated depths rather than continuous coring. The lithologic logs were thus developed from soil samples retrieved from boreholes B1 through B9 and MW1, and the soil cuttings from these borings. Partial continuous cores were obtained from MW5 through MW10.

From the lithologic logs (Volume II, Appendix B), the following general observations can be made about the subsurface lithology outside the tank farm:

- Aggregate backfill is present to the depth of 12 inches, minimum, below an 8-inch concrete slab. Sand and/or a granular bedding topped by select backfill surrounds the on-site storm drain pipe system.

- A clay layer is present from below the aggregate base course to the water-bearing zone. This layer consists of dense black and olive/grey silts and clays of medium plasticity (MH), light to dark brown silty clays (CL), and sandy silts (ML).

- Judging from the depths of the first-encountered groundwater (at depths ranging from 11 to 17 feet, 8 feet for MW6) and static water levels (usually 4 to 5 feet), groundwater is confined by this clay layer.

- Where observed in the soil borings, water-bearing zones are generally lenses of silts, sandy clays, or sands. The thickness of these varies but is probably less than 1 to 2 feet.

- Lithology of the water-bearing zone of the first-encountered groundwater at MW-6 is of poorly graded subrounded gravels with silt and sand, encountered at an approximate depth of 8 feet.

4.2 OCCURRENCE OF GROUNDWATER

Groundwater at the site occurs under confined conditions, with the exception of the tank farm area where the confining layer was breached during the excavation process for the installation of the fuel tanks. Within the confines of the tank farm, groundwater occurs under static water-table conditions. This phenomenon is shown graphically on a schematic cross section (see Figure 10). The depths to first-encountered groundwater are shown on Table 2. The depths to the static groundwater level are shown on Table 4.

The depth to the first-encountered water at the site varies with location. On the eastern portion of the site, the depth to first-encountered groundwater was generally in the vicinity of 11 feet. To the west of the tank farm, the depth to first-encountered groundwater varied from 11 to 17 feet, except MW6 where first-encountered groundwater occurred at 8 feet. Depth to the static water level in wells across the site is about 4 to 9 feet, with the depth in the tank farm area approximately 5 feet.

4.3 CONFINING LAYER

At the AC Transit site the confining layer is comprised of a poorly permeable clay interval. The depth to first-encountered water of about 11 feet and the lithology encountered suggest that this poorly permeable confining interval is at least 11 feet thick. Where the depth to the first-encountered confined groundwater is greater than 11 feet, such as at wells MW10 and MW7 (where the depths to first-encountered groundwater are 15 and 17 feet, respectively), the confining layer appears to be 4 feet to 6 feet thicker.

4.4 WATER-BEARING ZONES

Based on results from the on-site drilling performed (April 1989), the variable depth to the first-encountered groundwater indicates that the water-bearing zones are heterogenous in their distribution across the site. Available subsurface lithologic information indicates that the subsurface is comprised mostly of clay (see cross section, Figure 10). On occasions when groundwater flowed freely into the drill hole, it appeared that a sandy or gravely stringer had been encountered. In the cases where ingress of groundwater into the drill hole was much slower, it appeared that finer grained materials were present. These observations suggest a site underlain by coarser grained, braided alluvial stream channel deposits surrounded by finer grained mud flat or flood basin (fine-grained) materials.

The variable depth to first-encountered groundwater suggests that interconnection of these channel deposits may be more highly developed in some parts of the site than others. The influence of silt lenses or layers on the occurrence of groundwater was not explored.

4.5 HYDRAULIC GRADIENT

Examination of Figure 4 indicates that groundwater flows from east to west across the site in a downgradient direction of approximately S65W (245° from north). The gradient is more gentle (flatter) on the eastern portion of the site. Steepening of the gradient to the west suggests the possibility of a reduction of transmissivity in that direction. The average gradient across the site is calculated to be 0.016 ft/ft.

4.6 FIELD LITHOLOGIC LOGS

Field lithologic logs are provided in Volume II, Appendix B.

5. OCCURRENCE OF DIESEL COMPOUNDS IN SOIL AND GROUNDWATER

5.1 DIESEL COMPOUNDS IN SOIL (ON-SITE)

A sum of 23 soil samples from 16 soil borings was analyzed for total TPH-D. Analysis of soil samples from nine wells resulted in nondetectable limits of TPH-D (detectable limits would be 10 mg/kg); three wells had TPH-D at 73 mg/kg or below. Relatively high concentrations of TPH-D were found only in samples taken from the pea gravel backfill area of the tank farm. Results of these analyses and the depths from which the samples were taken are presented in Table 1.1.

Relatively high concentrations of TPH-D appear in the two soil samples taken from the tank farm backfill (pea gravel). The sample from a depth of 5 feet in B2, drilled in the tank farm backfill, contained 13,000 mg/kg TPH-D and the sample from a depth of 5 feet from boring B4, also drilled in the tank farm backfill, contained 700 mg/kg TPH-D.

Lesser TPH-D concentrations were detected in soil samples from boring B3 and monitoring well MW5 near the tank farm area. The sample from a depth of 5 feet from boring B3 contained 73 mg/kg TPH-D and the sample from a depth of 10 feet from MW5 contained 20 mg/kg. TPH-D was not detected in the soil sample taken from MW5 at a depth of 5 feet.

TPH-D concentrations for the four other soil samples taken at 5-foot depths in the vicinity of the tank farm were nondetectable. These samples are from boring B9 and monitoring wells MW1, MW3, and MW4.

TPH-D concentrations reported for the soil samples from the 5- and 10-foot depths from MW6 contained 150 mg/kg and 110 mg/kg, respectively.

A lesser TPH-D concentration was reported from the soil sample from a depth of 10 feet from the boring for monitoring well MW10 located south of the parking structure (see Figure 3). The 10-foot-depth soil sample from this well contained 30 mg/kg TPH-D. TPH-D was, however, nondetectable in soil samples from the 5- and 15-foot depths at MW10.

Soil samples taken from MW7, MW8, and MW9 located just east of the maintenance building in the vicinity of the subsurface drains (see Figure 3) contained no detectable levels of TPH-D. TPH-D was not detected in the 5-, 10-, and 14-foot-depth soil samples obtained from MW7 and was not detected in the 5- and 10-foot-depth soil samples from MW8 and MW9.

With the exception of the tank farm pea gravel backfill area where the diesel fuel was released, measured levels of TPH-D are significantly less (150 mg/kg, maximum) than the 1,000-mg/kg level frequently considered as the threshold requiring remedial treatment.

Certified analytical results (CARs) are presented in Volume II, Appendix E.

5.2 DIESEL COMPOUNDS IN GROUNDWATER (ON-SITE)

Diesel free product was observed only in the tank farm backfill. The maximum thickness of diesel free product, measured in one of the extraction wells entirely within the pea gravel, was 6 inches. This measurement was taken at extraction well E1 immediately following discovery of the leak and before the removal of free diesel product, by pumping, had commenced. Free product was not observed in any of the wells installed outside of the tank farm backfill. The extent of free product plume in the area of the tank farm backfill is shown on Figure 11.

Concentrations of dissolved TPH-D are shown on Table 3. Dissolved TPH-D in the vicinity of the tank farm was reported in groundwater from boring B9 (.066 mg/l), monitoring well MW4 (.07 mg/l), boring B8 (0.53 mg/l), and boring B3 (.48 mg/l). It is notable that boring B2/E3, which contains the highest reported concentration of TPH-D in the tank farm area, is between the tank farm and the subsurface N-S storm drain. B2/E3 is located in the pea gravel backfill area of the tank farm downgradient of the release point. The occurrence of dissolved TPH-D in groundwater diminished to nondetectable levels to the south at monitoring well MW3 and downgradient to the west at MW1. A TPH-D concentration of .56 mg/l was reported for the sample obtained from MW2 on May 2, 1989. However, groundwater obtained from this well on June 1, 1989, contained no detectable levels of TPH-D.

Groundwater from upgradient boring B5 also contained no detectable concentration of TPH-D. The same is true for downgradient monitoring well MW5 and the line of backup wells along the maintenance building, MW7, MW8, and MW9. Figure 11 graphically portrays the extent of detected dissolved diesel compounds in groundwater.

With the exception of groundwater samples taken from the tank farm pea gravel backfill area where the diesel fuel was released, measured levels of TPH-D were nondetectable or at levels generally considered not to require further remedial action.

Laboratory analyses from MW6 and MW10 reported detectable levels of TPH-D. The CAR for MW6 reported TPH-D at 47 mg/l and the CAR for MW10 reported TPH-D at 1.4 mg/l. (See Volume II, Appendix E.)

5.3 DIESEL COMPOUNDS IN SOIL (OFF-SITE)

On April 18, the extent of diesel, oil, and grease contamination of Temescal Creek in the vicinity of the first railroad trestle was investigated (see Figures 2, 9). Five soil samples, labeled T1-T5, were collected from 6 inches below the creek's surface. Analytical results are shown in Table 1.2.

Diesel levels in the soil ranged from 290 mg/kg at T2 to 4100 mg/kg at T4. At T4, 11,000 mg/kg of oil and grease was also detected.

Soil contaminated as a result of the unauthorized release of diesel fuel was removed by AC Transit at all locations as determined by EPA and RWQCB representatives.

To fulfill disposal requirements for the soils excavated from Temescal Creek, samples T2, T4, and T5 were also analyzed by EPA methods 624/8240, 625/8270, 8080, and 6010 (Title 22 Metals). Appendix E in Volume II presents the CARs for each of the compounds analyzed by these EPA methods.

5.4 DIESEL COMPOUNDS IN SURFACE WATERS (OFF-SITE)

In the waters of Temescal Creek, 19 mg/l diesel and 64 mg/l oil and grease were detected. Results are presented in Table 5.1.

Three water samples, labeled D1 through D3, were taken from the Doyle Street storm sewer on April 18, 1989. These samples were analyzed only for diesel. The detected values ranged from 25 mg/l at D2 to 130 mg/l at D1. D1 was taken from a location closest to the AC Transit Facility's oil interceptor. Results are summarized in Table 5.1. Samples were taken before water flushing of the storm sewer, which was performed as part of AC Transit's cleanup operations. (See Volume II, Appendix E.)

6. DISCUSSION OF MIGRATION AND TRANSPORT OF DIESEL COMPOUNDS

The information presented above suggests the following scenario for migration and transport of TPH-D at the site. Excavation of the confining layer for the fuel tank installation provided a window through which otherwise confined groundwater rose upward to its static level. During periods when the groundwater level was high enough to intersect the subsurface storm drain backfill located just west of the tank farm, groundwater from the tank farm excavation flowed to the backfill and entered the drain through leaky joints (see Figure 8 for location of joints). At the time of the diesel leak, the groundwater level (possibly the result of late season rainfall) was high enough that both groundwater and the floating diesel free product entered the storm drain. In this manner a high concentration of free diesel product was transported to the oil interceptor which is located at the western terminus of the on-site storm drain system (see Figure 12). When the interceptor capacity was exceeded, the overflow, with free diesel product, discharged into the storm drain along Doyle Street and on to Temescal Creek.

Monitoring wells close to and immediately downgradient from the tank farm do not contain any free product, indicating that the free product is restricted to the confines of the tank farm excavation and the region between the tank farm and the storm drain (see Figure 11). Analytical results from groundwater from these same wells did not detect TPH-D or contained only very low concentrations of TPH-D which appears to be a reflection of the poor solubility of diesel compounds in general (see Figure 11). With this in mind, it is not surprising that TPH-D was not detected in the downgradient line of backup wells just east of the maintenance building (see Figures 6 and 11).

TPH-D was, however, reported for groundwater from downgradient monitoring wells MW6 and MW10. The detection of dissolved TPH-D in well MW10 may be related to movement of dissolved hydrocarbons from the nearby storm drain to the well location (see Figure 3). The reported occurrence of TPH-D in groundwater from well MW6 may be related to migration from a previous source. In addition to TPH-D, TPH-G has been reported in groundwater from both of these wells. AC Transit has already defined for the RWQCB a program for additional site investigation and drilling to investigate the occurrence of TPH-G. This investigation includes the two well locations under discussion.

7. CLEANUP AND REMEDIAL ACTIONS COMPLETED

AC Transit has summarized the cleanup and remedial actions completed immediately following the leak in its report presented to the RWQCB dated May 26, 1989. This report (Ref. 8) is included in Volume II as Appendix A. Salient points of the report and other cleanup actions completed by AC Transit are summarized below.

7.1 FUEL LINE AND OIL INTERCEPTOR

On determining that a leak had occurred in one of its two diesel fuel supply systems, AC Transit shut down the affected part of the system. The loss of pressure was traced to a leaking fuel supply line. Repairs were effected and pressure testing completed by April 26, 1989. The repaired fuel system is now back in operation.

During the period immediately preceding discovery of the damaged fuel supply system, released diesel fuel escaped from the tank farm area through an adjacent storm drain pipe and through an oil interceptor located at the western terminus of the on-site storm drain system. The location of the oil interceptor is highlighted on Figure 12. The third stage of the oil interceptor was plugged to prevent further flow into the storm drain. No flow to the Doyle Street storm drain from the oil interceptor has occurred since April 12, 1989.

7.2 CRACKS IN THE YARD STORM DRAIN

Because the storm drain was suspected of functioning as the conduit for flow of diesel from the tank farm to the oil interceptor, AC Transit undertook a video pipeline survey to obtain visual confirmation. Leaks of groundwater and free product into the storm drain at locations immediately adjacent to the western edge of the tank farm area are shown on Figure 8 and are clearly visible on the video tape. Leak location information is provided in Volume II, Appendix A.

Recognizing that the storm drain functioned as an intercept to collect the flow of diesel and groundwater from the tank farm, AC Transit did not repair the leaks.

7.3 FREE PRODUCT REMOVAL - TANK FARM

Free product from the tank farm pea gravel was extracted from wells E1, E2, and E3. From these three extraction wells, liquid has been pumped intermittently into a 5,000-gallon holding tank located near the fuel island.

By pumping intermittently rather than continuously, each extraction well can recharge without significantly dropping the water table. Initially, 6 inches of free product was measured at extraction well E1. The depth of free product was reduced to less than 1/4-inch by June 6. On June 22 free product had recharged to 1 inch. Pumping activity continues as of the date of this report.

7.4 FREE PRODUCT REMOVAL - OIL INTERCEPTOR

Removal of diesel free product from the 4,500-gallon oil interceptor at the western terminus of the on-site storm drain system (see Figure 12) began on April 12. Manifests for product off-hauled by H&H Ship Service are provided in Volume II, Appendix G. Liquid collected in the oil interceptor was pumped with a dual diaphragm air pump into a 12,000-gallon holding tank at a delivery rate of approximately 3 gal/min. The flow of water in the storm drain has since decreased to approximately 1 gal/min.

Off-haul of the site's surface runoff and groundwater infiltration from the oil interceptor holding tank has been discontinued with the recent issuance of an EBMUD sanitary sewer discharge permit. The Facility's surface runoff is now treated on-site by a 550-gallon McTighe oil separator prior to discharge to the EBMUD sewer.

7.5 FREE PRODUCT REMOVED AND REMAINING

Of an estimated 16,000 gallons total of diesel fuel accidentally released, diesel free product recovered by AC Transit Yard through May 13, 1989 is estimated at 13,300 gallons. From May 13, in excess of 500 gallons of diesel fuel has been recovered through continuing pumping operations at the tank farm area and at the terminus of the on-site storm drain system. An additional 1,000 gallons of diesel fuel was estimated by the Coast Guard to have escaped into the Bay in spite of AC Transit's efforts to contain the off-site discharge of diesel fuel.

Free product remaining in the tank farm varies in depth but appears to stabilize at approximately 1/4-inch to 1/2-inch of product. Thus, the balance of less than 1,200 gallons is considered contained within the pea gravel (see Volume II, Appendix A). Pumping continues intermittently to permit stabilization at the extraction points.

8. REMEDIAL ACTION AND MONITORING PLAN

AC Transit's study has been developed to mitigate the environmental impact of the accidental discharge of diesel fuel on April 12, 1989.

Based on the occurrence of diesel compounds in the site soil and groundwater, the principal area requiring remedial activity is the pea gravel area surrounding the tank farm. AC Transit plans to continue the pumping of free product from this area until such time as the presence of diesel free product has been reduced to a sheen.

Analyses of samples taken of groundwater from wells adjacent to the tank farm suggest that diesel compounds dissolved in groundwater have not migrated from the general area of the tank farm. This is thought to be the combined result of the low solubility of diesel compounds in water and the presence of low permeability soils. For this reason, a quarterly monitoring program will be conducted for one year to determine any adverse trending that could result in a requirement for additional remedial action.

AC Transit has separately submitted an NPDES application that, when approved, will lead to the installation of a coalescence filter separator that will result in storm drain water discharge with TPH water quality of less than 15 ppm for off-site discharge.

The one-year monitoring program includes the monitoring of seven existing groundwater wells, and the construction and monitoring of two additional monitoring wells and one well-like installation. Existing wells to be monitored are monitoring well MW5 immediately downgradient of the tank farm, background well W3, and downgradient wells MW6, MW7, MW8, MW9, and MW10. In addition, two new groundwater monitoring wells will be constructed along the AC Transit property line--one downgradient from the oil interceptor and one downgradient from monitoring well MW10. The locations of existing monitoring wells and the two additional wells planned for construction are shown on Figure 11 17. The well-like installation (described below) is for the purpose of determining if diesel compounds are migrating downgradient through the subsurface storm drain bedding and will be constructed immediately upgradient from the oil interceptor. All monitoring wells will be monitored quarterly for TPH-D and BTEX.

An installation similar to a monitoring well will be constructed to monitor the possible presence of fluid in the storm drain pipe backfill near the terminus of the on-site storm drain system. It is planned that this installation be located in the vicinity of the existing oil interceptor. Based on the presence of fluid and fluid quality (TPH-D and BTEX) in this installation, AC Transit plans to review with RWQCB the need for an additional upgradient installation.

In addition to the monitoring program, a well and well-water use survey will be conducted in the region downgradient of the site to ascertain the presence of any well-water users who might be considered potentially at risk. The general fine-grained lithology observed in wells drilled at the site and lack of migration of diesel compounds away from the general area of the tank farm suggest that wells constructed off-site in this stratigraphic interval would not be prolific water producers. This statement, in conjunction with the fact that water is supplied to residents of Emeryville by EBMUD, greatly reduces the probability that downgradient pumping may be occurring and that a risk to downgradient human exposure exists. The well survey will test this hypothesis.

In summary:

- Pumping in the pea gravel will be continued until the thickness of free product is reduced to a sheen (less than 1/4-inch). The free product thickness will be determined after pumping has been discontinued for a period of two weeks to permit the fluid level to stabilize.
- Monitoring wells W3, MW5, MW6, MW7, MW8, MW9, and MW10 and two additional wells to be constructed will be monitored quarterly for TPH-D and BTEX.
- The yard storm drain pipe backfill will be monitored at a location in the vicinity of the existing oil interceptor.
- This installation will be monitored monthly for presence of water and if fluids are present, quarterly samples will be obtained for TPH-D and BTEX analyses.
- An off-site, downgradient well and well-water use survey will be conducted.

AC Transit's plan is to conduct the above monitoring program for one year. After one year's monitoring, the monitoring program will be reevaluated with RWQCB to determine if it is appropriate for the monitoring to be discontinued.

AC Transit has informed the RWQCB by letter dated June 14, 1989, of its intended program to evaluate the presence of light hydrocarbon compounds that were apparent in samples analyzed principally from wells MW6 and MW10. After completion of this study, AC transit will present to the RWQCB its recommendations relative to the mitigation of possible groundwater contamination for both TPH-D and TPH-G at wells MW6 and MW10.

REFERENCES AND BIBLIOGRAPHY

1. California Regional Water Quality Control Board, San Francisco Bay Region 2: "Water Quality Control Plan," December 1986.

2. AC Transit: "Characterization and Conceptual Remedial Action Plan for Soil at a Portion of AC Transit's Emeryville Facility," Kaiser Engineers, July 1988.

3. North Coast, San Francisco Bay and Central Valley Regional Water Quality Control Boards: "Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks," June 1988.

4. AC Transit: "Report of Unauthorized Release of Diesel Fuel," (Emeryville, CA), April 20, 1989.

5. AC Transit: "Status Report: Unauthorized Release of Diesel Oil, AC Transit, Emeryville, CA," May 11, 1989.

6. AC Transit: "Status Report: Unauthorized Release of Diesel Oil, AC Transit, Emeryville, CA," (Report No. 3), May 26, 1989.

7. AC Transit: "Groundwater Testing Program," June 14, 1989.

8. State Water Resource Control Board, "Leaking Underground Fuel Tank (LUFT) Field Manual," March 24, 1988.

DIESEL LEAK AT AC TRANSIT, EMERYVILLE

This report for AC Transit, Oakland, California, has been prepared under the supervision of Frank Fenzel, Principal Hydrogeologist, Environmental Controls and Remediation Department, Kaiser Engineers (California) Corporation.

Frank Fenzel

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Registered Geologist
California Registration 2388

REGISTERED GEOLOGIST
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No. 2388
STATE OF CALIFORNIA

80097F2028901

Figure 1

SITE LOCATION

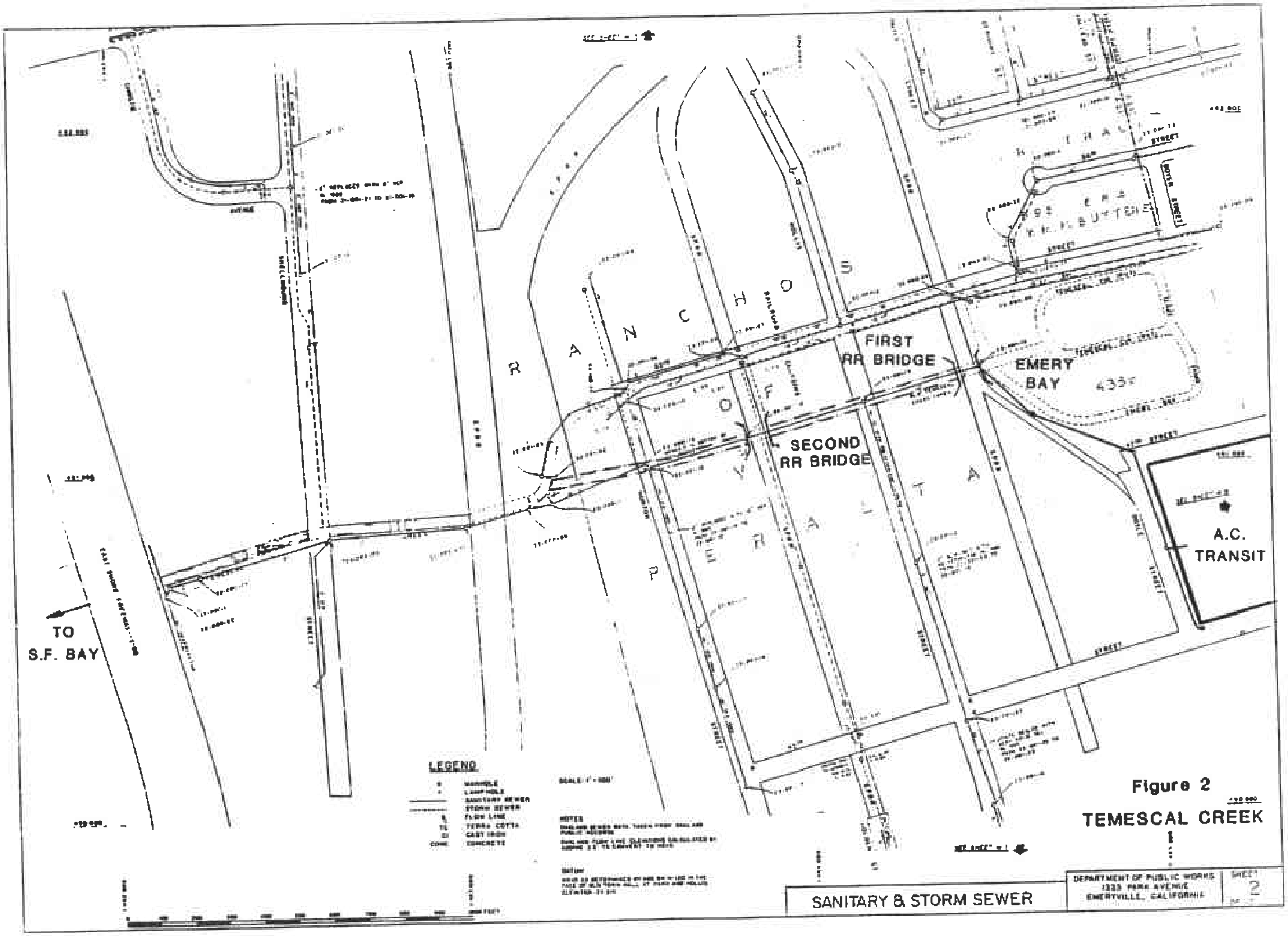

Figure 2
TEMESCAL CREEK

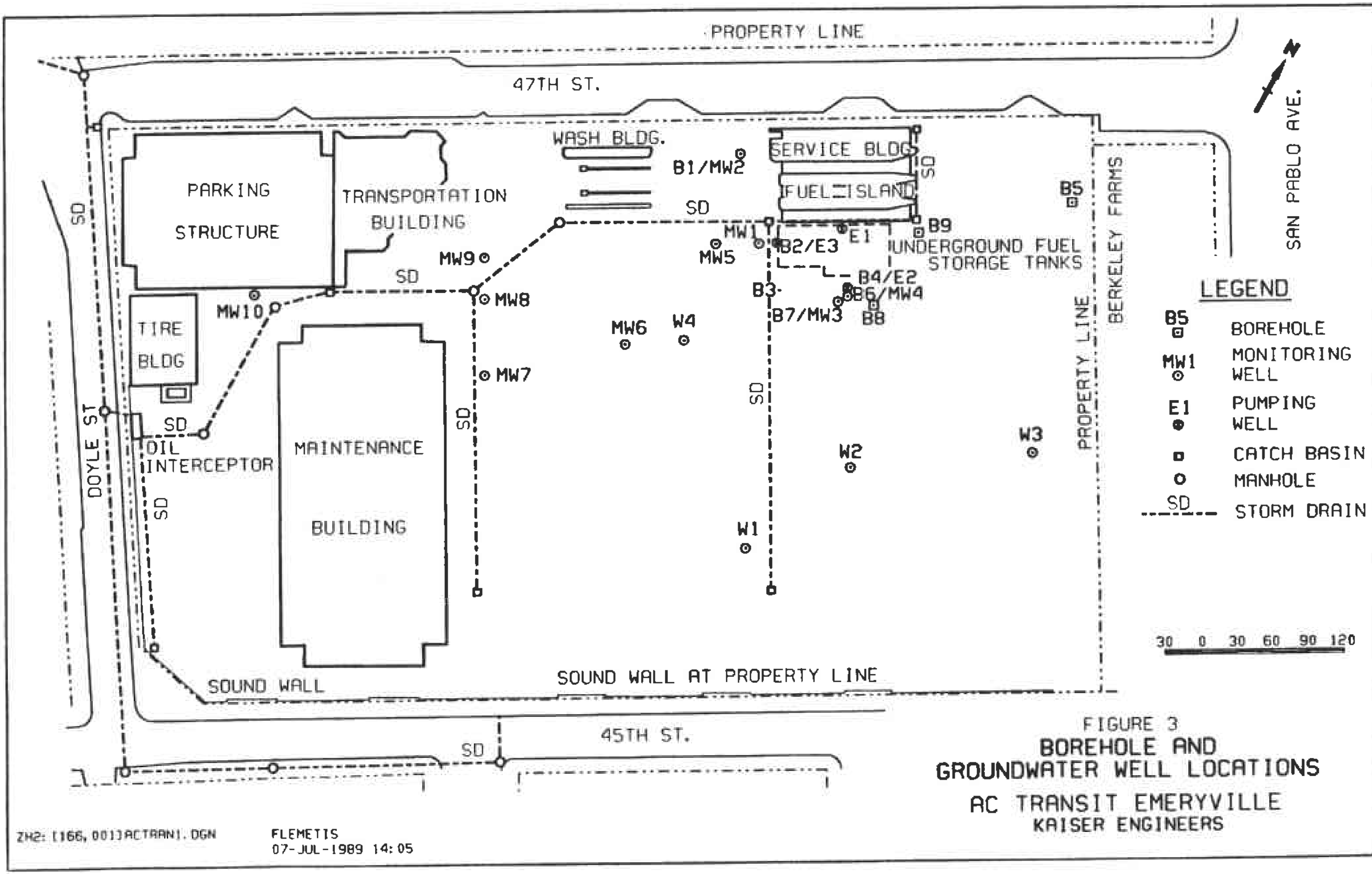

FIGURE 3
BOREHOLE AND
GROUNDWATER WELL LOCATIONS
AC TRANSIT EMERYVILLE
KAISER ENGINEERS

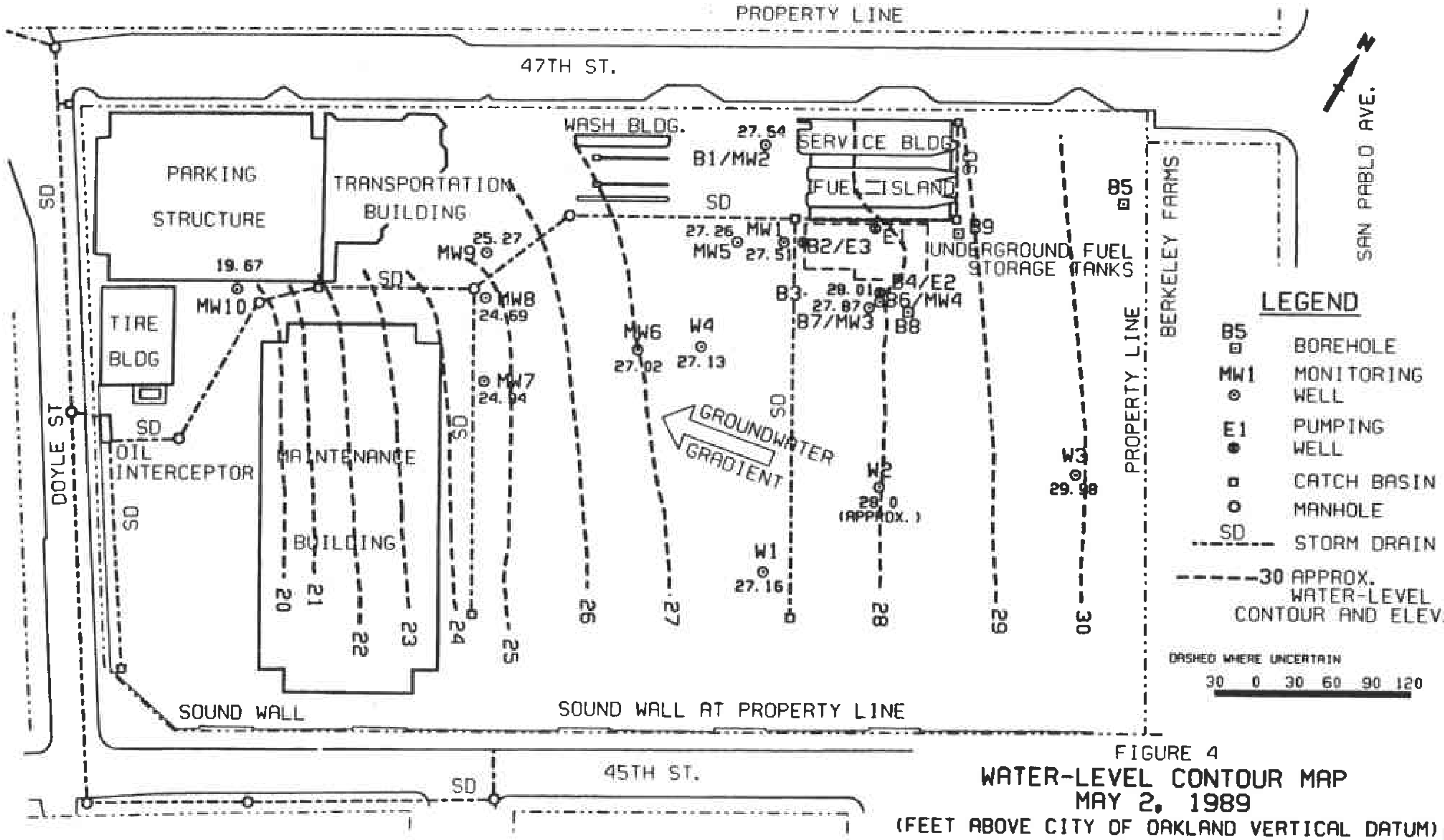

FIGURE 4
WATER-LEVEL CONTOUR MAP
MAY 2, 1989
(FEET ABOVE CITY OF OAKLAND VERTICAL DATUM)
AC TRANSIT EMERYVILLE
KAISER ENGINEERS

ZH2: [166,001]ACTRAN1.DGN

TEMPLETON
06-JUL-1989 23:39

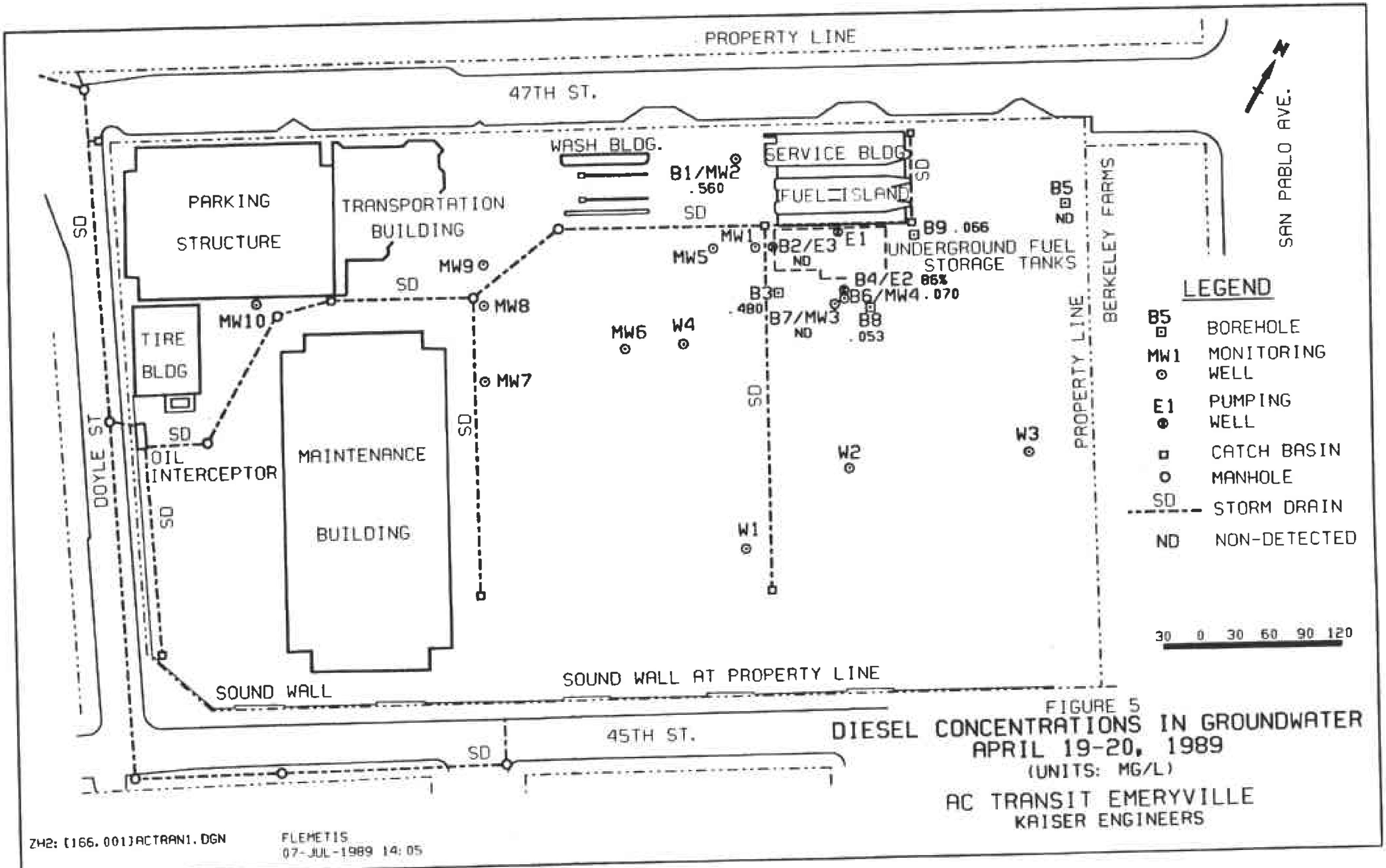

FIGURE 5
DIESEL CONCENTRATIONS IN GROUNDWATER
APRIL 19-20, 1989
(UNITS: MG/L)

AC TRANSIT EMERYVILLE
KAISER ENGINEERS

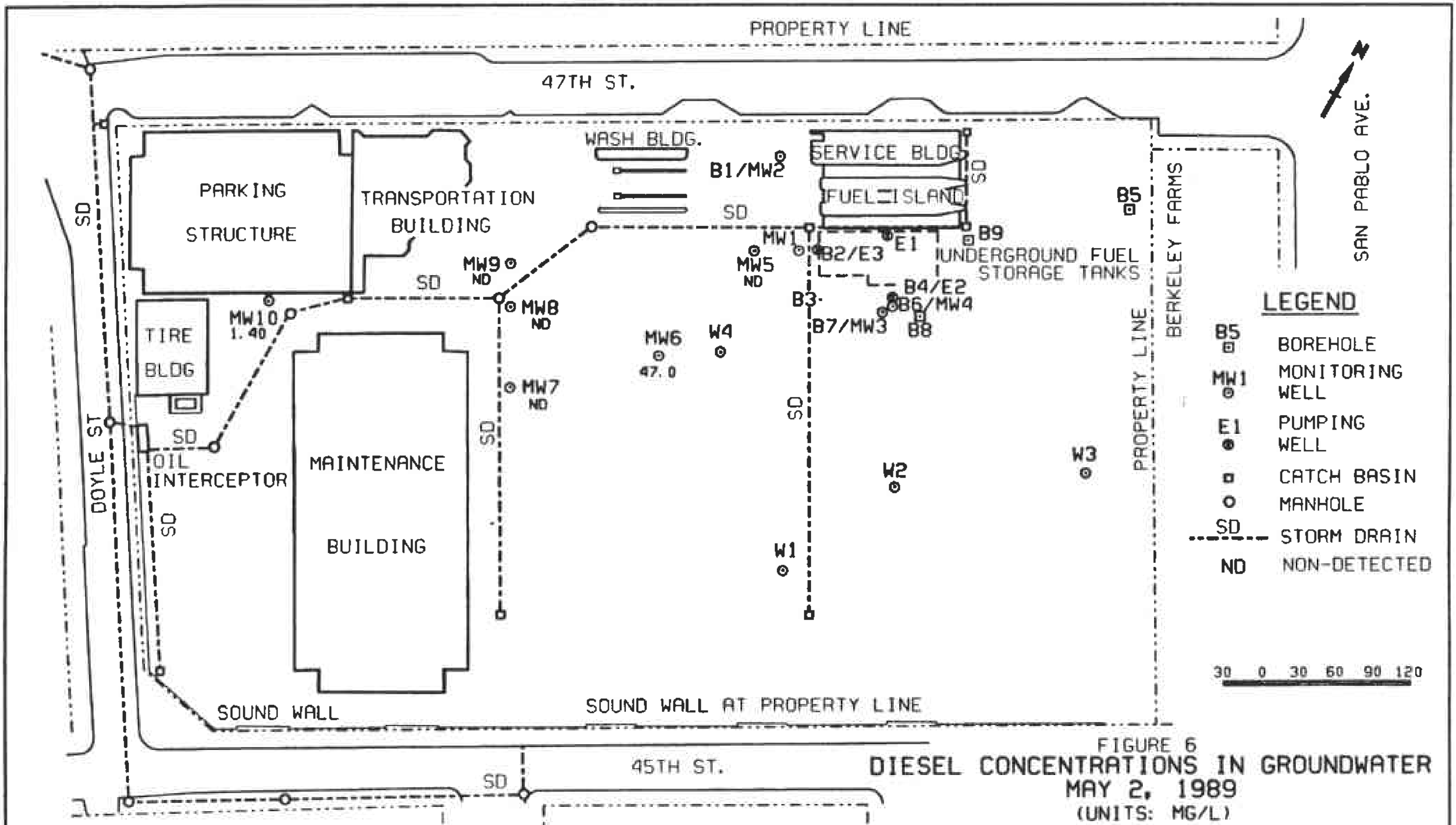

FIGURE 6
DIESEL CONCENTRATIONS IN GROUNDWATER
MAY 2, 1989
(UNITS: MG/L)

AC TRANSIT EMERYVILLE
KAISER ENGINEERS

ZH2: [166.001]ACTRAN1.DGN

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07-JUL-1989 14:05

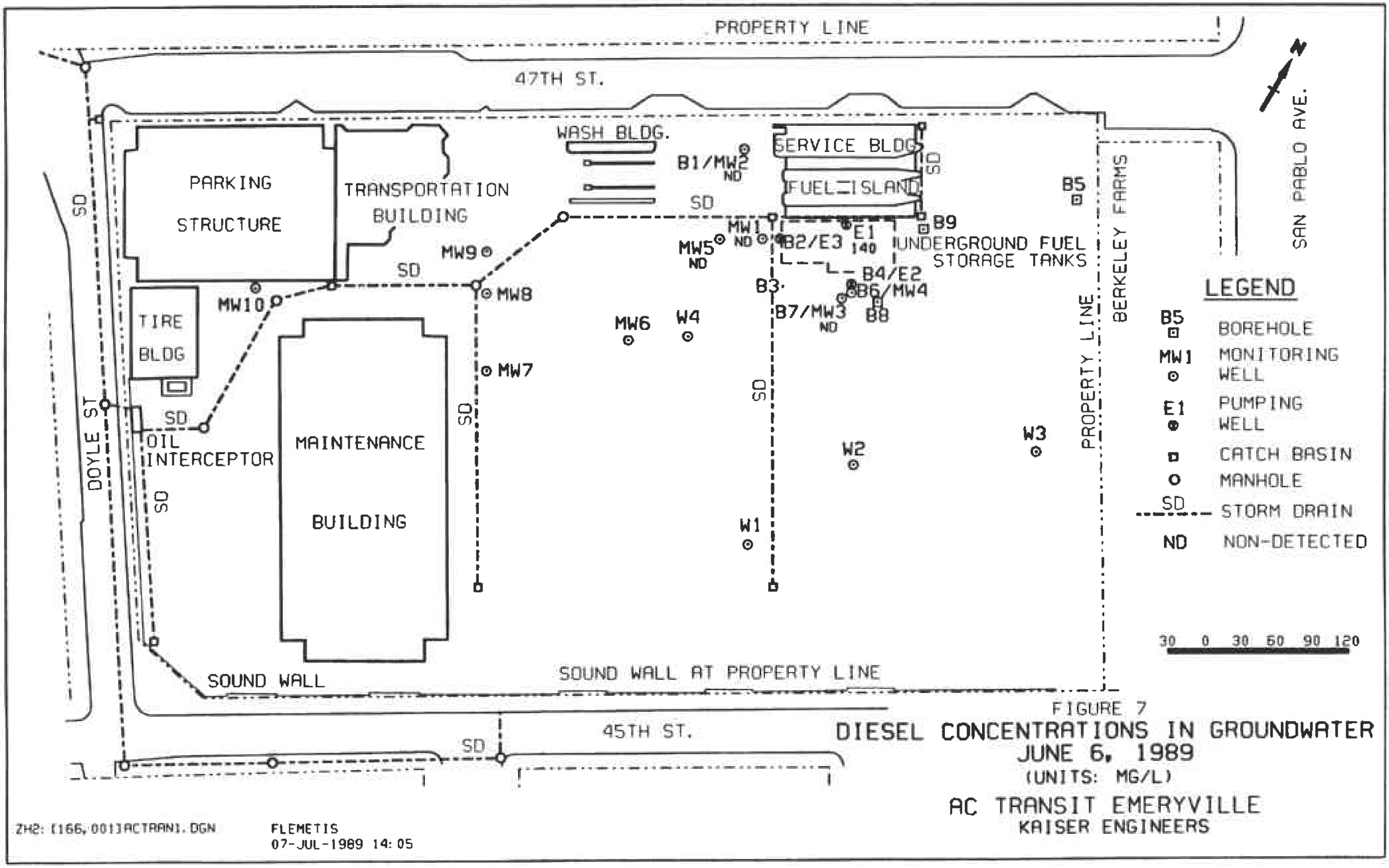

FIGURE 7
DIESEL CONCENTRATIONS IN GROUNDWATER
JUNE 6, 1989
(UNITS: MG/L)
AC TRANSIT EMERYVILLE
KAISER ENGINEERS

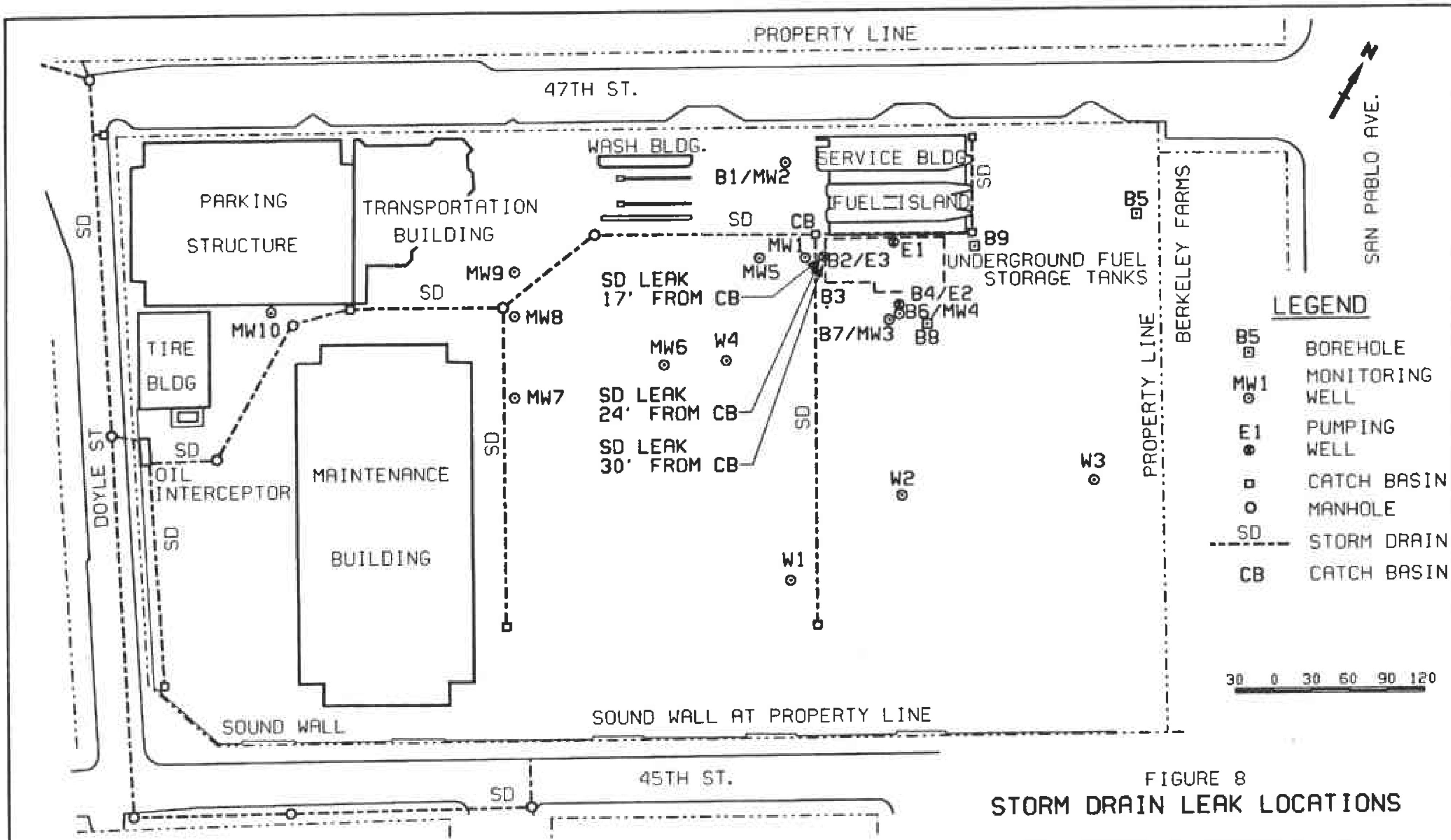

FIGURE 8
STORM DRAIN LEAK LOCATIONS

AC TRANSIT EMERYVILLE
KAISER ENGINEERS

ZH2: [166,001]ACTRAN1.DGN

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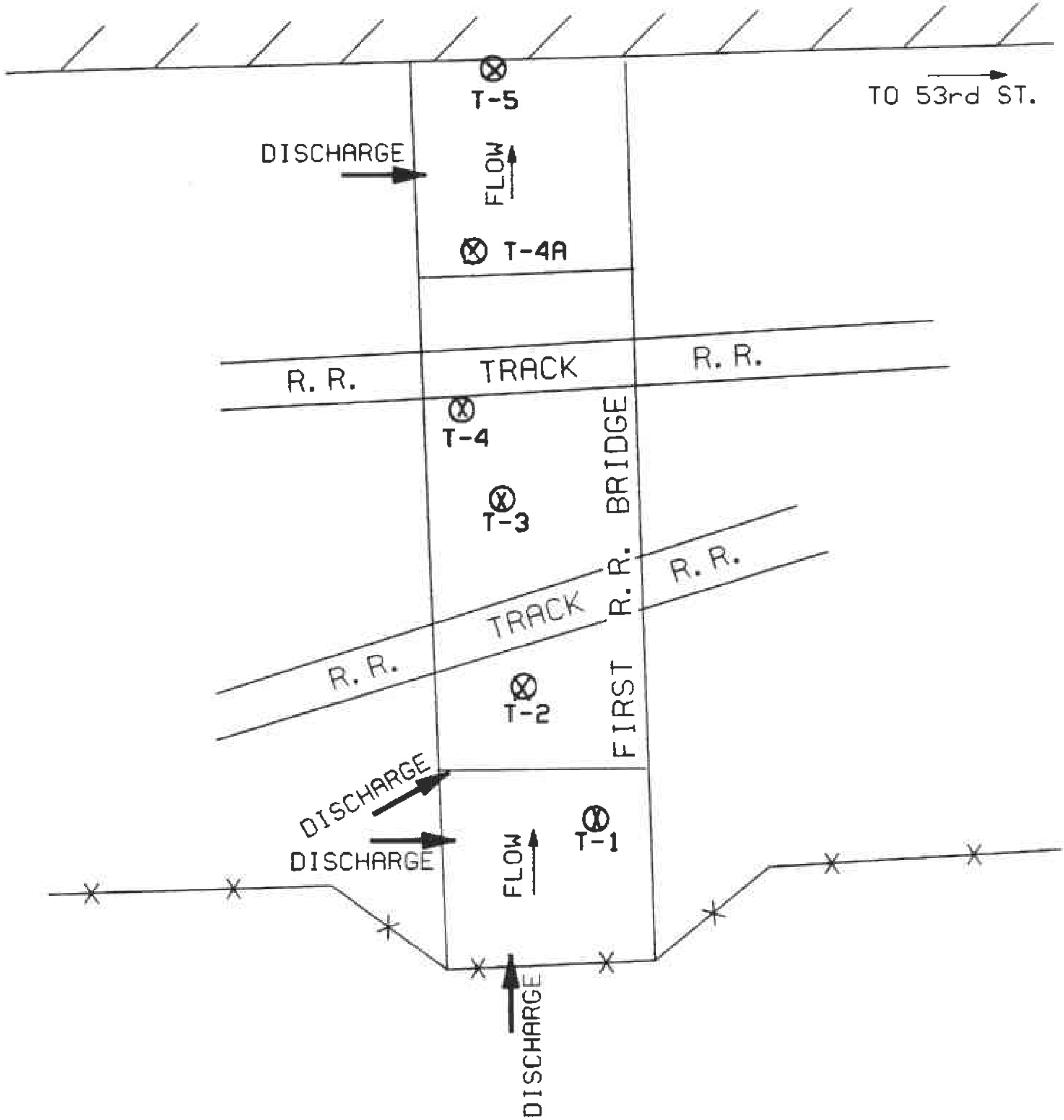

FIGURE 9

TEMESCAL CREEK INVESTIGATION
SAMPLE LOCATIONS

SCALE: 1" = 10'

ZH2: [166, 001]ACTRAN1.DGN

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07-JUL-1989 13:58

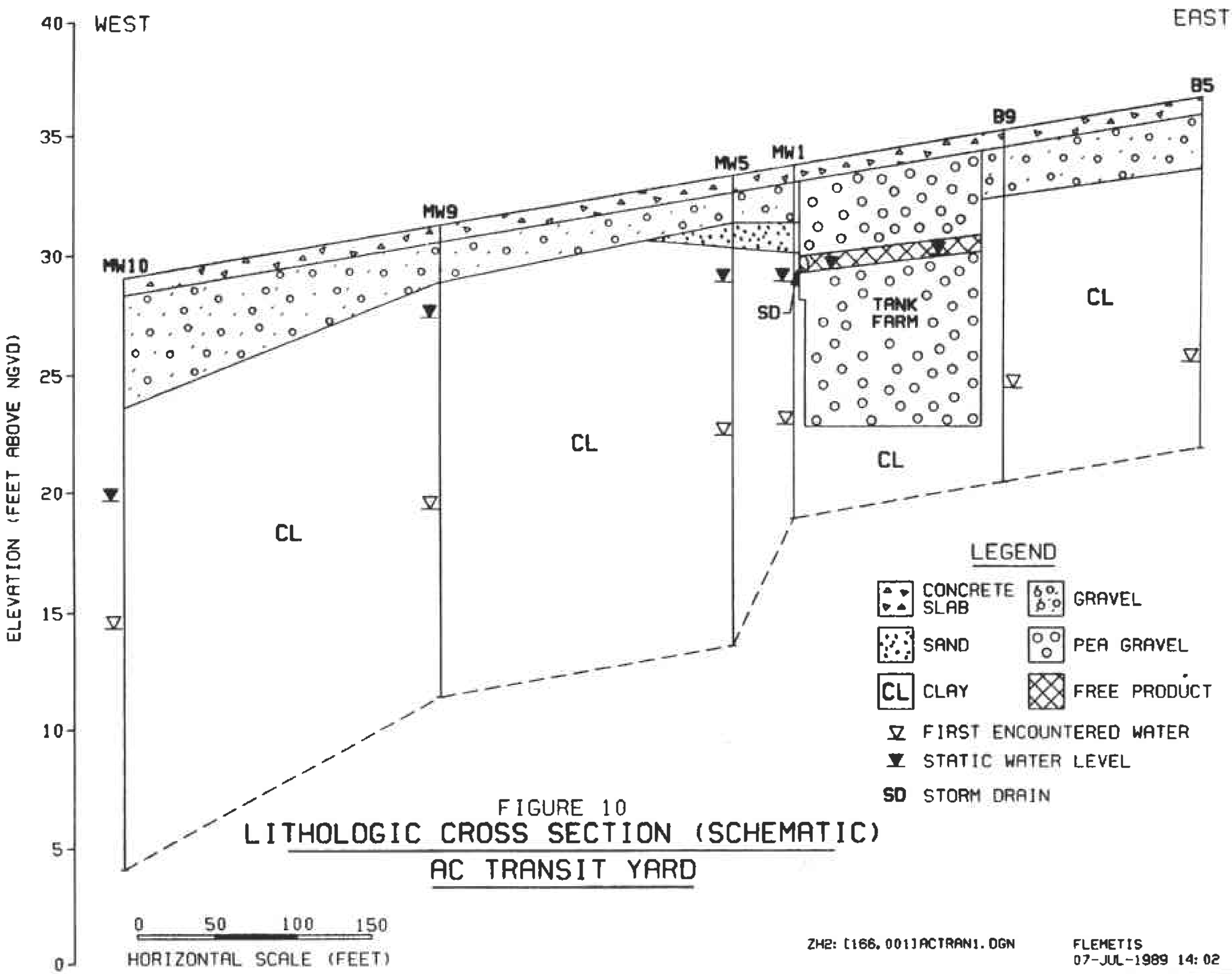

FIGURE 10

LITHOLOGIC CROSS SECTION (SCHEMATIC)

AC TRANSIT YARD

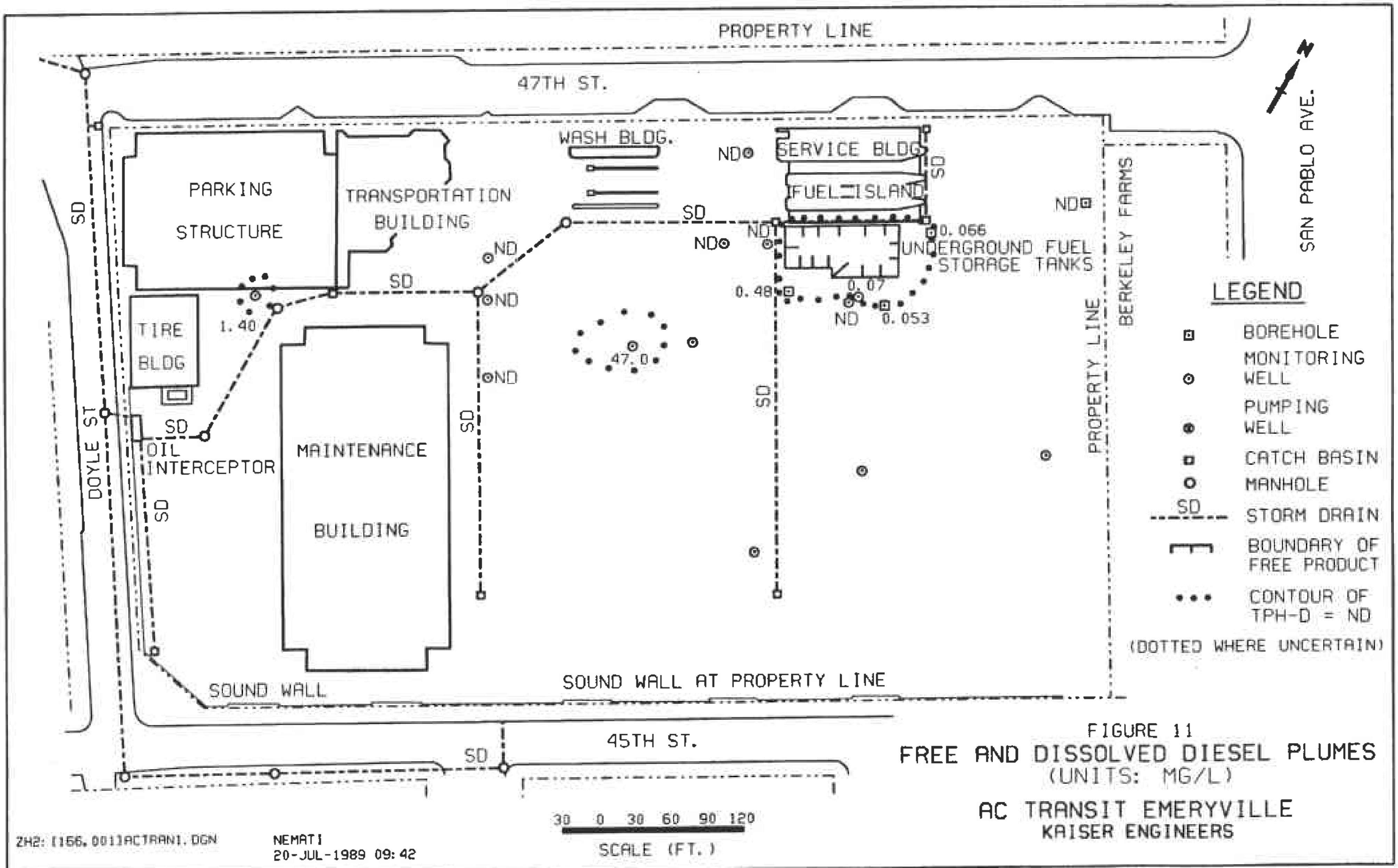

FIGURE 11
FREE AND DISSOLVED DIESEL PLUMES
(UNITS: MG/L)

AC TRANSIT EMERYVILLE
KAISER ENGINEERS

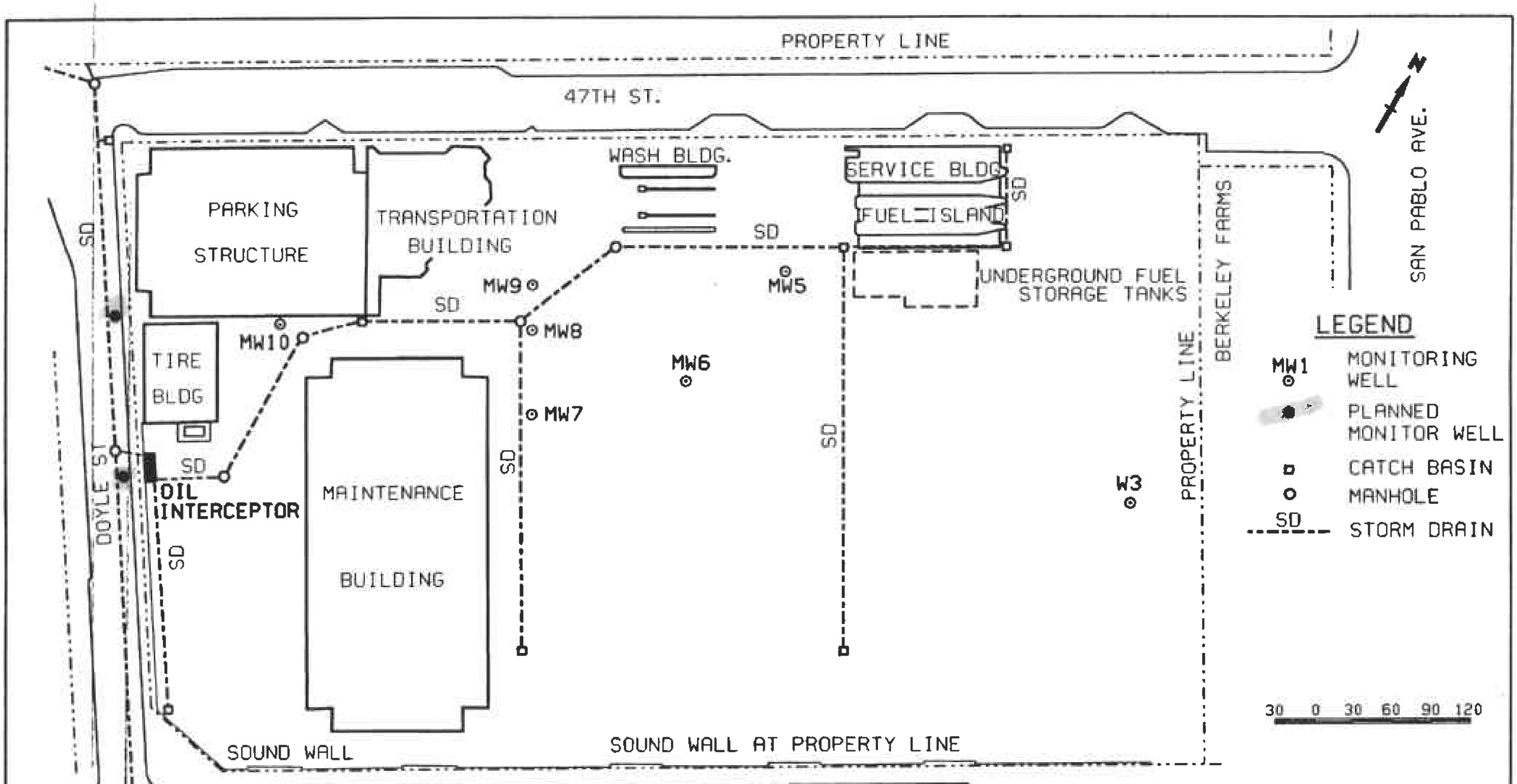

FIGURE 12

MONITOR WELL LOCATIONS

AC TRANSIT EMERYVILLE
KAISER ENGINEERS

ZH2: [166,001]ACTRAN1.DGN

NEMATI
20-JUL-1989 09:31

TABLE 1.1
SOIL ANALYSES - AC TRANSIT YARD

SAMPLE ID	SAMPLE DEPTH (FT)*	DATE	TPH-D (mg/kg)	TPH-G (mg/kg)	B	T	E	X
					(ALL ug/kg)			
MW-1	5	4/19/89	ND	-	-	-	-	-
B-1	5	4/19/89	ND	-	-	-	-	-
B-2	5	4/19/89	13000	-	-	-	-	-
B-3	5	4/19/89	73	-	-	-	-	-
B-4	5	4/19/89	700	-	-	-	-	-
B-5	5	4/19/89	ND	-	-	-	-	-
B-7	5	4/20/89	ND	-	-	-	-	-
B-8	5	4/20/89	ND	-	-	-	-	-
B-9	5	4/20/89	ND	-	-	-	-	-
MW-5	5	4/27/89	ND	ND	ND	ND	ND	ND
MW-5	10	4/27/89	20	260	ND	200	98	660
MW-6	5	4/27/89	150	840	45	670	1400	3100
MW-6	10	4/27/89	110	210	ND	200	200	540
MW-7	5	4/27/89	ND	15	ND	81	18	110
MW-7	10	4/27/89	ND	34	ND	28	20	68
MW-7	14	4/27/89	ND	ND	ND	ND	ND	ND
MW-8	5	4/29/89	ND	ND	ND	ND	ND	ND
MW-8	10	4/29/89	ND	ND	ND	ND	ND	ND
MW-9	5	4/29/89	ND	ND	ND	ND	ND	ND
MW-9	10	4/29/89	ND	ND	ND	ND	ND	ND
MW-10	5	4/29/89	ND	ND	ND	ND	ND	ND
MW-10	10	4/29/89	30	220	ND	270	180	650
MW-10	15	4/29/89	ND	ND	ND	ND	ND	ND

Detection Limits: TPH-D - 10 mg/kg; TPH-G - 1 mg/kg; BTEX - 3 ug/kg
* Below grade

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TABLE 1.2
SOIL ANALYSES - TEMESCAL CREEK

LOCATION	SAMPLE ID	DATE	MATRIX	TPH-D (mg/kg)	O&G (mg/kg)
Creek	T1	4/18/89	Soil	2,600	-
Creek	T2	4/18/89	Soil	290	3,400
Creek	T3	4/18/89	Soil	530	-
Creek	T4	4/18/89	Soil	4,100	11,000
Creek	T5	4/18/89	Soil	2,200	8,600

TABLE 2
DEPTHS OF SOIL SAMPLES - AC TRANSIT YARD

BOREHOLE/MONITOR WELL	SAMPLE ID AND DEPTH(S)		DEPTH TO FIRST WATER ENCOUNTERED
BH-1/MW-2	BH-1	5' BLS	11' BLS
BH-2	BH-2	5' BLS	NOT ENCOUNTERED
BH-3	BH-3	5' BLS	11'7" BLS
BH-4	BH-4	5' BLS	NOT ENCOUNTERED
BH-5	BH-5	5' BLS	11'6" BLS
BH-6/MW-4	NO RECOVERY		11' BLS
BH-7/MW-3	BH-7	5' BLS	11' BLS
BH-8	BH-8	5' BLS	10' 5" BLS
BH-9	BH-9	5' BLS	11' BLS
MW-1	MW-1	5' BLS	11' BLS
MW-5	S-101	5' BLS; S-102 10' BLS	11' BLS
MW-6	S-103	5' BLS; S-104 10' BLS	8' BLS
MW-7	S-105	5' BLS; S-106 10' BLS	17' BLS
	S-107	14' BLS	
MW-8	S-108	5' BLS; S-109 10' BLS	11' BLS
MW-9	S-110	5' BLS; S-111 10.5' BLS	11' BLS
MW-10	S-112	5' BLS; S-113 10' BLS	15' BLS
	S-114	15' BLS	

KEY: BH = BOREHOLE; MW = MONITOR WELL; BH/MW = BOREHOLE CONVERTED TO MONITOR WELL;
BLS = BELOW LAND SURFACE

TABLE 3
GROUNDWATER ANALYSES - AC TRANSIT YARD

SAMPLE ID	DATE	TPH-D (mg/l)	TPH-G (mg/l)	B (ALL ug/l)	T	E	X
MW-1	4/19/89	ND	-	-	-	-	-
B-1/MW-2	4/19/89	.560	-	-	-	-	-
B-3	4/19/89	.480	-	-	-	-	-
B-4	4/19/89	Noted [1]	-	-	-	-	-
B-5	4/19/89	ND	-	-	-	-	-
			-	-	-	-	-
B-6/MW-4	4/20/89	.070	-	-	-	-	-
B-7/MW-3	4/20/89	ND	-	-	-	-	-
B-8	4/20/89	.053	-	-	-	-	-
B-9	4/20/89	.066	-	-	-	-	-

Detection Limits for samples dated 4/19/89, 4/20/89: TPH-D - 0.05 mg/l

SAMPLE ID	DATE	TPH-D (mg/l)	TPH-G (mg/l)	B (ALL ug/l)	T	E	X	
MW-5	5/02/89	ND	1.9	ND	2.3	2.0	14.0	
MW-6	5/02/89	47	5000	<1500	3800	6100	16000	See Note [2]
MW-7	5/02/89	ND	1.3	16	0.5	3.2	1.2	
MW-8	5/02/89	ND	0.8	ND	ND	1.7	0.7	
MW-9	5/02/89	ND	ND	ND	ND	ND	ND	
MW-10	5/02/89	1.4	12.0	4.0	7.6	17	68	
MW-1	6/06/89	ND	-	-	-	-	-	
MW-2	6/06/89	ND	-	-	-	-	-	
MW-3	6/06/89	ND	-	-	-	-	-	
MW-5	6/06/89	ND	-	-	-	-	-	
E-1	6/06/89	140	-	-	-	-	-	

Detection Limits for samples dated 5/2/89, 6/6/89: TPH-D - 1 mg/l; TPH-G - 0.05 mg/l; BTEX - 0.3 ug/l

Note[1]: Sample was predominantly free product; TPH-D-86% by weight.
Note[2]: Detection limit for BTEX is 1500 ug/l.

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TABLE 4
GROUNDWATER ELEVATION MEASUREMENTS - MAY 2, 1989

WELL NO.	TOP OF CASING ELEV. (FT)*	DEPTH TO GROUNDWATER (FT)	GROUNDWATER ELEV. (FT)*
MW-1	32.56	5.05	27.51
MW-2	32.12	4.58	27.54
MW-3	34.06	6.19	27.87
MW-4	34.11	6.10	28.01
MW-5	31.70	4.44	27.26
MW-6	31.02	4.00	27.02
MW-7	29.62	4.68	24.94
MW-8	29.43	4.74	24.69
MW-9	29.18	3.91	25.27
MW-10	29.13	9.46	19.67
W-1	33.04	5.88	27.16
W-2	34.24	6.47	27.77
W-3	37.50	7.52	29.98
W-4	31.72	4.59	27.13

* Above City of Oakland Vertical Datum, which is 3.0 feet above National Geodetic Vertical Datum.

TABLE 5.1
SURFACE WATER ANALYSES
TEMESCAL CREEK AND DOYLE STREET STORM SEWER

LOCATION	SAMPLE ID	DATE	MATRIX	TPH-D (mg/l)	O&G (mg/l)
Creek	T4-A	4/18/89	Water	19	64
Sewer	D1	4/18/89	Water	130	-
Sewer	D2	4/18/89	Water	9.5	-
Sewer	D3	4/18/89	Water	23	-

TABLE 5.2
SURFACE WATER ANALYSES
HOLDING TANK ANALYSIS

TANK	DATE	TPH-D (mg/l)
FUEL ISLAND	4/25/89	214
OIL INTERCEPTOR	5/01/89	3.3
FUEL ISLAND	5/01/89	1.6
FUEL ISLAND	6/05/89	800

TABLE 5.3
SURFACE WATER ANALYSES
McTIGHE SEPARATOR INFLUENT/EFFLUENT

CONSTITUENT	UNITS	5/8/89	5/10/89	5/12/89	5/26/89
Naphthalene	ug/l	220 / <0.4			1100 / <2
n-Propylbenzene	ug/l	7 / <0.4			18 / <2
Toluene	ug/l	3 / <0.4			5 / <2
1,2,4 Trimethylbenzene	ug/l	57 / <0.4			410 / <2
1,3,5 Trimethylbenzene	ug/l	39 / <0.4			120 / <2
O-Xylene	ug/l	18 / <0.4			43 / <2
m & p Xylene	ug/l	17 / <0.4			29 / <2
n-Butylbenzene	ug/l	18 / <0.5			140 / <2
TPH - Gasoline	mg/l	<10 / <10	17 / <1	<10 / <2	
TPH - Diesel	mg/l	60 / 40	260 / 4	210 / 38	
TPH - Oil	mg/l	<100 / <100			
Oil & Grease	mg/l	60 / 41			
Cd	mg/l	<0.01 / <0.01			
Cr	mg/l	0.02 / 0.03			
Cu	mg/l	0.11 / 0.06			
Pb	mg/l	0.08 / 0.06			
Ni	mg/l	0.08 / 0.02			
Zn	mg/l	0.51 / 0.37			

Note: All values reported are formatted INFLUENT/EFFLUENT