IT CORPORATION
A Member of The IT Group

SITE INVESTIGATION REPORT

Soil and Groundwater Investigation
Former Phoenix Iron Works Facility
800 Cedar Street
Oakland, California

Volume 1 of 2

Prepared For:

California Department of Transportation, District 4
Office of Environmental Engineering
P.O. Box 23660
Oakland, California 94623-0660

Prepared By:

IT Corporation
1433 North Market Boulevard, Suite 1
Sacramento, California 95834

Task Order No. 04-190270-RG
Contract No. 43A0012

IT Project No. 779185
March 8, 2000

SITE INVESTIGATION REPORT

Soil and Groundwater Investigation
Former Phoenix Iron Works Facility
800 Cedar Street
Oakland, California

Volume 1 of 2

Prepared For:

California Department of Transportation, District 4
Office of Environmental Engineering
P.O. Box 23660
Oakland, California 94623-0660

Prepared By:

IT Corporation
1433 North Market Boulevard, Suite 1
Sacramento, California 95834

Task Order No. 04-190270-RG
Contract No. 43A0012

March 8, 2000
779185

REGISTERED GEOLOGIST
DONALD P. BRANSFORD
No. 5621
STATE OF CALIFORNIA

Donald P. Bransford, R.G.
Task Order Manager

Michael D. Miller, R.G.
Project Manager

Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

IT Corporation (IT) conducted a soil and groundwater investigation at the Phoenix Iron Works site (site) in the city of Oakland, California. The site has historically been occupied for residential and industrial uses over the past approximately 100 years. The objectives of this investigation were to assess the presence and concentration of hazardous materials and petroleum products within the soil and groundwater beneath the site. Additionally, the presence of the oil underground storage tank (UST) and other potential unreported underground facilities were evaluated.

Soil samples collected from the site were reported to contain total recoverable petroleum hydrocarbons (TRPH). Soil collected from three borings located in an area noted as containing "black stained sand" and as being used for drum storage were reported to contain of TRPH in excess of 1,000 mg/kg. The vertical extent of the elevated TRPH concentrations appears to be limited to the shallow soil. The source for the TRPH is not known.

Volatile organic compounds (VOCs) were reported by the laboratory in soil samples collected from several of the borings located across the site. The most frequently detected VOCs were trichloroethene and tetrachloroethene. The reported concentrations of VOCs are three to six orders of magnitude below their respective preliminary remediation goals (PRGs). The source for the VOCs is not known.

Semivolatile organic compounds (SVOCs) were reported by the laboratory in soil samples collected from two of the borings drilled in the western portion of the site. The reported concentration of only one SVOC, benzo(a)pyrene, exceeded its PRG. The source for the SVOCs reported in soil samples collected from the site is not known.

Soil samples collected from the site were reported to contain barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. Only lead was reported in soil samples collected from three locations at concentrations that exceeded its PRG. The source for the lead is not known. Heavy metal concentrations were compared to total threshold limit concentration (TTLC), soluble threshold limit concentration (STLC), and toxicity characteristic leaching procedure (TCLP) values to evaluate whether the soil would, should it become a waste, be considered a hazardous waste. Only lead was reported to exceed TTLC, STLC, and TCLP values.

Volatile organic compounds were reported in groundwater samples collected from borings predominantly located in the southern portion of the site. The source(s) for the VOCs is not known. The reported concentrations of benzene in the groundwater sample collected from boring P-23 and trichloroethene in the groundwater sample collected from borings P-17 and P-21 exceeded their respective maximum contaminant levels (MCLs).

Groundwater samples were reported to contain barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. Concentrations of barium, beryllium, chromium, lead, nickel, and total dissolved solids were reported in excess of the respective MCLs in certain groundwater samples. The heavy metal detections exceeding MCLs were reported in groundwater samples collected from borings drilled along the eastern and southern perimeter of the site. The source for the elevated heavy metal concentrations is not known.

The geophysical surveys were affected by the surficial and near surface metallic objects. However, no evidence was generated for the presence of USTs or other significant subsurface structures.

Based on the results of this investigation, the following recommendation is made:

- The concrete slab and metallic features should be removed and a vertical magnetic gradient survey again conducted.

- The laboratory analytical data should be evaluated to assess whether soil or groundwater remediation are necessary.

1.0 Introduction

This report has been prepared by IT Corporation (IT) to present the scope of work and results for soil and groundwater investigation at the Phoenix Iron Works site (site) in the city of Oakland, California (Figure 1). The former address for the site was 800 Cedar Street. The site is bound by 9th Street to the north, Shorley Street to the south, Pine Street to the east, and a frontage road to the west.

Following the collapse of the Cypress freeway structure during the October 17, 1989, Loma Prieta earthquake, the California Department of Transportation (Caltrans) reconstructed Interstate 880 (I-880) along a new alignment that circumvents the neighborhood where the Cypress freeway structure was located. The new alignment, which includes connections to the Bay Bridge approach and a new West Grand Avenue interchange, required the acquisition of right-of-way from Phoenix Iron Works (Caltrans, 1998). The southwest corner of the former Phoenix Iron Works property now lies beneath the new frontage road that runs parallel to the re-aligned I-880. This portion of the former Phoenix Iron Works property is outside the current investigation's boundaries.

1.1 Project History

The 1989 Loma Prieta earthquake damaged a portion of the I-880 Cypress freeway structure. The Cypress freeway structure was subsequently demolished and I-880 re-routed west of the former alignment. Additional right-of-way was acquired by Caltrans from the Phoenix Iron Works. The site has historically been occupied for residential and industrial uses over the past approximately 100 years. Based on Sanborn Fire Insurance (Sanborn) maps, residential dwellings were located on the eastern and southwestern portions of the site (Caltrans, 1998). The remainder of the site was generally occupied by industrial facilities, which included the following presented on maps contained within Caltrans (1998):

- The Dunn Cracker Co. on the northwestern portion of the site (1902 to 1911 Sanborn map);
- Independent Iron Works on the southern half of the site and California Fireworks Co. on the northwestern portion of the site (1912 to 1931 Sanborn map);
- Independent Iron Works over the entire site (1932 to 1951 Sanborn map); and

- Phoenix Iron Works on the western edge of the site, Plastic Bag Company on the north-central portion of the site, Stoltz/Bond Metal Shops in the Central portion of the site, Pine Iron Works on the southeastern portion of the site, and Cypress Auto Salvage Warehouse on the eastern portion of the site (1993 activity map).

Independent Iron Works is reported to have occupied the site from approximately 1924 to 1960 for manufacture of industrial steel products. Between 1970 and 1994, the site was owned by Phoenix Properties. During this period, the site was used primarily for manufacture of industrial steel products. Caltrans acquired the site in 1994 (Caltrans, 1997).

At the time of Caltrans' acquisition, the site contained an industrial warehouse constructed on a concrete slab. The warehouse structure encompassed the entire site and was removed by Caltrans in 1995, leaving the concrete slab in place. The southwest corner of the site was also remediated at that time to allow construction of the frontage road for the re-aligned freeway.

A 1990 site reconnaissance noted the presence of drums of waste oil, solvents, paints, inks, and metal scraps/shavings at several locations within the warehouse. Gasoline tanks and batteries were also observed in the eastern portion of the warehouse. In addition, the Sanborn map for the period 1902 to 1911 noted the presence of a 13,000-gallon oil underground storage tank (UST) within the area formerly used by The Dunn Cracker Co., in the northwestern portion of the site (Caltrans, 1998). A 2,600-gallon gasoline UST and 1,000-gallon diesel UST (Caltrans, 1997) are reported to have been present on or adjacent to the western side of the site (On-Site, 1993). The gasoline UST is shown to have been formerly within the site boundary, while the diesel UST was located outside the site boundary, beneath Cedar Street (On-Site, 1993).

Investigations at the site were conducted in 1990, 1992, 1993, and 1995. Groundwater samples collected from the site in 1992 were analyzed for total petroleum hydrocarbons as gasoline (TPHg) and total petroleum hydrocarbons as diesel (TPHd). Soil samples collected during various investigations were analyzed for the following constituents (Caltrans, 1998):

- Total volatile hydrocarbons/TPHg;
- Total extractable hydrocarbons/TPHd;
- Total recoverable petroleum hydrocarbons (TRPH);
- Benzene, toluene, ethylbenzene, and xylenes;

- Volatile organic compounds (VOCs);
- Semivolatile organic compounds (SVOCs);
- Polynuclcar aromatic hydrocarbons (PAHs);
- Organochlorine pesticides and polychlorinated biphenyls (PBS); and
- Heavy metals.

Elevated concentrations of TPHd and generally low concentrations of TPHg were detected in soil samples collected from borings drilled in the vicinity of the diesel and gasoline USTs. Concentrations of TPHd and TPHg were reported to be up to 2,400 milligrams per kilogram (mg/kg) and 17 mg/kg, respectively. Groundwater samples were not reported to contain TPHd or TPHg. The diesel and gasoline USTs were excavated and removed from the site. "Minor" concentrations of TPHg, ethylbenzene, and xylenes were detected in soil samples collected following UST removal and soil over-excavation (Caltrans, 1997). The concentrations were below the Cypress Replacement Project's Preliminary Remediation Goals (PRGs) established by the California Environmental Protection Agency, Department of Toxic Substances Control, Office of Scientific Affairs (OSA), for this specific project (Caltrans, 1995; Appendix A): 100 mg/kg for TPHg, 74 mg/kg for ethylbenzene, and 99 mg/kg for xylenes (Wilson, 1998). Discolored soil was observed following removal of the diesel UST, which was subsequently over-excavated until no further discoloration was observed or groundwater was reached. Approximately 800 cubic yards of soil were excavated and disposed (Caltrans, 1997).

Soil samples collected from the southwest corner of the former Phoenix property, outside the current site boundary, were reported to contain elevated concentrations of lead and arsenic. Up to 17,000 parts per million (p.m.) of lead and 44 p.m. of arsenic were detected in the soil samples (Caltrans, 1998). Soil containing concentrations of lead in excess of the PRG of 840 mg/kg was removed from the site. During excavation of the heavy-metal-impacted soil, two solvent-containing USTs (approximately 250 and 10 gallons in size) and a settling sump were encountered. Soil samples collected in the vicinity of these USTs were reported to contain oil and grease (O&G), VOCs, SVOCs, and PAHs. Soil in the vicinity of these features was included in the remedial effort. Approximately 2,000 cubic yards of soil were disposed as California-hazardous waste and 1,332 cubic yards of soil was disposed as Resource Conservation and Recovery Act (RCRA)-hazardous waste (Caltrans, 1997).

No permanent structures remain at the site. Three historical buildings displaced by construction of the re-aligned Interstate 880 freeway have been moved to and are temporarily stored on the northwestern portion of the site (Figure 2). The perimeter of the site is fenced, except where the sound wall is present adjacent to the southwest corner of the site. Access through a gate is present along 9th Street at the northwest corner of the site (Caltrans, 1998).

1.2 Geologic and Hydrogeologic Setting

The site is mapped as being underlain by Pleistocene beach and dune deposits of the Merritt Sand (Helley, et al., 1979). The Merritt Sand is the upper member, where present, of the San Antonio formation. The San Antonio formation is non-marine in origin and was deposited over the Older Bay Mud (Yerba Buena formation) in a complex system of alluvial fans, flood plains, lakes, swamps, and beaches (Rogers/Pacific, 1991). The Merritt Sand deposits are described as loose, well-sorted, fine- to medium-grained sand with varying amounts of silt. The Merritt Sand is reported to reach a maximum thickness of approximately 15 meters (50 feet) and overlies older peaty mud deposits that have been dated at over 40,000 years old (Helley, et al., 1979), which are likely swamp deposits mentioned in Rogers/Pacific (1991) within the San Antonio formation. The Merritt Sand has been interpreted to have been primarily deposited by wind erosion and transport of stream sediments during lower sea level stands. The sands may have been re-worked by beach or shoreline processes as sea levels rose (Helley, et al., 1979).

Groundwater has been encountered in the vicinity of the site at depths of approximately 1.5 to 2.1 meters below the ground surface (BGS) (5 to 7 feet BGS). The groundwater gradient is reported to generally slope in a westerly direction towards the bay (Wilson, 1998).

1.3 Project Objectives

The objectives of this investigation were to assess the presence and concentration of hazardous materials and petroleum products within the soil and groundwater beneath the site. Additionally, the presence of the oil UST and other potential unreported underground facilities were evaluated.

2.0 Scope of Work

The scope of work for the investigation was presented in IT's revised workplan dated January 25, 1999, which was approved for implementation by Caltrans (IT, 1999a). The following scope of work was conducted:

1. Planning and Permitting
2. Field Investigation
3. Laboratory Analyses
4. Investigation-Derived Waste Disposal
5. Site Investigation Report Preparation

2.1 Planning and Permitting

Planning and permitting included a pre-work site visit, preparation of a workplan and health and safety plan, acquisition of required permits, and clearance of underground utilities.

A pre-work site visit was conducted at the site on November 12, 1998, by Mr. Donald Bransford of IT and Mr. Chris Wilson of Caltrans. Locations for soil borings were observed, and the scope of work and objectives were discussed.

A site-specific health and safety plan (IT, 1999b) was prepared for the site in general accordance with 29 CFR 1910.120 and 8 CCR 5192. The health and safety plan included safety procedures for work to be performed at the site, chemical hazard information, site safety officers, and preferred medical emergency locations.

A drilling permit was obtained from the Alameda County Public Works Agency for the investigation. A copy of the permit is presented in Appendix B. Underground Service Alert was notified of the subsurface investigation prior to initiation of the investigation.

2.2 Field Investigation

The field investigation was conducted between June 21 and June 24, 1999. This task included a geophysical survey to evaluate the presence of the 13,000-gallon oil UST and other unreported underground facilities that may be present at the site, and the drilling of 26 soil borings for collection of soil samples. Temporary well casing was inserted into 15 of the borings to facilitate collection of groundwater grab samples. Boring locations were selected to provide data for systematic evaluation of subsurface conditions. The locations of the soil borings are shown in Figure 2. A listing of the borings with a summary of the samples collected, comments, and deviations from the workplan is presented on Table 1.

2.2.1 Soil Sample Collection

Twenty-six soil borings were advanced using a truck-mounted drill rig equipped with 15-centimeter (6-inch) diameter hollow-stem auger. Hollow-stem auger drilling services were provided by Spectrum Exploration, Inc., of Stockton, California. Prior to drilling, the horizontal locations of the borings were established and marked using a Trimble GPS Pathfinder™ Pro XRS global positioning system (GPS) by Caltrans personnel. The GPS utilized a GPS receiver and MSK radio beacon differential receiver to provide real-time differential corrections to the coordinates. The GPS is reported to have sub-meter precision for horizontal location of the borings. The locations were reported using the California State Plane Coordinate System, 1927 survey. Coordinates for the borings are presented on Table 1.

The soil borings were drilled to the depths shown on Table 1. Most borings were advanced to approximately 3.5 meters (11.5 feet) below the ground surface (BGS), a depth expected to allow for characterization of shallow subsurface soils and groundwater. One boring (P-15) was drilled to a depth of approximately 3.8 meters (12.5 feet) BGS. Drilling and sampling procedures are presented in Appendix C. Soil borings were logged for lithologic characteristics using the Unified Soil Classification System (USCS) under the direction of a California State Registered Geologist. The soil borings were screened for the presence of volatile organic compounds (VOCs) using an organic vapor meter equipped with a photoionization detector by an IT geologist using soil samples obtained during drilling. The boring logs are presented in Appendix D.

The number of soil samples collected from each boring are shown on Table 1. A total of 95 soil samples were collected and submitted for analyses. Most soil samples were collected from each boring at depths of approximately 0.15, 0.9, 2.1, and 3.1 meters (0.5, 3, 7, and 10 feet) BGS. Exceptions to these depths are noted on the boring logs (Appendix D) and Table 1. Sampling at the selected depth intervals was conducted to provide information on the subsurface stratigraphy and to assess the presence of hazardous materials and petroleum hydrocarbons in the subsurface. Soil samples were collected using a 5-centimeter (2-inch) diameter California-modified split-barrel sampler lined with stainless steel sample tubes. The soil samples were labeled, packaged, and stored in insulated chests for transport under chain-of-custody manifest to a California-certified analytical laboratory.

The borings were backfilled with an approximately 20:1 cement:bentonite grout. Significant caving or heaving of saturated sediments was not encountered. Therefore, the grout was placed into open boreholes in a manner such that bridging of the grout was not likely.

All drilling and sampling equipment was washed prior to drilling. In addition, to minimize cross-contamination between borings, all appropriate downhole drilling and sampling equipment was washed between borings. Soil cuttings generated during the field investigation were placed into 208-liter (55-gallon) drums approved by the United Nations for transport of liquid and solid wastes, and stored in a secure area at the site.

2.2.3 Groundwater Grab Sample Collection

Collection of groundwater grab samples was attempted from 15 of the boring locations. Groundwater was generally encountered within approximately 2.4 to 3.2 meters (8 to 10.5 feet) of the ground surface. After completion of the soil borings, and to facilitate water sampling, a well casing was inserted into the selected soil borings. The casing consisted of approximate 5-centimeter (2-inches) diameter, Schedule 40, flush-threaded, 0.05-centimeter (0.020-inch), machine-slotted polyvinyl chloride (PVC) well screen. Dedicated disposable polyethylene bailers were used for sample collection.

A total of 15 groundwater samples were collected and submitted for laboratory analyses. The groundwater grab samples were labeled, packaged, and stored in an insulated chest for transport under chain-of-custody manifest to the analytical laboratory.

2.3 Geophysical Surveys

Surface geophysical surveys were conducted to assess the presence of the 13,000-gallon oil UST reported to have been present in the northwestern portion of the site (Figure 2) and any other unreported underground facilities at the site. The surveys were conducted on June 30 and July 1, 1999, by Norcal Geophysical Consultants, Inc., of Petaluma, California. The surveys were conducted using electromagnetic line locator (EMLL), vertical magnetic gradient (VMG), and ground-penetrating radar (GPR) methods. The approach for the geophysical surveys was to initially conduct EMLL and VMG surveys to locate magnetic anomalies followed by the GPR survey to locally investigate suspect magnetic anomalies. Prior to the start of the surveys, aboveground materials not anchored in place that may interfere with the surveys were removed, to the extent practical. The procedures used for the surveys are presented in Appendix E and are summarized below.

The EMLL survey was conducted throughout the site along traverses spaced from 10 to 20 feet apart. The VMG survey was conducted using nodes spaced approximately 10 feet apart, a grid selected based on the expected size of the target UST. The magnetic field data was reduced in the field and a contour map produced that is referenced to aboveground structures that may affect the results (Appendix E).

Anomalies detected by the EMLL and VMG surveys potentially created by USTs and other subsurface structures were investigated using GPR. The GPR traverses were spaced approximately five feet apart and oriented both parallel and perpendicular to the anomaly.

2.4 Laboratory Analyses

The soil and groundwater samples collected and retained for analysis were submitted to Sparger Technology, Inc. (Sparger), of Sacramento, California, a California-certified analytical laboratory. Chain of custody procedures, including the use of chain of custody forms, were used to document sample handling and transport from the time of collection to delivery to the laboratory for analysis. The chain of custody forms and laboratory analytical reports are included in Appendix F.

Rationale for the design of the analytical program is provided in the workplan (IT, 1999a). Selected soil and groundwater samples were analyzed for the following parameters in general accordance with the U.S. Environmental Protection Agency (U.S. EPA) method listed.

Analysis	U.S. EPA Method	Analysis	U.S. EPA Method
Total Recoverable Petroleum Hydrocarbons	1664	Semivolatile Organic Compounds	8270
Total Petroleum Hydrocarbons as Gasoline	DHS-LUFT	Volatile Organic Compounds	8260
Total Petroleum Hydrocarbons as Diesel	DHS-LUFT	Heavy Metals	6010/7471
Total Dissolved Solids	160.1		

DHS LUFT = California Department of Health Services Leaking Underground Fuel Tank Manual method.

Heavy metal analyses included analysis of for 17 heavy metals referred to as California Assessment Manual (CAM) Metals. Groundwater samples submitted for heavy metals analyses were filtered at the laboratory prior to analysis. Based on the results of heavy metal analyses, specific soil samples were further analyzed for the soluble concentration of selected heavy metals in the samples.

Generally, soil samples reported to contain heavy metals at concentrations that exceeded approximately 10 times their Soluble Limit Threshold Concentration (STLC) were analyzed for soluble heavy metal concentrations using the Waste Extraction Test (WET). Selected soil samples with reported heavy metal concentrations that exceeded approximately 20 times the STLC were analyzed for soluble heavy metal concentrations using the Toxicity Characteristic Leaching Procedure (TCLP). The STLC and TCLP results are used to judge whether a waste is hazardous based on the soluble concentrations of the metals within the waste.

Soluble heavy metal analyses were conducted for lead. The samples and analyses were selected by Caltrans. Soluble lead analyses were conducted on six soil samples by the WET, seven soil samples by the TCLP, and three soil samples by both the WET and TCLP.

2.5 Investigation-Derived Waste Disposal

Soil cuttings from the drilling and equipment rinsate generated during decontamination of drilling equipment were placed in United Nations (UN) approved 208-liter (55-gallon) drums for temporary storage at the site. Seven drums of soil and two drums of rinsate were generated. All drums were fitted with a gasket lid, and then secured with a bolted ring. The rings were tightened so that the contents of the drums were secured from spillage. Each drum was labeled with its contents, origin of contents, and date generated.

Wastes generated were transported from the site on February 8, 2000. The soil was submitted as non-RCRA hazardous waste to Onyx Environmental at their Azusa, California, facility. The waste water was profiled and transported for recycling at the Demenno Kerdoon facility in Compton, California. A copy of the soil manifest is included in Appendix G.

3.0 Site Investigation Results

3.1 Site Geology

Based on soil cuttings and soil samples from the borings, lithologies encountered were observed to consist primarily of fine to medium sand and silty sand. These materials are interpreted to represent deposits of the Merritt Sand discussed in section 1.2. Poorly graded sand tended to be encountered in the eastern portion of the site. Silty sand was predominantly encountered in the western portion of the site. Where both lithologies were encountered, the silty sand was overlain by poorly graded sand. Detailed lithologic information collected from the borings were recorded on visual classification forms (boring logs) and are presented in Appendix D.

Water-saturated sediments were encountered beginning at approximately 2.4 to 3.2 meters (8 to 10.5 feet) BGS.

3.2 Analytical Results

Laboratory analytical results are summarized on Tables 2 through 6. The laboratory analytical reports are presented in Appendix F.

3.2.1 Soil Sampling Results

Soil sample analytical results are summarized on Tables 2 through 4. Selected soil samples were analyzed for TPHg, TPHd, TRPH, VOCs, SVOCs, and heavy metals. The analytical data presented here are compared to the Cypress PRGs (Appendix A). A summary of the results is presented below.

Total Petroleum Hydrocarbons as Gasoline and Diesel

Ninety-five soil samples were analyzed for TPHg and TPHd. The analyses did not report the presence of TPHg or TPHd in any of the soil samples at concentrations exceeding the analytical method reporting limit (Table 2).

Total Recoverable Petroleum Hydrocarbons

Total recoverable petroleum hydrocarbons were reported in 37 of the 95 soil samples analyzed. The concentrations reported, when TRPH was detected, ranged from 60 to 1,200 mg/kg (Table 2).

Volatile Organic Compounds

Volatile organic compounds were reported in 11 of the 95 soil samples analyzed (Table 2). The following VOCs and concentrations ranges were detected.

styrene	0.0037 mg/kg	tetrachloroethene	0.010 to 0.015 mg/kg
trichloroethene	0.0042 to 0.028 mg/kg		

Semivolatile Organic Compounds

Semivolatile organic compounds were reported in 2 of the 95 soil samples analyzed (Table 2). The following SVOCs and concentrations ranges were detected.

anthracene	0.780 mg/kg	benzo(a)anthracene	0.340 mg/kg
benzo(b)fluoranthene	0.520 mg/kg	benzo(k)fluoranthene	0.520 to 8 mg/kg
benzo(g,h,i)perylene	0.430 to 2 mg/kg	benzo(a)pyrene	0.500 to 13 mg/kg
chrysene	0.440 mg/kg	di-n-octyl phthalate	1.4 mg/kg
dibenz(a,h)anthracene	1.1 mg/kg	fluoranthene	0.910 mg/kg
indeno(1,2,3-cd)pyrene	0.920 mg/kg	pyrene	0.960 mg/kg

Heavy Metals

Heavy metal analyses were conducted on 95 soil samples. The soil samples were reported to contain barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc (Table 3). Lead was reported in three soil samples at concentrations that exceeded the Cypress PRG. Lead concentrations ranged from 1.0 mg/kg to 1,690 mg/kg.

A summary of heavy metal results compared to 10 times STLC and TTLC values is presented below. Results are presented on Table 4.

Heavy Metal	10 Times STLC (mg/l)	Number Samples Exceeding 10 Times STLC	TTLC (mg/kg)	Number Samples Exceeding TTLC	Concentration Range (mg/kg)
Lead	50	16	1,000	1	<1.0 to 5,021

Selected soil samples reported to contain lead concentrations exceeding 10 times the STLC were analyzed for soluble lead concentrations by the WET. Selected soil samples reported to contain lead concentrations exceeding 20 times the STLC were analyzed for soluble concentrations by the TCLP.

A summary of soluble lead results compared to STLC and TCLP values is presented below and on Table 4.

Heavy Metal	STLC (mg/l)	No. Samples Exceeding STLC	WET Concentration Range (mg/l)	TCLP (mg/l)	No. Samples Exceeding TCLP	TCLP Concentration Range (mg/l)
Lead	5.0	7 of 9	0.077 to 35	5.0	2 of 10	0.063 to 60

3.2.2 Groundwater Sampling Results

Groundwater sample analytical results are summarized on Tables 5 and 6. The groundwater samples were analyzed for TPHg, TPHd, TRPH, VOCs, SVOCs, heavy metals, and total dissolved solids (TDS). A summary of the results is presented below.

Petroleum Hydrocarbons

Total petroleum hydrocarbons as gasoline, TPHd, and TRPH were not reported in the 15 groundwater samples analyzed at concentrations exceeding the analytical method reporting limit (Table 5).

Volatile Organic Compounds

Volatile organic compounds were reported in 8 of the 15 groundwater samples analyzed (Table 5). The following VOCs and concentrations ranges were detected.

benzene	0.055 milligrams per liter (mg/l)	carbon disulfide	0.0022 to 0.0070 mg/l
chloroform	0.0026 to 0.023 mg/l	2-hexanone	0.370 mg/l
styrene	0.0028 mg/l	toluene	0.0055 mg/l
trichloroethene	0.0023 to 0.140 mg/l	vinyl acetate	0.0055 mg/l

Semivolatile Organic Compounds

Semivolatile organic compounds were not reported in the 15 groundwater samples analyzed at concentrations in excess of the analytical method reporting limits (Table 5).

Heavy Metals

Groundwater samples were analyzed following filtering at the laboratory. Barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc were reported in the samples analyzed (Table 6). The following heavy metals and concentrations ranges were detected.

barium	0.030 to 3.3 mg/l	beryllium	<0.004 to 0.013 mg/l
chromium	<0.010 to 1.8 mg/l	cobalt	<0.050 to 0.36 mg/l
copper	<0.020 to 0.48 mg/l	lead	<0.010 to 1.1
nickel	<0.040 to 2.3 mg/l	vanadium	<0.050 to 1.4 mg/l
zinc	<0.015 to 1.5 mg/l		

Total Dissolved Solids

Total dissolved solids concentrations for the groundwater samples analyzed ranged from 287 to 1,312 mg/l (Table 6).

3.2.3 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) consisted of both field and laboratory QA/QC. Field and laboratory QA/QC were outlined in the work plan (IT, 1999a). The QA/QC program was designed to obtain a high confidence level in the data generated from this investigation. It includes measures designed to minimize error in data gathering and analysis. The field QA/QC program included the collection and analysis of an equipment rinse sample. The laboratory additionally had its own QA program, which included the analysis of method blank samples, laboratory control spike samples, and matrix spike samples.

One equipment rinse sample was collected and submitted for analysis. The equipment rinse sample was collected from boring P-10 and was analyzed for TPHg, TPHd, TRPH, VOCs, SVOCs, heavy metals, and TDS. The equipment rinse sample was not reported to contain any of the analytes in concentrations that exceeded the analytical method reporting limits (Tables 5 and 6).

The laboratory QA/QC program is described and discussed within the laboratory analytical reports (Appendix F). The method blanks were not reported to contain target parameters in concentrations exceeding the analytical method reporting limits. Percent recovery for laboratory control spike, laboratory control spike duplicate, matrix spike, and matrix spike duplicate samples were generally within limits of acceptability established by the laboratory. Some low surrogate recoveries were noted for specific samples which was attributable to matrix interferences (Appendix F).

To summarize, based on the analytical results for the QA/QC samples submitted for analysis, it is judged by IT that the accuracy of the reported analytical results is satisfactory for the range of analyte concentrations of interest and that the data is representative of subsurface conditions at the site. Further, field and laboratory procedures were judged repeatable so that the results from one day can be compared to those obtained during the remainder of the investigation.

4.0 Data Evaluation

4.1 Soil Conditions

Soil samples collected from the site have been reported by the laboratory to contain TRPH, VOCs, SVOCs, and heavy metals.

4.1.1 Total Recoverable Petroleum Hydrocarbons

Total recoverable petroleum hydrocarbons were reported in soil samples collected from 18 of the 26 soil borings. The reported concentrations ranged from 60 to 1,200 mg/kg (Table 2). Soil samples collected from throughout the soil column were reported to contain TRPH. The TRPH appears to be distributed across the site (Figure 3). Of the 37 detections of TRPH, 31 of the reported concentrations were less than 200 mg/kg. Three soil samples were reported to contain between 240 to 360 mg/kg TRPH.

Only three soil samples were reported to contain of TRPH in excess of 1,000 mg/kg. These soil samples were collected from borings P-8, P-25, and P-26. These borings are located in the northwestern portion of the site (Figure 3). Borings P-25 and P-26 are located in areas previously noted as containing "black stained sand" and as being used for drum storage (On-Site, 1993). However, the source for the TRPH is not known. Concentrations of TRPH exceeding 1,000 mg/kg were reported in the shallowest soil samples collected from 0.15 meters (0.5 feet) BGS. In each of the three borings, detectable concentrations of TRPH were not reported in the underlying sample collected from approximately 0.9 meters (3 feet) BGS (Table 2). Therefore, the vertical extent of the elevated TRPH concentrations appears to be limited to the shallow soil.

4.1.2 Volatile Organic Compounds

Volatile organic compounds were reported by the laboratory in soil samples collected from 7 of the 26 borings drilled at the site. These borings were located throughout the site (Figure 4), although three borings are located along Pine Street, in the southeastern portion of the site. The source for the VOCs is not known.

The most frequently detected VOCs were trichloroethene and tetrachloroethene. Styrene was detected in one soil sample. The reported concentrations of trichloroethene and tetrachloroethene are three to four orders of magnitude below their respective Cypress PRGs of 250 mg/kg and 92 mg/kg, respectively. The reported concentration of styrene is six orders of magnitude below the U.S. EPA, Region 9, residential soil PRG of 1,700 mg/kg (U.S. EPA, 1998).

4.1.3 Semivolatile Organic Compounds

Semivolatile organic compounds were reported by the laboratory in soil samples collected from 2 of the 26 borings drilled at the site. Borings with soil samples reported to contain SVOCs include P-16 and P-19 (Table 2). These borings were located in the western portion of the site (Figure 5). The SVOCs were detected in the shallowest soil samples collected from approximately 0.15 meters (0.5 feet) BGS.

Except for di-n-octyl phthalate, the SVOCs detected are polynuclear aromatic hydrocarbons (PAHs). No other SVOCs were reported. Di-n-octyl phthalate is a man-made compound used to make plastics soft and flexible. Polynuclear aromatic hydrocarbons can form from incomplete burning of coal, oil, gas, garbage, and other organic substances, and are found in coal tar, crude oil, creosote, and roofing tar (ATSDR, 1999). Polynuclear aromatic hydrocarbons are also used in the manufacture of dyes, plastics, insecticides, and fungicides (Merck, 1996). Of the PAHS reported present in the soil samples, pyrene, benzo(a)anthracene, benzo(a)pyrene, and benzo(g,h,i)perylene can be present in gasoline (SWRCB, 1988). The source for the SVOCs reported in soil samples collected from the site is not known.

Cypress PRGs (Caltrans, 1995) have been published for the following SVOC/PAH compounds:

benzo(a)anthracene (30 mg/kg)	benzo(b)fluoranthene (30 mg/kg)	benzo(k)fluoranthene (30 mg/kg)
benzo(a)pyrene (3 mg/kg)	chrysene (300 mg/kg)	dibenzo(a,h)anthracene (3 mg/kg)
fluoranthene (2,300 mg/kg)	indeno(1,2,3-c,d)pyrene (30 mg/kg)	pyrene (1,700 mg/kg)

U.S. EPA, Region 9, residential soil PRGs (U.S. EPA, 1998) have been published for anthracene (14,000 mg/kg). The concentrations for PAH compounds reported in the soil samples ranged from 0.340 mg/kg to 13 mg/kg. The reported concentration of only one PAH, benzo(a)pyrene, exceeded its Cypress PRG. The soil sample collected from boring P-19 was reported to have 13 mg/kg of benzo(a)pyrene at a depths of 0.15 meters (0.5 feet) BGS (Table 2 and Figure 5).

4.1.4 Heavy Metals

Soil samples collected from the site were reported to contain barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc (Table 3). Only lead was reported in soil samples at concentrations that exceeded its Cypress PRG.

The Cypress PRG for lead is 840 mg/kg. Lead concentrations in excess of the Cypress PRG ranged from 871 to 1,690 mg/kg. Soil samples with reported total lead concentrations in excess of the Cypress PRG were collected from borings P-9, P-12, and P-21 (Table 3, Figure 6).

In general, what are interpreted to be elevated concentrations of lead were reported in the shallowest samples collected from 0.15 meters BGS (0.5 feet BGS), except for one sample collected from approximately 2.1 meters (7 feet) BGS. Elevated lead concentrations were reported in soil samples collected from borings distributed across the site. The source for the lead is not known.

Heavy metal concentrations were compared to TTLC and STLC values to evaluate whether the soil would, should it become a waste, be considered a California-hazardous waste. Generally, TTLC and STLC values for heavy metals are used to judge whether a waste is a California-hazardous waste based on the total and soluble concentrations of the heavy metals within the waste. However, Class III landfill maximum allowable concentrations may be less than TTLC and STLC values. The TCLP values are used to judge whether a waste is a Resource Conservation and Recovery Act (RCRA)-hazardous waste based on the soluble concentration of heavy metals within the waste.

Soluble heavy metal results are summarized on Table 4. Only lead was reported to exceed TTLC, STLC, and TCLP values. Soil samples from the following borings were reported to exceed TTLC, STLC, and TCLP values for lead.

Boring	Exceeded TTLC	Exceeded STLC	Exceeded TCLP	Boring	Exceeded TTLC	Exceeded STLC	Exceeded TCLP
P-2		X	X	P-8			X
P-9	X			P-10		X	
P-13		X		P-19		X	
P-21	X			P-23		X	
P-25		X		P-26		X	

4.2 Groundwater Conditions

Groundwater samples collected from the site have been reported by the laboratory to contain VOCs and heavy metals. These results will be compared to California and Federal Maximum Contaminant Levels (MCLs) for drinking water to evaluate the magnitude of the reported concentrations. Drinking water MCLs are directly applicable to groundwater resources when they are specifically referenced as water quality objectives in the pertinent Water Quality Control Plan (CVRWQCB, 1998). According to the Water Quality Control Plan for San Francisco Bay Basin, the site lies within the East Bay Plain Groundwater Basin. Existing and potential beneficial uses assigned to this groundwater basin include municipal and domestic water supply, industrial water supply, industrial process water supply, agricultural water supply, and freshwater replenishment to surface waters. The San Francisco Bay Basin Water Quality Control Plan provides that groundwater within basins designated for domestic or municipal supply shall not contain concentrations or organic or inorganic constituents in excess of the Primary or Secondary MCLs (RWQCB, 1995).

4.2.1 Organic Results

Volatile organic compounds were reported by the laboratory in groundwater samples collected from 8 of the 15 borings sampled at the site. Borings with groundwater samples reported to contain VOCs include P-2, P-9, P-13, P-14, P-17, P-21, P-23, and P-24 (Table 5). These borings were predominantly located in the southern portion of the site (Figure 7). The VOCs detected include halogenated VOCs and aromatic VOCs. Although the VOCs were predominantly detected in the southern portion of the site, the source(s) for the VOCs is not known. However, low concentrations of trichloroethene were reported in soil samples collected from borings P-17 and P-21, from which two of the three groundwater samples reported to contain this VOC were collected. It is not readily apparent whether the trichloroethene reported in the soil samples is related to an on-site source for trichloroethene in the soil, as the concentrations within the soil are considered to be low.

Maximum contaminant levels (CVRWQCB, 1998) have been published for the VOC compounds listed below. The MCL noted is the lowest of the California and Federal primary and secondary MCL published.

benzene (0.001 mg/l)	chloroform (0.1 mg/l)	styrene (0.1 mg/l)
toluene (0.1 mg/l)	trichloroethene (0.005 mg/l)	

The reported concentrations of benzene in the groundwater sample collected from boring P-23 and trichloroethene in the groundwater sample collected from borings P-17 and P-21 exceeded their respective MCLs.

4.2.2 Inorganic Results

Groundwater samples were reported to contain barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc (Table 9). Concentrations of barium, beryllium, chromium, lead, nickel, and TDS were reported in excess of the respective MCLs in certain groundwater samples (Table 6 and Figure 8). The heavy metal detections exceeding MCLs were reported in groundwater samples collected from borings drilled along the eastern and southern perimeter of the site (Figure 8). The source for the elevated heavy metal concentrations is not known.

4.3 Geophysical Surveys

The EMLL survey located numerous near-surface metallic objects, most of which corresponded to features such as rails and gutters observed at the surface. However, larger metallic anomalies of the size that could be produced by USTs or other significant buried features were detected in the northeast and southwest quadrants (Appendix E, Plate 1).

Numerous magnetic anomalies were detected by the VMG survey. Most of the anomalies are interpreted to have been produced various metallic objects visible at the surface or small metallic objects in the concrete slab or shallow subsurface. Because of the intensity of the magnetic anomalies detected (Appendix E, Plate 2) , it was not possible to differentiate the location of anomalies that could be created by USTs or other significant subsurface structures.

Surveys using GPR were conducted over the EMLL anomalies in the northeast and southwest quadrants and within the fenced area containing the Historical Buildings. Ground penetrating radar surveys were also conducted over four representative VMG anomalies to evaluate if the detected

VMG anomalies could be related to USTs or other significant subsurface structures. The areas included in the GPR surveys are shown in Plate 1 of Appendix E. The GPR survey data do not indicate hyperbolic signatures in the upper zones of the subsurface that are interpreted to be large enough to be considered potential USTs. The GPR surveys do provide data that are interpreted to indicate the presence of rebar within the concrete and possible utility alignments, in addition to horizons of undisturbed strata.

5.0 Conclusions and Recommendations

Based on the laboratory results, current regulatory guidelines, and the judgement of IT the following conclusions and recommendations are offered.

- Lithologies encountered were observed to consist primarily of fine to medium sand and silty sand. These materials are interpreted to represent deposits of the Merritt Sand. Poorly graded sand tended to be encountered in the eastern portion of the site. Silty sand was predominantly encountered in the western portion of the site. Where both lithologies were encountered, the silty sand was overlain by poorly graded sand.

- The only petroleum hydrocarbons reported in the soil samples analyzed were TRPH. Total recoverable petroleum hydrocarbons were reported in soil samples collected from 18 of the 26 soil borings. The reported concentrations ranged from 60 to 1,200 mg/kg. The TRPH appears to be distributed across the site. Only three soil samples from borings P-8, P-25, and P-26 at were reported to contain of TRPH in excess of 1,000 mg/kg. Borings P-25 and P-26 are located in areas previously noted as containing "black stained sand" and as being used for drum storage. However, the source for the TRPH is not known. The vertical extent of the elevated TRPH concentrations appears to be limited to the shallow soil.

- Volatile organic compounds were reported by the laboratory in soil samples collected from 7 of the 26 borings drilled at the site. These borings were located throughout the site. The source for the VOCs is not known. The most frequently detected VOCs were trichloroethene and tetrachloroethene. The reported concentrations of VOCs are three to six orders of magnitude below their respective Cypress and U.S. EPA PRGs.

- Semivolatile organic compounds were reported by the laboratory in soil samples collected from 2 of the 26 borings drilled at the site. These borings were located in the western portion of the site. The SVOCs were detected in the shallowest soil samples collected from approximately 0.15 meters (0.5 feet) BGS. All but one of the SVOCs are PAHS. The source for the SVOCs reported in soil samples collected from the site is not known. The reported concentration of only one PAH, benzo(a)pyrene, in a soil sample collected from boring P-19, exceeded its Cypress PRG.

- Soil samples collected from the site were reported to contain barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. Only lead was reported in soil samples at concentrations that exceeded its Cypress PRG.

    - Lead concentrations in excess of the Cypress PRG ranged from 871 to 1,690 mg/kg. Soil samples with reported total lead concentrations in excess of the Cypress PRG were collected from borings P-9, P-12, and P-21.

    - In general, what are interpreted to be elevated concentrations of lead were reported in the shallowest samples collected from 0.15 meters BGS (0.5 feet BGS), except for one sample collected from approximately 2.1 meters (7 feet) BGS. Elevated lead concentrations were reported in soil samples collected from borings distributed across the site. The source for the lead is not known.

    - Heavy metal concentrations were compared to TTLC, STLC, and TCLP values to evaluate whether the soil would, should it become a waste, be considered a hazardous waste. Only lead was reported to exceed TTLC, STLC, and TCLP values. Soil samples from the following borings were reported to exceed TTLC, STLC, and TCLP values for lead.

Boring	Exceeded TTLC	Exceeded STLC	Exceeded TCLP	Boring	Exceeded TTLC	Exceeded STLC	Exceeded TCLP
P-2		X	X	P-8			X
P-9	X			P-10		X	
P-13		X		P-19		X	
P-21	X			P-23		X	
P-25		X		P-26		X	

- Volatile organic compounds were reported by the laboratory in groundwater samples collected from 8 of the 15 borings predominantly located in the southern portion of the site. The source(s) for the VOCs is not known. The reported concentrations of benzene in the groundwater sample collected from boring P-23 and trichloroethene in the groundwater sample collected from borings P-17 and P-21 exceeded their respective MCLs.

- Groundwater samples were reported to contain barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. Concentrations of barium, beryllium, chromium, lead, nickel, and TDS were reported in excess of the respective MCLs in certain groundwater samples. The heavy metal detections exceeding MCLs were reported in groundwater samples collected from borings drilled along the eastern and southern perimeter of the site. The source for the elevated heavy metal concentrations is not known.

- The geophysical surveys were affected by the surficial and near surface metallic objects. However, no evidence was generated for the presence of USTs or other significant subsurface structures. However, because of the intensity of the VMG anomalies, it may have been possible that the anomaly potentially produced by a UST may have been masked.

Based on the results of this investigation, the following recommendation is made:

- The concrete slab and metallic features should be removed and a VMG survey again conducted.

- The laboratory analytical data should be evaluated to assess whether soil or groundwater remediation are necessary.

6.0 References

ATSDR (U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry), 1998, ToxFAQs: Internet address, http://atsdr1.atsdr.cdc.gov.

Caltrans (California Department of Transportation, District 4), 1995, Final feasibility study/remedial action plan, Interstate 880, Cypress replacement project, Oakland, California; Appendix B - preliminary remediation goals and revised health-based acceptable soil concentrations for the Cypress project: dated August 1995.

_____, 1997, Cypress reconstruction project and proposed Mandela extension, site investigations for the former Hall, former Phoenix and OTR properties: task order 04-192213-01, dated January 29, 1997, 15 p.

_____, 1998, California Department of Transportation, District 4, Office of Environmental Engineering, task order 04-190270-DO: dated August 25, 1998, 8 p.

CVRWQCB (Regional Water Quality Control Board, Central Valley Region), 1998, A compilation of water quality goals: dated March 1998.

U.S. EPA (U.S. Environmental Protection Agency), 1998, Region 9 preliminary remediation goals (PRGs) 1998: dated 1998, Internet address http://www.epa.gov/region09.

Helley, E.J., Lajoie, K.R., Spangle, W.E., and Blair, M.L., 1979, Flatland deposits of the San Francisco Bay Region, California - their geology and engineering properties, and their importance to comprehensive planning: U.S. Geological Survey Professional Paper 943, 88 p.

IT (IT Corporation), 1999a, Workplan, revision 1, soil and groundwater investigation, Phoenix Iron Works site investigation: workplan dated January 25, 1999, 9 p.

_____, 1999b, Health and safety plan, revision 1, soil and groundwater investigation, Phoenix Iron Works site investigation: plan dated March 25, 1999, 26 p; with revisions in letters dated June 15, 1999, and July 6, 1999.

Merck (Merck & Co., Inc.), 1996, *The Merck index, an encyclopedia of chemicals, drugs, and biologicals*: 12th edition, Merck Research Laboratories, Whitehouse Station, New Jersey.

On-Site (On-Site Technologies), 1993, Locations of former storage units, figure 2.3.2: revision dated February 1993, cad file 357-7-5, scale 1:600.

Rogers/Pacific (Rogers/Pacific, Inc.), 1991, Final report to the National Science Foundation, engineering geologic site characterization of the greater Oakland-Alameda area, Alameda and San Francisco Counties, California: dated December 30, 1991.

RWQCB (Regional Water Quality Control Board, San Francisco Bay Region), 1995, San Francisco Bay basin (region 2), water quality control plan: dated June 21, 1995.

SWRCB (California State Water Resources Control Board), 1988, Leaking underground fuel tank manual: guidelines for site assessment, cleanup, and underground storage tank closure: dated May 1988, 121 p.

Wilson, Christopher, 1998, California Department of Transportation, Office of Environmental Engineering, Associate Engineer, telephone communication, April 21, 1998.

TABLE 1

BORING SUMMARY

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Depth Meters	Depth Feet	Coordinates Easting	Coordinates Northing	Soil Samples	GW Samples	Comments / Deviations from Workplan
P-1	3.5	11.5	1479638	482063	4	1	
P-2	3.5	11.5	1479563	482112	4	1	
P-3	3.5	11.5	1479488	482161	4	1	
P-4	3.5	11.5	1479413	482211	4		
P-5	3.5	11.5	1479583	481979	4	1	
P-6	3.5	11.5	1479508	482028	3	1	No sample recovery from 0.5 meters
P-7	3.5	11.5	1479433	482078	3	1	No sample recovery from 2.1 meters
P-8	3.5	11.5	1479315	482124	3		No sample recovery from 2.1 meters
P-9	3.5	11.5	1479548	481850	4	1	
P-10	3.5	11.5	1479453	481945	4		Field quality assurance/quality control sample collected.
P-11	3.5	11.5	1479378	481995	3		No sample recovery from 2.1 meters
P-12	3.5	11.5	1479303	482044	4	1	
P-13	3.5	11.5	1479473	481812	4	1	
P-14	3.5	11.5	1479398	481862	4	1	
P-15	3.8	12.5	1479323	481911	4	1	
P-16	3.5	11.5	1479247	481961	3		No sample recovery from 3.1 meters
P-17	3.5	11.5	1479418	481729	4	1	
P-18	3.5	11.5	1479342	481778	3		No sample recovery from 3.1 meters
P-19	3.5	11.5	1479267	481828	4		
P-20	3.5	11.5	1479237	481887	4		
P-21	3.5	11.5	1479362	481645	4	1	
P-22	3.5	11.5	1479287	481695	3		No sample recovery from 2.1 meters
P-23	3.5	11.5	1479212	481744	3	1	No sample recovery from 2.1 meters
P-24	3.5	11.5	1479231	481637	3	1	No sample recovery from 0.5 meters
P-25	3.5	11.5	1479266	482137	4		
P-26	3.5	11.5	1479231	482052	4		

Notes:
1. Depths reported in approximate meters/feet below the ground surface.
2. GW Samples = groundwater samples.

TABLE 2

ORGANIC RESULTS - SOIL

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Depth (m)	Sample Depth (ft)	DHS-LUFT TPHg	DHS-LUFT TPHd	1664 TRPH	8260 VOCs	8270 SVOCs
P-1	0.15	0.5	ND	ND	100	ND	ND
	0.9	3	ND	ND	60	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	120	ND	ND
P-2	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-3	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-4	0.15	0.5	ND	ND	ND	trichloroethene - 0.012	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	trichloroethene - 0.0068	ND
P-5	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	140	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	120	ND	ND
P-6	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-7	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-8	0.15	0.5	ND	ND	1,100	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-9	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	60	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-10	0.15	0.5	ND	ND	180	tetrachloroethene - 0.010	ND
	0.9	3	ND	ND	80	ND	ND
	2.1	7	ND	ND	120	ND	ND
	3.1	10	ND	ND	240	ND	ND
P-11	0.15	0.5	ND	ND	160	ND	ND
	0.9	3	ND	ND	60	ND	ND
	3.1	10	ND	ND	80	ND	ND
P-12	0.15	0.5	ND	ND	ND	trichloroethene - 0.026	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-13	0.15	0.5	ND	ND	60	tetrachloroethene - 0.015	ND
	0.9	3	ND	ND	80	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	60	ND	ND
P-14	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-15	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND

TABLE 2

ORGANIC RESULTS - SOIL
Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Depth (m)	Sample Depth (ft)	DHS-LUFT TPHg	DHS-LUFT TPHd	1664 TRPH	8260 VOCs	8270 SVOCs
P-16	0.15	0.5	ND	ND	100	ND	anthracene - 0.780 benzo(a)anthracene - 0.340 benzo(b)fluoranthene - 0.520 benzo(k)fluoranthene - 0.520 benzo(g,h,l)perylene - 0.430 benzo(a)pyrene - 0.500 chrysene - 0.440 fluoranthene - 0.910 pyrene - 0.960
	0.9	3	ND	ND	120	ND	ND
	2.1	7	ND	ND	ND	ND	ND
P-17	0.15	0.5	ND	ND	180	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	60	trichloroethene - 0.015	ND
	3.1	10	ND	ND	ND	trichloroethene - 0.028	ND
P-18	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	320	ND	ND
	2.1	7	ND	ND	ND	ND	ND
P-19	0.15	0.5	ND	ND	80	ND	benzo(k)fluoranthene - 8 benzo(g,h,l)perylene - 2 benzo(a)pyrene - 13 di-n-octyl phthalate - 1.4 dibenz(a,h)anthracene - 1.1 indeno(1,2,3-cd)pyrene - 0.920
	0.9	3	ND	ND	100	ND	ND
	2.1	7	ND	ND	100	ND	ND
	3.1	10	ND	ND	60	ND	ND
P-20	0.15	0.5	ND	ND	140	ND	ND
	0.9	3	ND	ND	80	ND	ND
	2.1	7	ND	ND	120	ND	ND
	3.1	10	ND	ND	160	ND	ND
P-21	0.15	0.5	ND	ND	260	trichloroethene - 0.023	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	trichloroethene - 0.0042	ND
	3.1	10	ND	ND	ND	trichloroethene - 0.0057	ND
P-22	0.15	0.5	ND	ND	80	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-23	0.15	0.5	ND	ND	ND	ND	ND
	0.9	3	ND	ND	100	ND	ND
	3.1	10	ND	ND	100	ND	ND
P-24	0.9	3	ND	ND	ND	styrene - 0.0037	ND
	2.1	7	ND	ND	60	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-25	0.15	0.5	ND	ND	1,200	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
P-26	0.15	0.5	ND	ND	1,140	ND	ND
	0.9	3	ND	ND	ND	ND	ND
	2.1	7	ND	ND	ND	ND	ND
	3.1	10	ND	ND	ND	ND	ND
Reporting Limits			1.0	1.0	50	0.002 to 0.0071	0.33 to 1.6

Notes:
1. Analyses conducted in general accordance with the U.S. Environmental Protection Agency Method listed. DHS-LUFT = Department of Health Services Leaking Underground Tank Manual method.
2. Sample depths reported in approximate meters (m) / feet (ft) below the ground surface.
3. Concentrations reported in milligrams per kilogram.
4. ND = not detected in concentrations exceeding the listed reporting limit.
5. VOCs = volatile organic compounds. SVOCs = semivolatile organic compounds. TPHg = total petroleum hydrocarbons as gasoline. TPHd = total petroleum hydrocarbons as diesel. TRPH = total recoverable petroleum hydrocarbons.
6. Soil samples labeled as follows: boring no.-depth-sample tube no. with 1 being from the bottom. Ex.: P1-0.5': boring P-1, 0.5-foot depth.

TABLE 3

INORGANIC RESULTS - SOIL

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Depth (m)	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
P-1	0.15	0.5	ND	ND	78	ND	ND	28	4.2	17	13	ND	ND	20	ND	ND	ND	21	40
	0.9	3	ND	ND	46	ND	ND	32	ND	16	3.2	ND	ND	23	ND	ND	ND	25	27
	2.1	7	ND	ND	115	ND	ND	60	5.8	35	2.6	0.028	ND	53	ND	ND	ND	38	43
	3.1	10	ND	ND	97	ND	ND	55	9.2	103	2.9	ND	ND	63	ND	ND	ND	38	78
P-2	0.15	0.5	ND	ND	88	ND	ND	34	ND	19	**225**	0.450	ND	22	ND	ND	ND	23	79
	0.9	3	ND	ND	56	ND	ND	30	ND	12	1.5	0.011	ND	21	ND	ND	ND	22	21
	2.1	7	ND	ND	67	ND	ND	53	6.1	13	1.8	ND	ND	46	ND	ND	ND	28	29
	3.1	10	ND	ND	84	ND	1.1	45	8.6	16	2.4	0.014	ND	54	ND	ND	ND	33	34
P-3	0.15	0.5	ND	ND	80	0.46	ND	27	ND	24	5.9	0.021	ND	16	ND	ND	ND	21	29
	0.9	3	ND	ND	46	ND	ND	33	ND	12	2.0	0.011	ND	20	ND	ND	ND	26	21
	2.1	7	ND	ND	67	ND	ND	43	5.1	15	1.9	ND	ND	38	ND	ND	ND	28	27
	3.1	10	ND	ND	78	0.32	ND	46	8.2	12	2.8	ND	ND	66	ND	ND	ND	34	35
P-4	0.15	0.5	ND	ND	61	ND	ND	31	ND	18	2.3	0.014	ND	18	ND	ND	ND	20	27
	0.9	3	ND	ND	51	ND	ND	35	ND	13	1.7	ND	ND	22	ND	ND	ND	23	21
	2.1	7	ND	ND	72	ND	ND	46	6.7	12	2.2	0.013	ND	45	ND	ND	ND	28	27
	3.1	10	ND	ND	84	ND	ND	81	ND	18	2.2	ND	ND	54	ND	ND	ND	34	34
P-5	0.15	0.5	ND	ND	380	0.43	1.4	34	7.7	65	**704**	0.566	ND	33	ND	ND	ND	33	831
	0.9	3	ND	ND	53	ND	ND	32	ND	20	3.5	ND	ND	23	ND	ND	ND	25	24
	2.1	7	ND	ND	44	ND	ND	36	5.8	15	1.6	0.022	ND	32	ND	ND	ND	25	23
	3.1	10	ND	ND	64	ND	ND	38	6.1	25	2.2	ND	ND	41	ND	ND	ND	26	32
P-6	0.9	3	ND	ND	36	ND	ND	32	ND	12	1.8	0.012	ND	24	ND	ND	ND	22	462
	2.1	7	ND	ND	61	ND	ND	44	7.6	12	2.5	ND	ND	54	ND	ND	ND	32	33
	3.1	10	ND	ND	64	ND	ND	52	7.1	16	2.3	ND	ND	55	ND	ND	ND	ND	36
P-7	0.15	0.5	ND	ND	108	ND	ND	37	5.9	40	6.2	0.018	ND	28	ND	ND	ND	28	49
	0.9	3	ND	ND	46	ND	ND	32	ND	12	2.7	0.011	ND	20	ND	ND	ND	23	20
	3.1	10	ND	ND	66	ND	ND	48	6.6	14	1.9	0.011	ND	53	ND	ND	ND	28	34
P-8	0.15	0.5	ND	ND	172	ND	ND	31	5.7	38	**711**	0.24	ND	30	ND	ND	ND	22	194
	0.9	3	ND	ND	57	ND	ND	39	ND	7.1	2.5	ND	ND	21	ND	ND	ND	25	57
	3.1	10	ND	ND	57	ND	ND	34	6.0	8.3	1.8	ND	ND	42	ND	ND	ND	26	24
P-9	0.15	0.5	ND	ND	236	0.41	ND	29	5.5	161	***1,690***	1.1	ND	19	ND	ND	ND	27	254
	0.9	3	ND	ND	46	ND	ND	27	ND	15	1.9	ND	ND	19	ND	ND	ND	21	23
	2.1	7	ND	ND	69	0.32	ND	38	7.0	31	3.0	0.023	ND	48	ND	ND	ND	35	35
	3.1	10	ND	ND	67	ND	ND	37	6.8	43	2.0	ND	ND	46	ND	ND	ND	26	42
P-10	0.15	0.5	ND	ND	108	ND	ND	27	ND	17	108	0.263	ND	20	ND	ND	ND	23	100
	0.9	3	ND	ND	42	ND	ND	27	ND	5.5	8.5	ND	ND	19	ND	ND	ND	21	14
	2.1	7	ND	ND	79	ND	ND	36	7.0	9.8	2.0	ND	ND	47	ND	ND	ND	29	26
	3.1	10	ND	ND	71	ND	ND	39	6.0	9.9	1.5	ND	ND	45	ND	ND	ND	26	25
P-11	0.15	0.5	ND	ND	207	ND	0.91	27	5.6	36	**505**	0.665	ND	28	ND	ND	ND	21	510
	0.9	3	ND	ND	56	ND	ND	30	ND	5.4	1.2	ND	ND	22	ND	ND	ND	22	17
	3.1	10	ND	ND	68	ND	ND	39	5.8	8.4	1.4	ND	ND	48	ND	ND	ND	27	24
P-12	0.15	0.5	ND	ND	334	ND	0.95	25	5.0	33	**871**	0.17	ND	23	ND	ND	ND	23	822
	0.9	3	ND	ND	46	ND	ND	27	ND	5.2	1.7	ND	ND	18	ND	ND	ND	21	16
	2.1	7	ND	ND	54	ND	ND	33	6.7	11	2.0	ND	ND	38	ND	ND	ND	26	25
	3.1	10	ND	ND	72	ND	ND	28	6.4	8.3	2.4	ND	ND	43	ND	ND	ND	26	23
P-13	0.15	0.5	ND	ND	204	ND	ND	ND	ND	31	**90**	0.090	ND	17	ND	ND	ND	19	65
	0.9	3	ND	ND	51	ND	ND	32	ND	32	2.0	ND	ND	17	ND	ND	ND	20	31
	2.1	7	ND	ND	97	0.37	ND	60	9.7	69	2.9	ND	ND	60	ND	ND	ND	40	58
	3.1	10	ND	ND	67	ND	ND	67	6.1	28	1.9	0.012	ND	46	ND	ND	ND	28	34
P-14	0.15	0.5	ND	ND	66	ND	ND	38	ND	21	9.9	0.035	ND	21	ND	ND	ND	23	48
	0.9	3	ND	ND	36	ND	ND	33	ND	13	2.9	0.012	ND	19	ND	ND	ND	22	24
	2.1	7	ND	ND	72	ND	ND	47	7.6	11	2.3	ND	ND	54	ND	ND	ND	32	33
	3.1	10	ND	ND	74	ND	ND	50	8.2	29	3.3	ND	ND	61	ND	ND	ND	34	46
P-15	0.15	0.5	ND	ND	134	ND	ND	26	ND	11	27	0.088	ND	19	ND	ND	ND	20	38
	0.9	3	ND	ND	54	ND	ND	30	ND	7.9	1.5	ND	ND	22	ND	ND	ND	24	20
	2.1	7	ND	ND	27	ND	ND	27	ND	5.1	1.2	0.017	ND	19	ND	ND	ND	18	14
	3.1	10	ND	ND	58	ND	ND	30	5.1	6.8	1.6	ND	ND	36	ND	ND	ND	20	21

TABLE 3

INORGANIC RESULTS - SOIL

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Depth (m)	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
P-16	0.15	0.5	ND	ND	107	ND	ND	28	ND	32	**53**	0.078	ND	21	ND	ND	ND	22	43
	0.9	3	ND	ND	51	ND	ND	30	ND	4.8	1.0	ND	ND	18	ND	ND	ND	20	27
	2.1	7	ND	ND	59	ND	ND	32	5.5	7.3	1.4	ND	ND	38	ND	ND	ND	24	23
P-17	0.15	0.5	ND	ND	74	ND	ND	35	ND	16	2.1	0.034	ND	19	ND	ND	ND	21	38
	0.9	3	ND	ND	44	ND	ND	32	ND	13	1.6	ND	ND	20	ND	ND	ND	23	22
	2.1	7	ND	ND	85	ND	ND	47	7.3	28	2.6	0.032	ND	55	ND	ND	ND	33	39
	3.1	10	ND	ND	80	ND	ND	53	7.5	28	2.0	0.10	ND	54	ND	ND	ND	30	47
P-18	0.15	0.5	ND	ND	56	ND	ND	21	ND	6.6	11	ND	ND	16	ND	ND	ND	18	48
	0.9	3	ND	ND	51	ND	ND	27	ND	5.6	1.7	ND	ND	18	ND	ND	ND	23	18
	2.1	7	ND	ND	77	0.39	ND	44	ND	11	2.1	ND	ND	41	ND	ND	ND	34	29
P-19	0.15	0.5	ND	ND	158	ND	ND	21	ND	29	**351**	0.24	ND	16	ND	ND	ND	20	203
	0.9	3	ND	ND	50	ND	ND	26	ND	8.6	1.7	0.024	ND	18	ND	ND	ND	24	20
	2.1	7	ND	ND	59	0.30	ND	35	6.2	7.5	2.1	ND	ND	36	ND	ND	ND	27	26
	3.1	10	ND	ND	58	ND	ND	31	6.3	20	3.5	ND	ND	39	ND	ND	ND	28	42
P-20	0.15	0.5	ND	ND	238	ND	ND	25	6.0	44	**518**	0.28	ND	32	ND	ND	ND	24	274
	0.9	3	ND	ND	54	ND	ND	35	5.1	8.2	2.4	ND	ND	22	ND	ND	ND	28	23
	2.1	7	ND	ND	168	0.44	ND	37	7.8	52	**282**	0.16	ND	31	ND	ND	ND	36	168
	3.1	10	ND	ND	77	0.30	ND	31	6.0	7.5	2.2	ND	ND	38	ND	ND	ND	27	28
P-21	0.15	0.5	ND	ND	313	ND	4.2	23	6.0	75	<u>***1,500***</u>	0.20	ND	28	ND	ND	ND	20	1,690
	0.9	3	ND	ND	55	ND	ND	30	7.2	15	6.8	0.011	ND	23	ND	ND	ND	23	22
	2.1	7	ND	ND	91	0.42	ND	57	12	54	3.8	ND	ND	64	ND	ND	ND	44	54
	3.1	10	ND	ND	64	ND	ND	38	6.0	11	2.1	ND	ND	42	ND	ND	ND	26	26
P-22	0.15	0.5	ND	ND	60	ND	ND	25	ND	5.3	1.6	0.017	ND	17	ND	ND	ND	20	29
	0.9	3	ND	ND	29	ND	ND	25	ND	5.6	1.4	ND	ND	16	ND	ND	ND	20	15
	3.1	10	ND	ND	47	ND	ND	33	ND	6.0	1.4	ND	ND	33	ND	ND	ND	20	22
P-23	0.15	0.5	ND	ND	154	ND	ND	30	ND	15	**144**	0.20	ND	20	ND	ND	ND	23	61
	0.9	3	ND	ND	47	ND	ND	22	ND	4.8	1.4	ND	ND	18	ND	ND	ND	21	15
	3.1	10	ND	ND	59	ND	ND	30	ND	6.7	1.5	ND	ND	35	ND	ND	ND	22	22
P-24	0.9	3	ND	ND	54	ND	ND	38	5.6	46	10	0.15	ND	27	ND	ND	ND	25	41
	2.1	7	ND	ND	28	ND	ND	33	ND	12	1.1	0.14	ND	22	ND	ND	ND	18	26
	3.1	10	ND	ND	82	ND	ND	46	10	43	5.5	ND	ND	54	ND	ND	ND	31	62
P-25	0.15	0.5	ND	ND	123	ND	ND	42	7.4	76	**182**	0.216	ND	40	ND	ND	ND	35	196
	0.9	3	ND	ND	47	ND	ND	29	ND	7.3	ND	ND	ND	18	ND	ND	ND	20	18
	2.1	7	ND	ND	56	ND	ND	37	6.0	28	2.0	0.010	ND	42	ND	ND	ND	25	34
	3.1	10	ND	ND	69	ND	ND	48	6.8	29	1.8	ND	ND	57	ND	ND	ND	30	44
P-26	0.15	0.5	ND	ND	289	ND	ND	28	5.9	39	70	0.073	ND	29	ND	ND	ND	36	81
	0.9	3	ND	ND	92	ND	ND	24	ND	11	19	0.092	ND	16	ND	ND	ND	20	50
	2.1	7	ND	ND	86	ND	ND	44	5.7	16	2.2	0.043	ND	43	ND	ND	ND	28	34
	3.1	10	ND	ND	83	0.32	ND	49	5.5	10	2.4	ND	ND	52	ND	ND	ND	35	30
TTLC			500	500	10,000	75	100	2,500	8,000	2,500	1,000	20	3,500	2,000	100	500	700	2,400	5,000
10X STLC			150	50	1,000	7.5	10	5,600	800	250	50	2	3,500	200	10	50	70	240	2,500
PRG			67	19	12,000	1.8	24	170,000	22	5,000	840	45	830	400	830	830	27	1,200	50,000
Reporting Limit			6.0	10	2.0	0.30	0.50	1.0	5.0	2.0	1.0	0.010	5.0	4.0	10	1.0	10	5.0	1.5

Notes:

1. Metals analyses conducted in general accordance with U.S. Environmental Protection Agency (EPA) Methods 6010 and 7471.
2. Sample depths reported in approximate meters (m) / feet (ft) below the ground surface.
3. Concentrations reported in milligrams per kilogram.
4. ND = not detected in concentrations exceeding the listed reporting limit.
5. Soil samples labeled as follows: boring no.-depth. Ex.: P1-0.5': boring P-1, 0.5-foot depth.
6. TTLC = Total Threshold Limit Concentration.
7. 10X STLC = 10 times the Soluble Threshold Limit Concentration. Values listed in milligrams per liter.
8. PRG = preliminary remediation goal established for the Cypress area of investigation by the Office of Scientific Affairs. PRG for chromium is for trivalent chromium.
9. Bold results equal or exceed 10X STLC values. Bold and italics results equal or exceed the TTLC. Underlined results equal or exceed the PRG.

TABLE 4

SOLUBLE METAL RESULTS - SOIL

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Depth meters	Sample Depth feet	Lead Total	Lead WET	Lead TCLP
P-2	0.15	0.5	225	**11**	**17**
P-5	0.15	0.5	704		0.42
P-8	0.15	0.5	711		**60**
P-9	0.15	0.5	**1,690**		1.2
P-10	0.15	0.5	108	**14**	
P-11	0.15	0.5	505		0.57
P-12	0.15	0.5	871		0.12
P-13	0.15	0.5	90	**6.2**	
P-16	0.15	0.5	53	0.26	
P-19	0.15	0.5	351	**33**	0.066
P-20	0.15	0.5	518		0.16
	2.1	7	282	0.077	0.063
P-21	0.15	0.5	**1,500**		3.1
P-23	0.15	0.5	144	**10**	
P-25	0.15	0.5	182	**35**	
P-26	0.15	0.5	70	**10**	
TTLC			1,000		
STLC				5.0	
TCLP					5.0
Reporting Limit			1.0	0.050	0.050

Notes:

1. TTLC = total threshold limit concentration. STLC = soluble threshold limit concentration. WET = waste extraction test. TCLP = toxicity characteristic leaching procedure.
2. Sample depths reported in approximate meters (m) / feet (ft) below the ground surface.
3. WET conducted in general accordance with California Title 22 procedures. TCLP extraction and metal analyses conducted in general accordance with U.S. Environmental Protection Agency methods.
4. Total metal results reported in milligrams per kilogram. WET and TCLP results reported in milligrams per liter.
5. ND = not detected in concentrations exceeding the listed reporting limit.
6. Soil samples labeled as follows: boring no.-depth. Ex.: P1-0.3 - boring P-1, 0.3-meter depth.
7. Bold values exceed the TTLC, STLC, or TCLP.

TABLE 5

ORGANIC RESULTS - WATER

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Type	DHS-LUFT TPHg	DHS-LUFT TPHd	1664 TRPH	8260 VOCs	8270 SVOCs
P-1	GW	ND	ND	ND	ND	ND
P-2	GW	ND	ND	ND	styrene - 0.0028	ND
P-3	GW	ND	ND	ND	ND	ND
P-5	GW	ND	ND	ND	ND	ND
P-6	GW	ND	ND	ND	ND	ND
P-7	GW	ND	ND	ND	ND	ND
P-9	GW	ND	ND	ND	chloroform - 0.023	ND
P-12	GW	ND	ND	ND	ND	ND
P-13	GW	ND	ND	ND	2-hexanone - 0.370	ND
P-14	GW	ND	ND	ND	vinyl acetate - 0.0055 chloroform - 0.0026	ND
P-15	GW	ND	ND	ND	ND	ND
P-17	GW	ND	ND	ND	carbon disulfide - 0.0037 trichloroethene - 0.140	ND
P-21	GW	ND	ND	ND	trichloroethene - 0.046	ND
P-23	GW	ND	ND	ND	carbon disulfide - 0.0022 benzene - 0.055 toluene - 0.0055	ND
P-24	GW	ND	ND	ND	carbon disulfide - 0.0070 trichloroethene - 0.0023	ND
P-10	ER	ND	ND	ND	ND	ND
Reporting Limits		0.05	0.05	5.0	0.002 to 0.0071	0.01 to 0.05

Notes:

1. Analyses conducted in general accordance with the U.S. Environmental Protection Agency Method listed. DHS-LUFT = Department of Health Services Leaking Underground Tank Manual method.
2. Sample types: GW = groundwater grab sample. ER = equipment rinse sample.
3. Concentrations reported in milligrams per liter (mg/l).
4. ND = not detected in concentrations exceeding the listed reporting limit.
5. VOCs = volatile organic compounds. SVOCs = semivolatile organic compounds.
   TPHg = total petroleum hydrocarbons as gasoline. TPHd = total petroleum hydrocarbons as diesel.
   TRPH = total recoverable petroleum hydrocarbons.
6. Groundwater samples labeled as follows: boring no.-GW. Ex.: P-1-GW for the groundwater sample collected from boring P-1.

TABLE 6

INORGANIC RESULTS - WATER

Caltrans - Phoenix Iron Works (Phoenix 800) Investigation

Boring Number	Sample Type	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	TDS
P-1	GW	ND	ND	0.92	ND	ND	**0.33**	0.071	0.076	**0.025**	ND	ND	**0.53**	ND	ND	ND	0.24	0.43	**809**
P-2	GW	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.13	393
P-3	GW	ND	ND	0.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.13	**961**
P-5	GW	ND	ND	0.35	ND	ND	**0.12**	ND	0.031	**0.027**	ND	ND	**0.19**	ND	ND	ND	0.097	0.11	**926**
P-6	GW	ND	ND	0.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.17	**531**
P-7	GW	ND	ND	0.030	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.049	**898**
P-9	GW	ND	ND	0.28	ND	ND	**0.086**	ND	0.020	ND	ND	ND	0.082	ND	ND	ND	0.072	0.10	287
P-12	GW	ND	ND	0.098	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**749**
P-13	GW	ND	ND	**1.3**	**0.0042**	ND	**0.56**	0.11	0.13	**0.059**	0.00029	ND	**0.70**	ND	ND	ND	0.45	0.50	320
P-14	GW	ND	ND	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22	470
P-15	GW	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.028	**744**
P-17	GW	ND	ND	**1.2**	0.0034	ND	**0.46**	0.11	0.12	**0.061**	0.00037	ND	**0.68**	ND	ND	ND	0.38	0.38	**609**
P-21	GW	ND	ND	**1.7**	**0.0045**	ND	**0.65**	0.16	0.18	**0.51**	0.00050	ND	**0.97**	ND	ND	ND	0.52	0.87	**979**
P-23	GW	ND	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.016	**735**
P-24	GW	ND	ND	**3.3**	**0.013**	ND	**1.8**	0.36	0.48	**1.1**	0.0016	ND	**2.3**	ND	ND	ND	1.4	1.5	**1,312**
P-10	ER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Drinking Water Standards	CA MCL	0.006	0.05	1	0.004	0.005	0.05		1.3	0.015	0.002		0.1	0.05		0.002			
	CA 2 MCL								1						0.1			5	500
	US MCL	0.006	0.05	2	0.004	0.005	0.1		1.3	0.015	0.002		0.1	0.05		0.002			
	US 2 MCL								1						0.1			5	500
Reporting Limits		0.060	0.10	0.020	0.0030	0.0050	0.010	0.050	0.020	0.010	0.00020	0.050	0.040	0.10	0.010	0.10	0.050	0.015	10

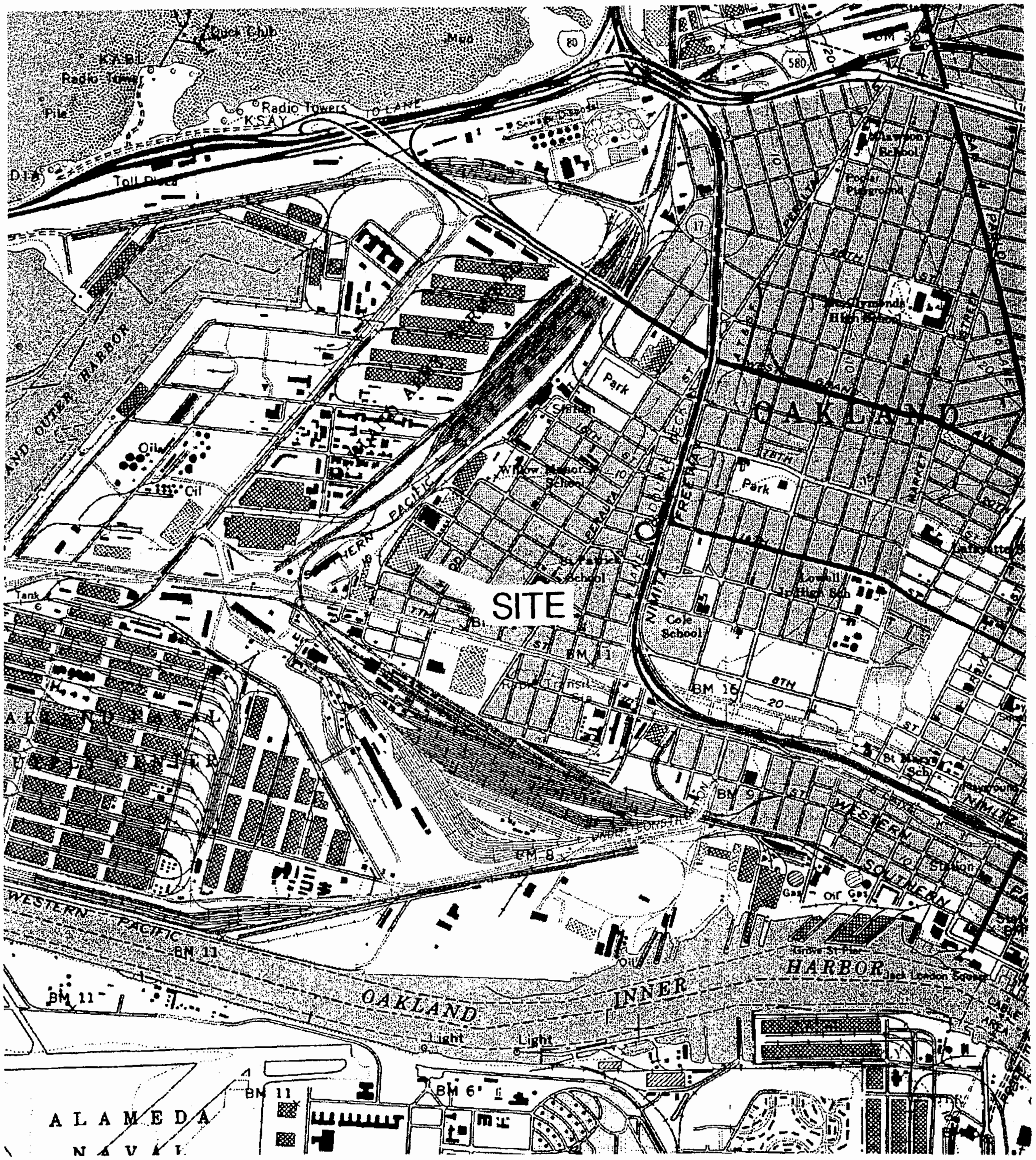
Notes:
1. Metals analyses conducted in general accordance with U.S. Environmental Protection Agency (EPA) Methods 6010 and 7471. TDS analysis conducted in general accordance with EPA Method 160.1.
2. Sample type: GW = groundwater grab sample. ER = equipment rinse sample.
3. Concentrations reported in milligrams per liter.
4. TDS = total dissolved solids.
5. Bold results exceed drinking water standard levels.
6. ND = not detected in concentrations exceeding the listed reporting limit.
7. Groundwater samples labeled as follows: boring no.-GW. Ex.: P-1-GW for the groundwater sample collected from boring P-1.
8. CA MCL = California primary maximum contaminant level (MCL). CA 2 MCL = California secondary MCL. US MCL = U.S. primary MCL. US 2 MCL = U.S. secondary MCL.

DRAWING NUMBER 776768-A1

DRAWN BY 9-10-98

CHECKED BY SJZ

APPROVED BY



REFERENCE: USGS 7.5' QUADRANGLE "OAKLAND WEST, CALIF." DATED: 1959, PHOTOREVISED:1980 SCALE 1:24,000

SCALE

0 2000 4000 FEET

0 .5 1 km

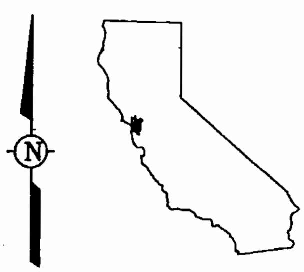


FIGURE 1

SITE LOCATION MAP

PHOENIX IRON WORKS

PREPARED FOR

CAL TRANS

TO 04-190270-DO

INTERNATIONAL TECHNOLOGY CORPORATION

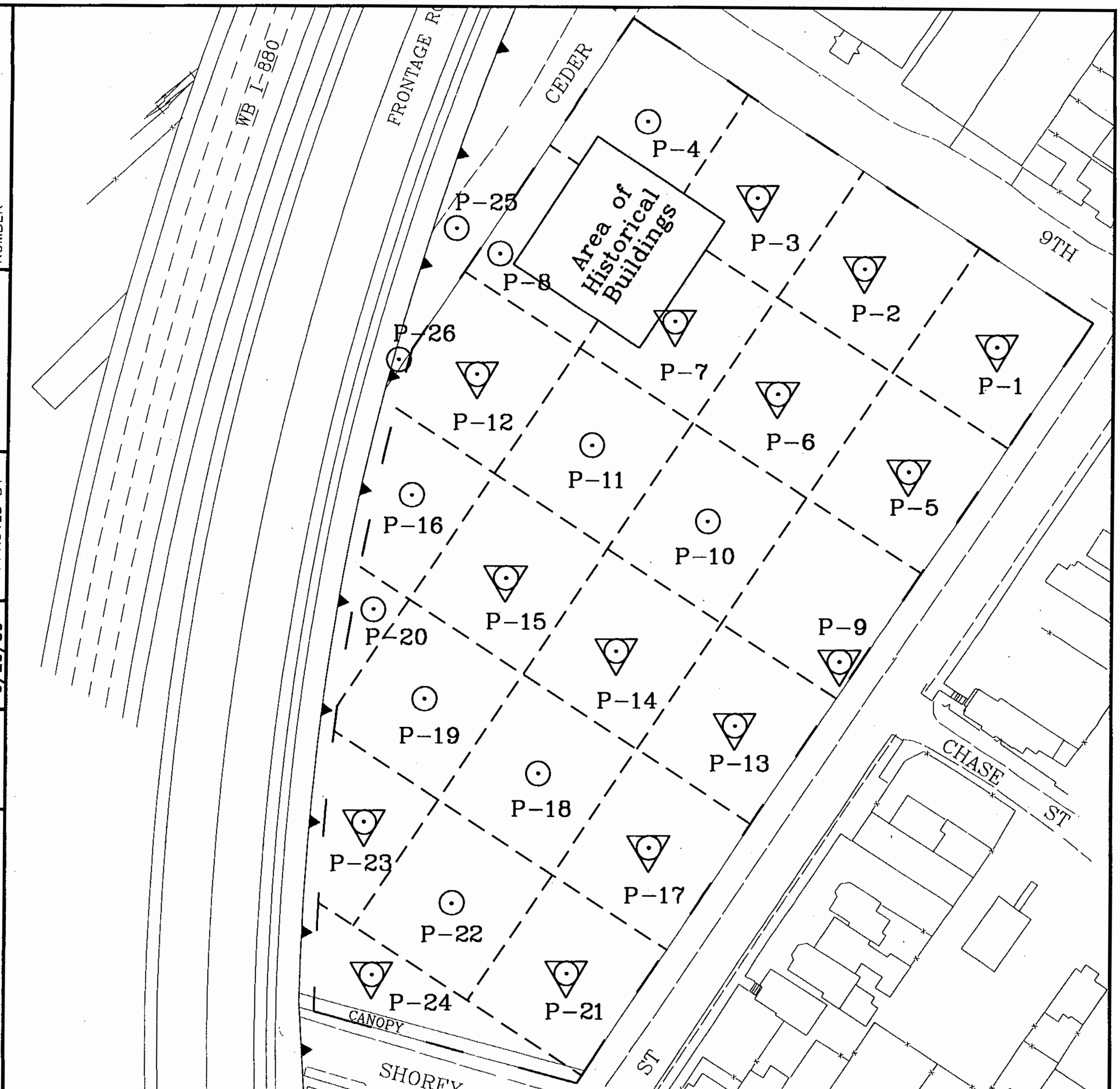
CT-PI-LM(CT15)

DRAWING NUMBER 776768-2R

CHECKED BY

APPROVED BY

DRAWN BY DPB 9/29/99



LEGEND

P-2 BORING LOCATION AND DESIGNATION

GROUNDWATER SAMPLE LOCATION

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.

APPROXIMATE SCALE

0 30 61 METERS

0 100 200 FEET

N

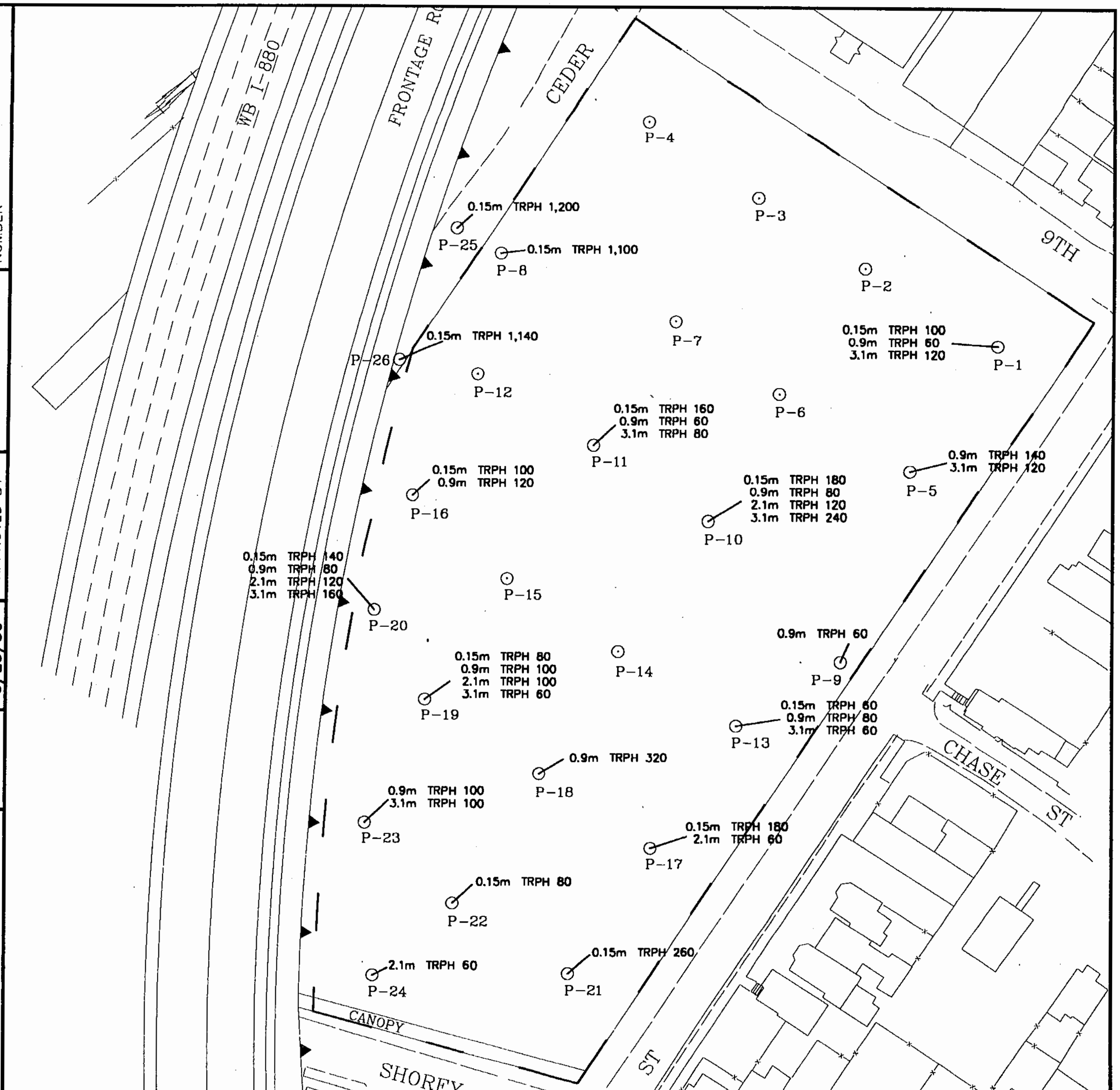
FIGURE 2

SOIL AND GROUNDWATER SAMPLE LOCATIONS

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

PHXFIG2R.DWG



DRAWING NUMBER 776768-3R

CHECKED BY

APPROVED BY

DRAWN BY DPB 9/29/99

LEGEND

P-2 BORING LOCATION AND DESIGNATION

0.15m TRPH 180 SAMPLE DEPTH (meters) AND TOTAL RECOVERABLE PETROLEUM HYDROCARBON CONCENTRATION (milligrams per kilogram)

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.

APPROXIMATE SCALE

0 30 61 METERS

0 100 200 FEET

N

FIGURE 3

PETROLEUM HYDROCARBON DETECTIONS IN SOIL

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

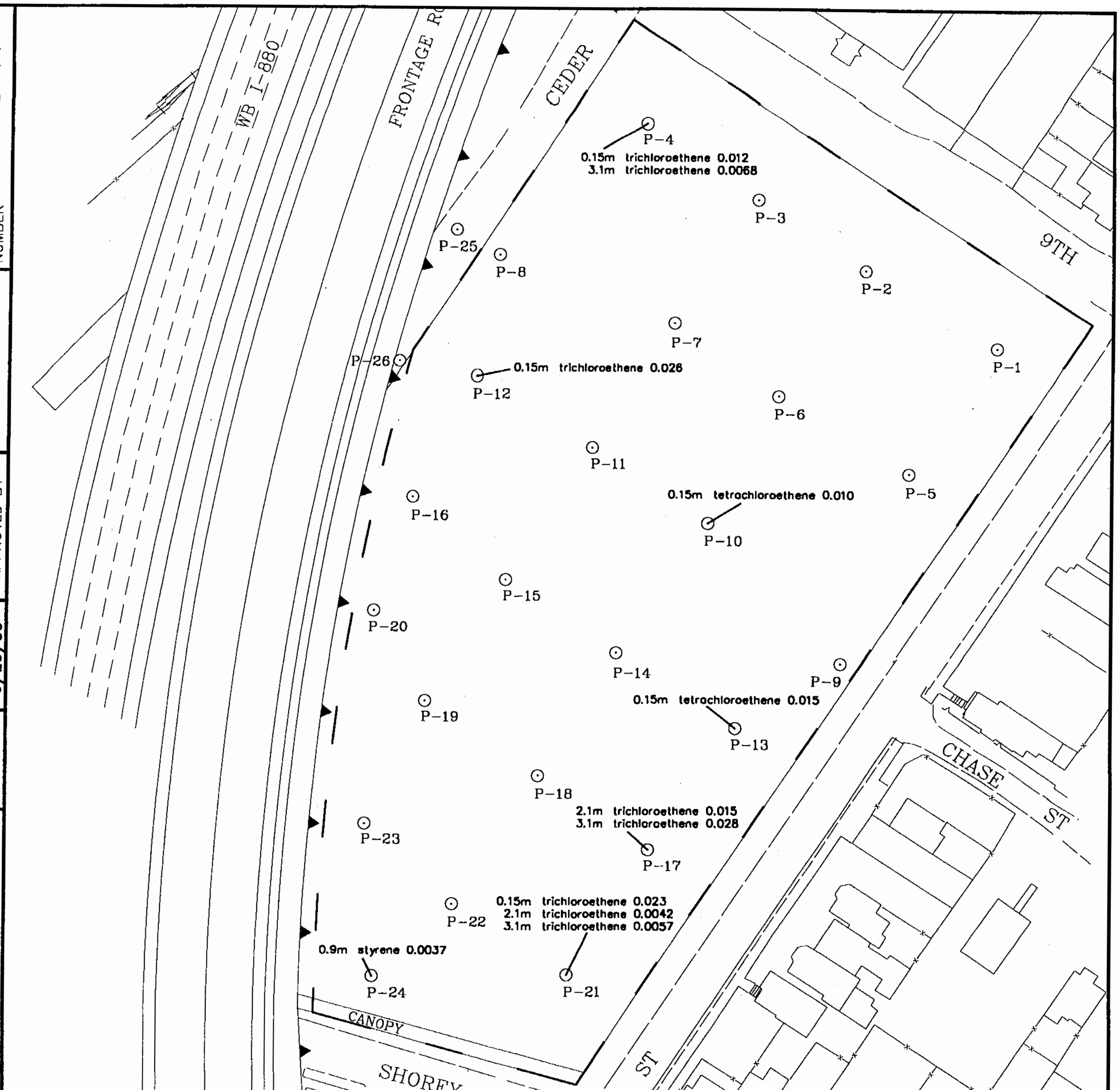
PHXFIG3R.DWG/HYDROCARBONS

DRAWING NUMBER 776768-4R

CHECKED BY

APPROVED BY

DRAWN BY DPB 9/29/99



LEGEND

P-2 — BORING LOCATION AND DESIGNATION

0.15m trichloroethene 0.012 — SAMPLE DEPTH (meters) AND VOLATILE ORGANIC COMPOUND CONCENTRATION (milligrams per kilogram)

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.

APPROXIMATE SCALE

0 — 30 — 61 METERS

0 — 100 — 200 FEET

N

FIGURE 4

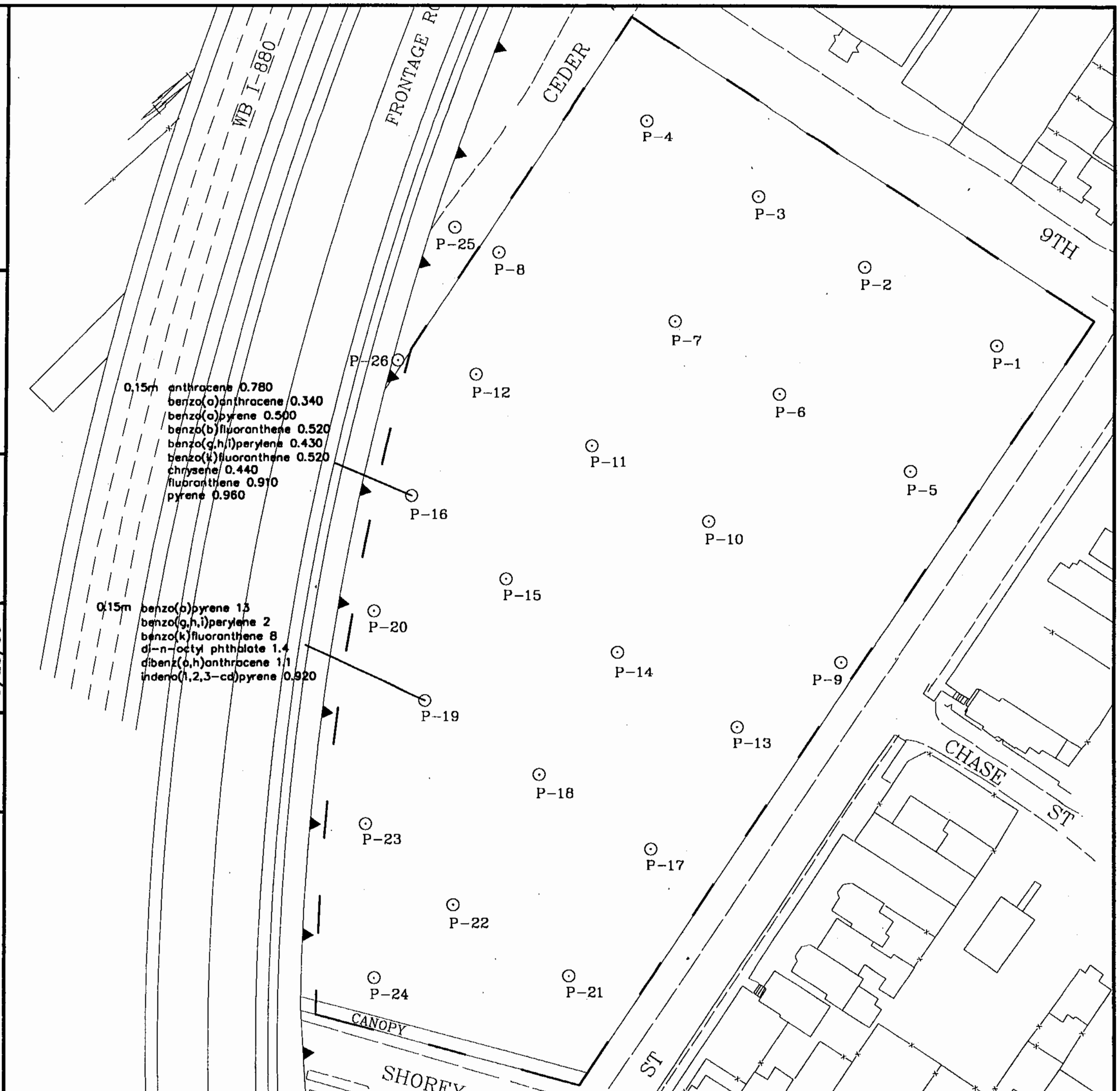
VOLATILE ORGANIC COMPOUND DETECTIONS IN SOIL

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

PHXFIG3R.DWG/VOCS

DRAWING NUMBER	776768-5R
CHECKED BY	
APPROVED BY	
DPB	9/29/99
DRAWN BY	



LEGEND

⊙ P-2 — BORING LOCATION AND DESIGNATION

0.15m chrysene 0.440 — SAMPLE DEPTH (meters) AND SEMIVOLATILE ORGANIC COMPOUND CONCENTRATION (milligrams per kilogram)

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.

APPROXIMATE SCALE

0 — 30 — 61 METERS
0 — 100 — 200 FEET

N

FIGURE 5

SEMIVOLATILE ORGANIC COMPOUND DETECTIONS IN SOIL

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

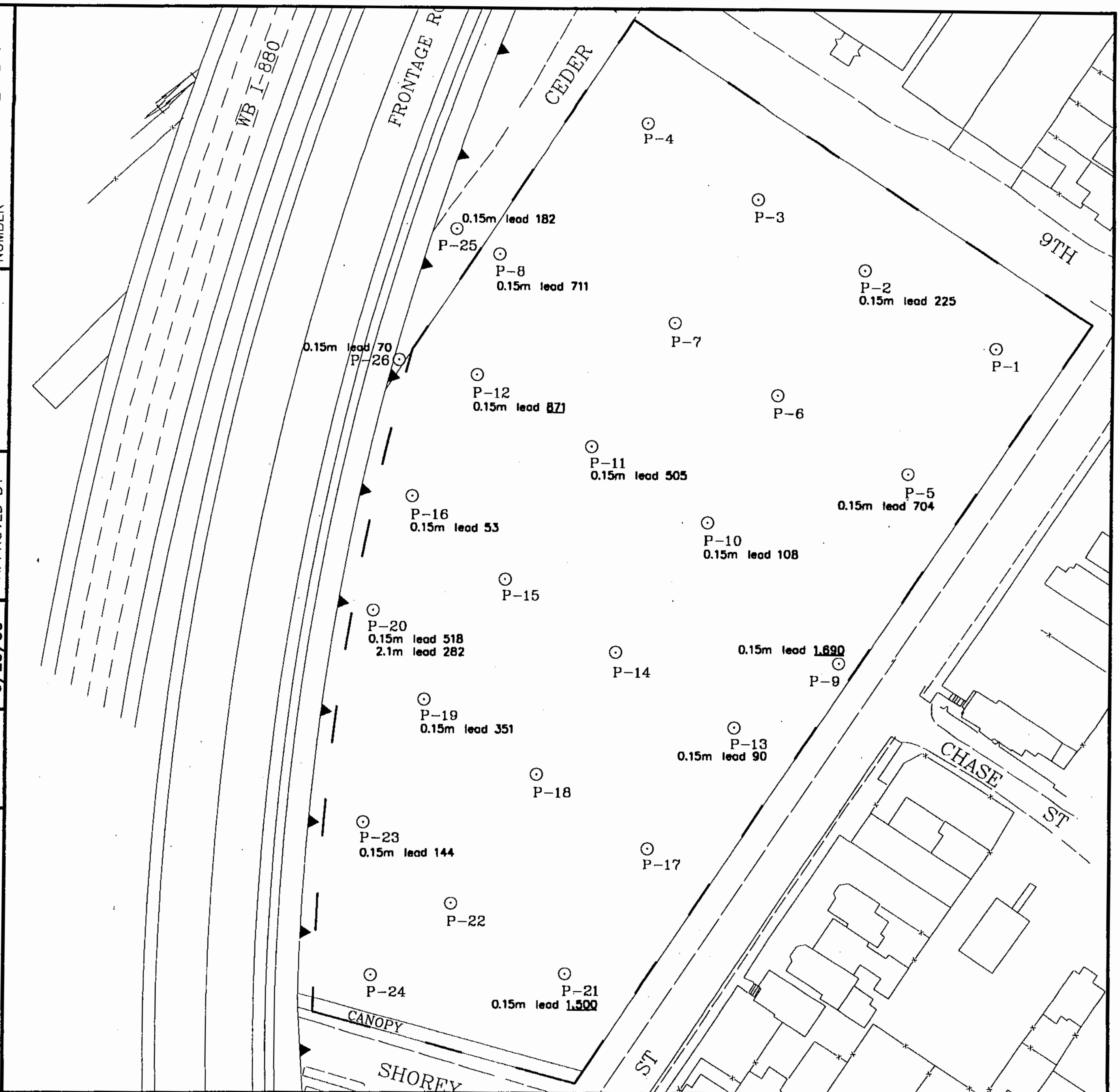
PHXFIG3R.DWG/SVOCS

DRAWING NUMBER 776768-6R

CHECKED BY

APPROVED BY

DRAWN BY DPB 9/29/99



LEGEND

P-2 BORING LOCATION AND DESIGNATION

0.15m lead 225 SAMPLE DEPTH (meters) AND TOTAL LEAD CONCENTRATION (milligrams per kilogram)

Notes:
1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.
3. Underlined concentrations exceed the Preliminary Remediation Goal.

APPROXIMATE SCALE

0 30 61 METERS
0 100 200 FEET

N

FIGURE 6

SELECTED TOTAL LEAD DETECTIONS IN SOIL

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

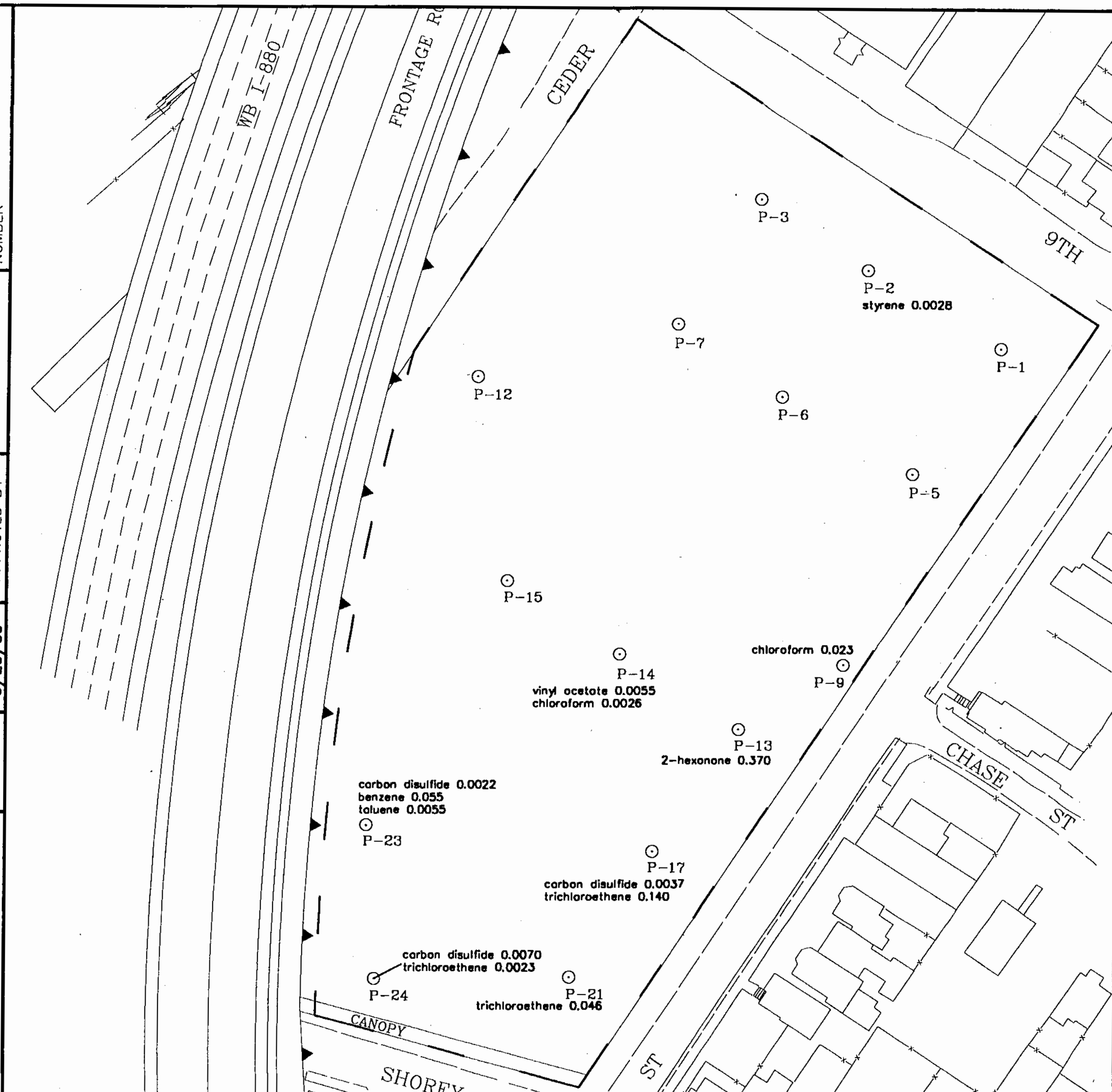
PHXFIG3R.DWG/LEAD

DRAWING NUMBER 776768-7R

DRAWN BY DPB 9/29/99

CHECKED BY

APPROVED BY



LEGEND

⊙ P-2 — GROUNDWATER SAMPLE BORING LOCATION AND DESIGNATION

styrene 0.0028 — ORGANIC COMPOUND CONCENTRATION (milligrams per liter)

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.
3. TDS = total dissolved solids.
4. Only results exceeding Drinking Water Standards shown.

APPROXIMATE SCALE

0 30 61 METERS
0 100 200 FEET

N

FIGURE 7

ORGANIC COMPOUND DETECTIONS IN GROUNDWATER

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

PHXFIG4R.DWG/ORGANICS

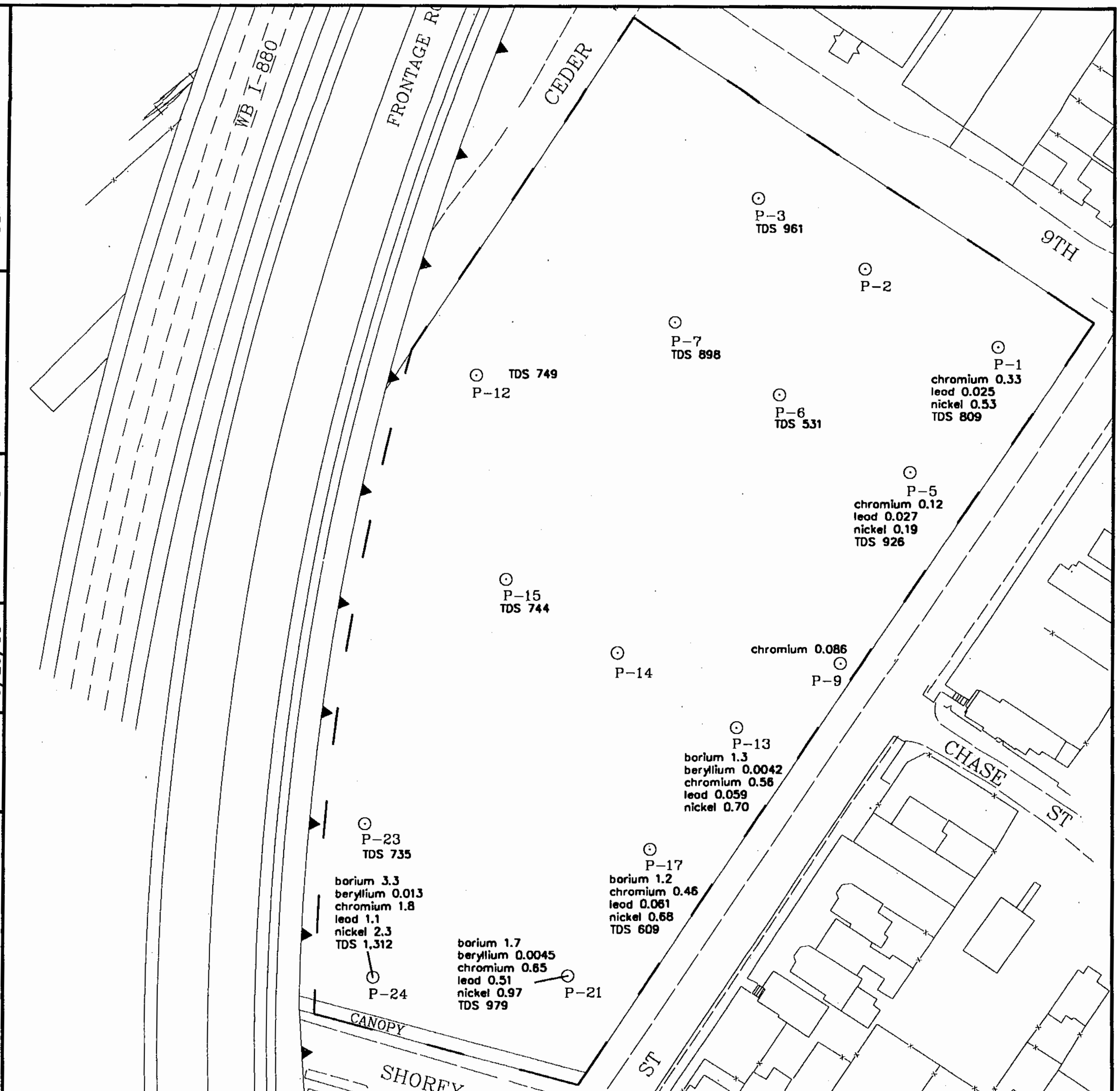
DRAWING NUMBER 776768-8R

CHECKED BY

APPROVED BY

DPB 9/29/99

DRAWN BY



LEGEND

⊙ P-2	GROUNDWATER SAMPLE BORING LOCATION AND DESIGNATION
lead 0.025	HEAVY METAL OR TDS CONCENTRATION (milligrams per liter)

Notes:

1. All locations and dimensions are approximate.
2. Base map provided by Caltrans.
3. TDS = total dissolved solids.
4. Only results exceeding Drinking Water Standards shown.

APPROXIMATE SCALE

0 30 61 METERS

0 100 200 FEET

N

FIGURE 8

SELECTED INORGANIC ANALYSIS DETECTIONS IN GROUNDWATER

PHOENIX IRON WORKS
OAKLAND, CALIFORNIA

IT CORPORATION
A Member of the IT Group

PHXFIG4R.DWG/INORGANICS

Appendix A

Cypress Preliminary Remediation Goals

Cypress Preliminary Remediation Goals

Compound	***PRG (mg/kg)***
<u>Carcinogens</u>	
benzo(a)anthracene	30
benzo(b)fluoranthene	30
benzo(k)fluoranthene	30
benzo(a)pyrene	3
chrysene	300
dibenzo(a,h)anthracene	3
indeno(1,2,3-cd)pyrene	30
benzene	31
tetrachloroethylene	92
trichloroethylene	250
vinyl chloride	0.94
chloroform	110
1,1-dichloroethylene	3.8
1,4-chlorobenzene	120
<u>Non-Carcinogens</u>	
fluoranthene	2,300
pyrene	1,700
ethylbenzene	74
toluene	280
xylene	99
1,1-dichloroethane	380
1,1,1-trichloroethane	470
chlorobenzene	160
1,2-dichlorobenzene	360
naphthalene	82

Compound	***PRG (mg/kg)***
<u>Heavy Metals</u>	
antimony	67
arsenic	19
barium	12,000
beryllium	1.8
cadmium	24
chromium (III)	170,000
chromium (VI)	0.076
cobalt	22
copper	5,000
fluorine	10,000
lead	840
mercury	45
molybdenum	830
nickel	400
selenium	830
silver	830
thallium	27
vanadium	1,200
zinc	50,000

Notes:

1. PRG = preliminary remediation goal (Caltrans, 1995).
2. Mg/kg = milligrams per kilogram.

Appendix B

Permit

ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
951 TURNER COURT, SUITE 300, HAYWARD, CA 94545-2651
PHONE (510) 670-5575 ANDREAS GODFREY FAX (510) 670-5262
(510) 670-5248 ALVIN KAN

FAXED 16JUNE99

DRILLING PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

LOCATION OF PROJECT 800 Cedar Street
Oakland, California

California Coordinates Source ____ ft. Accuracy ± ____ ft.
CCN ____ ft. CCE ____ ft.
APN ____

CLIENT
Name Caltrans - Environmental Engineering
Address 111 Grand Avenue Phone 510-286-5647
City Oakland, CA Zip 94612

APPLICANT
Name IT Corporation - Don Bransford
11315 Sunrise Gold Cr. Fax 916-858-2355
Address Suite A Phone 916-858-2350
City Rancho Cordova, CA Zip 95742

TYPE OF PROJECT
Well Construction
- Cathodic Protection ☐
- Water Supply ☐
- Monitoring ☐

Geotechnical Investigation
- General ☐
- Contamination ☒
- Well Destruction ☐

PROPOSED WATER SUPPLY WELL USE
- ~~New Domestic ☐ Replacement Domestic ☐~~
- ~~Municipal ☐ Irrigation ☐~~
- ~~Industrial ☐ Other ____ ☐~~

DRILLING METHOD:
- Mud Rotary ☐ Air Rotary ☐ Auger ☒
- Cable ☐ Other ☐

DRILLER'S LICENSE NO. 512268

WELL PROJECTS
- Drill Hole Diameter ____ in. Maximum
- Casing Diameter ____ in. Depth ____ ft.
- Surface Seal Depth ____ ft. Number ____

GEOTECHNICAL PROJECTS
- Number of Borings 26 Maximum
- Hole Diameter 6-8 in. Depth 10 ft.

ESTIMATED STARTING DATE 6/21/99
ESTIMATED COMPLETION DATE 6/29/99

I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE ____ DATE 6/15/99

FOR OFFICE USE

PERMIT NUMBER 99WR303
WELL NUMBER ____
APN ____

PERMIT CONDITIONS

Circled Permit Requirements Apply

A. GENERAL
1. A permit application should be submitted so as to arrive at the ACPWA office five days prior to proposed starting date.
2. Submit to ACPWA within 60 days after completion of permitted work the original Department of Water Resources Water Well Drillers Report or equivalent for well projects, or drilling logs and location sketch for geotechnical projects.
3. Permit is void if project not begun within 90 days of approval date.

B. WATER SUPPLY WELLS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved.

C. GROUNDWATER MONITORING WELLS INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.

D. GEOTECHNICAL
Backfill bore hole with compacted cuttings or heavy bentonite and upper two feet with compacted material. In areas of known or suspected contamination, tremied cement grout shall be used in place of compacted cuttings.

E. CATHODIC
Fill hole above anode zone with concrete placed by tremie.

F. WELL DESTRUCTION
See attached.

C. SPECIAL CONDITIONS SEE ATTACHED INFORMATION

APPROVED ____ DATE 6-16-9

ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
951 TURNER COURT, SUITE 300, HAYWARD, CA 94545-2651
PHONE (510) 670-5575 ANDREAS GODFREY FAX (510) 670-5262
(510) 670-5248 ALVIN KAN

WATER RESOURCES SECTION
GROUNDWATER PROTECTION ORDINANCE
For Monitoring Well at Clean or Contaminated Site

Destruction Requirements:

1. Drill out the well so that the casing, seal, and gravel pack are removed to the bottom of the well.
2. Sound the well as deeply as practicable and record for your report.
3. Using a tremie pipe, fill the hole to 2 feet below the lower of finished grade or original ground with neat cement.
4. After the seal has set, backfill the remaining hole with compacted material.

Appendix C

Drilling and Sampling Procedures

Drilling and Sampling Procedures

The procedures used for drilling the borings, collecting soil samples, and collecting groundwater grab samples are presented below.

- Permits for the field investigation were obtained from the Alameda County Public Works Agency prior to the field work.

Drilling and Soil Sample Collection

- Twenty-six 3.5 to 3.8 meters (11.5 to 12.5 feet) below the ground surface (BGS) by a truck-mounted drill rig equipped with 6-inch diameter hollow-stem augers.

- The drilling equipment was washed using a hot-water pressure washer prior to drilling. Waste water generated by washing the drilling equipment was placed into 208-liter (55-gallon) drums approved by the United Nations for transport of liquid and solid wastes. The drums were labeled with the contents, date, and job number. The drums were stored at the northern end of the site in a fenced area provided by the California Department of Transportation (Caltrans).

- Soil descriptions, sample type and depth, and related drilling information were recorded on a boring log under the supervision of a State-registered geologist from IT Corporation (IT). The soil was logged in the field in accordance with the Unified Soil Classification System (USCS).

- Soil samples were generally collected from 0.15, 0.9, 2.1, and 3.1 meters (0.5, 3, 7, and 10 feet) BGS using California-modified split-barrel samplers.

- The samplers were washed between sample intervals using a bristle brush with Alconox solution followed by two tap water rinses and a deionized water rinse. The samplers were dried by air or with paper towels prior to sampling.

- Soil samples were collected in six-inch long, stainless steel sample tubes inserted inside the samplers. The sample tubes were prewashed by the supplier. Three tubes were inserted per sampler.

- The split-spoon samplers were driven using a 63.5 kilogram (140 pound) hammer dropping approximately 0.76 meters (30 inches). The number of blows (blow count) required to advance the sampler 0.3 meters (12 inches) was recorded on the boring log.

- Following retrieval of the sampler, the first sample tube (lowest sample tube within the sampler) was removed from the sampler, the ends covered with Teflon film, and capped with polyvinyl chloride (PVC) end caps. Each sample was labeled with the sample number, date, project number, and samplers initials.

- Soil in the middle sample tube (where available) was used to describe the lithology and measure volatile organic compound (VOC) concentrations. Approximately half of the sample from the middle sample tube was removed. The tube was then capped with PVC end caps and set aside in approximately isothermal conditions to allow VOCs, if present, to accumulate in the headspace above the sampled soil. The headspace was then sampled using portable photo-ionization detector. The probe was inserted through a hole made in the PVC end cap and the highest measurement encountered recorded on the boring log.

- Soil from the drilling operations was placed into 208-liter (55-gallon) drums approved by the United Nations for transport of liquid and solid wastes. The drums were labeled with the contents, date, well number, and job number. The drums were stored at the site.

Groundwater Grab Sample Collection

- Groundwater grab samples were collected from well casing inserted into 15 of the borings. The well casing consisted of flush-jointed, threaded, 5-centimeter (2-inch) inner diameter, Schedule 40 PVC casing. The slotted interval consisted of 0.05-centimeter (0.020-inch) machined slots. The well casing was delivered to the site in factory plastic wrap.

- Groundwater grab samples were collected from the casings using new, disposable polyethylene bottom valve bailers. New nylon rope was used to lower the bailers into the wells.

- Groundwater grab samples were placed into laboratory-supplied containers containing preservatives, where appropriate.

- Groundwater was discharged from the bailer via a bottom emptying device. Discharge to the containers was conducted in a manner to minimize bubbling and agitation of the liquid. The container were filled to the top forming a meniscus to eliminate the headspace.

- Groundwater grab samples were collected in the following order for the indicated analyses: VOCs, total petroleum hydrocarbons as gasoline, semivolatile organic compounds, total petroleum hydrocarbons as diesel, total recoverable petroleum hydrocarbons, heavy metals, and total dissolved solids. Groundwater grab samples collected for metals analyses were not filtered in the field, but were filtered at the laboratory prior to analysis.

- An equipment rinse blank sample was collected from boring location P-10. The rinse blank sample was collected by passing deionized or distilled water through a washed split-spoon sampler into the sample containers. The equipment rinse blank sample was not collected from the groundwater sample equipment since the equipment was new and dedicated to the sample locations.

- The borings were backfilled with bentonite-cement grout. The well casing was removed prior to backfilling.

Sample Retention and Analysis

- All samples were placed on ice in an insulated chest cooled to a temperature of approximately 4 degrees Celsius.

- Chain of custody procedures, including the use of chain of custody forms, was used to document sample handling and transport from collection to delivery to the laboratory for analysis.

- The samples were retained in the insulated chests preserved with ice overnight in the custody of an IT employee. The samples were picked up within approximately 24 hours of collection by a courier supplied by the laboratory, or were delivered to the laboratory by IT personnel within approximately 24 hours of collection. The samples were transported to the laboratory in a motor vehicle.

- Upon receipt of the samples by the laboratory, the laboratory recorded the internal temperature of the chests on log forms.

- Soil samples were labeled with the boring number and approximate sample collection depth. For example, P-20@7', where P-20 is the boring number and @7' is the sample collection depth at approximately 7 feet below the ground surface. Groundwater grab samples were labeled with the boring number and the suffix "GW." For example, P6-GW for the groundwater grab sample collected from boring P-6.

- Laboratory quality assurance/quality control procedures are summarized below:

    - Method Blank Frequency = one per 20 samples
    - Matrix Spike/Matrix Spike Duplicate = one per 20 samples
    - Laboratory Control Sample/Laboratory Control Sample Duplicate = one per 20 samples

Appendix D

Boring Logs

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-1	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: D Bransford	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY~~ (TSF) PID	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-1@0.5	9/7/7 14	90	Dusky brown (5YR 2/2), damp, medium dense, fine SAND, trace silt	SP	0		
	P-1@3	2/2/3 5	90	Moderate yellowish brown (10YR 5/4) and loose at 3 ft		0		
5								
	P-1@7	6/7/7 14	100	Moderate yellowish brown (10YR 5/4), moist, medium dense, Silty SAND Becomes saturated at 8.5 ft	SM ▽	0		water at 8.5 ft
10	P-1@10	7/10/17 27	100			1.2		
				Bottom of Boring at 11.5 ft				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-2	COORDINATES:	DATE: 6-22-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-22-99
ENGINEER/GEOLOGIST: M. Lauenroth	Depth Date/Time	DATE COMPLETED: 6-22-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				concrete				
	P-2 @0.5	3/3/2	100	med-fine grain sand; well sorted; moist; grayish brown (5YR3/2); loose	SP	<1		
	P-2 @3	3/3/3	100	moderate brown (5YR4/4); minor silt	SP	<1		
5								
	P-2 @7	5/10/17	90	wet; medium dense	SP	<1		
								▽ gw at 9.5'
10	P-2 @10	4/12/18	100	Saturated; Silty sand	SM	0		
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-3	COORDINATES:	DATE: 6-22-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-22-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-22-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~	WELL CONSTRUCTION	REMARKS
				concrete				
	P-3 @ 0.5	7/10	90	Fine to med sand; grayish brown (5YR3/2); minor silt; med. dense	SP	<1		
	P-3 @ 3	3/3	95	silty sand; med. brown (5YR3/1); moist; loose	SM	<1		
5 — 2								
	P-3 @ 7	7/12	95	moist to wet; med. dense;	SM	0		slight oxidation at bottom of sample ▽ GW at 9.5'
10 — 4	P-3 @ 10	7/13		Saturated; med. dense		<1		
				End of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works
BORING NUMBER: P-4	COORDINATES: / DATE: 6-22-99
ELEVATION:	GWL: Depth Date/Time / DATE STARTED: 6-22-99
ENGINEER/GEOLOGIST: [illegible]	Depth Date/Time / DATE COMPLETED: 6-22-99
DRILLING METHODS: Hollow Stem Auger	PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ FID	WELL CONSTRUCTION	REMARKS
	P-4 @0.5	3/3/4	95	concrete Silty Sand; Dusky brown (5YR 2/2); moist to wet; loose	SM	<1		
	P-4 @3	3/5/10	100	mod. brown (5YR 4/4); moist; MnO nodules; loose	SM	0		MnO/Fe staining at bottom of sample.
5								
	P-4 @7	4/5/15		moist to wet at bottom; mottled; med. dense	SM	0		MnO nodules Increased silt content
9	P-4 @10	4/10/6		Saturated; med. dense		0		▽ GW at 9'
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-5	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M. Lavenoois	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY~~ (TSF) PID	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-5 @0.5'	3/4/5	100	Dusky brown (5YR 3/2), med. to coarse sand, wet, loose	SP	0		
	P-5 @3'	2/3/4	100	moderate brown (5YR 4/4), well sorted, fine to med sand, moist, loose	SP	0		
5								
	P-5 @7'	4/7/16	75	Sand with silt; moderate brown, medium dense, wet	SP	~1		▽ GW at ~8.5'
10	P-5 @10'	4/6/10	100	moderate brown (5YR 4/4), well sorted, saturated, medium dense	SP	0		
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-6	COORDINATES:	DATE: 6/22/99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6/22/99
ENGINEER/GEOLOGIST: Don Bransford ~~[illegible]~~	Depth Date/Time	DATE COMPLETED: 6/22/99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-6@3	2/4/5 9	100	Moderate brown (5YR 3/4), damp, loose, Silty SAND	SM	>2		
5								
	P-6@7	8/11/13 24	85	Moderate yellowish (10YR 5/4) at 7 ft Saturated beginning at 8 ft	▽	0		Groundwater at 8 ft
0								
	P-6@10	8/14/18 32	100					
				Bottom of Boring at 11.5 ft				
6								
8								
10								

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-7	COORDINATES:	DATE: 6-22-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-22-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-22-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	~~MEASURED~~ ~~CONSISTENCY~~ (ISE) ~~FID~~ PID	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-7 @0.5	6/1/3/6	95	Silty sand; moist; loose; grayish brown (5YR 3/2)	SM	<1		
	P-7 @3	3/3/10	90	Silty sand; moist; mod. brown (5YR 4/4)	SM	<1		mod staining
5 ~~2~~								
	P-7 @7	N/A		no recovery	N/A	N/A		no recovery at 3'
10 ~~4~~	P-7 @10	9/4/12		saturated; med. dense; mod. brown (5YR 4/4)		0		▽ GW at 9.5'
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-8	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenooth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-8 @ 0.5	3/4/5	100	med - coarse sand; moist; loose; pale brown (5YR 6/2)	SP	>1		Few small quartz pebbles
	P-8 @ 3	3/4/4	100	fine to med. silty sand; moist; loose; mod. brown (5YR 4/4)	SM	0		
5								
	P-9 @ 7	9/7/8	5		SM	0		Increased silt content, not enough to sample
								▽ GW at 9'
10	P-9 @ 10			Saturated	SM	0		
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-9	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M. Lavenmoh	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED~~ ~~CONSISTENCY~~ ~~(TSF)~~ FID	WELL CONSTRUCTION	REMARKS
				Concrete	fill			
	P-9 @0.5	3/2/2	90	med-fine sand; well sorted, dark yellowish brown (10YR4/2), moist, loose	SP	<1		
	P-9 @3	1/1/2	50	mod. yellow brown (10YR 5/4); moist, very loose	SP	<1		
5								
	P-9 @7	8/4/18	100	Silty sand; grayish olive green (5Gy3/2); moist to wet; med. dense	SM	<1		▽ GW@~9.5'
10	P-9 @10	9/13/13	90	mod. yellow brown; saturated mod. dense	SM	>1		
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: R-10	COORDINATES:	DATE: 6-24-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-24-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-24-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (PID)	WELL CONSTRUCTION	REMARKS
				Asphalt				
	R-10 @0.5	3/3/4	100	Silty sand; dusky brown (5YR2/2) moist; loose	SM	2		
	R-10 @3	3/3/3	90	Dusky brown (5YR2/2) to mod. brown (5YR4/4) at 3.5'; loose	SM	1		Sharp contact of color change at 3.5'
5								
	R-10 @7	3/9/11	60	mod. brown; moist to wet; mid. dense	SM	0		
10								▽ GW at 9'
	R-10 @10	4/3/5		Saturated at 9'		0		
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-11	COORDINATES:	DATE: 6-24-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-24-99
ENGINEER/GEOLOGIST: M. Laurendeau	Depth Date/Time	DATE COMPLETED: 6-24-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED~~ CONSISTENCY (~~TSF~~)	WELL CONSTRUCTION	REMARKS
	P-11 005	7/8/9	85	Silty sand; grayish brown (5YR 3/2); moist; mod. dense	SM	>1		Brick fragments throughout first 1' of sample.
	P-11 03	3/4/4	70	mod. brown (5YR 4/4); loose	SM	>1		slight Fe staining
5								
	P-11 07		0		NA	NA		no recovery at 7'
10	P-11 010	4/10/13		wet to saturated at 10.5'; mod. dense	SM	>1		Fe staining at 10'.
				Bottom of boring at 11.5 ft.				
6								
8								
10								

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-12	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-12 @ 0.5	1/1/1	100	Silty sand; moist; grayish brown (5YR 3/2); very loose; moist	SM	>2		
	P-12 @ 3	3/3/4	90	mod. brown (5YR 4/4); loose	SM	>2		Fe staining
5								
	P-12 @ 7	4/12/13	100	moist to wet at 7.5'; med. dense	SM	>2		Fe staining
								∇ GW at 9'
10	P-12 @ 10	7/9/12		Saturated; med. dense		>3		
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-13	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M. Lavenson	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
				concrete				
	P-13 @0.5	4/3/2	80	Fine to med. sand; dusky red (5R 7/4); moist; oxidation at 2-4; loose; well sorted	SP	<1		
	P-13 @3	7/3/3	40		SP	N/A		poor recovery
5								
	P-13 @7	7/12/14	85	Fine to med. sand with minor silt; wet; med. dense	SP	0		▽ GW at 9'
10	P-13 @10	8/12/14	100	Well sorted fine to med. sand; saturated; med. dense	SP	<1		
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-14	COORDINATES:	DATE: 6/22/99
ELEVATION: Don Bransford	GWL: Depth Date/Time	DATE STARTED: 6/22/99
ENGINEER/GEOLOGIST: [illegible]	Depth Date/Time	DATE COMPLETED: 6/22/99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-14@0.5	5/4/4 8	95	Dusky brown (5YR 2/2), damp, loose, fine SAND, trace silt	SP	<3		
	P-14@3	4/2/3 5	50	Moderate yellowish brown (10YR5/4) at 3 ft		<1		
5								
	P-14@7	9/11/13 24	100	Moderate yellowish brown (10YR5/4), moist, medium dense, silty sand from 7 to 8.5 ft		0		
					∇			Sampler wet at 10 ft
10	P-14@10	7/10/17 27	95	Medium dense, saturated, with increased silt at 10 ft		<1		
				Bottom of Boring at 11.5 ft				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd

2438-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-15	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-15 @0.5	7/5/4	100	Silty sand; grayish brown (5YR 3/2); moist; loose	SM	>2		
	P-15 @3	1/1/2	90	mod. brown (5YR 3/4); very loose	SM	>1		
5								
	P-15 @7	1/3/4	100	moist to wet at 7.5'	SM	0		Fe staining
10	P-15 @10	8/4/8		saturated at 9'; dense	SM	0		GW at 9'
				Bottom of boring at 12.5'				

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-16	COORDINATES:	DATE: 6-24-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-24-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-24-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (Ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (")	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSE)	WELL CONSTRUCTION	REMARKS
				Asphalt	fill			
	P-16 @0.5	3/3/3		Silty sand, dusky brown (5YR 2/2); moist; loose	SM	>1		Thin (2") layer of quartz rich sand. Fill.
	P-16 @3	3/3/2		Dusky brown to mod. brown (5YR 4/4) at 3.5'; loose	SM	0		Sharp color contact at 3.5'.
5								
	P-16 @7	6/7/5		moist to wet at 7.5'; mod. dense; mod. brown (5YR 3/4)	SM	0		
10	P-16 @10	5/11/12	5	wet to saturated at 10.5'.	SM	>1		Poor recovery
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd & Byron

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-17	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M. Lawrence	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (PID)	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-17 @0.5	2/3/2	60	Fine to med. sand; moist; dusky brown (5YR2/2); loose	SP	>2		
	P-17 @3	2/2/2	90	moderate brown (5YR4/4); moist; loose	SP	0		
5								
	P-17 @7	9/12/12	90	wet; med. dense	SP	0		▽ gw at ~9'
10	P-17 @10	7/9/14	100	saturated; mod. brown;		0		
				Bottom of Boring at 11.5'				
16								
18								
20								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-18	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenoold	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED ~~CONSISTENCY~~ ~~(TSF)~~	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-18 @0.5	3/3/3	100	Silty sand; Dusky brown (5YR 2/2); moist; loose	SM	0		
2	P-18 @3	3/3/3	100	mod. brown (5YR 4/4); loose	SM	0		
5 - 4								
	P-18 @7	5/7/7		med. dense; moist to wet at 7.5'	SM	>1		Increased slt. content; Fe staining
10 - 4	P-18 @10		0					no recovery
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-19	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	P-19 00.5	3/3/3	100	Asphalt silty sand AB ~~sandy silt~~; dusky brown (5YR 3/2); moist; loose	SM	0		
	P-19 03	2/2/2		mod. brown (5YR 3/4); moist; loose;	SM	>1		
5								
	P-19 07	8/12/15		moist to wet; med. dense	SM	>1		
10	P-19 010	9/11/12		Saturated at 10.5'	SM	>1		Fe staining
				Bottom of boring at 11.5'				

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-20	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenoth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (.5')	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED~~ CONSISTENCY (~~TSF~~)	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-20 @0.5	4/6/9	90	Silty sand; dusky brown (5YR 3/2); moist; med. dense	SM	>1		
	P-20 @3	3/3/2	95	mod. brown (5YR 4/4); loose	SM	0		gravel at top of sample.
5								
	P-20 @7	4/10/10	10	dense; moist; mottled	SM	0		
10	P-20 @10	4/9/10		olive grey (5Y 3/2); saturated; mod. dense	SM	>1		
				Bottom boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd + Brian

2438-3-88

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-21	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY %	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (PID)	WELL CONSTRUCTION	REMARKS
				concrete				
	P-21 @0.5	6/6/6		Fine to med. sand; Greyish brown (5YR 3/2); moist; med. dense	SP	>1		
	P-21 @3	4/4/4		med. brown (5YR 4/4); moist; minor silt; loose	SP	0		
5								
	P-21 @7	3/3/3		Oxidation; wet; loose		<1		Cas. Seepage?
								▽ GW at 9.5'
10	P-21 @10	3/14/16		Saturated; med. dense		0		
				End of boring at 11.5'				

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-22	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lawrence	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
				Concrete				
	P-22 @ 0.5	2/3/3	90	Silty Sand; grayish brown (5YR 3/2); moist; loose;	SM	>1		
	P-22 @ 3	2/3/4	90	mod. brown (5YR 4/4); moist to wet at 3.5'	SM	>1		
2								
	P-22 @ 7	4/8/12	0			N/A		no recovery
4	P-22 @ 10	4/8/10	85	saturated at 10.5'; medium dense	SM	>1		
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

9/12/14

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-23	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				Asphalt				
	P-23 @0.5	1/1	100	Silty sand; grayish brown (5YR 3/2) moist; very loose	SM	>1		
	P-23 @3	3/2/2	100	med. brown (5YR 3/4); loose	SM	>1		
5								
	P-23 @7	9/12/12	0					no recovery
10	P-23 @10	9/12/14		Saturated at 10.5'; med dense		>1		∇ GW at 10.5'
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor: Spectrum

Drilling Equipment: HSA

Driller: Floyd & Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-24	COORDINATES:	DATE: 6-21-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-21-99
ENGINEER/GEOLOGIST: M Lavenmoth	Depth Date/Time	DATE COMPLETED: 6-21-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
	P-24 @0.5	NA	0	Concrete		NA		
	P-24 @3'	3/3/3	80	Fine to med sand, mod. brown (5YR3/4); loose; moist	SP	<1		
5								
	P-24 @7	3/4/6	80	saturated; loose	SP	0		▽ GW at 7.5'
	P-24 @10	6/12/12	30	saturated; loose	SP	0		Poor recovery
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd + Brian

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-25	COORDINATES:	DATE: 6-22-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-22-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-22-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	P-25 @0.5	7/10/12	15	Concrete Gravel-sand-silt mixture; grayish brown (5YR 3/2); slightly moist; organics; med. dense	GM	NA		Bore collected off asphalt in grassy area.
2	P-25 @3	4/8/8	100	Fine to med silty sand; well sorted; moist; med. brown (5YR 4/4); med. dense	SM	0		Minor gravel at top of sample only. Possibly fill?
	P-25 @7	8/13/12		wet; med. dense; mottled	SM	0		MnO/Fe staining
4	P-25 @10	6/13/12		saturated; med. dense		<1		∇ GW at 9'
6				Bottom of boring at 11.5'				
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Lloyd + Brian

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 776768	PROJECT NAME: Phoenix Iron Works	
BORING NUMBER: P-26	COORDINATES:	DATE: 6-23-99
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-23-99
ENGINEER/GEOLOGIST: M. Lavenroth	Depth Date/Time	DATE COMPLETED: 6-23-99
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	~~MEASURED CONSISTENCY (TSF)~~ PID	WELL CONSTRUCTION	REMARKS
				Grassy area				
	P-26 @0.5	8/12/8	90	Gravel, sand, silt mixture; med. brown (5YR 4/4); moist; sub-angular gravel; med. dense;	GM	>1		Roots & organics; gravel most abundant at top of sample; fill?
	P-26 @3	7/6/7	100	silty sand; well sorted; grayish brown (5YR 3/2); moist; loose	SM	>2		
5								
	P-26 @7	7/8/8	100	med. brown (5YR 4/4); moist to wet; med. dense	SM	>1		
10	P-26 @10	7/6/4		wet to saturated at 10.5		>1		∇ GW at 10.5'
				Bottom of boring at 11.5'				
6								
8								
10								

NOTES:

Drilling Contractor Spectrum

Drilling Equipment HSA

Driller: Floyd & Brian

Appendix E

Geophysical Survey Report

July 9, 1999

Mr. Don Bransford
IT Corporation
11315 Sunrise Gold Circle, Suite A
Rancho Cordova, CA 95742-6534

Dear Mr. Bransford:

This report presents the findings of a geophysical investigation performed by NORCAL Geophysical Consultants, Inc. at the Phoenix Iron Works property at 800 Cedar Street in Oakland, California. The field survey was conducted on June 30 through July 1, 1999 by Registered Geophysicist Donald J. Kirker and Geophysical Technician Jeff Blom. Logistical support was provided by Don Bransford of IT Corporation. This investigation was conducted under Cal Trans Contract No. 43Y097.

PURPOSE

Information, provided by IT Corporation, indicates that this property was previously occupied by several industrial facilities. This information indicates that these facilities may have used several underground storage tanks (UST's), including a 13,000 gallon UST that may be located in the northwest corner of the site. All above ground structures related to these facilities have since been demolished and removed from the property. However, it is not known if the UST's were removed or left in place. Therefore, the purpose of the geophysical investigation is to obtain subsurface information that will aid in determining if UST's exist at this site.

SITE DESCRIPTION

The area of investigation, as specified by IT Corporation, comprises approximately 5.3 acres. It is bound by 9th Street to the north, Pine Street to the east, Shorey Street to the south, and a large block wall to the west. A chain link fence lines the perimeter of the site along the north, east, and south boundaries. Most of the site is covered by a concrete/reinforced concrete slab. Within this slab are numerous metal rails, gutters, and metal plates (footings for heavy equipment), as shown on Plate 1. With exception to the northwest corner of the site, the survey area is generally free of above ground structures. In the northwest corner, three wooden structures are stored within a chain link fence enclosure. East-west trending railroad tracks are located along the north and south boundaries.

METHODOLOGY

For this investigation, we used the vertical magnetic gradient (VMG), ground penetrating radar (GPR), and electromagnetic line locating (EMLL) methods. The VMG method was used to determine the presence of buried ferrous metal that may indicate the location of a UST. The GPR and EMLL methods were used to aid in further characterizing the source of any detected

VMG anomalies. Descriptions of the VMG, GPR, and EMLL methods are provided in Appendix A, of this report.

EQUIPMENT FUNCTIONAL CHECKS

At the beginning and end of each field day, we performed equipment functional checks, as recommended by the instrument manufacturers to ensure proper equipment function. These functional checks included testing the power supply, as well as obtaining several readings at a predetermined location. Proper functioning of the equipment was verified by determining that the trends observed in the data were repeatable. The results of these tests indicated that our equipment was functioning properly and accurately throughout the duration of the survey.

During the VMG data acquisition we made periodic checks of the magnetometer to ensure that the sensor was properly oriented (north-south) and that the station coordinates were recorded accurately. In addition, we made field notes (diagrams) regarding surface features and metal that were in close proximity to specific measurement stations. At the end of the day, VMG data were down-loaded to a portable laptop computer and displayed in spreadsheet form. We reviewed the data to monitor quality, repeatability, and field survey parameters.

DATA ACQUISITION AND ANALYSIS

Descriptions of data acquisition and analysis procedures for the MAG, GPR, and EMLL surveys are provided in Appendix A.

RESULTS

The results of the geophysical investigation are presented on the Site Map and Vertical Magnetic Gradient Contour Map, Plates 1 and 2, respectively. The Site Map shows the limits of the survey area, the structures or above ground cultural features that may be in close proximity to the site, and the locations of the GPR traverses. The VMG contour map represents the variations in the vertical magnetic gradient throughout the site. A description of the results for the EMLL, VMG, and GPR surveys are presented in the following paragraphs.

<u>EMLL Investigation</u>

A preliminary EMLL survey was conducted throughout the site. The results of this investigation defined the location of numerous near surface metal objects. Most of these objects correspond with the known features that are evident within the concrete, such as the rails, metal gutters, and footings. However, additional subsurface objects were detected in the northeast and southwest quadrants of the survey area. Based on site observation, we believe that some of these objects represent reinforced concrete slabs and railroad spurs.

EMLL detected objects that could not be associated with known features are designated as EMLL anomalies on Plate 1. It has been our experience that EMLL anomalies of these sizes can represent many different subsurface features including vaults, reinforced sumps, UST's, footings, and small reinforced concrete slabs.

VMG Investigation

The VMG contour map (Plate 2) shows the variations in the vertical magnetic gradient within the survey area. This map is characterized by a series of contour lines that represent specific values. Areas that lack contour lines, or where the contours are spaced far apart, indicate a minimal change or variation in the respective values and is indicative of relatively uniform conditions. Areas where contours are closely spaced indicate variations that are not uniform and probably caused by more local sources.

The closely spaced contours shown on Plate 2 form numerous circular closures that occur throughout the survey area. The distribution of these closures generally increases from east to west, with most of the variations occurring in the west portion. The variations are manifested by closely spaced contours that exhibit both positive and negative values that range from -8990 to over 6800 nanoTesla per meter (nT/m). The areal extent of these variations is highly variable, with some of the negative closures measuring up to 30 feet across. Most of the anomalies shown on Plate 2 appear to be due to miscellaneous variable metallic sources that are probably associated with various past uses of the property. Most of the contour closures correspond with the location of the rails, gutters, reinforced concrete pads, and footings. It should be noted, however, that the high intensity of these anomalies may mask effects from sources such as a UST. In addition, it is not possible to differentiate which anomaly could be related to a UST because of the large number of closures defined in these areas.

GPR Survey

Because it is not possible to differentiate which anomaly could be related to a UST, GPR data were obtained over four representative VMG anomalies. These are generally located in the center of the survey area, as shown on Plate 1. GPR was also obtained over the EMLL anomalies, and within the chain link fence enclosure. The GPR data obtained over these areas do not indicate hyperbolic signatures within the upper two to four feet that are large enough to represent a UST. The GPR data do define reflection patterns typical of small scattered objects, rebar within the concrete slab, and possible utility alignments. The GPR data also exhibits continuous reflecting horizons typical of undisturbed subsurface strata in curtain areas.

CONCLUSION AND RECOMMENDATIONS

The results of the geophysical investigation define numerous VMG variations throughout the site. It is our belief that most of these variations represent effects from the known cultural features (rails, metal gutters, footings, and reinforced concrete). Since the magnetic intensities of these variations are significantly greater than those produced by UST's, it is likely that UST's could easily go undetected at this site. Therefore, we recommend that the concrete slab and all metal features within the slab be removed. Following their removal, a second VMG survey can be performed. A comparison of the new VMG contour map will then be made to the original to determine potential locations for possible UST's.

STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using geophysical methods to characterize the shallow subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having the opportunity to provide you with this information.

Respectfully,

NORCAL Geophysical Consultants, Inc.

Donald J. Kirker

Donald J. Kirker
Geophysicist, GP-997

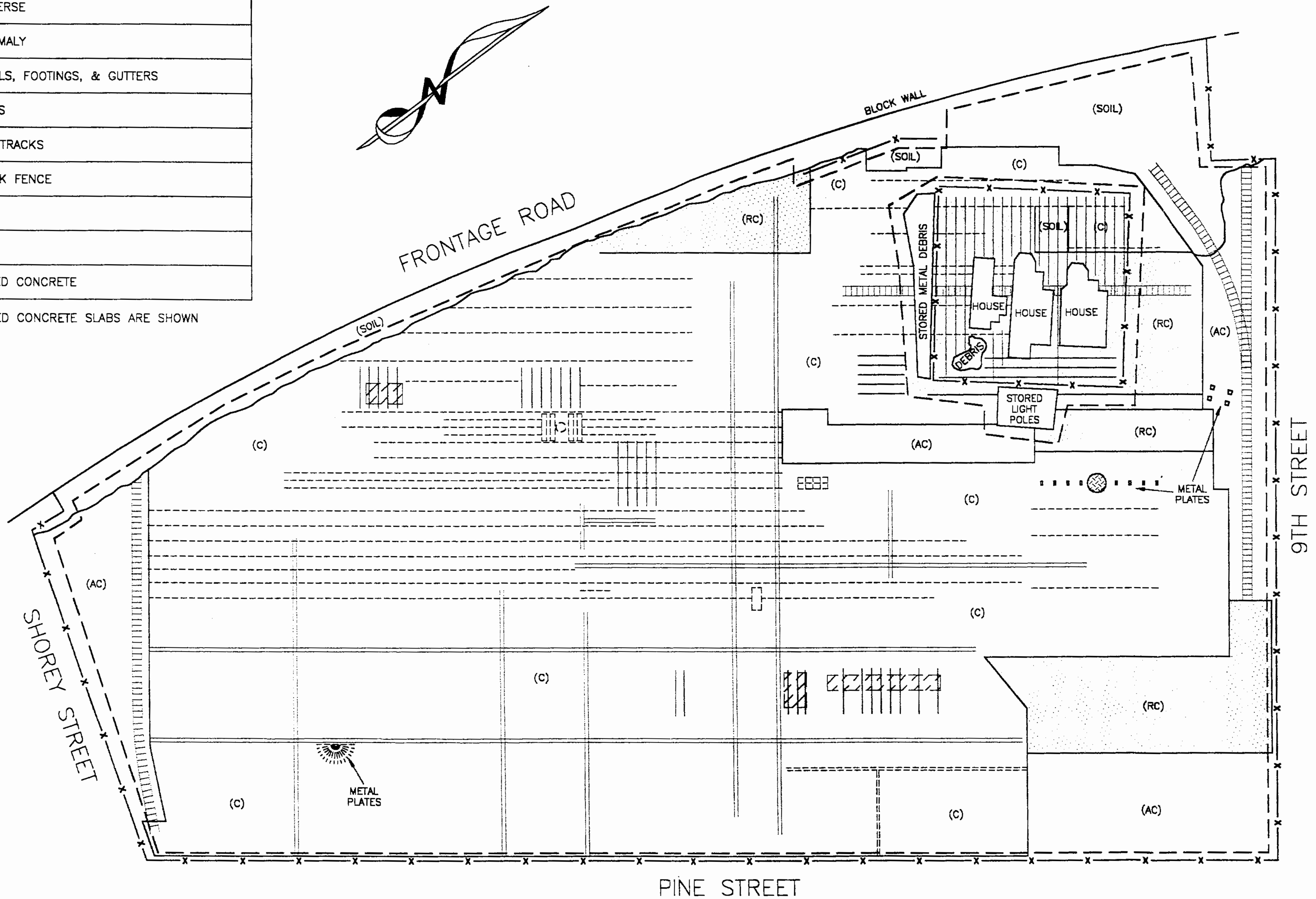
DJK/jh

Enclosure: Plates 1 and 2
Appendix A, METHODOLOGY, DATA ACQUISITION AND ANALYSIS

LEGEND

— — —	LIMITS OF VMG SURVEY
———	GPR TRAVERSE
//////	EMLL ANOMALY
- - - - - -	METAL RAILS, FOOTINGS, & GUTTERS
═══	CART RAILS
┼┼┼┼┼	RAILROAD TRACKS
—x—	CHAIN-LINK FENCE
(AC)	ASPHALT
(C)	CONCRETE
(RC)	REINFORCED CONCRETE

NOTE: NOT ALL REINFORCED CONCRETE SLABS ARE SHOWN ON THIS MAP

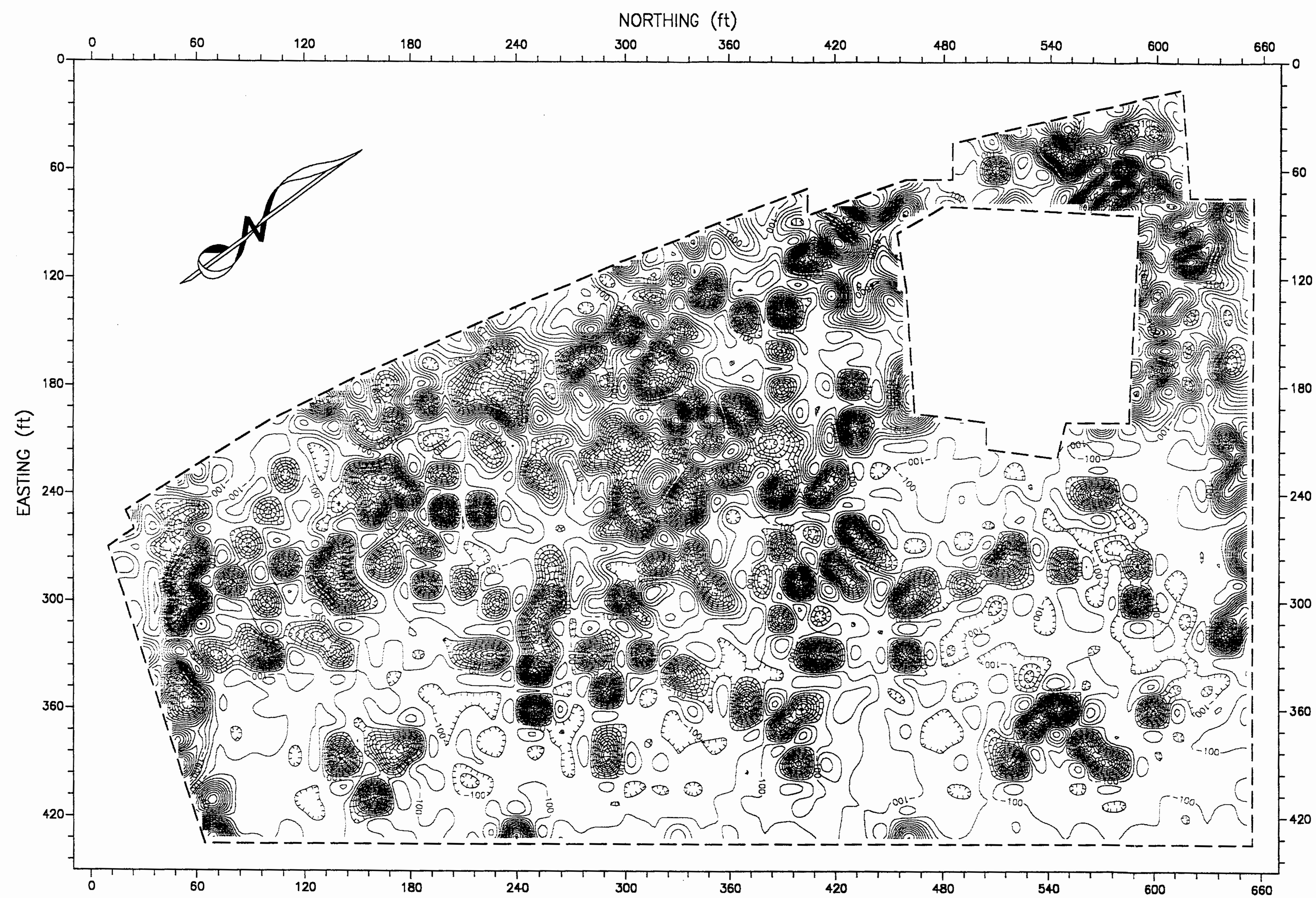


SCALE
0 30 60 120
(1 inch = 60 feet)

NORCAL

SITE MAP
PHOENIX IRON WORKS

LOCATION: OAKLAND, CALIFORNIA
CLIENT: IT CORPORATION
NORCAL GEOPHYSICAL CONSULTANTS INC.
JOB #: 99-147.20
DATE: JULY 1999
DRAWN BY: G.RANDALL
APPROVED BY: DJK
PLATE 1



	LEGEND
— — —	LIMITS OF VMG SURVEY
—o—	VERTICAL MAGNETIC GRADIENT CONTOUR (CONTOUR INTERVAL = 500 nT/m)

SCALE
0 30 60 120
(1 inch = 60 feet)

NORCAL	VERTICAL MAGNETIC GRADIENT CONTOUR MAP PHOENIX IRON WORKS	
	LOCATION: OAKLAND, CALIFORNIA	
	CLIENT: IT CORPORATION	PLATE 2
JOB #: 99-147.20	NORCAL GEOPHYSICAL CONSULTANTS INC.	
DATE: JULY 1999	DRAWN BY: G.RANDALL / APPROVED BY: DJK	

NORCAL

Appendix A

GEOPHYSICAL METHODS
DATA ACQUISITION AND ANALYSIS

NORCAL

GEOPHYSICAL METHODS

Magnetometry

Magnetometers measure variations in the earth's magnetic field. These may include the total intensity of the magnetic field and/or its vertical or horizontal gradient. The magnetometry method that measures the vertical gradient is referred to as vertical magnetic gradient (VMG).

A magnetic gradiometer measures the vertical gradient of the earth's magnetic field. It consists of two total field magnetic sensors separated vertically by one-half meter. The magnetic field strength is measured simultaneously at both of these sensors. The difference in magnetic intensity between these measurements is proportional to the vertical gradient of the earth's magnetic field. Because the vertical gradient is constant with respect to time, the effect of diurnal variations is eliminated. Since a gradiometer is effected less by cultural features, it provides higher sensitivity and better resolution of near surface sources than total field magnetometers. Areas with significant amounts of buried metal typically produce anomalously steep magnetic gradients. Because the gradiometer is sensitive to ferrous metal sources both above and below ground, site and vicinity surface conditions can affect survey results.

We used an SCINTREX ENVI-MAP magnetometer to obtain the VMG data. The instrument features a built-in memory that stores the vertical magnetic gradient and survey grid information. The information can be down loaded to a computer for further processing.

Ground Penetrating Radar

Ground penetrating radar is a method that provides a continuous, high resolution cross-section depicting variations in the electrical properties of the shallow subsurface. The method is particularly sensitive to variations in electrical conductivity and electrical permittivity (the ability of a material to hold a charge when an electrical field is applied).

The system operates by continuously radiating an electromagnetic pulse into the ground from a transducer (antenna) as it is moved along a traverse. Since most earth materials are transparent to electromagnetic energy, only a portion of the radar signal is reflected back to the surface from interfaces representing variations in electrical properties. When the signal encounters a metal object, however, all of the incident energy is reflected. The reflected signals are received by the same transducer and are printed in cross-section form on a graphical recorder. Depending upon depth and/or thickness the resulting records can provide information regarding the location of UST's, sumps, buried debris, underground utilities, and variations in the shallow site materials. Generally, electrically conductive materials, such as clay, saturated silt, and rebar can reduce the penetration capability and limit radar performance.

For this investigation, we used a Geophysical Survey Systems, Inc. SIR-2 Subsurface Interface Radar System equipped with a 500 megahertz (MHz) transducer. This transducer is near the center of the available frequency range and is used to provide high resolution at shallow depths.

Electromagnetic Line Location (EMLL)

Electromagnetic line location techniques are used to locate the magnetic field resulting from an electric current flowing on a line. These magnetic fields can arise from currents already on the line (passive) or currents applied to a line with a transmitter (active). The most common passive signals are generated by live electric lines and re-radiated radio signals. Active signals can be introduced by connecting the transmitter to the line at accessible locations or by induction.

The detection of underground utilities is determined by the composition and construction of the line in question. Utilities detectable with standard line location techniques include any continuously connected metal pipes, cables/wires or utilities with tracer wires. Unless carrying a passive current these utilities must be exposed at the surface or in accessible utility vaults. These generally include water, electric, natural gas, telephone, and other conduits related to facility operations. Utilities that are not detectable using standard electromagnetic line location techniques include those made of non-electrically conductive materials such as PVC, fiberglass, vitrified clay, and pipes with insulated connections.

The induction mode is also used to detect buried near surface metal objects such as rebar, manhole covers, and various metallic debris. This is done by holding the transmitter-receiver unit above the ground and continuously scanning the surface. The unit utilizes two orthogonal coils that are separated by a specified distance. One of the coils transmits an electromagnetic signal (primary magnetic field) which in turn produces a secondary magnetic field about the subsurface metal object. Since the receiver coil is orthogonal to the transmitter coil, it is unaffected by the primary field. Therefore, secondary magnetic fields produced by buried metal will generate an audible response from the unit. The peak of this response indicates when the unit is directly over the metal object.

Our instrumentation for this investigation consisted of a Radiodetection RD-400 line locator and a Fisher TW-6 inductive pipe and cable locator.

DATA ACQUISITION

Horizontal Control

Site definition and data acquisition were based on a horizontal control grid. We used spray paint to mark the grid nodes on 20 by 20 foot centers. During data acquisition, measurement points between grid nodes were located by pacing. The location of the VMG survey boundary is shown on Plate 1. The specific locations of the grid nodes are not shown.

Geophysical Survey

We obtained MAG data at 10 foot intervals (stations) along south-north trending traverses spaced 10 feet apart. Following data acquisition, we downloaded the data to a portable laptop computer and produced a preliminary contour map in the field. We reviewed this map for locations of VMG anomalies that may represent possible UST's. We then obtained GPR data over representative anomalies along north-south or west-east trending traverses spaced

5 feet apart. The traverses ranged in length from 20 to 100 feet. The EMLL equipment was operated systematically over the entire survey area.

DATA ANALYSIS

Computer Processing

We down loaded the VMG data to a portable computer. We then used the computer program "Surfer" by Golden Software to calculate an evenly spaced array of values (gridded) based on the observed field data. We also used Surfer to contour the gridded values and produce the VMG contour map shown on Plate 2.

Contour Map Interpretation

Generally, VMG values vary smoothly throughout a given region with uniform conditions. Areas where variations are strong are defined by closely spaced contours and are typically considered anomalous if they are not associated with known above or below ground objects. If the source of a particular anomaly is an isolated object or a group of closely spaced objects, the contours may form circular or elliptical closures. A large accumulation of buried objects may appear as a group of closely spaced anomalies or one large anomaly.

Actual anomaly magnitude and shape are dependent on the relative position and size of the buried objects with respect to the location of the data points. In general, anomaly magnitude will decrease and anomaly width will increase as distance (depth) to the source increases. Anomalies may or may not have paired high and low values creating what are known as magnetic dipoles.

UST's typically give rise to VMG anomalies with amplitudes ranging from several hundred to several thousand nanoTeslas per meter (nT/m). Small UST's, such as 500 gallon waste oil tanks, typically are manifested by anomalies that range from 300 to 1,000 nT/m. Whereas, large UST's are typically manifested by anomalies that exhibit values of over several thousand nT/m. The lateral extent of UST anomalies are usually somewhat larger than the UST itself, depending on its depth of burial. In addition, the contours often indicate positive values above the UST, and negative values just to the north of it.

GPR and EMLL Analysis

We examined the GPR records for hyperbolic reflection patterns characteristic of UST's and underground utilities. We also reviewed the records for changes in reflection character that could indicate the presence of fill material associated with an excavation.

The EMLL instrumentation indicates the presence of buried metal by emitting an audible tone. There are no recorded data to analyze. The locations of buried objects detected with the EMLL method were marked on the ground surface with white marking paint.